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Examining the socioeconomic determinants that impact Indian modes of transportation for Daily Commuting: An investigation of Moradabad City of India

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ABSTRACT

Objectives: The present study aims to analyze the factors which influence the selection of modes by commuters for daily travel to work .

Methodology: For accomplishment of this objective, a field survey has been conducted in Moradabad city among the commuters to collect the data by using a structured questionnaire in month of April-May, 2017 following the simple random sampling method. The data obtained through the survey has been analyzed by simple percent method. The public transport, private vehicles and non-motorized modes were taken as the dependent variable while the age, education, monthly income, household size, settlement status and distance were considered as the independent variables.

Results: The result clearly reveals that the selection of modes of transit varies with the variations in socio-economic conditions of commuters. It has also been found that the commuters living in better socio-economic condition in terms of education, monthly income, and size of household were likely more to commute by private modes of transportation than the commuters belonging to poor socio-economic condition who mostly rely on public and non-motorized vehicles.

Conclusion: The study suggests the base to better understand which attributes are more effective in selecting the means to travel for work Moreover, the commuting modes discussed in terms of public, private and non-motorized vehicles used by commuters according to their demographic, social and economic characteristics can help to formulate the effective and successful transportation policies.

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1. INTRODUCTION

Modes of commuting generally mean the modes of transportation which is used by commuters for their daily travel to work. Mode of transportation is a basic necessity for a commuter to accomplish its daily trip to work. Therefore, it is clear that without good accessibility and availability of transportation, the act of commuting can't be performed. Nevertheless, the choice of modes for daily journey to work by commuters is highly influenced by their socio-economic and demographic status. Therefore, the variations in modes of commuting are enough to show the disparity in socio-economic condition of commuters.

A mode of transportation is a key component of commuting. It has changed the volume, nature and pattern of commuting over time because the

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commuting involves the people who require the means of transportation at any given point of time and place to visit to place of work or return to home. Thus, commuting is not possible in absence of sufficient, punctual, fast and safe transportation. Besides, the mode of commuting is one of its basic components which greatly shapes the pattern of commuting existing in a particular region. In other words, the pattern of commuting in a particular place largely depends on the availability and accessibility of transportation of that particular area (Malokin et al. 2019; Rasca & Saeed, 2022; Sridhar & Nayka, 2022). The probability of long-distance commuting enhances with availability of rapid and punctual modes of transportation and decreases with the lack of efficient availability of transport mode (Zhou & Murphy, 2019).

Modes of commuting generally mean the modes of transportation which is used by commuters for their daily travel to work. The term “mode usage”, “mode choice”, or “modal split” are often used to describe the decisions people make regarding their travel means. Modal choice is the process of opting “persons trips" or “freight movements" by the mode of transport (Cracknel, 2001). Mode of transportation is a basic necessity for a commuter to accomplish its daily trip to work. Therefore, it is clear that without good accessibility and availability of transportation, the act of commuting can’t be performed. Nevertheless, the choice of modes for daily journey to work by commuters is highly influenced by their socio-economic and demographic status. It considers the factors that are important to people or companies when making the decision as to which mode to use. In fact, selection of mode of transport is a function of combination of factors such as demographic factors, physical determinants, economic factor, cultural factors (choice, taste, tradition, technological knowledge, social-status, advancement of civilization etc.) and governance factors (laws, regulations, etc.). Rasca and Saeed (2022) find that the young and adults commuters select the public means of transit. Commuters from oldest age group use public transport more than middle aged ones.

Gender differential in selection of commuting mode is also remarkable. The women being low wage earner prefer to commute by public modes of transportation. The financial prosperity of commuters influences selection of commuting transport considerably. Low and middle-income people travel more number of trips than high income people. The low groups usually prefer those modes, which have minimum cost rather than comfort, privacy and security. But most of the middle and higher groups prefer to use the modes that are more comfortable, safe and secure. In this context, an example can be cited, in Hanoi City of Vietnam, there are two settlements-old settlement and new settlement (Motte et al. 2016). The old settlement is inhibited by low income people and new settlements are occupied relatively by better off people. Residents of old settlement cover short distance simple by walking and for longer distance, they depend on bicycle but people of new settlement use motorbikes for both short and long distance movement (Hoai and Ann, 2010). One study reported that people do not necessarily minimize their travel time or always choose the most cost-efficient mode or route, even when they are making work trips (Anable and Gatersleben, 2005).

In the United States in urban areas (with a population of 2500 or more) 64 percent of the commuters went to work by car, while in Belgium only 14 percent used this transport mode (U.S. Census, 1962). A survey conducted during the fall of 1963 in the standard metropolitan statistical areas (exclusive of New York) found that of all journeys to work, 84 percent were made by car, 90 percent of the cars containing only one person. Contrary to it, in developing countries, at a time, hand pulled carts, bicycle, cycle rickshaw, intermediate public transport dominated the streets (Pain, 2004). However, with the advanced degree of urbanization and increase in city sizes, trips become longer. As a consequence, both cycling and walking reduce considerably. These reduce to about 1/2 of all trips in medium cities and 1/3 in large cities in India in between 1986 and 2005 (Chowdhury and Chowdhury, 2011). In another study, it has been claimed that the adoption of ridesharing services is influenced primarily by reliability, convenience of the booking system, comfort, and time savings (Tyrinopoulos et al., 2020). The findings of a research conducted by Nordfjærn et all (2019) showed that situational constraints were somewhat more important for mode use than psychological variables.

The commuting modes and their variable impacts on health have also been associated in considerable previous studies which clearly exhibits that the health of commuters is very much affected by the types of vehicles the commuter rely for daily commute. The past studies showed that travel by both public and private modes of transport can cause considerable stress (Tse et al., 2000; Wener et al., 2005; Bhat and Sardesai, 2006; Bayramzadeh & Fari, 2019; Mousavi et al, 2025) as well as poor quality of life (Costa et al., 1988). Insufficient capacity and crowding is a major cause of stress among commuters who use public transport. Stressors like traffic congestion, lack of reliable and punctual services of public transport can cause motivational deficiency, increasing absenteeism and low productivity among tired workers. Elevated stress levels can contribute to serious health problems such as cardiovascular disease and suppressed immune functioning (Wener et al., 2005).

