Characteristics of Travel Mode Choice of Families with Children Below Five Years Old

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ABSTRACT

Travel mode choices for children under five years old have not been fully explored in past research studies The main objectives of this study were to identify travel characteristics of children aged below five years, travel mode choices for them, and investigate the factors affecting their selection. A survey using a questionnaire was conducted with parents in the Western Province of Sri Lanka to collect data. It revealed that private cars as the most frequent vehicle choice followed by public buses. The Multinomial Logistic Regression analysis identified the age of the child, distance, income, type of vehicle owned, and walking time to the nearest public transport station as the main factors that affect the travel mode choice of children under five years old. Also, the habit of securing the child and the child's familiarity with the use of a car seat when traveling in a private car were identified as factors that affect travel safety. The recommendations were provided to policy makers, parents, and the public in order for children to make safer, comfortable, economical, and sustainable trips.

KEYWORDS: *Travel Mode Choice, Multinomial Logistic Regression Analysis, child travel safety, child travel behavior*

1   INTRODUCTION

Transportation has existed since ancient times and with time, it has evolved in many ways. In the current world, transportation plays a major role in safety, health, economy, and sustainability. Transportation is required for all people regardless of age. This study focuses on children aged 0-5 category. With the increasing population in the world, a large cohort is in the 0-5 age category (McCarthy et al, 2017).

Annually about 1.3 million fatalities are reported because of road traffic crashes and car crashes were identified as the primary cause of death among 4 - to 7-year-old children in the world (Dissanayake and Amarasingha, 2016). World Health Organization (WHO) also points out that road traffic accidents are a leading cause of deaths among children. (WHO, 2022). As shown in Table 1, a higher number of deaths are caused by accidents in Sri Lanka annually and 37% of these victims are between ages 0 to 14 years. (Sri Lanka Police, 2022). According to Census of Population and Housing (2012), Sri Lanka has a 10.28% of the population aged below five years. In Sri Lanka, the mortality rate is 6.93 per 1,000 live births for children below five years (WHO, 2022). Therefore, it is important to investigate this issue and make safer and sustainable transportation systems to fulfill their needs.

Table 1. Accident statistics in Sri Lanka (Source: Sri Lanka Police, 2022).

Year	2013	2014	2015	2016	2017	2018	2019
Total number of accidents	37,877	35,966	38,107	37,591	36,599	35,158	30,433
Number of fatalities	2,362	2,439	2,818	3,017	3,147	3,151	2,839
Number of Injuries	30,023	29,406	32,964	34,574	33,452	32,007	24,611

As children aged 0-5 travel mostly with their parents, accordingly, the travel mode will depend on their parents' opinions and decisions. They mostly travel for their medical needs, education needs, leisure needs, etc. The choice of travel mode of children can be dependent on several factors. At present, one of the most influencing factors for travel mode choice may be the transportation cost. When parents travel with their children, the selection of their vehicles does not depend only on economic factors but also other factors like comfort, safety, travel time, trip distance, etc. At the same time, Cheng et al. (2019) argued families with children under 6 years old have limited the mode choice behavior. Also, travel information of children in the world is not available for reference.

Therefore, it is important to find out the travel characteristics of the children below five years old, the mode choices for them, the factors that affect the travel modes choices for those children, and to investigate the ways to reduce traffic accidents and travel issues. If the countermeasures are identified, the relevant authorities would be able to implement them. This would be helpful to improve the safety, comfort, and sustainability of the transport system of families with children under five years old.

2   LITERATURE REVIEW

Chakrabarti and Joh (2019) discovered that families with young children are associated with a relatively higher selection of cars, and lower use of public transport and active travel such as walking and bicycling. It is important to keep children physically active because active transport is associated with a wide range of health benefits. Dessing, et al. (2014) have done research on active transport between home and school by collecting the data of seventy-nine children of Dutch elementary schools with the help of GPS. The students were required to wear Global Position System receivers for one week to get the distance between home and school; to determine the average and maximum speeds. The results of the study revealed that nearly 80% of the students use active transport that can influence the healthy behavior of children. It has also been identified that with increased distance between home and school, cycling and motorized trips have too been increased. The results suggested guidelines for locating schools related to residences.

