Socioeconomic characteristics of travel behavior in Khulna metropolitan city, Bangladesh

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Abstract: Urban transportation problem has become one of the main problems faced by cities in developing countries. The rapid growth of motorization and city structure, such as mixed land-use and the increasing rate of urbanization are some causes of this phenomenon. Travel survey identifies the start and end of a trip, the trip purpose and the mode of travel as well as the socio-economic characteristics of the trip makers. Travel characteristics are very important resources that give valuable information about travel behavior of people over a period of time across the population. Household interviews were used through questionnaire survey on demographic and socio-economic characteristics in khulna metropolitan city. The results of the analysis show that people with higher income and more automobile availability make more travel than people with low income and less automobile availability. The home-based trips take the largest percentage (50%) of people in the study area. The result also indicates that the shopping trips (15%) contribute higher among different trip purpose. The results also show that about 57% of individuals are between 20-50 years. The analysis of this paper reveals that the travel behavior in the study area is quite similar to the middle sized city in asian countries.

Keywords: Khulna Metropolitan City, Household Survey, Travel Behavior, Socio-Economic Data

1. Introduction:

Travel behaviour is complex, not only in terms of its motivations, but also in terms of how it manifests itself (Parsons *et al.*, 2002). People travel because they get benefits from it, or more precisely, they get benefits from the things they do or buy at the end of the trip (Puget Sound Regional Council, 2001). The environment in which transport analysis and infrastructure planning is taking place has changed radically during the last few decades. The urbanization in developing countries is dynamic; the big cities in these countries are reporting sustained pressure due to heavy migration from rural areas and high growth of private mode of transportation along with public transportation services (Domencish and McFadden, 1975).

One of the key issues of travel behavior is travel mode choice decision. More choice plays a vital role in transportation planning and policy making in any city. Past research has clearly shown that individual and household socio-economic characteristics have strong influence on mode choice decision (Miller *et al.*, 2005; Bhat and Sardesai, 2006). They identified that income, gender, vehicle ownership, employment status are the most influencing variables in mode choice decision. Residential location and built environment attributes also play an important role in travel mode choice decisions (Pinjari *et al.*, 2007; Frank *et al.*, 2000). Many urban transportation studies have been done in several metropolitan areas such as in Bangkok, Thailand; Manila, Philippine; Kuala Lumpur, Malaysia and Jakarta, Indonesia. Generally, metropolitan area means city with two million people or over (Itorralba, 1988). Although Bangladesh has seven metropolitan cities, very few

transportation studies have been conducted to these cities. In Bangladesh, the middle sized cities (i.e. population between 0.3 – 1.0 million) are the majority but, as yet, a few studies have been conducted and the availability of data is limited. The study area, Khulna Metropolitan City (KMC) is one of the most important middle sized cities in south-west of Bangladesh and very urbanizing area. The traffic load is rapidly increasing day by day due to the urbanization trend and changes in socio-economic level of the people. As such, the travel behavior in KMC is carried out. The aim of this paper is to expose the existing dimensions of travel behavior in terms of socio-economic and travel characteristics information such as trips purpose, trips mode, trips distance, cost of trips, household income, and vehicle ownership in Khulna Metropolitan city.

2. Methodology:

The study area is located in Khulna. Total population of this district is 2.38 million based on the Census 2001(BBS, 2001). Approximately, 1.28 of the city population is residing in the city corporation area. The population density of Khulna Metropolitan city (KMC) is around 16242 persons per km^2 as compared to the figure 541 persons per km^2 for Khulna district. The KMC with its geographical area of 50.57 km^2 comprises of five police stations (Thanas). The transportation system of KMC is dominated mainly by public transportation mode. Public transportation systems in KMC include the buses and intermediate public transport (IPT) modes like baby taxi and Easy bike. Khulna City Corporation has 31 wards which almost covered the study area. As a result, these 31 wards were used as

31 zones with one external zone outside the metropolitan area. A large amount of time, money and man power was required to cover all these 32 zones. Accordingly the study area was divided into three major divisions according to land use pattern. The major divisions were Division-1 (Zone 1 to Zone 15), Division-2 (Zone 16 to Zone 23) and Division-3 (Zone 24 to Zone 31). In this study, two zones from each major division were randomly selected for survey and analysis. The selected zones are shown in Table 1.

Table 1: Selected Zone for Study

Major Division	Selected Zones
Division-1	Zone 4, Zone 5
Division-2	Zone-18, Zone 21
Division-3	Zone 26, Zone 28

The socio-economic data are categorized as the number of population, land use patterns, transportation data such as road network and so on. In this study, the socio-economic and population data were collected from Bangladesh Bureau of Statistics, Regional Office, Khulna, Bangladesh. The survey data were categorized into travel pattern data and travel time data. In this study, data relating to the present pattern of individual movement was collected by a home interview survey (HIS). Data were obtained by visiting the house of every respondent.