In countries where the public transport system is not well-developed, daily experience of unreliable

transport, conflicting time schedules, congested roads and crowded trains contribute to commuters' physical and psychological stress (Cantwell et al., 2009). Various modes of transportation have been found affecting commuters' health well-being differently. Car driving in commuting has been found to elevate psychological markets of stress such as blood pressure and neuroendocrine hormone levels (e.g. Robinson 1991; Bellet et al., 1969; Simonson et al., 1968). Moreover, highway congestion increases blood pressure among car drivers (e.g., Stokols et al).
1978; Novaco et al., 1979; Schaeffer et al., 1988; Evans and Carrere 1991; White and Rotton, 1998). Public transportation commuting in especially crowded trains has been found to increase psychological stress (e.g., Singer et al., 1974; Cox et al., 2006). Unreliability and delays on commuter trains in London have been associated with low productivity and low efficiency in tired workers. This loss in productivity has been estimated to cost London city at least £230 million per annum (Cox et al., 2006).

The analysis of the determinants influencing the mode choice of commuters considered in terms of demographic and socio-economic characteristics of commuters and their place of origin as rural and urban is very important to understand the variations in their socio-economic status as well as variations in selection of different modes of transportation. The study will surely provide the base to better understand which attributes are more effective in selecting the means to travel for work.

The study has been organized into various sections. The first part of the study contains introduction. The rest of the study is organized as follows. Sect. II reviews of existing literature done so far; Sect. III presents the aims & objectives, research questions and research methodology used. The results and discussion portion are presented in Sect. 4. Last but not least, major findings, conclusions and policy implications are presented in Sect 5.

1.1. Review of Literature

A number of studies have examined the factors that influence choice of travel modes by daily commuters. For example, Palma and Rochat (2000) investigated the mode choice for trips to work in the city of Geneva using a nested logit approach. They observed that the car ownership decision was primarily related to the income level of the household and was also influenced by the number of working people in the household and location issues. The study highlighted the relative inadequacy of public transport to some commuters' needs, especially those who live in suburban areas across the border. This was attributed to the peculiar geographical location of the city of Geneva. Kingham et al. (2001) analyzed factors influencing commuting choice and the potential for drivers to change to more sustainable transport modes such as cycling and bus, using the journey to work surveys from two large companies in Hertfordshire, England. The findings show that people comprehend the issues relating to air pollution and traffic congestion arising from car use and are willing to change their mode of travel, given certain changes: living closer to the workplace, more efficient public transport services and reduced ticket prices.

Studying in the same context, Titheridge and Hall (2006) examined the relationships between patterns of commuting mode choice with socio-economic and land-use characteristics (residential and workplace) in South East England using regression models. They found that traveling to work by public transport, cycling and walking were promoted in dense, urban areas, with and shorter journey distances. Liu (2007) analyzed travelers' choice behavior using combined revealed preference/stated preference survey data on work-trip mode choice in Shanghai, China. Several versions of a multinomial choice model were specified and estimated in this study. For those at middle and high income levels, the study observed that in-vehicle time when traveling by bus and the money cost of choosing to travel by taxi were more important attributes, whereas for low incomes, money cost and in-vehicle time of choosing to travel by bus seemed to be more important. Nurdeen et al. (2007) modeled the transportation behavior for coercive measures for car driving in Kuala Lumpur. A binary logit model was developed for the three alternative modes: bus, train, and car. It was found that time of travel, cost of travel, gender, age, income level, and car ownership were significant factors in influencing car users' mode choice behavior. Reduction in total time of travel and cost of travel for the bus and train mode emerged as the most important element attracting car users toward public transport and away from car mode. Mahlawat et al. (2007) examined the travel behavior of students at Texas A & M University (College Station, TX). The mode choice model showed that time of travel, cost of travel, income, expenses, household type, number of hours in school, gender, and ethnicity were important factors in the student's choice of mode.

Using two comparable national travel surveys, Buehler (2011) empirically investigated the determinants of transport mode choice in Germany and the United States. The analysis revealed significant differences in travel behavior even between similar individuals in Germany and the United States. The use of car was found to be on two different levels in the two countries with significantly higher rates of travel by car for all groups of society in the United States. The Germans in households with more cars than drivers were found to make three times higher share of trips by foot, bike, and public transport compared with Americans in similar households. Chandrasekhar, et al (2020)

conducted a comprehensive study on the determinants of commuters' choice in context of rural and urban India. They used the data from Census of India 2011 covering 640 districts in order to understand what drives the commuting choice among non-agricultural workers. They found that urbanization level, population size and density along with education attainment and worker's sex ratio (gender ratio among workers), age (elderly) and land use mix play very important role in regional pattern in transport mode choice for commuting. Adriana, et al (2023) in their study on commute mode choice among the students explore that despite living in Jakarta, a motorcycle and car-dominated city, the students prefer to use sustainable transport. Public transport is the most common mode, followed by motorcycles, walking, cars, and ride-hailing. The analysis of a study done by Yong Hu et al (2023) revealed that only about half of the couples commute by their preferred travel mode, whereas the remaining couples were those where one or both partners were unable to use their preferred travel mode, mostly due to travel distance.

The review of previous studies related to mode choice analysis reveals that the choice of the mode varies significantly with socio-economic and demographic characteristics of the commuters. Most of the cities of developing countries have been reported depending on inefficient and unreliable means of transportation. In a country like India, where exclusive bus lanes are almost absent and with limited efforts for promoting the public transport, the attitudes and the preferences of travelers for selecting the modes are different. Moreover, majority of the cities in India are on the verge of taking major policy decisions for improving existing public transport system and also contemplating the need for introducing new systems of mass transport such as Bus Rapid Transit System, Metro rail. However, there is scanty research in developing countries on mode choice behavior of traveler to work. In this context, carrying out a study on behavior of commuters with regard to mode choice will be useful to the planners and decision makers to assess the shift to public transport, if the existing system is improved or a new system is introduced (Ashalatha et al, 2013).

1.2. Aims and Objectives

The aim of this research paper is to present the key determinants, factors, and motivators that affect the use, adoption or selection of transportation means for their daily commute.

- To examine the demographic factors affecting the decision of commuters of selection of means of transportation for daily commuting. To analyze and discuss the socio-economic factors which determine the selection of means of transportation for daily commuting.

1.3. Research Questions

The study contains followings research questions:

- Is there any impact of demographic characteristics on the choice of transport modes for daily commute to work in the city?
- Is the selection of the different means of commuting highly selective in terms of social and economic characteristics?
- Do the commuters belonging to rural and urban background areas have variations in their use of means of transportation for commuting?

