Analyzing Influence of Socio-Demographic Factors on Travel Behavior of Employees, A Case Study of Kathmandu Metropolitan City, Nepal

Ashim Ratna Bajracharya, Sudha Shrestha

Abstract: Kathmandu Metropolitan City (KMC) is the stage of rapid urbanization and its population is on the steep rise with increase in economic activities. Many people are migrating to KMC from other parts of the country for job opportunities. In urban mobility, work trip has a dominant share and at present, people are dependent more on private vehicles, than public transport to go to their work places. This research investigates the travel behavior of employees, living in KMC and its relation to four main variables of socio-demographic background of an employee, i.e. age, gender and income group and household vehicle ownership. Data was collected by household questionnaire survey. Different descriptive analysis and inferential statistical analysis were carried out and it shows that role of socio-demographic variables on travel behavior is quite significant in many aspects on choice of travel mode and trip length of the employees. Finally, based on the findings of the research, recommendations for urban transport policy were made, so as to increase the share of public transport for work trips.

Index Terms: Kathmandu Metropolitan City; Travel Behavior; Socio-demographic factors; Work Trips, Public Transport

1. INTRODUCTION

Travel behavior can be characterized the way people travel, mainly trip purpose, trip distance, trip frequency, modal choice. Urban mobility is the accumulation of travel behavior of all commuters, that constitute the urban transport system. Travelers try to optimize their outcomes in the context of the benefits and costs that they personally incur [1]. According to Handy [2], there are four main theories, related to travel behavior. They are (i) utility-maximizing theory, (ii) activity-based approach, (iii) theory of planned behavior, and (iv) social-cognitive theory. The first two theories refer to the mechanism determining travel behavior, whereas the latter two theories define factors influencing travel behavior.

This research is focused on the fourth theory i.e. social-cognitive theory, whereby the influencing factors determining travel behavior were studied for employees of Kathmandu Metropolitan City, in commuting their work trips. The social-cognitive theory postulates relationships among the individual's characteristics, the individual's behavior and the social environment, in which the behavior is performed [3]. Many research done in studying travel behavior gives emphasis on gender, household composition and income, occupation and vehicle ownership as significant factors in influencing travel behavior [4].

Public transportation (PT) plays an important role in any highly developed and densely populated city. Its huge capability to carry passengers to and from the urban area or inside the city helps to reduce traffic congestion and improve air quality [5].

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To promote shift to energy efficient modes, it is required to bring change in travel behavior of the people. Thus, studying travel behavior forms an essential component in urban transport system to bring change in the system for improvement.

Cities are the center of energy consumption and emissions; they account for 75% of global energy consumption and nearly 80% of greenhouse gas emissions [6]. Cities in emerging economies have an urgent need to tackle sustainable transport on a grand scale in order to create pathways towards sustainability. Such cities are growing very rapidly and more and more people, especially the younger generation, pursue modern lifestyles that are high in energy consumption and CO_2 emissions [7].

In many developing and middle-income countries, the transportation sector accounts for the greatest share of the increase in carbon emissions because many individuals aspire to own and drive their own vehicles as incomes rise. This has made transportation the most difficult sector to reduce energy consumption and CO_2 emissions [8]. Travel using private motorized transport needs to be reduced, while the share of non-motorized and public transport must be increased to achieve energy efficiency [9].

2. LITERATURE REVIEW

Number of research point to the fact that the socio-demographic variables have significant impact on travel choice [10], [11], [12]. The role of socio-demographic factors is more complex and includes gender, household income, household composition, car ownership, and age amongst other variables [13]. Many studies have explored the relationships between work patterns, time-use and travel behavior [14], [15].

Travel behavior is quite different for female and male workers. The causes of gender differences in travel behavior have been the subject of variety of interpretations [16]. Hanson and Johnston [16] argued that women's shorter trip distance is

primarily due to spatial and economic factors - lower average incomes, the location of female-dominated occupations in metropolitan areas, and women's greater dependence on public transit. While economic and spatial factors clearly play a role in women's home and work location choices, commuting patterns, and employment outcomes, a number of scholars have argued that an unequal division of power and labour in the household is an important determinant of gender variation in travel behavior [17], [18], [19].

