"Studying the Impact of Parent's Socio-Economic Factors and Built Environment on Mode Choice of School Going Children"

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ABSTRACT: Alike western countries there have been very few research related to mode choice for school children in India. This study aims to investigate mode choice for school children in India based on socioeconomic attributes of the parents and trip characteristics of the children. Survey of 526 parents was carried out from different primary schools in the study area. Descriptive analysis was done to study the change in travel behavior of present school going children and travel behavior of their parents when they used to go to school. The results show an alarming decline of 46% in use of NMT over a period of 25 years. A Multinomial Log it (MNL) model was developed in which the factors like vehicular ownership, school distance, education level of parents, type of school, and standard of child showed significant effect on mode choice of children in the model. Apart from socioeconomic factors, built environment factors and their effect on safety for NMT use were also investigated. Results showed that 54% parents did not feel safe to send their children to school by walk or cycle. Since trip length had a severe disutility for feeling safe to walk or bicycle to school, a binary log it analysis was done to find the probability of NMT use based on home to school distance. The result shows that the break-even distance is 2.4 km. At this distance the probability of usage of motorized vehicle and non-motorized vehicle is same. The paper concludes with planning policy implications of the findings.

I. INTRODUCTION

Walking and bicycling are considered to be the cheap, healthy and environmentally beneficial modes of transport. Studies have shown many positive impacts on health and costs associated with use of NMT modes, particularly in the case of children. Mode choice among children is a transport issue, as it also has health and social implications (McMillan, 2005). Therefore, associated health and social benefits must also be kept in mind while discussing the use of NMT as a mode for transport for school children.

A few decades back, most of the children walk or cycled to school, and therefore were not much dependent on parents. Walking and cycling gave opportunity to explore the surrounding environment along with health benefits. Rapid urbanisation, especially increase in motor vehicles, and associated sprawl (mainly resulting from households preferring peri-urban areas for housing) has changed the scenario in two ways. Distance to school on average has increased, thus, making automobile the preferred mode. In addition, higher intensity of vehicles on roads also means higher probability of accidents. This is more common in Indian context as most cities do not have safe footpaths and crossings. It is argued that traffic congestion in peak hours will worsen and more children will be chauffeured by parents(Mackett, 2002)(Black, 2001)(Wen, 2008). School trips have been more dependent on parents than it used to be before due to change in the cities and rapid urbanisation in last decade. The results by (Roya Shokoohi, 2012)reveals that parents and children with negative perceptions of neighbourhood safety tend to use motor vehicles or to escort their children while walking to and from school.

It is apparent that the socioeconomic status of parents will affect their decision on the mode choice for their children's school trips. Socioeconomic characteristics like income, vehicular ownership, age, gender, number of children, etc. can have effect on decision of choosing mode for their child to go to school. Along with the socioeconomic factors, neighbourhood conditions can also have an influence on using NMT modes to school trips. Various neighbourhood conditions like availability of foot path, cycle lanes, crimes and accident, etc. can affect the decision to use NMT modes for school trips. Hence, when it comes to mode choice of school going children it becomes necessary to look at socioeconomic aspects related to parents and also the built environment effects since these factors have changed to a great extent in last decade.

II. STUDY AREA AND DATA COLLECTION

Anand lies between two metropolitan cities Ahmedabad and Vadodarain the state of Gujarat which lies in western part of India (see Figure 1). The metropolitan area of Anand city has a population of 2.8 lakhas per 2011 Census of India. The area has a fast growing belt of Anand-Vidyanagar-Karamsad which is burgeoning with economic activities. The study area has around 50 primary schools ranging from government schools to high end private elite schools.

Parents were given the survey forms which had two parts: their own details and their children details.A total of 526 samples were collected from 30 schools in the region (summarised in Table 1). The scope of the sampling was limited to primary schools, having students aged below 15 years. This forms the target group because of their higher dependency on parents for travelling to school. The sampling method adopted in this study is proportionate stratified sampling. The schools are divided in two strata (government and private) and sampled based on the proportion of school in each strata.

Fig. 1. Anand Location.

Table 1: Survey Summary.

No	Factor		Category	Percentage %
	School type		Government	31.7
			Private	68.3
	Parent's education level		Primary school	25.9
		Sec.	Secondary and higher	39.5
			Graduate and above	34.6
	Vehicular ownership		No vehicle	13.7
			Owns Vehicle	86.3
	Child Standard		Standard level 1: 1-2	10.1
			Standard level 2: 3-5	30.0
			Standard level 3: 6-8	59.9

III. MODEL FORMATION

All combinations of variables were used and finally the model was derived based on the significance (CI=95%). Initially, the variables can be categorized as socioeconomic variables related to parents, children characteristics, and travel characteristics. The first category of variable included age, household income, vehicular ownership, school type, number of children, and occupation type related to parents. The second category of variables included age, gender, standard, school type, school timing, and trip length.