2. METHODOLOGY

The present study is mainly based on primary sources of data that has been generated through the comprehensive field survey by using a well-structured questionnaire to the respondents pertaining the demographic and socio-economic aspects of commuters. The field survey has been conducted in Moradabad city during 2017. Since, some commuters are very difficult to be identified due to lack of fixed work place and hidden in nature; in the city, the working and transit palaces were visited before drawing the actual sample of commuters and the sample of 5% individual commuters was selected following the purposive random sampling method for the survey from the working and transit points, connecting roads and labour markets. The survey is consisted of total 2294 respondents in the Moradabad city whereas the total number of sampled commuter households was 2256 in which the sampled male commuter households consisted of 2093 and sampled female commuter household included 163. The total number of selected rural and urban commuters in the survey were comprised of 1672 and 622 respectively. For the collection of data, only those commuters have been taken into consideration who were identified visiting to Moradabad city by crossing the administrative boundary of Moradabad city either from nearby village, town, city, block, tehseel or across the other districts particularly for the purpose of work, and all those who had been travelling to city for recreation, excursion, shopping, health or other individual purposes were excluded from the survey. For the collection of primary data, the administrative boundary of Municipal Corporation of Moradabad city has been taken as the unit of study and the individual commuter as the unit of enquiry. Before filling the questionnaires, commuters were recognized on the basis of their places of origin; rural commuters and urban commuters, the separates individual slips having the attributes of rural and urban environment were used to ease the task of survey. Hence the commuters are always in hurry either to reach to their place or to return to their place of residence after performing their duty, that's why it

was very difficult to agree them to give the answers of the questionnaire. Mainly three times for the survey were selected, the first one was of early morning (7 am to 10 am) in the morning, second one was of noon (1pm to 3 pm) and last third was of evening (from 5 pm to 9 pm). These are peak the times of commuters' arrival or departure either to workplace or to return to place of residence. The data collected through the field survey using individual slips have been scrutinized and processed in tabular form according to the requirements of the various aspects of the study. Moreover, possible attention has been paid to maximize the accuracy and validity of the data after screening, sorting, excluding of invalid and incomplete questionnaires. The obtained data through the field work has been analyzed through the simple percentage, average and descriptive method. The map of Moradabad city has been drawn by using Arc GIS Programme.

2.1. Study Area

Moradabad city has been selected for the present study which lies in the western part of Uttar Pradesh. Moradabad has been servicing as an industrial, commerce, educational and administrative city since long of period for employment attraction as well as for the movement for various purposes. Above of all, it has immense popularity because of the locations of brass manufacturing industries all over the world and consequently widely known as Brass city or Peetal Nagari. The geographical location of city lies between the parallel of 28° 16' to 28° 21' north latitude and meridians of 78° 46' to 79° east longitude. It is situated at a distance of 167 km from the national capital New Delhi on the banks of the Rāmgangā River, a tributary of Ganga River passing to the north-east of the city. The city occupies an area of 75 sq. km. Administratively, Moradabad City has been given the status of class first town by qualifying all the criteria. With respect to its demographic characteristic, Moradabad city has a population of 887871 inhabitants in which male and female constitute 464580 and 423290 respectively. The total literacy rate is 68.75% whereas the male and female literacy is 72.22 percent and 64.95 percent respectively.

The Moradabad city is speedily growing into an industrialized city of western Uttar Pradesh which has attracted the attentions of majority of population living in its periphery or surrounding villages and small town characterized with low level of industrialization, lack of sufficient job opportunities, shrinking employment, declining work force and decreasing size of land holding resulted in minimizing the demand of human labor force, in search of suitable sources of their livelihood. Its significance further lies in its well connectivity of both road and railway not only with its surrounding towns and villages but also with major commercial, industrial cities of India as being a headquarter of northern railway it facilitated the exports and imports of raw as well processed material to the other cities. The good connectivity of road network even to small villages further motivated the workforce to commute to city and good availability of transportation facilitated them to return back to their home after having performed their regular jobs.

Having observed the prevailing condition in Moradabad City in terms of its geographical location, growing industrialization, fast development after being included in smart city plans in 2015, transport infrastructure, good connectivity and its attachment with its hinterland having the sufficient labor force, it can be concluded that the phenomenon of commuting may accelerate over the period of time with fast rate until the diffusions of industrialization on the same rate occurs in its nearly located town and villages.

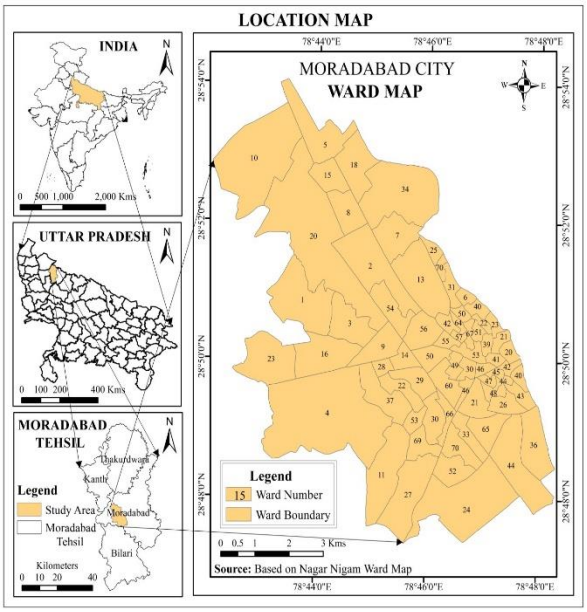

Fig 1. Map of the study area

3. RESULTS

3.1. Commuting Mode by Age and Sex-composition

The data on percentage distribution of modes of transportation of commuters based on their age and sex-composition has been depicted in table-1. It can be analyzed from the table that the younger (below 15) and older commuters (aged 60 and above) are more to commute by non-motorized vehicle and relatively less to commute by private and public transport than the commuters aged 15-59 years old. The similar condition has been observed among the females, while the reverse trend for both sexes male and females has been found among the adult commuters aged 15-59 years old where they use more the private vehicles than non-motorized modes as compared the those belonging to

juvenile (below 15 years) and senile age-groups (aged 60 and above).

Table 1. Percentage Distribution of Commuting Modes by Age and Sex Composition in Moradabad City, 2017

Age-Groups	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Below 15	Male	45.45	-	54.55	100.00
	Female	50.00	-	50.00	100.00
	Total	46.67	-	53.33	100.00
15-29	Male	70.39	11.18	18.42	100.00
	Female	91.67	4.17	4.17	100.00
	Total	71.95	10.67	17.38	100.00
30-44	Male	73.61	10.09	16.31	100.00
	Female	60.00	26.67	13.33	100.00
	Total	72.78	11.09	16.13	100.00
45-59	Male	67.11	9.21	23.68	100.00
	Female	88.89	3.70	7.41	100.00
	Total	69.41	8.63	21.96	100.00
60 and above	Male	50.00	8.70	41.30	100.00
	Female	71.43	-	28.57	100.00
	Total	52.83	7.55	39.62	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

A further examination of table-1 shows that in age-group below 15, the proportion of the commuters using the non-motorized modes (53.33) is more than the people using the public transport to travel (46.67 percent), while no commuter has been reported to commute by his own private vehicles. As the age of commuters increases, the use of public and private transport also increases but percent of non-motorized transport decreases. It is evident from the data that the commuters falling in age-group of 30-44 who travel to work by public transport are the highest in percentage by comprising 72.78 percent followed by those who lie in age-group of 15-29 where they share 71.95 percent. The non-motorized vehicles have recorded its highest position in age-group below 15 where it has constituted 53.33 percent of people aged below 15. The percentage of non-motorized vehicles further declined to 39.62 in age group of 60 and above, and further reduced to 21.96 percent in age-group of 45-59. The pattern has been witnessed opposite in case of private vehicles where these types of vehicles have secured the highest position in age-group of 30-44 (11-09 percent) followed by age-group 15-29 (10.67 percent), and age-group 45-59 (8.63 percent).