By recognizing the factors affecting the travel mode choice among families with young children it may be possible to encourage sustainable travel practices (McCarthy, et al, 2017). The secondary data was used to identify the crucial factors such as structural factors, psychosocial factors, and household characteristics. It has been identified that private cars are an important travel mode when families travel with young children. Parental preferences also affect the travel mode choice of young children. Policy makers can address the issues and encourage other travel modes by developing related infrastructure facilities.

The factors on traffic crashes and the characteristics of child safety restraint, and the effective countermeasures to increase the safety of children on highways were investigated by Dissanayake and Amarasingha (2016). This investigation was done using the crash data from Kansas, USA and the frequencies and percentages of restraint used among children aged 4-13 were tabulated. The connection between the use of restraints with the severity of injuries and the characteristics of children were analyzed by estimating odd ratios. The results of this research revealed that severe injuries can happen when children are seated in front, travelling with drunk drivers, travelling on rural roads, or travelling during nighttime. Also, cases reckless driving, speeding and disturbances on the road may affect the severity of injuries of children. To avoid these incidents in future, the researchers suggested children travelling in the rear seats using size appropriate and age-appropriate child seats. Educating parents and children about safety measures that can be used will also improve the highway safety of children.

Amarasingha and Balasayanthan (2018) studied the travel mode share of people in Jaffna district, Sri Lanka through a questionnaire survey and identified cars as the predominant mode among the urban residents while the motorcycle is the most frequent travel mode among the rural residents. Gunathilaka et al. (2021) investigated mode choices of three provinces in Sri Lanka and found that the most predominant travel mode in the Southern province as the van while in Northern and Eastern provinces, it was the motorcycle. Overall, the highest modal share was from public buses and trains accounting for 44.1%. It was found that personal characteristics and the travel- based characteristics were the most influential characteristics for transport mode selection. However, these studies are focused on adult population do not represent children under five years of age.

Madhuwanthi, et al. (2016) conducted a questionnaire survey to identify the aspects of personal characteristic and the travel-based characteristic for the travel mode choice in Colombo Metropolitan area in Sri Lanka. Income, vehicle ownership, safety and comfort have been identified as the main factors that influence the travel mode choice of individuals over 15 years old. Pathirana and Sirisoma (2022) developed a mode choice model considering commuter trips for the Western province of Sri Lanka using the travel details collected through a travel diary survey from all household members except children aged below five. Amarasingha and Piantanakulchai (2009) developed a mode choice model considering the shopping trips for Palinda Nuwara of Sri Lanka using a household travel survey excluding the children.

The studies on the mode choices of the school students could also be found in the literature. Damsara et al. (2021) did an analysis for mode selection of school students in Colombo, Sri Lanka focusing on children above five years old. Nevelsteen et al. (2012) conducted a questionnaire survey among children aged six to twelve years old in northern Belgium to identify the parental factors for the travel mode choice. The safety of the child is affected by factors such as gender, age, and traffic infrastructure at the child's home or destinations. Shokoohi et al. (2012) investigated the association of parental perception in traffic safety in the neighborhood considering walking to and from school using the data from a cross sectional survey of parents. The survey was conducted in the Netherlands for school children between ages 7 to 12 across 15 different schools to investigate the factors influencing travel satisfaction and travel mood among the children traveling to school. Van den Berg et al. (2020) investigated the factors influencing travel satisfaction and travel mode among the primary school children traveling to school. The data for the research was gathered via a survey from both students and their parents. The survey was conducted in the Netherlands for school children between ages 7 to 12 across 15 different schools. Then the results were characterized, and path analysis was used to estimate the effects of descriptive variables on the dependent variables and their relationships. It was identified that the age of the child, income, perceptions of neighborhood infrastructure and social cohesion are the factors that affect parental safety perceptions on children travelling to school the most. Also, the findings show that factors like sunny days, travelling with a friend, or with the favorite mode of transport will increase the travel satisfaction of the children.