A. Model fitting information. The presence of a relationship between the dependent variable and combination of independent variables is based on the statistical significance of the final model chi-square in table 3. The null hypothesis that there is no relationship between independent and dependent variables was rejected. The alternative hypothesis, i.e. a relationship between the independent variables and the dependent variable was accepted.

Table 2 : Variable description.

Variable Name	nit	Variable type	Description
Parent's Age	ears	Continuous	Age of person filling the survey form
Household Income	NR	Categorical	Income of household.
Occupation	A	Categorical	Occupation: 1) both fulltime, 2) 1 Fulltime(FT) and 1 Halftime(HT) 3) Both HT, 4) 1 FT and 1 homemaker
Parent's education level	A	Categorical	1) Primary school 2) Secondary and higher secondary 3) Graduate and above.
Vehicular ownership	A	Categorical	0) no vehicle, 1) owns vehicle
Parent's school type	A	Categorical	0) Government, 1)Private
Number of children	A	Continuous	Number of children in primary school
Child age	ears	Categorical	1) 0-5, 2) 6-10, 3)11-15
Gender	A	Categorical	0) Male, 1) Female
Standard	A	Categorical	1)1 to 2 2)3 to 5 3)6-8
Child school type	A	Categorical	0) Government, 1)Private
School timing	A	Categorical	0) Morning 1) Afternoon
Trip length	m	Continuous	Home to school distance
Mode used (DV)	A	Categorical	1) NMT (Walk and cycle) 2) Private (2 wheeler and 4 Wheeler) 3) PT (School bus, Van and Auto, other PT)

Table 3: Model fitting.

Model	Model fitting criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Significance
Intercept Only	692.988	0	0	
Final	458.595	234.392	14	.000

B. Likelihood Ratio test

Table 4: Likelihood test.

Effect	Model fitting criteria	Likelihood Ratio Tests		
	-2 log likelihood of reduced model	Chi-Square	df	Significance
Intercept	458.595	.000	0	
C HS DIS	502.249	43.654	2	.000
C STYP	491.142	32.547	2	.000
V OWN	504.939	46.343	2	.000
P EDU	473.421	14.825	4	.005
C STD	481.557	22.962	4	.000

Table 5: Pseudo R-square.

Cox and Snell	0.360
Nagelkerke	0.418
McFadden	0.226

The utility equation for the mode that can be made of the above table is an under:

$$UM = Mode\ constant + \beta_{hsd} * Home\ school\ distance + \beta_{typ} * School\ type + \beta_{vown}$$
$$* Vehicular\ ownership + \beta_{pedu} * parent's\ education + \beta_{std} * standard\ level$$

UM=Utility of particular mode

β_{hsd}= Utility parameter for home to school distance.

β_{typ}= Utility parameter for school type.

β_{vown}= Utility parameter for vehicular ownership.

β_{pedu}= Utility parameter for parent's education level.

β_{std}= Utility parameter for standard level of child.

Multinomial Logit Model (MNL): $\Pr(j) = \frac{exp(Vj)}{\sum \exp(Vi)}$

Vj= Utility of mode j

Vi= Utility of all modes, i from 1to n where n is total number of mode.

IV. PARAMETER ESTIMATES

Table 6 : Parameter estimate.

Mode	Parameter	β	Exp(β)
NMT	Intercept	1.311	
	C HSDIS	-.272	0.762
	C STYP=0	2.087	8.060
	C STYP=1	0[b]	
	V OWN=0	21.511	2198823882
	V OWN=1	0[b]	
	P EDU=1	1.230	3.420
	P EDU=2	.313	1.368
	P EDU=3	0[b]	
	C STD=1	-1.400	0.247
	C STD=2	-1.207	0.299
	C STD=3	0[b]	
Public Transport	Intercept	0.603	
	C HSDIS	0.066	1.068
	C STYP=0	0.930	2.535
	C STYP=1	0[b]	
	V OWN=0	18.450	102940441.0
	V OWN=1	0[b]	
	P EDU=1	0.188	1.207
	P EDU=2	0.223	1.250
	P EDU=3	0[b]	
	C STD=1	-.252	0.777
	C STD=2	-.318	0.728
	C STD=3	0[b]	

The above table shows that the factors like home to school distance, school type, vehicular ownership, education level of parents, and standard of the child has a significant effect on mode choice of school going children. The significance test is at 95% confidence interval. The explanation of how these variables affect the mode choice is explained below.