With respect of sex-wise analysis, the data exposes that the females aged below 15 are more to commute by public modes of transport but less to travel by cycle or walk than the males, the similar trend exists in age-group 15-29 where the ratio of males commuting by private and non-motorized transport exceed the females, but condition gets reversed in age-group 30-44 where the percentage share of females using the private modes of commuting is sufficiently more but remarkably less to travel by public modes of transportation than their counterpart males but the previous condition is repeated in age-groups of 45-59 and 60 and above where the females commuting by public modes of transit are higher than males but lower by using the private as well non-motorized vehicles than the males.

3.2. Modes of Commuting by Settlement Status

The data regarding the percentage distribution of modes of transportation based on settlement status has been given in table-2. An analysis of the data brings the fact into light that as a whole the percentage share of public modes of transport used by commuters to travel is the highest followed by non-motorized and private vehicles and their respective figures are 70.53 percent, 19.35 percent, 10.11 percent. But the variations are notable among the males and females travelling by different types of modes of transportation. It can be seen from the data that the males who have been commuting by non-motorized modes are more than females but trend gets opposite in use of public and private vehicles where the females exceed the males to commute by public and private modes of transportation. The females commuting by public modes of transportation, private vehicle and non-motorized means of commuting comprised 77.17 percent, 10.87 percent and 11.96 percent respectively whereas the corresponding figures for males have been noticed to be 69.95 percent, 10.05 percent and 20 percent respectively.

Table 2. Percentage Distribution of Modes of Commuting based on Settlement Status in Moradabad City, 2017

Settlement Status	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Rural	Male	69.81	9.03	21.16	100.00
	Female	77.05	6.56	16.39	100.00
	Total	70.33	8.85	20.81	100.00
Urban	Male	70.36	12.86	16.79	100.00
	Female	77.42	19.35	3.23	100.00
	Total	71.06	13.50	15.43	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

The further examination of the data regarding the distribution of commuters based on modes of transportation by settlement status exposes that the commuters from urban areas are more in percentage to travel by public modes of transportation and less likely to opt the non-motorized vehicles than those coming from rural areas who in number exceed their counterpart using the non-motorized transport. The overall use of non-motorized vehicles is the least in both rural and urban areas. This finding is pertinent to the past study which exhibits that with very high growth rates and increasing per capita level of income, the use of motorized transport modes (especially personal two and four wheeler vehicles) is on the rise (Schafer and Victor, 2000; Pucher et al., 2005) in rural and especially urban areas. The proportion of people commuting from the rural and urban areas using the public vehicles have been observed 70.33 percent and 71.06 percent respectively, whereas their corresponding figures for the private vehicles have been observed 8.85 percent, 13.50 percent respectively. The ratio of rural commuters (20.81 percent) traveling by non-motorized have been noted sufficiently higher than the urban commuters (15.43 percent). Moreover, the females commuting from the both rural and urban sectors are more than the males to commute by public modes of transportation but the share of females living in urban areas becomes higher than females from rural areas to access the private vehicles, while the dependency on non-motorized modes is more for rural females commuters than the women from urban area.

3.3. Modes of Commuting based on Household Size

The data pertaining the percentage distribution of modes of commuting based on household size has been presented in table-3. The size of household has been observed influencing the use of modes of transportation. It can be seen from the table that the commuters who are living in households with more than 12 members are more likely to commute by public and private modes of transportation and less likely to travel by non-motorized modes of transportation. On the hand, the commuters, living in households with less than 12 members are more to commute by public and non-motorized modes of transportation and less likely to commute by private vehicles. The reason behind this difference is that the household income of commuters living in joint family is higher than the commuters living in nuclear family and thus they are more to afford the private vehicles. The trend completely gets reversed among the female commuters where they are more in percentage than males to commute by private modes living in nuclear family with one exception which is in case of 10-12 household members.

Table 3. Percentage Distribution of Modes of Commuting by Household Size of Commuters in Moradabad City, 2017

Household Size	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Up to 3	Male	67.68	6.06	26.26	100.00
	Female	64.29	14.29	21.43	100.00
	Total	67.26	7.08	25.66	100.00
4 – 6	Male	71.43	9.23	19.34	100.00
	Female	78.00	12.00	10.00	100.00
	Total	71.96	9.46	18.59	100.00
7-9	Male	69.11	11.31	19.57	100.00
	Female	84.00	4.00	12.00	100.00
	Total	70.17	10.80	19.03	100.00
10-12	Male	67.44	13.95	18.60	100.00
	Female	66.67	33.33	-	100.00
	Total	67.39	15.22	17.39	100.00

Household Size	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
More than 12	Male	50.00	33.33	16.67	100.00
	Female	-	-	-	-
	Total	50.00	33.33	16.67	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

3.4. Modes of commuting by Educational Status

The data considering the percentage distribution of modes of commuting based on education has been arranged in table-4. The data discloses the fact that the commuters who are illiterate or educated to the level of high school are comparatively greater to commute by non-motorized vehicles and proportionally lower to travel to place of work by the private modes than the commuters with higher level of education. This condition is witnessed similar among the both genders; male and female.

Table 4. Percentage Distribution of Commuting Modes Categorized by Educational Status in Moradabad City, 2017

Educational Status	M/F/T	Types of Commuting Modes			Total
		Public	Private	Non-motorized	
Illiterate	Male	74.13	2.62	23.26	100.00
	Female	79.41	-	20.59	100.00
	Total	74.60	2.38	23.02	100.00
Primary	Male	72.54	5.04	22.42	100.00
	Female	84.62	-	15.38	100.00
	Total	72.93	4.88	22.20	100.00
High School	Male	72.36	8.13	19.51	100.00
	Female	75.00	-	25.00	100.00
	Total	72.52	7.63	19.85	100.00
Intermediate	Male	58.06	27.42	14.52	100.00
	Female	66.67	33.33	0.00	100.00
	Total	58.82	27.94	13.24	100.00
Graduation	Male	54.69	37.50	7.81	100.00
	Female	78.57	21.43	-	100.00
	Total	58.97	34.62	6.41	100.00
Post-Graduation	Male	56.86	41.18	1.96	100.00
	Female	63.64	36.36	-	100.00
	Total	58.06	40.32	1.61	100.00
Others	Male	42.86	35.71	21.43	100.00
	Female	83.33	16.67	-	100.00
	Total	55.00	30.00	15.00	100.00
Total	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on primary survey by author, 2017.