In general, workers are using more motorized modes in average, than the rest of the adult population. Indeed, private mode is often the most relevant mode to reach workplace especially when it is located in remote subcenters [20]. The share of kilometers traveled daily, especially by private modes by workers is by far more important than what they represent in the overall population. Hence policies promoting a better matching between employment and residence location are of great importance to reduce travel demand and particularly car use within metropolitan areas [21].

Age is also one of the factor, influencing travel behavior, but it is often difficult to isolate the age factor alone as other factors also play a role simultaneously [22].

Vehicle ownership has a significant effect on level of private vehicle use. There are several factors associated with the ownership of vehicles in a household - income group, spatial dimension, Household structure, Household size and other factors. Income group is one of the prime factor in vehicle ownership. Vehicle ownership is generally high among high income groups [23], [24], [25]. Thus, use of private vehicle is generally high among high income groups. Also, average distance to workplace is generally greater for high-income workers [26].

Travel behavior is expected to vary with place. For instance, Giuliano [27] found significant differences in travel behaviour between different demographic groups in the USA and the UK. So, travel behavior of one area cannot be generalized to other area and thus, it needs to be studied, specific to the place.

3. Study Area and the Research Purpose

Kathmandu Metropolitan City (KMC) is a fast-growing city with a population of 975,453 as per census of 2011 AD [33]. The metropolitan city area is 50.67 sq.km and has a population density of 19,250 per km². It lies in capital district, Kathmandu, of Bagmati zone. The city is in the stage of rapid urbanization and with it, the level of urban mobility.

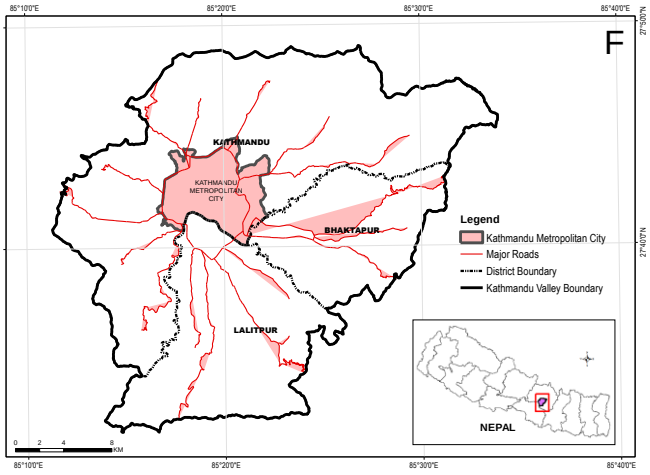

Fig. 1: *Location Map - KMC*

Number of vehicles have increased drastically in the past few decades. Over the past 10 years, population has increased by 4.32 % per year and motorization has increased by 12% per year while the modal share of public transport has remained stagnant [28], [29]. Share of private vehicles have gone up rapidly with increasing vehicle ownership in a household. The level of dissatisfaction with public transport is very high. The main reason is due to the fact that the current public transport is not able to provide quality service to the people. Survey conducted by CEN/CANN [30] showed that about 61.7% of female respondents feel uncomfortable with the space in public transport because of overcrowding; 57.7% of passengers were not happy with the travel time in public transport; 69.1% of surveyed passengers said that the public transport drivers practice reckless driving making travel uncomfortable and unsafe; 24.9% passenger perceived service as unreliable; and 30.5% of people said that they have to wait for more than 10 minutes during morning peak hour to get a ride.

All the above causes are driving the transportation system towards unsustainable mobility that is leading to road congestion, economy loss, more energy consumption and environmental pollution. It has now become very essential to optimize the mobility pattern to minimize the problems stated. The population of capital city is growing with increasing migration of people from other parts of the country for employment opportunities. KMC is serving as a main hub, for economic activities and thus work trips have a dominant share in overall trips with rise in number of workers, along with availability of employment opportunities. Work trip forms a highest share in overall trip composition, of about 39% as shown in Figure 2 [30].