Attitudes and beliefs will contribute considerably to a travel behavior when considering children, as they have less self-regulation skills and lack control over their behaviors (Stark and Hössinger, 2018). Therefore, this study expects to evaluate a travel awareness campaign for the aged. Without relying on earlier methods and to gain more specific details on children, a multi-methodological design is used. The study will test out three different formulations. They are value-based concepts, theory of planned behavior related concept: that is a measuring mode on a one-dimensional scale and content related concept. The data for the survey has been collected via a questionnaire survey. A descriptive analysis was done to several items that were taken from the survey such as Universalism – which focused on environmental aspects, social status and autonomy. Also, a factor analysis and a regression analysis have been done to evaluate the results. It was found that the theory of planned behavior related attitudes triggers intentional travel behaviors but not evidence based and emotional attitudes. The results from all the analyses showed that the one-dimensional theory of planned behavior related attitudes is the most suitable/appropriate predictors for the travel mode choice behavior.

According to the literature review, no research has been done on the travel mode choice of children between age 0 to 5 years in Sri Lanka though similar studies have been done for occupants aged more than 15 years old. Also, a very limited number of studies have been conducted to investigate the issue globally. By conducting a travel mode choice study among the families with children aged 0 to 5, their travel pattern can be identified and that can be used for improvement of safety, health, and sustainability in transportation.

3 METHODOLOGY

3.1 Study Area

The study area for the research was selected as the Western Province, Sri Lanka which is the densest province, in Sri Lanka. Both the commercial capital Colombo and the legislative capital Sri Jayawardenepura Kotte are in this province. The province is divided into three administrative districts which are Colombo, Gampaha, and Kalutara. The province also includes 40 Divisional Secretary's Divisions. Western province has a population of 5,821,710 according to the Census of Population and Housing (2012). The population of children aged 0-5 is identified as 530,477 with data from the survey done in 2011.

3.2 Questionnaire

Data collection for the study was done using a questionnaire survey. The questionnaire consisted of several questions, mainly considering three aspects; the factors affecting the travel mode choice; use

of safety related equipment for children; and the behavior of the child while travelling. The questionnaires were prepared in both Sinhala and English languages.

3.3   Pilot Study

A pilot study was done before the main survey was done for the study. The pilot study is a small-scale trial study that is useful to validate the questionnaire, to identify any mistakes and to ensure the validity of the research process. This also helps to do the main study in a similar manner in a wider scale. About 100 data samples were collected for the pilot study. From those data samples, it was identified that the majority travel in their private car with 33 samples and the motorcycle was the second highest mode used for traveling with 20 samples. Other modes that were used were walking, three-wheeler, bus, taxi car and train. Also, 80% of those who travelled with motorcycle used a helmet for their child and 54.5% who travel with their private car used a child safety car seat for their child. With the data collected for the pilot survey some minor changes were made to the questionnaire survey to collect more reliable, and accurate data.

3.4   Data Collection

The sample size for the study was decided to take from the Solvin's Formula as shown in equation (1) (Madhuwanthi et al., 2016);

$$n = \frac{N}{(1+NE^2)} \tag{1}$$

where: n = sample size, N = population size, and E = error tolerance. The error tolerance was taken as 5% considering a confident interval of 95%. N is taken as the population of children between 0 to 5 years in Western Province which is 530,477. Therefore, for this case, the sample size would be 400 and in this study the sample size was decided through random sampling techniques.