The data given in table-4 discloses that the highest percentage (23.02 percent) of non-motorized vehicles has been traced among the illiterate commuters followed by the commuters educated up to primary level (22.20 percent), having the education of high school (19.85 percent), other diplomas holders (15.00 percent), intermediates (13.24 percent), and graduation (6.41 percent), while the lowest share of non-motorized modes has been recorded among the post-graduates commuters (1.61 percent). Moreover, the lowest percentage share of private vehicles has been registered among the illiterates, after that it has been seen continuously increasing with the increase in level of commuters' education and became highest among the post-graduate commuters in which it constitutes more than two-fifth of all modes. In addition to it, the public modes of transportation are mostly used by all categories of education but its maximum share has been witnessed among the illiterate commuters, after that it has been recorded constantly declining with increase in level of education with few exceptions. It clears positive relationship between the education and

income of commuters and consequently its effect on the selection of modes of commuting. The commuters getting higher income in terms of high level of education are more to afford the private vehicles than those who are earning lower income along with the low level of education.

A gender-wise analysis shows that the women who completed education up to high school are more likely to commute by the cycle or walk than the women who are illiterate or educated up to level of primary, after that no women has found commuting by non-motorized modes, while the highest dependency of women commuters on private vehicles to travel to workplace has been witnessed among the post-graduates, however, this ratio is comparatively lower than the males. In addition fluctuating trend of public modes of transportation has seen among the educational categories of educated female commuters.

3.5. Modes of Commuting based on Monthly Income

The data regarding the percent distribution of modes of transportation based on monthly income has been presented in table-5. The data exhibits that the public modes of transportation are mostly used by the commuters whether earning high or low income but the people who earn very low income per month prefer to commute by non-motorized vehicles and carry the higher percentage value while those who like to commute by public and private modes have the low percentage value. Moreover, the percentage of commuters earning handsome amount per month is comparatively higher to select private vehicles than the commuters earning low income who significantly depend on public modes of transportation.

The further analysis of data contained in table-5 depicts that little more than four-fifth of commuters who earn up to 1500 rupees per month have been found to commute by non-motorized vehicle, while less than one-fifth people have been recorded to travel by public modes of transportation. It is because, the people earning very low income can not afford their own privates modes and also the expense of public modes of transportation, therefore, in order to save the money, they mostly travel to work by cycle or by walk. Moreover, it has been seen that the ratio of people commuting by non-motorized vehicles begins to decline but tends to increase by public vehicles as their monthly income tends to rise. It is evident from the table that the commuters who earn 1500-3000 are the highest (50.00 percent) to commute by public modes of transportation followed by the commuters travelling by non-motorized (43.48 percent) and by private vehicles (6.52 percent).

Table 5. Percentage Distribution of Commuting Modes based on Monthly Income of Commuters in Moradabad City, 2017

Monthly Income (in rupees)		Types of Commuting Modes			Total
	M/F/T	Public	Private	Non-motorized	
Below 1500	Male	25.00	-	75.00	100.00
	Female	-	-	100.00	100.00
	Total	16.67	-	83.33	100.00
1500-3000	Male	37.04	7.41	55.56	100.00
	Female	68.42	5.26	26.32	100.00
	Total	50.00	6.52	43.48	100.00
3000-6000	Male	72.98	2.18	24.84	100.00
	Female	88.10	2.38	9.52	100.00
	Total	74.25	2.20	23.55	100.00
6000-9000	Male	73.12	10.02	16.86	100.00
	Female	92.31	7.69	-	100.00
	Total	73.67	9.96	16.37	100.00
9000-12000	Male	57.89	34.21	7.89	100.00
	Female	66.67	33.33	-	100.00
	Total	59.09	34.09	6.82	100.00
Above of 12000	Male	55.68	42.05	2.27	100.00
	Female	50.00	50.00	-	100.00
	Total	55.10	42.86	2.04	100.00
All	Male	69.95	10.05	20.00	100.00
	Female	77.17	10.87	11.96	100.00
	Total	70.53	10.11	19.35	100.00

Source: Calculation is based on sample survey by author, 2017.

The percentage of the commuters using the non-motorized vehicles to commute has been found continuously decreasing with the increase of monthly income. It can be seen from the data that the people who earn 3000-6000 and 6000-9000 rupees per month constitute 74.25 percent and 73.67 percent respectively

to have the use of public modes of transportation whereas the commuters who use their own private modes for commuting account for 2.20 percent and 9.96 percent respectively, whereas, the corresponding figures for the commuters depending on non-motorized modes are 23.55 percent and 16.37 percent.