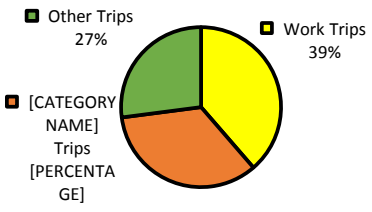

Fig. 2: *Trip Purpose for Kathmandu Valley*

Although number of researches have been done on urban transport planning of Kathmandu Valley, there isn't much done, on studying travel behavior of the commuters from socio-demographic perspective. But it is evident that travel behavior is one of the most essential component of urban mobility and thus it has to be given a priority. This paper is focused on the study of travel behavior of the employees with respect to their socio-economic background, mainly - gender, age and income and household vehicle ownership.

4. Study Approach and Methodology

Travel behavior has to be studied at the level of household as it is where the trip originates. The research is focused on work trips, which people commute daily, for going from home to their regular work place.

4.1 Data collection:

For collection data, cross sectional household questionnaire survey method was carried out. The survey consisted of 1118 households, collected from different parts of Kathmandu Metropolitan City (KMC). The sample size was determined for confidence interval 95%, Margin of error 3%, out of total 318,063 Households. The total household number is the projected figure of census data of 2011 AD, to the current year.

The households were selected randomly using stratified proportionate random sampling. There were 20 traffic analysis zones which are the strata, identified within the survey area. These are the administrative regions, either wards or municipal boundary. From each zone (stratum), the number of samples was determined in proportion to the number of households in the zone. Houses for sampling were identified using, random points generated from QGIS software, within the zone. This allowed us to have sampling locations randomly and uniformly distributed over the zone.

Questionnaire consisted of two parts – Household Characteristics and Trip Data, for work trips of household members, who are employed. From each household, trip data of individual members who are workers, was collected. The work trip is a typical weekday trip from home to the work place. In total, from 1118 households surveyed, there were 1785 respondents.

4.2 Data Analysis

For data analysis, both descriptive and inferential statistical analysis were used. Descriptive analysis was used for describing socio-demographic characteristics and travel characteristics of work trips of the sample population. For mode choice analysis, Pearson Chi square test was used, for carrying out bivariate and multivariate analysis. For trip length analysis, independent t-test and one-way independent ANOVA test were used, to compare trip length mean, among different groups.

5. Description of a Sample

5.1 Household Characteristics and Socio-demographic profile of Respondents

Household characteristics include socio-economic status of a household and individual characteristics of the household member, who are workers, which is tabulated in Table 1. Average household size is 4.3. Regarding household monthly income, about 24% of the households are having income over NRs. 75,000. Low income group, earning less than 25,000 per month is around 9% and those belonging to middle income group (NRs. 25,001 to 75,000) is about 67%. Average car ownership is found to be 0.36 per household, whereas for motorcycle, it is 1.03, meaning that, in average, each household owns at least one motorcycle. In contrast, ownership rate of bicycle far less, only 0.07 per household in average.

Table 1: *Household Characteristics of the Sample*

1.	**Household Monthly Income (NRs.)**[1]	**N**	**%**
	≤ 25000	97	8.7%
	25,001 – 50,000	337	30.1%
	50,001 – 75,000	417	37.3%
	75,000	267	23.9%
			Mean (St.dev.)
2.	**Household Size**		4.3 (1.2)
3.	**No of vehicles owned in a Household**		
	Car		0.36
	Motorcycle		1.03
	Bicycle		0.07

Regarding gender of the respondents, 73% are male and 27% are female. Most of the respondents are between age 31 to 50, about 61%. 22% are below 30 and 17% are above 50 years of age. Work trip rate is found to be 1.59 per household per day for weekdays.

5.2 Travel Characteristics

5.2.1 Modal Split

Modal split here is showing the share of each travel mode for work trips, which is summarized in Table 2, categorized as Private, Public and Non-Motorized Modes of Transport (NMT). Share of private vehicles, i.e. car and motorcycle is comparatively high, about 73%. Motorcycle has the highest usage overall, of about 48%. Share of public transport is only about 15%, which is the combined share of all public vehicles – bus, microbus and tempo. Bus occupies about 8% share and low occupancy public vehicles i.e. microbus and tempo has about 4% and 3% respectively. About 12% of the trips are made by walking and share of bicycle is the least, which is less than 1%.