Data on characteristics of the traveler (age, gender, monthly family income, vehicle ownership, etc.); characteristics of the trip (purpose of the trip, travel mode, approximate distance, accessibility public transport); characteristics of the mode (travel time, safety, comfort, cost, flexibility, environmentally friendly); safety measure usage (helmet usage, car seat usage, etc.); and behavior of the child during the travel were collected and tabulated for analysis.

3.5   Multinomial Logistic Regression Analysis

After the data collection, the analysis for the study was done using the Multinomial Logistic Regression Analysis. Logistic regression analysis can be used to explain the relationship between a dependent and an independent variable based on the probabilities, odd ratios etc. This can only be applied when the dependent variable is categorical. In this study the dependent variable is 'travel mode choice' consisting of 8 categories.

There are several assumptions on Multinomial Logistic Regression analysis, and they are verified before conducting the analysis (Peng et al., 2002). The assumptions are:
- The dependent variable is measured at the nominal level
- One or more independent variables exist which are continuous, ordinal or nominal (including dichotomous variables)
- Observations should be independent, and the dependent variable is mutually exclusive and exhaustive categories
- Multicollinearity should be avoided
- The logit transformation of the dependent variable and any continuous independent variables should have a linear relationship
- Outliers should not exist.

In the multinominal logistic regression model, the utility maximization assumes that the means an individual traveler selects the mode which has the maximum utility. The utility that an individual traveler n associates with the alternative mode i in the alternative available mode choice set C_n is given by U_{in} (Including both deterministic V_{in} and uncertainty ε_{in}; $U_{in} = V_{in} + \varepsilon_{in}$). Then an alternative with

the maximum utility is chosen. Therefore, the probability that the alternative mode i is chosen by the traveler n from the choice set C_n is presented in Equation 2 (Ben-Akiva. and Bierlaire, 1999).

$$P_{in} = Porb\,(U_{in} \geq U_{jn}\ \forall\ j \in C_n) \tag{2}$$

The probability of using mode i (P_i) based on multinomial logistic model can be expressed as in Equation 3.

$$P_{in} = \frac{e^{U_{in}}}{\sum_{k=1}^{j} e^{u_{ik}}} \tag{3}$$

Equation 4 shows the utility function of mode (i) for a number of independent variables (Ben-Akiva, and Bierlaire, 1999).

$$U_i = C + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_{31} + \cdots + \alpha_a x_a \tag{4}$$

where,
U_i = Utility function of mode i,
C = Constant,
α = coefficient of the attribute, and
x = independent variable.

The coefficient estimation is done using maximum likelihood estimation methods.

4 RESULTS

Table 2 shows descriptive data of the study. A majority of children in the sample were transported by private cars which accounted for 29% ,followed by buses (22%).

Table 2. Descriptive data collected targeting families with children age below five years

Variable	Variable category	Number of responses	Variable	Variable category	Number of responses
Age of the child	Younger than 1	42	Travel Mode	Walking	15
	1 year	50		Motorcycle	65
	2 years	50		Three-wheeler	49
	3 years	70		Bus	88
	4 years	88		Private car	116
	5 years	100		Taxi car	45
Household Monthly Income	Less than Rs 50,000	41		Train	11
	Rs 50,000 - Rs 100,000	143		Other	11
	Rs 100,000 - Rs 150,000	135	Travel purpose	Educational needs	138
	Rs 150,000 - Rs 200,000	49	Travel purpose	Healthcare needs	124
Private Car ownership	Yes	242	Travel purpose	Leisure needs	101
	No	158		Other	37

4.1 Likelihood Ratio Test

Table 3 represents the likelihood ratio values indicating how the independent variables are significant with the dependent variable. Initially, there were 27 variables for the analysis with child behavioral data. After checking the correlations of the variables, 21 independent variables were used for the analysis. The dependent variable was "Travel Mode". Several independent variables as shown in Table 3 were significant at 95% significant level. The significant variables were the age of the child, approximate distance to the location, household monthly income, type of vehicle owned, walking time for the nearest public transport station, habit of securing the child in a car seat if travelling in a private

car, and whether the child is familiar with the use of car seat if travelling in a private car. The latter two variables were subcategories of the use of child safety car seat in a private car that signify the safety of the child while travelling. The variables related to travel behavior of children were not significant in the analysis.