3. Results and discussion:

This section provides a descriptive analysis of socioeconomic characteristics of household and individuals obtained from the sample. A total of 233 households were interviewed, and the questionnaires were distributed among 765 individuals over 7 years old. The respondents consist of 395 (49.7%) male and 390 (50.3%) female. Reported 1556 trips were used in the analysis. Lot of trips were generated and attracted within a zone. The reason to this might be the relative size of the zones .That is because the study area was a medium city, where the distance between different land use facilities were not so far.

In this study, the age structure was grouped into 4 age divisions as less than 7 years old, 7-20 years old, 20-50 years old and greater than 50 years of age bracket. It was assumed that the people between 20-50 years old are active and independent travelers. Meanwhile, people between 7-20 years can be active but have some limitations as they have no fixed income yet. For people less than 7 years or more than 50 years old are considered groups who could not travel independently. This group also may travel less or differently than the working age groups. Figure 1 shows the age structure of the household members obtained from the survey. It is seen that 56.9% of individuals is between 20-50 years of age, the 7-20 age bracket followed with 19.3% share. There are

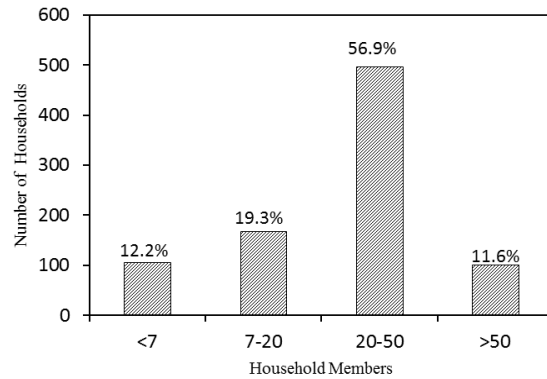12.2% and 11.6% share for the young children and the elderly.

Figure 1: Age Structure of Household Members

The income is one of the most important factors shaping the travel patterns. In this study, the household income was calculated including whole monthly income of the members and head of household. Figure 2 shows the household income structure. It is seen that 89 (38.2%) households have monthly income ranging from BDT10000 to BDT20000. It is also seen that the monthly income ranging from BDT5000 to BDT10000 followed with 80 (34.3%) households and BDT20000 to BDT50000 followed with 38 (16.3%) households.
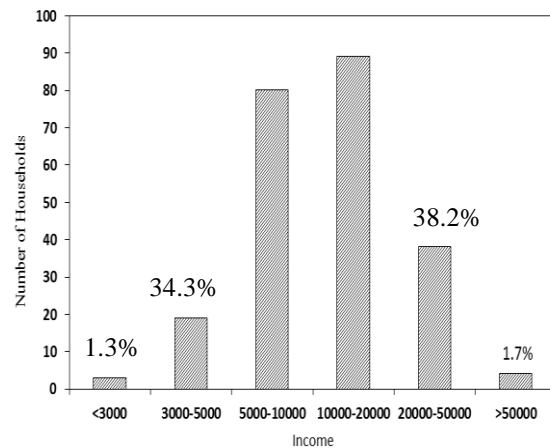

Figure 2: Household Income Structure

Figure 3 shows the total and percentage occupation of respondents. Most of the individuals interviewed came from housewives 242 (31.6%), student 196 (25.4%), businessmen 99 (12.9%), and private service 110 (14.4%). It also shows that the Government employee followed with 44 individuals (5.8%). Meanwhile, retired and others have proportion of 18(2.4%) and 56 (7.3%), respectively.
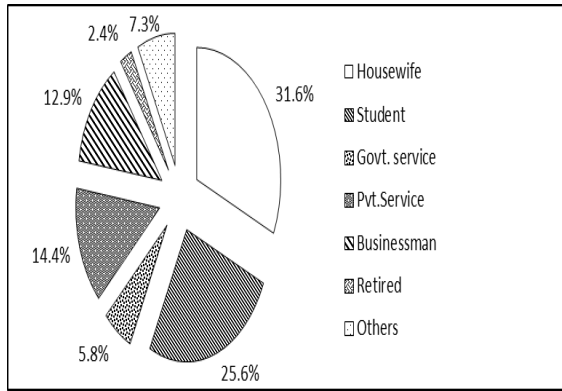
Figure 3: Totals and Percentage Occupation of Respondent

Car occupancy is associated with the access to private vehicles. Table 2 shows the distribution of households belonging to vehicles ownership and vehicle rate per households. It is seen that the car ownership is very low (3.9% share) compare with motorcycle 8.6%. Car ownership includes private and office cars; it is categorized that the role of an office car is similar to private car. More than 65% have no access to private vehicles and about 22% have access to bicycle only.