[1] 1 US$ = NRs. 102.3 as of April 28, 2017

Table 2: *Modal Split and Average Trip Length*

Mode Category		Mode	N	Modal Split	Average Trip Length			Average Journey Speed (Km/hr)
					Distance (km)		Std. Dev.	
1.	Private	Car	442	24.8%	4.1	4.85	4.10	13
		Motorcycle	852	47.7%		3.82	3.14	15
2.	Public	Bus	137	7.7%		4.48	3.13	11
		Microbus	75	4.2%		3.29	3.11	11
		Tempo	49	2.7%		2.96	1.66	10
3.	NMT	Bicycle	15	0.8%	0.9	3.33	2.09	
		Walking	215	12.0%		0.81	0.65	

5.2.2 Trip Length

In average, work trip length is 4.1 km for motorized and 0.9 km for non-motorized modes (Table 2). Car is having the highest average trip distance of about 4.85 km and for motorcycle, it is 3.82 km. For public modes, bus has the highest average trip distance, compared to microbus and tempo. Walk trips are mostly below 1 km. Most of the Bicycle users are travelling a distance of about 3 km. When we look at the figures of average journey speed, public modes have comparatively slower speed, as compared to private modes. Public vehicles take more time to travel due to their slow-moving speed and also more time is needed, with added out-vehicle time for walking and waiting. This comes as one of the major cause for high modal share of private modes over public transport.

Figure 3 and 4 shows trip length distribution for NMT and motorized modes, respectively. Motorized mode, here, denotes both private and public motorized vehicles. People are walking for short trips, mostly within a kilometer and gradually decreases, with increasing distance, showing a negative exponential trip distribution pattern. Because bicycle users are very few in number, there are insufficient samples for this research to represent the trip distribution pattern clearly.

For motorized modes, trip distances are mostly between 2 to 5 km. The distribution pattern is tending to be lognormal, where initially, for short trips, it is low and increases up to certain distance to about 3 to 4 km and then again declines.

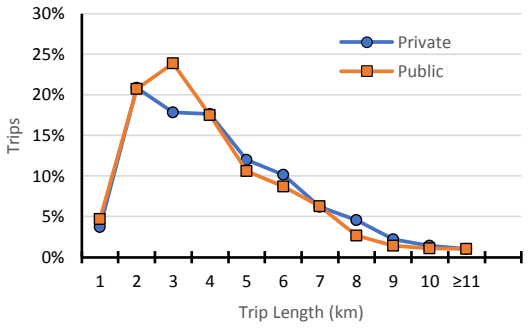

Fig. 3: *Trip Length Distribution for Motorized*

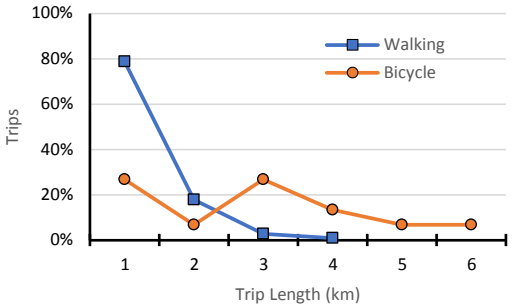

Fig. 4: *Trip Length Distribution for Non-Motorized Modes*

Time of Morning Trip

Most of the work trips originates between 8 am to 10 am (Figure 5). It is at these peak hours, when the roads are congested. Private vehicles have major share at all times.

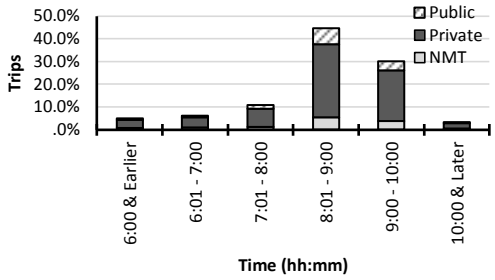

Fig. 5: *Time of Morning Trip*

6. Analysis of Mode Choice

The Pearson chi-square statistic (γ^2) was used to evaluate tests of independence using a cross-tabulation, that presents the distributions of two categorical variables simultaneously, with the intersections of the categories of the variables appearing in the cells of the table. For calculating effect size, Cramer's V was used, to assess the measure of association. The value of 0.1 for Cramer's V, can be taken as small effect and 0.3 and 0.5 as medium and large effect respectively [31].