Table 3. Likelihood ratio test results

Variables	Chi-Square	P value
Age	295.987	0.000
Purpose of the trip	10.296	.999
Distance	368.315	0.000
Time of travelling	31.818	.061
Safety	21.183	.818
Comfort	12.360	.995
Time consumption	14.840	.980
Easy and flexible	9.909	.999
Environmentally friendly	28.208	.453
Monthly income	652.926	0.000
Vehicle ownership	1.317	.988
Type of vehicle owned	375.382	0.000
Walking time to the nearest public transport station	85.513	0.000
Helmet usage	1.183	.991
Helmets keep your child safer	27.105	.513
Parent has a habit of providing a helmet for the child	8.516	.286
Child is familiar and likes to wear a helmet	9.963	.999
Car seat usage	12.059	.996
Car seat keeps your child safer	32.260	.055
Parent has a habit of securing the child in a car seat	207.891	0.000
Child is familiar and likes to use a car seat	439.912	0.000

4.2 Parameter Estimates

Parameter estimates can be further used to understand the significant factors' effect as it is more descriptive. Here a reference category of the dependent is compared with the other categories of the dependent variable. Also, each of those dependent categories is compared with all the independent variable categories. These results can be used to understand how the factors differ with the reference category. For this study, the reference category has been taken as the "Private Car". As it is the most frequent category available, it will be more effective to compare it with other categories.

Table 4. shows the parameter values only for the significant factors obtained from this study. The coefficients in the table represent the unstandardized regression coefficient of each variable. A coefficient can be of a positive or negative value and can be used to compare the independent categories with the reference category. If it is a positive value, then the dependent variable category has a more choice/significance than the same variable in the reference category whereas if the "B" coefficient is negative the dependent variable category will have a less choice/significance than the same variable in the reference category. This will be more clear from the example described below. Also, the coefficient gives the measure as to how stronger or weaker the choosing of a travel mode is. Some independent variables have been measured on an ordinal scale. Safety and comfortability etc. have been measured on a scale of a five-point scale system as strongly disagree, disagree, neutral, agree and strongly disagree.

Table 4. Parameter Estimates

Travel Mode	Independent variable	Category	coefficient	Sig.
Walking	Distance	Within 1km	2.326	0.049
	Safety	Strongly disagree	-0.582	0.000
	Time consumption	Strongly disagree	0.724	0.000
	Monthly Income	Less than Rs.50,000	2.414	0.033
	Car seat keeps the child safer	Neutral	-1.375	0.020

	Parent has a habit of securing the child in a car seat	Strongly disagree	0.413	0.027
Motorcycle	Purpose of the trip	Educational needs	-1.384	0.021
		Medical/healthcare needs	-.0.861	0.004
	Safety	Strongly Disagree	-0.011	0.000
Three-wheeler	Distance	Between 5-10km	0.784	0.016
	Comfort	Neutral	-1.679	0.040
	Monthly Income	Between Rs.50,000-100,000	1.765	0.060
Bus	Easy and flexible	Strongly disagree	2.641	0.023
	Monthly Income	Less than Rs.50,000	1.726	0.043
	Vehicle Ownership	No	1.857	0.009
Taxi Car	Comfort	Disagree	-1.088	0.015
	Environmentally friendly	Agree	0.799	0.021
	Monthly Income	Between Rs.150,000-200,000	2.476	0.022
	Parent has a habit of securing the child in a car seat	Strongly disagree	1.468	0.008
Train	Distance	Within 1-5km	-0.666	0.018
	Time of travelling	Afternoon	1.290	0.016
	Comfort	Disagree	0.323	0.033
Other	Distance	Within 1-5km	0.331	0.014
	Vehicle Ownership	Yes	-1.843	0.016