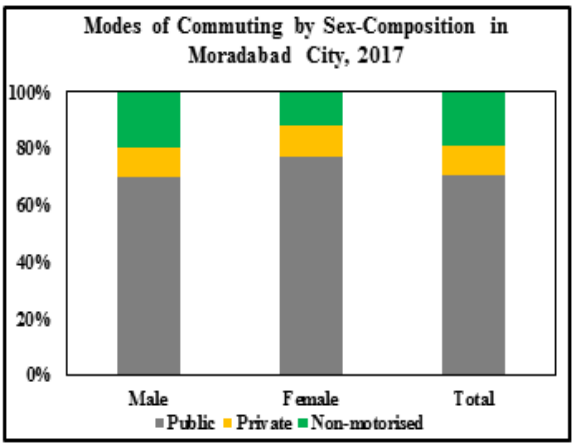

Fig.2

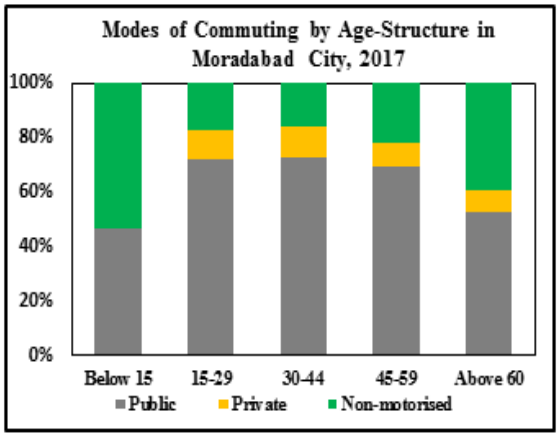

Fig.3

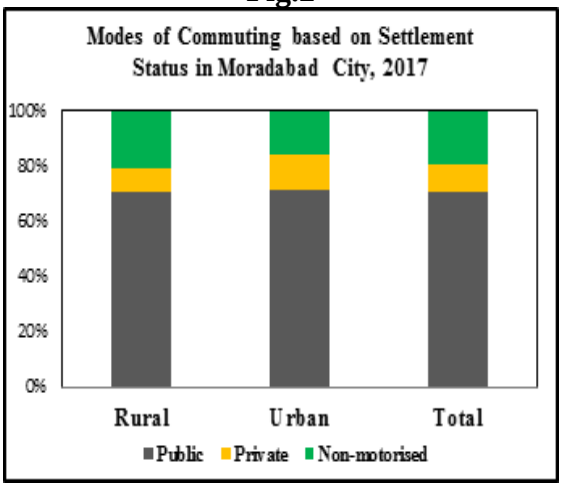

Fig.4

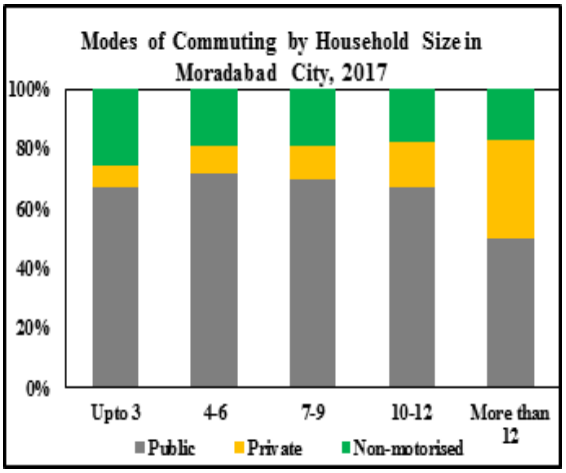

Fig.5

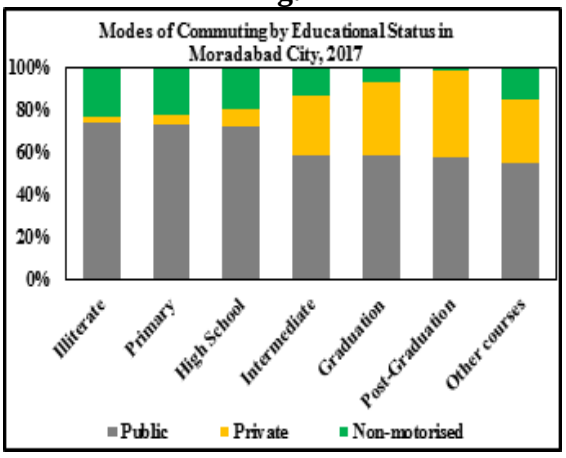

Fig.6

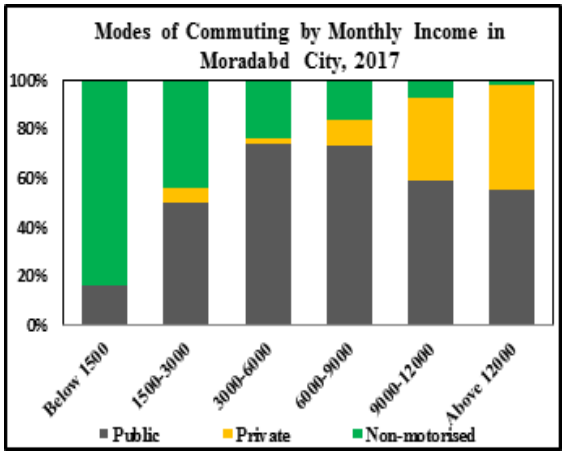

Fig. 7

Modes of Commuting based on Socio-Economic Characteristics in Moradabad City, 2017

It has been observed that the use of private vehicles rises with rise in monthly income. It is evident from the table, that percentage share of commuters who earn 9000-12000 and more than 12000 rupees per month and commute by the private vehicles becomes higher than commuters who were recorded having the monthly income less than 9000. However, the ratio of public modes transportation still exits highest, but percentage share of commuters using the non-motorized vehicles becomes the lowest in above categories of monthly income.

A further examination of the data reveals the fact that females earning upto 1500 are the highest to commute by non-motorized modes and their ratio is also higher

than the males commuting by the same modes of transportation. Likewise, the women who earn more 1500 rupees per month are more than males to use the private vehicles. It has been also found that women in categories of 1500-3000 and 9000-12000 rupees per month are more than the males to depend on public modes of transportation and relatively less to travel by both private as well non-motorized modes of commuting than their counterpart males.

4. DISCUSSION

- Place of origin of commuters has been seen an important factor determining the selection of commuters' mode of transportation as the commuters commuting form rural were more dependent on non-motorized vehicle than the urban commuters who were greater in amount to commute by public as well private vehicles because of their availability of public transportation and affordability of private vehicles. Another reasons is that the towns/cities as the place of residence of commuter were far located from Moradabad city, therefore, it was nearly impossible to commute by non-motorized vehicle.
- A sex-wise analysis reveals the striking finding that the females who were found using the private and public modes of transportation were likely more than the males whose share in commuting by both kind of transportation was lower than their counterpart. But the condition gets reversed in selection of non-motorized mode of commuters when the male exceed the female. This may be because the females due to perceived sense of security mostly rely on public transportation. Another reason can be associated with the fact that the highly educated women commuters were able to afford the private the vehicles mainly commuting form the urban areas.
- The age-wise assessment of commuters'mode choice makes it clears that the use of non-motorized vehicle was higher among the juvenile and senile age-group than the adult commuters who exceeded them in travelling to work by public and private modes of commuting.
- The relationship between household size and modes of commuting is also notable. It has been found that the commuting living in big sized household were higher to commute by public modes of transport than those living in small size of household who were more to travel by private modes of transportation.
- The commuters being comparatively highly educated were greater to commute by private vehicle rather than by public and non-motorized vehicles while opposite trend has been observed among the commuters having the low status of education who were largely using the public modes of transportation to commute..
- The major problems faced by commuters in Moradabad city were overcrowded modes, congestion on the road, old and polluted vehicles, occurrence of accidents, exposure to the pollution, mental and health stress, etc.
- The data exhibits that the public modes of transportation were mostly used by the commuters whether earning high or low income but the people who earned very low income per month were more likely to commute by non-motorized vehicles and less likely to commute by public and private modes while the percentage of people earning handsome amount per month was comparatively higher to use private vehicles than the commuters earning low income.