Odd's ratio was calculated for 2 x 2 contingency table as an additional measure of effect size. Odd's ratios are particularly useful for clear interpretation of comparison [32].

For studying the relation, between the variables, bivariate and multivariate (tri-variate) analysis were done, using chi-square statistic, which are described in the following sections.

6.1 Bivariate Analysis

For bi-variate analysis, two categorical variables were cross-tabulated. The dependent variable is the mode choice, either private or public mode, used for work trips. The independent variables are the variables of socio-economic background and personal characteristics. Variable description is tabulated in Table 3. Mode choice was tested against Household Income, Household Vehicle Ownership, Gender and Age group.

Table 3: *Variable Description*

S.N.	Variables	Description
1.	**Sociodemographic Variables: (Independent Variable)**	
a.	Gender	Gender of an employee
b.	Age Group	Age of an employee
c.	Household Monthly Income	Total household income earned in a month, in Nepalese Rupees (NRs)
d.	Household Vehicle Ownership	Total number of private vehicles owned in a household, both 2-wheeler (Motorcycle) and 4-wheeler (Car), together
2.	**Variables of Mode Choice: (Dependent Variable)**	
a.	Private	Trips made by private vehicle – either car or motorcycle.
b.	Public	Trips made by public transport – either bus, microbus or tempo.

6.1.1 Gender

Table 4 shows that there is a significant relation ($P < 0.01$) between mode choice and gender with medium effect size. 61.2% of the females are using private modes whereas for males it is almost 90%. It shows that both males and females are more dependent on private modes than public modes for work trips. However, males are more likely to use private modes as compared to females as indicated by odd's ratio of 5.68.

Table 4: *Gender × Mode Choice*

Gender	Private		Public	
	N	%	N	%
Female	222	61.2%	141	38.8%
Male	1072	89.9%	120	10.1%

γ^2 = 164.9, P <0.01, Cramer's V = 0.326, Odd's Ratio (M / F) = 5.68

6.1.2 Age Group

Regarding age group, Table 5 reveals that share of public transport decreases with age. For age group below 30 years, 29.0%, are using public mode. For age group, between 31 to 50 and above 50 years, public transport is not proving to be attractive and as a result, very few people are using it, only 14.0% and 12.6% respectively. The relation is statistically significant as shown by chi-square test, significant at p <0.01, which indicates that mode choice and age group are related. However, effect size is small (Cramer's V=1.65), which signifies only a weak association between the variables.

Table 5: *Age Group × Mode Choice*

Age Group	Private		Public	
	N	%	N	%
≤ 30	223	71.0%	91	29.0%
31 - 50	836	86.0%	136	14.0%
> 50	235	87.4%	34	12.6%

γ^2 = 42.2, P <0.01, Cramer's V = 0.165,

6.1.3 Household Vehicle Ownership

Another factor that influences the mode choice is the household vehicle ownership. Table 6 shows that there is significant relation between the two variables. People with no vehicles are merely, the captive travelers and they are fully dependent on public transport, except in few cases. Those people, owning 2 or more vehicles in a household, are hardly using public transport. Less than 5% of the people, belonging to these categories are using public transport.

Table 6: *Household Vehicle Ownership × Mode Choice*

No. of Household Vehicle Owned	Private		Public	
	N	%	N	%
No Vehicle	3	2.86%	102	97.14%
1	502	80.32%	123	19.68%
2	628	95.59%	29	4.41%
≥ 3	160	95.81%	7	4.19%

γ^2 = 467.1, P <0.01, Cramer's V = 0.433,

6.2.4 Household Income

Table 7 shows the cross tabulation between household monthly income and mode choice. Chi-square test is significant ($p<0.01$), which shows that there is an association between income level and the choice of the mode, with medium effect (Cramer's V = 0.339). Low income group are more dependent on public mode (61.1%), than private mode (38.9%). With rise in income level, there is an increased tendency in private vehicle usage and decrease in the use of public transport. Only 6.1% of the workers belonging to high income group, earning more than NRs. 75,000 in a household per month, are travelling by public transport for their work trips.