Table 2: Distribution of Vehicle Ownership

Vehicle ownership	Number	Households (%)	Vehicle Rate Per Household
No Vehicle	153	65.7	-
Bicycle	51	21.9	0.22
Motorcycle	20	8.6	0.09
Car	9	3.9	0.04
Total	233	100.0	-

The distribution of types and numbers of the vehicles are concentrated with the income of the household especially with the upper income group and these groups are much more mobile than lower income groups. Figure 4 shows the relationship between car ownership level and household monthly income. It is seen that the level of car ownership increased rapidly with their income. Higher income group has more luxurious vehicle than the lower income groups.
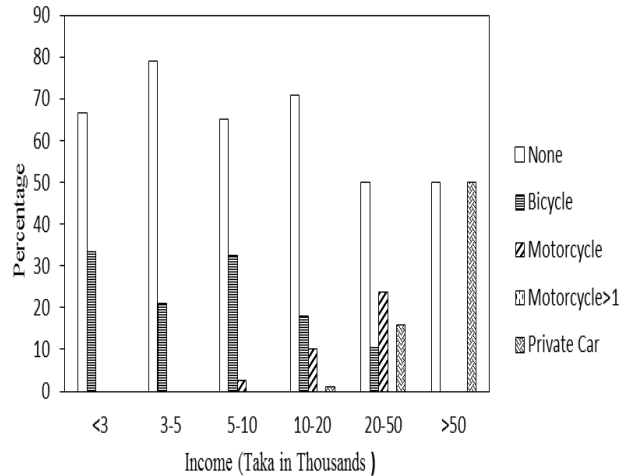

Figure 4: Relationships between Vehicle Ownership and Monthly income

In Khulna, the office hour is different for government and private sector. Government office hour usually finish at 17:00, and different private sectors have different time limit. Figure 5 shows the distribution of trips by time of trip start. It is seen that at 8:00 am to 10:00 am there is peak in the trip distribution.
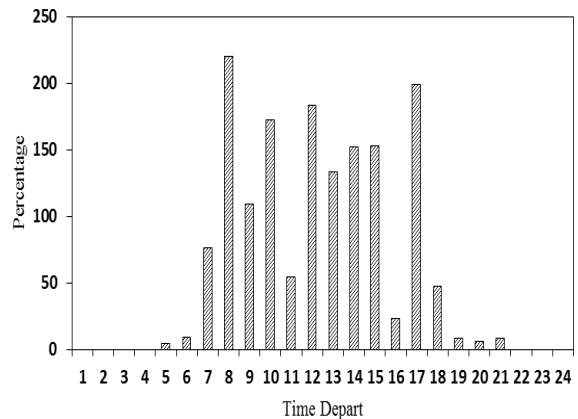

Figure 5: Distribution of Trip by Time of Trip Start

Figure 6 shows that most of the trips are generated from home (50% of the total trips) followed with trips from office (16.6%). Trips generated from education facilities, shopping, recreational and others are 12.5%, 16.2%, 2.4% and 2.3%, respectively.
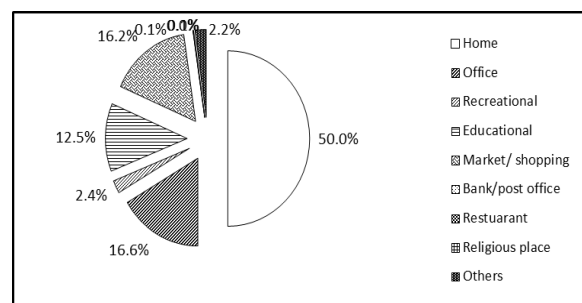

Figure 6: Total trip Based on Facility of Origin

Table 3 shows the daily trips per household for various purposes. It is seen that most of the trip makers are distributed among four purposes; home (50%), work (15%), school (13%) and shopping (12%). Business trip has shared of 8%, recreation 2% and others 1%.

Table 3: Daily Trips per Household for Various Purposes

Trip purpose	No. of Trips	Trips per household per day	Percentage of Trips
Home	780	3.3	50
Work	232	1.0	15
School	195	0.8	13
Shopping	185	0.8	12
Business	119	0.5	8
Recreation	33	0.1	2
Others	12	0.1	1
Total	1556	6.7	100.0

In Khulna, public transport is provided for fixed route which is mainly on the major streets. Many households, especially those who have income at the average level or lower live away from the major streets, walk trips are the first mode to access for the public mode on the major streets. By using cross-tabulation analysis the joint frequencies of the main-mode have been obtained. The number of trips for each mode is presented in Table 4. It is seen that the dominant mode in Khulna is walking with 46.6%. Travel within shorter distance in choice of public modes, favorable mode is rickshaw and auto rickshaw. People choose city bus mainly for long distance trips, also the access to bus is slightly limited as all buses have operated with fixed route as well as fixed stop. There is no doubt that walking is the dominant mode of travel in Khulna. It is important for school, work and shopping purposes, and rickshaw for business, and shopping purposes. Now a day's auto rickshaw has become more popular than rickshaw. For the relatively longer trips for work and business purpose auto rickshaw, bus and motorcycle are frequently used.