5. CONCLUSION

The overall results reveal that the modes of transporatation selected by commuters to travel vary according to their age, sex, education, income, household size, and distance between the place of work and place of residence and the suitability of modes of transportation. The females and elderly people are more to depend on public means of transit than the males and the adults. Commuters living in poor and low status household in terms of education and affordability are more likely to commute by public transport and non-motorized and less likely to commute by private vehicles than commuters with the high level of income and education who depend more on private vehicles for their daily journey to work. Thus the people due to their low level of income may have less options of transport modes and therby less likely to spare the time for social activities, education, health accessibility and more work opportunity which may affect their social well being and life chances in future. Overall, what the study finds is a strong linkages between educational attainment and income levels on one hand and the use of different kinds of modes of transport on the other. Thus it is clear that social as well as economic background has a great influence on selection of modes of commuting.

Investments in transport infrastructure are acknowledged to be transformative in nature since they facilitate increase in the mobility of individuals and workers, reduce transport costs and integrate various markets. These investments hasten structural changes in the economy by stimulating growth, facilitating social inclusion, and improving sustainability (Berg et al 2020). Moradabad city having good connectivity by both railways and roadways, and availability of modes of transportation experiences the increasing rate of commuting but the quality and quantity of

transportation required by the commuters according to thier demographic, social and economic status are not efficient. Therefore, there is an immediate need for proper development of transport infrastructure and understanding its various dimensions from socio-economic, demographic and spatial point of view to regulate the commuting in city for its social development and economic growth. There should be a continuous assessment of the changes in demand of modes and responses thereby to maintain the reliability of the system.

It is expected that the recommendations proposed in the research may provide better solution to the existing transportation system in Moradabad city and improve the options for commuters. The findings of this study will be of high importance to the government agencies responsible for urban planning such as the Ministry of Urban Planning who can take into consideration the results to add gravity to the effects of congestion, the National Transport Commission for formulating policies regarding transit and all authorities relevant to motor traffic and urban infrastructure. The Central Bank can use the findings to take into effect the economic impact when measuring econometrics of labour. It is expected that this research will be of some use in this regard.

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REFERENCES

Adriana, M. C., Situmorang, R., & Aji, B. J. (2023). Exploring the transport mode choice of University students in Jakarta: A case study of Universitas Trisakti. Spatium, 020-029. https://doiserbia.nb.rs/Article.aspx?id=1450-569X2300003A

Ashalatha, R., Manju, V. S., & Zacharia, A. B. (2013). Mode choice behavior of commuters in Thiruvananthapuram city. Journal of Transportation Engineering, 139(5), 494-502. http://dx.doi.org/10.1061/(ASCE)TE.1943-5436.0000533

Bayramzadeh, N., & Fari, M. (2019). The effect of land use planning on traffic with a sustainable development approach. Traffic Management Studies Quarterly, (52), (65-86). https://www.sid.ir/paper/402959/fa

Bellet, S., Roman, L., & Kostis, J. (1969). The effect of automobile driving on catecholamine and adrenocortical excretion. The American Journal of Cardiology, 24(3), 365-368. https://doi.org/10.1016/0002-9149(69)90430-5

Bhat, C. R., & Sardesai, R. (2006). The impact of stop-making and travel time reliability on commute mode choice. Transportation Research Part B: Methodological, 40(9), 709-730. https://doi.org/10.1016/j.trb.2005.09.008

Buehler, R. (2011). Determinants of transport mode choice: a comparison of Germany and the USA. Journal of transport geography, 19(4), 644-657. https://doi.org/10.1016/j.jtrangeo.2010.07.005

Cantwell, M., Caulfield, B., & O'Mahony, M. (2009). Examining the factors that impact public transport commuting satisfaction. *Journal of public transportation*, *12*(2), 1-21. http://doi.org/10.5038/2375-0901.12.2.1

Chandrasekhar, S., Mishra, S., & Sharma, A. (2017). Transport mode choice for commuting: evidence from India. *SocArXiv. August*, *3*. https://ideas.repec.org/p/osf/socarx/qh8m5.html

Chowdhary, R. B. and Chowdhary, R. A. (2011). Transport as an Urban Hazrd- A Case Study in India. *Indian Journal of Landscape System and Education Studies*, 34(1), 383-400.

Costa, F. F., Silva, K. S., Schmoelz, C. P., Campos, V. C., & de Assis, M. A. A. (2012). Longitudinal and cross-sectional changes in active commuting to school among Brazilian schoolchildren. *Preventive Medicine*, *55*(3), 212-214. https://doi.org/10.1016/j.ypmed.2012.06.023

Costa, G., Pickup, L., & Di Martino, V. (1988). Commuting--a further stress factor for working people: evidence from the European Community. II. An empirical study. *International archives of occupational and environmental health*, *60*(5), 377-385. https://doi.org/10.1007/BF00405674

Cox, T., Houdmont, J., & Griffiths, A. (2006). Rail passenger crowding, stress, health and safety in Britain. *Transportation Research Part A: Policy and Practice*, *40*(3), 244-258. https://doi.org/10.1016/j.tra.2005.07.001

Cracknel, K (2001). *Urban Mobility and Livable Cities for Future*, Sydney: McGraw Hill.

Gang, L. I. U. (2007). A behavioral model of work-trip mode choice in Shanghai. *China Economic Review*, *18*(4), 456-476. https://doi.org/10.1016/j.chieco.2006.09.001

Hu, Y., Sobhani, A., & Ettema, D. (2023). Are men or women happier commuters? A study on the determinants of travel mode dissonance and travel satisfaction for dual-earner couples with school-age children in Ganyu, China. *Travel behaviour and society*, *31*, 131-140. https://doi.org/10.1016/j.tbs.2022.11.009

John, L. M., Flin, R., & Mearns, K. (2006). Bus driver well-being review: 50 years of research. *Transportation research part F: traffic psychology and behaviour*, *9*(2), 89-114. https://doi.org/10.1016/j.trf.2005.10.002

Kingham, S., Dickinson, J., & Copsey, S. (2001). Travelling to work: will people move out of their cars. *Transport policy*, *8*(2), 151-160. https://doi.org/10.1016/S0967-070X(01)00005-1

Mahlawat, M., Rayan, S., Kuchangi, S., and Patil, S. (2007). Examination of student travel mode choice. Rep. 07-2616, Transportation Research Board 86th Annual Meeting, Transportation Research Board, Washington DC. https://trid.trb.org/View/802309

Maibach, E., Steg, L., & Anable, J. (2009). Promoting physical activity and reducing climate change: Opportunities to replace short car trips with active transportation. *Preventive medicine*, *49*(4), 326-327. https://doi.org/10.1016/j.ypmed.2009.06.028