Table 7: *HH Income × Mode Choice*

Household Monthly Income (NRs.)	Private		Public	
	N	%	N	%
≤ 25000	37	38.9%	58	61.1%
25001 - 50000	347	78.5%	95	21.5%
50001 - 75000	508	86.1%	82	13.9%
> 75000	385	93.9%	25	6.1%

γ^2 = 178.9, P <0.01, Cramer's V = 0.339,

One of the main reason behind the increment in private vehicle use with rising income level, is the increasing vehicle ownership (Table 8). Few of the households earning less than NRs. 25,000, have their own vehicle. However, with increasing affordability, more of the households are owning private vehicles, accordingly its ownership rate is high for both middle and high-income group.

Table 8: *Household Income × Vehicle Ownership*

Household Monthly Income (NRs.)	No. of Vehicles (car/motorcycle) owned in a Household			
	No Vehicle	1	2	≥ 3
≤ 25000 (N / %)	62	45	1	0
	57.4%	41.7%	0.9%	0.0%
25001 - 50000	41	214	86	6
	11.8%	61.7%	24.8%	1.7%
50001 - 75000	16	194	148	34
	4.1%	49.5%	37.8%	8.7%
> 75000	9	46	166	35
	3.5%	18.0%	64.8%	13.7%

γ^2 *= 453.8, P <0.01, Cramer's V = 0.368*

6.2 Multivariate Analysis

For multi-variate analysis, tri-variable analysis was done whereby three categorical variables were cross-tabulated. Mode choice is the dependent variable, gender/age group as independent variable and income group as the control variable.

Table 9 shows the cross tabulation of income group, gender and mode choice. According to the table, for low income group, having household monthly income less than NRs. 25,000, p-value of chi-square is greater than 0.05, which means that null hypothesis of independence will have to be accepted. It infers that there is no significant relation between mode choice and gender for this particular income group. Both males and females are dependent more on public modes, as vehicle ownership rate of this group is low as compared to other income groups (Table 7).

However, for rest of the income group, the relation is significant, shown by all p-values, less than 0.01. Most significant relation between gender and mode choice is found for the income group earning between NRs. 25,000 and 50,000, with strong effect size (Cramer's V = 0.5). Males are pre-dominantly using private mode, as compared to females in this group, shown by high odd's ratio of 7.6, highest of all. It also shows that males are getting preference over females in the use of vehicle owned in a household.

Table 9: *Income Group × Gender × Mode Choice*

IG*	Gender	Private		Public		γ^2	P-Value	Cr. V	Odd's Ratio (M/F)
		N	%	N	%				
1	Female	3	18%	13	81.3%	3.3	> 0.05		
	Male	34	43%	45	57.0%				
2	Female	36	38%	57	61.3%	110.5	< 0.01	0.5	7.6
	Male	311	89.1%	38	10.9%				
3	Female	89	63.6%	51	36.4%	77.7	< 0.01	0.4	4.7
	Male	419	93.1%	31	6.9%				
4	Female	90	82.6%	19	17.4%	33.3	< 0.01	0.3	4.0
	Male	295	98.0%	6	2.0%				

**Household Income Group - NRs. (IG) - 1: ≤ 25000, 2: 25001 – 50000; 3: 50001 – 75000; 4: > 75000*

Table 10 compares the mode choice with age group for each income group. For low income group and high-income group, the relation is not significant (p-value > 0.1), showing that age and mode choice are independent for these groups. For low income group, workers of all ages are mostly dependent on public modes, whereas for high income group, all age group workers are mostly relying on private modes.