[I.] NMT over Private:

The negative sign of β for home to school distance shows that the increase in home to school distance results in decrease of the odds of choosing NMT. Exp (β)=0.762 which means that increase in the home to school distance by 1 km will decrease the chance of using NMT by 24% with reference to private mode.

Children in government school prefer to go to school using NMT modes as compared to children in private schools. If there is a change from private to government school, the relative odds of choosing NMT will be roughly 8 times of choosing private mode.

Vehicular ownership has a significant impact on mode choice of school going children. If parents do not own a vehicle then log odds of choosing NMT are very high. Also, a particular behaviour is observed here that if a family does not own vehicle then odds of choosing NMT are high over public transport. The reason could be that families who do not own a vehicle are unable to afford public transport (which includes van, auto rickshaw, city bus, and school bus). Second reason might be that public transport does not seem to be a safer option due to deterrents like overcrowding or accidents, etc.

Fig. 2. School children in Ahmedabad July 20, 2011/ Reuters/Amit Dave/files.

As parents' education level increases from primary to graduate level, the odds of choosing NMT for their child decreases. The relative risk of choosing NMT over private transport decreases to 0.313 with moving from primary education to graduate level education.

As standard increases, the log odds of choosing NMT decrease. If child is in standard level 1 (1st and 2nd class), relative risk of choosing NMT over private is 0.247.

[II.] Public transport over Private mode:
Parents with education level up to secondary school prefer using public transport over private for their children. If parent's education level is secondary, relative risk of choosing public transport will be 1.25 times of choosing private, while for primary level education it will be 1.207 times of the same. Higher standard children uses public transport more than lower standard with reference to private mode. Lower standard children uses private modes more than public transport that is they are dropped on private vehicles by parents. Also, reason of sending higher standard student to school by public transport may be that parents feel that child is mature enough to use public transport.

V. CROSS TABS ANALYSIS

Out of 526 samples, 46% felt that is it was safe to send their children to school by NMT while 54% felt unsafe to send their children to school by walk or cycle. Total five factors were given to respondents as reasons for feeling unsafe out of which two factors "accident/crimes" and "long distance to school" turned to be most significant. Out of 283 people that felt unsafe to send their children to school by cycle or walk 38% felt long distance responsible for their fear and 63% felt accidents and crime is the reason for not sending their children to school.

Comparing the use of NMT 25-30 years ago when parents used to go to school, the use of NMT was 95.05% and now it has reduced to 51.14%. So, overall decrease of NMT use is 46.2% in a generation (around 25 years' time).Since, parents considered "long distance to school" as a factor for feeling unsafe to send their children on cycle or walk to school, binary logit analysis was done and probability of using NMT was found with respect to distance of the school from. The graph below shows the home to school distance and probabilities of using NMT.
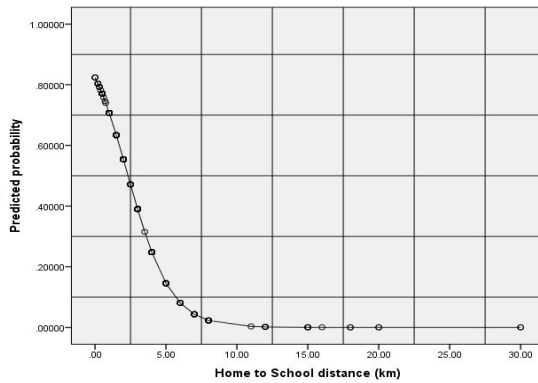
Fig. 3. Probability graph.

It was found that after a distance of 2.4 km mode shift occurs from NMT to motorized mode. Thus, if a school is available within a distance of 2.4 km then at least 50% will use NMT mode. At 1.25 km distance a mode share of 70% for the NMT can be achieved. This result can be used for higher city level planning process where it comes to locating education institutes and schools in their master plans.

VI. CONCLUSION

The principal objective of the study was to understand the effect of socioeconomic characteristics of parents and characteristics of the built environment on mode choice of school going children. This question was addressed by developing a model for understanding the mode choice in which factors like home to school distance, parent's education level, school type, standard, and vehicular ownership were used. Apart from developing a model, a check for trend of using NMT mode (cycle and walk) was tested. A decline of 46.2% in use of NMT for going to school in a time period of about 25 years was observed, attributed mainly to factors like 'long distance to school' and 'crime or accidents'. In case of children going to school, use of NMT should not be seen merely as a mode since walking and bicycling to school has many other positive externalities attached to it, such as socialising and experiencing their environment. In order to understand the reason for decreased use of NMT, analysis was carried out for use of NMT based on the built environment. Moving forward a solution to this was derived by finding probability of NMT use based on home to school distance by binary log it modelling. The result showed that there was shift from motorized mode to a non-motorized mode at a breakeven distance of approximately 2.4 km.

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