Malokin, A., Circella, G., & Mokhtarian, P. L. (2019). How do activities conducted while commuting influence mode choice? Using revealed preference models to inform public transportation advantage and autonomous vehicle scenarios. *Transportation Research Part A: Policy and Practice*, *124*, 82-114. https://doi.org/10.1016/j.tra.2018.12.015

Motte, B., Aguilera, A., Bonin, O., & Nassi, C. D. (2016). Commuting patterns in the metropolitan region of Rio de Janeiro. What differences between formal and informal jobs?. *Journal of Transport Geography*, *51*, 59-69. https://ideas.repec.org/a/eee/jotrge/v51y2016icp59-69.html

Mousavi, M., Jafarpour Ghalehteimouri, K., & Bayramzadeh, N. (2025). Assessing social infrastructure in border areas from a city prosperity perspective: a case study of border townships in West Azarbaijan Province, Iran. Discov. Cities, 2(1), 1–20. https://doi.org/10.1007/s44327-025-00057-3

Mwale, M., Luke, R., & Pisa, N. (2022). Factors that affect travel behaviour in developing cities: A methodological review. *Transportation Research Interdisciplinary Perspectives*, *16*, 100683. https://doi.org/10.1016/j.trip.2022.100683

Nordfjærn, T., Egset, K. S., & Mehdizadeh, M. (2019). "Winter is coming": Psychological and situational factors affecting transportation mode use among university students. *Transport policy*, *81*, 45-53. https://doi.org/10.1016/j.tranpol.2019.06.002

Nurdeen, A., Rahmat, R. A. O. K., & Ismail, A. (2007). Modeling of transportation behavior for coercive measures for car driving in Kuala Lumpur. *ARPN Journal of engineering and Applied Sciences*, *2*(2), 18-23. https://www.researchgate.net/publication/238739017_MODELING_OF_TRANSPORTATION_BEHAVIOR_FOR_COERCIVE_MEASURES_FOR_CAR_DRIVING_IN_KUALA_LUMPUR

Pucher, J., Korattyswaropam, N., Mittal, N., & Ittyerah, N. (2005). Urban transport crisis in India. *Transport policy*, 12(3), 185-198. http://dx.doi.org/10.1016/j.tranpol.2005.02.008

Rasca, S., & Saeed, N. (2022). Exploring the factors influencing the use of public transport by commuters living in networks of small cities and towns. *Travel Behaviour and Society*, *28*, 249-263. https://doi.org/10.1016/j.tbs.2022.03.007

Robinson, A. A. (1991). Cancer deaths due to all causes, its relationship with vehicle travel in Australia, Japan and European countries. *Medical hypotheses*, *36*(2), 166-171. https://doi.org/10.1016/0306-9877(91)90263-X

Schaeffer, M. H., Street, S. W., Singer, J. E., & Baum, A. (1988). Effects of control on the stress reactions of commuters 1. *Journal of Applied Social Psychology*, *18*(11), 944-957. https://psycnet.apa.org/doi/10.1111/j.1559-1816.1988.tb01185.x

Schafer, A., & Victor, D. G. (2000). The future mobility of the world population. *Transportation research part a: policy and practice*, *34*(3), 171-205. https://doi.org/10.1016/S0965-8564(98)00071-8

Simonson, E., Baker, C., Burns, N., Keiper, C., Schmitt, O. H., & Stackhouse, S. (1968). Cardiovascular stress (electrocardiographic changes) produced by driving an automobile. *American Heart Journal*, *75*(1), 125-135. https://doi.org/10.1016/0002-8703(68)90123-3

Singell, L. D., & Lillydahl, J. H. (1986). An empirical analysis of the commute to work patterns of males and females in two-earner households. *Urban Studies*, *23*(2), 119-129. https://doi.org/10.1080/00420988620080111

Sridhar, K. S., & Nayka, S. (2022). Determinants of commute time in an Indian city. *Margin: The Journal of Applied Economic Research*, *16*(1), 49-75. https://doi.org/10.1177/09749101211073375

Stokols, D., Novaco, R. W., Stokols, J., & Campbell, J. (1978). Traffic congestion, type A behavior, and stress. *Journal of Applied Psychology*, *63*(4), 467. https://psycnet.apa.org/doi/10.1037/0021-9010.63.4.467

Titheridge, H., & Hall, P. (2006). Changing travel to work patterns in South East England. *Journal of Transport Geography*, *14*(1), 60-75. http://dx.doi.org/10.1016/j.jtrangeo.2005.06.006

Tran, H. A., & Schlyter, A. (2010). Gender and class in urban transport: the cases of Xian and Hanoi. *Environment and Urbanization*, *22*(1), 139-155. http://dx.doi.org/10.1177/0956247810363526

Tyrinopoulos, Y., & Antoniou, C. (2020). Review of factors affecting transportation systems adoption and satisfaction. In *Demand for emerging transportation systems* (pp. 11-36). Elsevier. http://dx.doi.org/10.1016/B978-0-12-815018-4.00002-4

van den Berg, P., Waygood, E. O. D., van de Craats, I., & Kemperman, A. (2020). Factors affecting parental safety perception, satisfaction with school travel and mood in primary school children in the Netherlands. *Journal of Transport & Health*, *16*, 100837. https://doi.org/10.1016/j.jth.2020.100837

Wener, R. E., & Evans, G. W. (2007). A morning stroll: levels of physical activity in car and mass transit commuting. *Environment and Behavior*, *39*(1), 62-74. http://dx.doi.org/10.1177/0013916506295571

Wener, R. E., & Evans, G. W. (2011). Comparing stress of car and train commuters. *Transportation Research Part F: Traffic Psychology and Behaviour*, *14*(2), 111-116. https://psycnet.apa.org/doi/10.1016/j.trf.2010.11.008

Wener, R. E., Evans, G. W., Phillips, D., & Nadler, N. (2003). Running for the 7: 45: The effects of public transit improvements on commuter stress. *Transportation*, *30*, 203-220. https://doi.org/10.1023/A:1022516221808

Wener, R., Evans, G. W., & Boately, P. (2005). Commuting stress: Psychophysiological effects of a trip and spillover into the workplace. *Transportation Research Record*, *1924*(1), 112-117. https://doi.org/10.1177/0361198105192400114

White, S. M., & Rotton, J. (1998). Type of commute, behavioral aftereffects, and cardiovascular activity: A field experiment. *Environment and Behavior*, *30*(6), 763-780. https://psycnet.apa.org/doi/10.1177/001391659803000602

Zhou, J., & Murphy, E. (2019). Day-to-day variation in excess commuting: An exploratory study of Brisbane, Australia. *Journal of Transport Geography*, *74*, 223-232. https://doi.org/10.1016/j.jtrangeo.2018.11.014