For the rest of the two income groups, it shows the significant relation (p-value <0.5). For lower middle-income group (25000-50000), young (<30 yrs) and old aged (>50 yrs) workers are seen to use more of the private vehicles as compared to that of mid-age group (31-50). For upper middle-income group (50001 – 75000), even though the chi-square statistic is significant, the effect size is quite small (Cramer's V = 0.12), as variation is pretty small for choice of mode, with age

Table 10: *Income Group × Age Group × Mode Choice*

IG*	Age Group	Private		Public		γ^2	P-Value	Cramer's V
		N	%	N	%			
1	≤ 30	15	39.5%	23	60.5%	0.14	> 0.1	.
	31 - 50	19	39.6%	29	60.4%			
	> 50	3	33.3%	6	66.7%			
2	≤ 30	56	60.9%	36	39.1%	27.9	< 0.01	0.251
	31 - 50	257	85.4%	44	14.6%			
	> 50	34	69.4%	15	30.6%			

3	**≤ 30**	83	77.6%	24	22.4%	8.5	< 0.5	0.120
	31 - 50	340	87.4%	49	12.6%			
	> 50	85	90.4%	9	9.6%			
4	**≤ 30**	62	89.9%	7	10.1%	3.2	> 0.1	
	31 - 50	215	93.9%	14	6.1%			
	> 50	108	96.4%	4	3.6%			

**Household Income Group – NRs. (IG) - 1: ≤25000, 2: 25001 – 50000; 3: 50001 – 75000; 4: > 75000*

7. Analysis of Trip Length

The purpose of analysis of trip length is to assess the relationship between trip length of work trips from home to work place (dependent variable) and gender, age-group and income group (independent variables). For gender, independent t-test was conducted. For age group and income group, with more than two levels of categorization, independent ANOVA one-way test was done to compare means.

7.1 Gender

Results of the independent t-test shows that trip length for work trips is not dependent on gender, indicated by p-value > 0.05 and thus null hypothesis is to be accepted. It states that mean trip length for men and women is not statistically different. This finding comes in contrary to many literature, where it says women commute shorter trip distance as compared to men.

Table 11: *Summary of independent t-test – Gender and Trip Length*

Gender	Trip Length (km)				t-test for Equality of Means		
	N	Mean	Std. Dev.	Std. Error Mean	t	DF	P Value
Male	1192	4.20	3.82	0.11	1.59	1553	0.11
Female	363	3.84	3.50	0.18			

7.2 Age Group

Table 12 shows the output of the ANOVA test, between age group and trip length. It shows that there is no statistically significant different among mean trip length of different age groups, indicated by P-value > 0.05 and thus null hypothesis has also to be accepted in this case. It indicates that trip distance is not dependent on age.

Table 12: *Summary of ANOVA, - Age Group and Trip Length*

Age Group	N	Trip Length (km)			ANOVA (one-way) Result		
		Mean	Std. Dev.	Std. Error	DF - total	F	P Value
≤ 30	314	3.86	3.98	0.22	1554	1.01	0.36
31 - 50	972	4.15	3.70	0.12			
> 50	269	4.28	3.65	0.22			
Total	1555	4.12	3.75	0.10			

7.3 Income Group

Table 13 shows that difference of mean trip length for different income group is significant (P-value < 0.01). For multiple comparison of trip length between the income groups, Tukey post-hoc test was carried out, which is tabulated in Table 14. It shows that there is not much difference in trip length among lower income and middle-income groups i.e. among income groups 1, 2 and 3. Difference of mean trip length, for these income groups are not statistically significant. However, for income group 4, i.e., for high income group, mean trip length difference with other income groups is significant. It reveals that in general, high income group people are travelling longer distances as compared to lower and middle-income groups, for work trips. The effect size is weak (r = 0.16), as difference of mean trip length is not significant for between lower and middle-income groups, but only between high income group and other income groups.

Table 13: *Summary of ANOVA, - Income Group and Trip Length*

IG *	N	Trip Length (km)			ANOVA (one-way) Result		
		Mean	Std. Dev.	Std. Error	DF - total	F	P Value
1	95	3.47	2.36	0.24	1536	11.13	< 0.01
2	442	3.91	3.60	0.17			
3	590	3.76	3.51	0.14			
4	410	5.01	4.37	0.22			
Total	1537	4.12	3.76	0.10			