Table 4: Numbers of Trips by Mode

Mode	Number	Trips per Household	% of Trips
Walking	725	3.11	46.6
Bicycle	92	0.39	5.9
Rickshaw	351	1.51	22.6
Motorcycle	48	0.21	3.1
Auto	218	0.94	14.0
rickshaw			
Bus	107	0.46	6.9
Microbus	0	0.00	0
Private car	10	0.04	0.6
Others	5	0.02	0.3
	1556	6.70	100.0

As transportation studies of cities in Bangladesh are very limited, a study of Manado, Indonesia is selected to compare with Khulna Metropolitan City (KMC). Manado is the Capital city of North Sulawesi province in Indonesia. It has played an important role in the entire North Sulawesi as centre of administration, education, trade, business, culture, and tourism. Table 5 shows the comparison of daily trips household for various purposes between KMC and Manado. The result of Manado is based on the result of Rumayar (1992) and the rate of trip generation in Manado was 8.3 trips per household per day; whereas the value for Khulna is 6.7 trips per household per day. Although, the trip per person per day is 1.5 trips compare with 1.8 trips/person/day of Manado. The rate of trip per person per day can be reflected from several factors such as number active worker, size, and income of a household. It is seen that home-based trip in Khulna is 50% and in Manado 43% share. Whereas, the work trips in KMC and Manado are shared about 15% and 17%, respectively. Educational trip in Khulna (13%) is also lower than Manado (14%). Trips related to shopping in Khulna (about 12%) are found higher than Manado (about 7%).

Table 5: Daily Trips per Household comparison

Trip Purpose	Trips Per Household Per Day		Percentage of Trips	
	KMC	Manado	KMC	Manado
Home	3.3	3.6	50	43
Work	1.0	1.4	15	17
School	0.8	1.1	13	14
Shopping	0.8	0.6	12	7
Business	0.5	1.1	8	13
Recreation	0.1	0.2	2	2
Others	0.1	0.3	1	4
Total	6.7	8.3	100	100

Table 6 shows the comparison of modal split by trip purpose of the study area, KMC and Manado. The access to the private vehicle in KMC is still low with respect to Manado. The average rate is about 4%. Household income is the main factor reflected to this pattern.

Table 6: Mode by Trip Purpose Comparison

City	Mode	Trip purpose (%)				
		Home	Work	School	Shopping	Others
Khulna	Walking	52.8	43.5	50.3	45.9	41.7
	Bicycle	5.9	7.3	7.7	0.5	0.0
	Rickshaw	17.9	34.9	23.1	30.3	25.0
	Motorcycle	3.2	0.4	4.6	0.0	16.7
	Auto Rickshaw	14.0	10.3	7.2	15.7	0.0
	Bus	5.3	2.2	5.6	7.6	16.7
	Microbus	0.0	0.0	0.0	0.0	0.0
	Private Car	0.6	0.4	1.0	0.0	0.0
	Others	0.3	0.9	0.5	0.0	0.0
Manado	Walking	25.08	12.9	25.07	28.0	46.20
	Bicycle	1.20	1.8	.6	1.4	.90
	Motorcycle	15.6	16.3	9.3	10.80	12.30
	Bus	41.1	44.0	57.60	46.30	17.30
	Car	11.4	18.60	5.10	10.80	17.00

4. Conclusions:

This study gives an idea about the travel pattern of the people living in Khulna. The travel pattern generally depends on the age of the traveler, socio-economic conditions, vehicle ownership, etc. It is found that people with higher income generally travels more than people with lower income. Vehicle ownership is directly related to the income of the households. It is also seen that car ownership in Khulna is still low about 3.9% share compare with motorcycle 8.6%. A large proportion of home-based trips imply that most of the trips are limited and have a single purpose. The percentage of home-based trips is 50% of the total. The dominant mode in Khulna is walking with 46.6%. Rickshaw is the second highest mode with 22.6%. Now-a-days auto rickshaw has become more popular about 14% of the total trip's mode. People generally choose walking, rickshaw and auto rickshaw for travelling shorter distances and choose city bus mainly for long distance trips. The analysis of this paper reveals that the travel behavior in KMC is quite similar to the middle sized city in Asian countries.

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