**Household Income Group- NRs.(IG) - 1: ≤25000, 2: 25001 – 50000; 3: 50001 – 75000; 4: > 75000*

Table 14: *Post-hoc test (Tukey)- Income Group and Trip Length*

Income Group		Mean Difference (I-J)	Std. Error	P Value.
I	J			
1	**2**	-0.43	0.42	0.73
	3	-0.29	0.41	0.90
	4	-1.54*	0.42	0.00
2	**1**	0.43	0.42	0.73
	3	0.15	0.23	0.92
	4	-1.11*	0.26	0.00
3	**1**	0.29	0.41	0.90
	2	-0.15	0.23	0.92
	4	-1.25*	0.24	0.00
4	**1**	1.54*	0.42	0.00
	2	1.11*	0.26	0.00
	3	1.25*	0.24	0.00

** The mean difference is significant at the 0.05 level (Effect Size: r = 0.16)*

8. Discussion and Conclusion

In this research, influence of household characteristics and personal attributes on choice of travel mode for work trips, was studied. It shows that factors of income group, gender, age-group, vehicle ownership, indeed are the persuading factors, behind mode choice, between private and public modes. In summary, it reveals that public transport is more attractive to lower income group. Upper income groups are less dependent on public transport as they are relying on their own private vehicles. Many households of middle and high-income group are owning their own private vehicle. Regarding gender, males are more using private vehicles than public, as compared to females, in all income groups, except for low income group. Most of the workers of low income are captive travelers, and thus rely on public vehicles as many of them don't own their own vehicle. Regarding age, in general, it shows that with increasing age, people seems to be less attracted towards public transport.

In terms of trip length, there isn't significant difference of mean trip length for men and women. Same also applies for people of different age groups. It reveals that the distance, a person commutes for going to work place is not dependent on gender or age group. However, for income group, it shows that higher income group are travelling longer distances, as compared to lower and middle-income group, shown by difference of mean trip length between them, that is statistically significant. This points out that, trip length of high income group is comparatively longer, it is also one of the reason, to have preference on private modes to public modes, as shown by mode choice analysis. This is because of the travel-time factor, as public vehicles have comparatively slower journey speed.

Overall, it shows, that current public transport is not proving to be good enough to attract adequate number of users for their work trips. One of the main reason is the travel time. Public transport is not providing good service and it takes more time to travel, as compared to private vehicles.

KMC is the focal point of economic activities and it provides job opportunity for many people. So, share of work trips in overall trip composition is expected to rise in future. The current transport system needs to have substantial improvement, to increase the share of public transport for work trips. Level of service of public transport has to be improved, and it should be convenient for travel to all users, especially for females as many of them are relying on it. Same applies to old-age people and it should be comfortable to them as well.

City development strategies should give more priority for public transport, more importantly a mass rapid transit system, like Bus Rapid Transit System, to relieve congestion, minimizing energy consumption and reducing environmental pollution. Adequate facilities, timely service, comfortable travelling and cost-effective travel, are all essential to encourage attract more people in the use of public transport, especially during peak hours, when most of the workers are going to their work place. This will initiate more shift from private to public modes, for both short and long trips.

Promotion of non-motorized modes is also important. Walking has a share of about 12% in work trips and bicycle, less than 1%. In order to have walking and cycling as a real alternative for local trips, the transport system needs have the policy to encourage walking and cycling, by providing adequate infrastructure and facilities for bicycle riders and pedestrians.

9. Limitation of the Study and Further Research

This research is focused on studying influence of socio-demographic factors on travel behavior of workers in Kathmandu Metropolitan City, which is the main urban core area of the Kathmandu Valley. With rapid growth in population, peripheral areas of the Valley are also in the stage of densification, as more settlements are growing in these areas. So, this study could be extended to these new developing areas as well so as to have overall insight. Many employees from these regions travel to KMC for job and thus mobility pattern of KMC is also influenced by these external trips. Further, more variables can be included for the analysis apart from gender, age, income-group and vehicle ownership. For instance, household structure and professional status of the workers can be the variables for analysis at household level. In broad perspective, variables related to urban landuse, accessibility to public transport and level of service offered by the transport system, can also have an influence on the travel behavior. Number of short work trips are made by walking and some by bicycles in the area, which are not included in the analysis of this research. More research is also required in the use of non-motorized modes as well.

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