Considering the travel mode of "Walking" as shown in Table 2, there have been six sub-categories that have been significant against the reference category. In the first sub-category, if the distance of the journey is within 1km, there is a 2.326 odd chance of choosing the travel mode walking than the private car. If a user does "Strongly disagree" on safety at all when choosing a travel mode, it has 0.582 odd times less chance of choosing walking than the private car. But there is a 0.724 odd chance of choosing walking if a user does "Strongly disagree" on the time consumed when choosing the travel mode. Also, if the monthly income of the family is less than Rs 50,000 it is 2.414 odd chance of more users choosing walking as the travel mode over the private car. If a parent has a "Neutral" status on the "Car seat keeps the child safer" variable there is 1.375 times lesser chance that the user will choose walking over the private car. And if the user has a "Strongly disagree" opinion on the "Parent has a habit of securing the child in a car seat" there is a 0.413 times more chance of choosing walking as a travel mode than the private car. For the other categories in the travel mode choice, the variables can be compared with the reference category as same as the first category. This will give a more descriptive analysis of how each category of the independent variables would affect the travel mode choice.

4.3   Usage of Safety Equipment

In this study, the usage of safety gear for children under five was also identified. Specifically, the usage of safety helmets while travelling on motorcycles and the usage of child safety car seat in private vehicles are identified with the aid of the questionnaire survey. Some factors for using the safety gear from both the child's and the parent's perspective were obtained. The usage of safety equipment and factors used to determine them would affect traffic safety.

In Figure 1 and Figure 2, the percentages of usage of safety helmets and child safety car seat are shown. About 16.25% of participants were motorcycle users. Among them, 76% of motorcyclists used a safety helmet while travelling with a child aged below five. However, 24% of motorcyclists did not use a helmet for their child while travelling. Out of the 29% of private car users of the participants of this study, only 52% users placed their child in a safety car seat while travelling with a child aged below five while 48% of users did not place their child in a safety car seat while travelling.
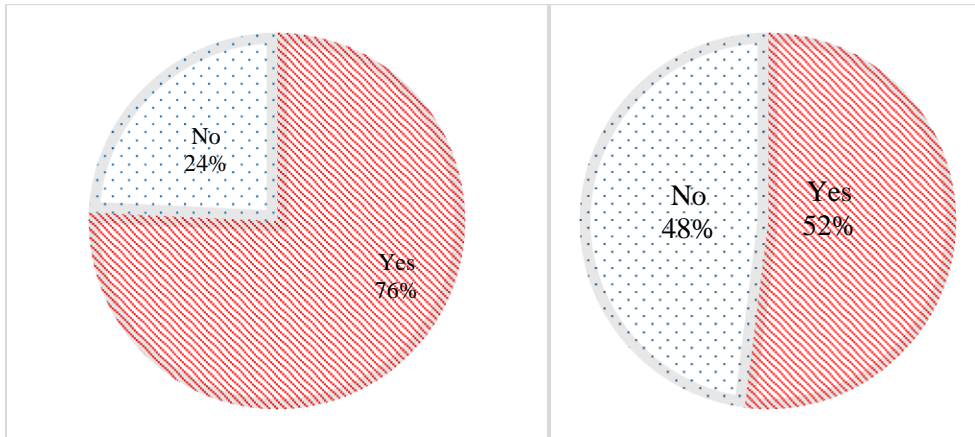
Figure 1. Safety helmet usage of motorcyclists   Figure 2. Car seat usage of private car users

4.4   Child Behavior While Travelling

One of the objectives of the study was to identify the travel behavior of children while travelling. For this purpose, there were several questions included in the questionnaire related to travel behavior.. Figure 3 shows the results obtained through the questionnaire.
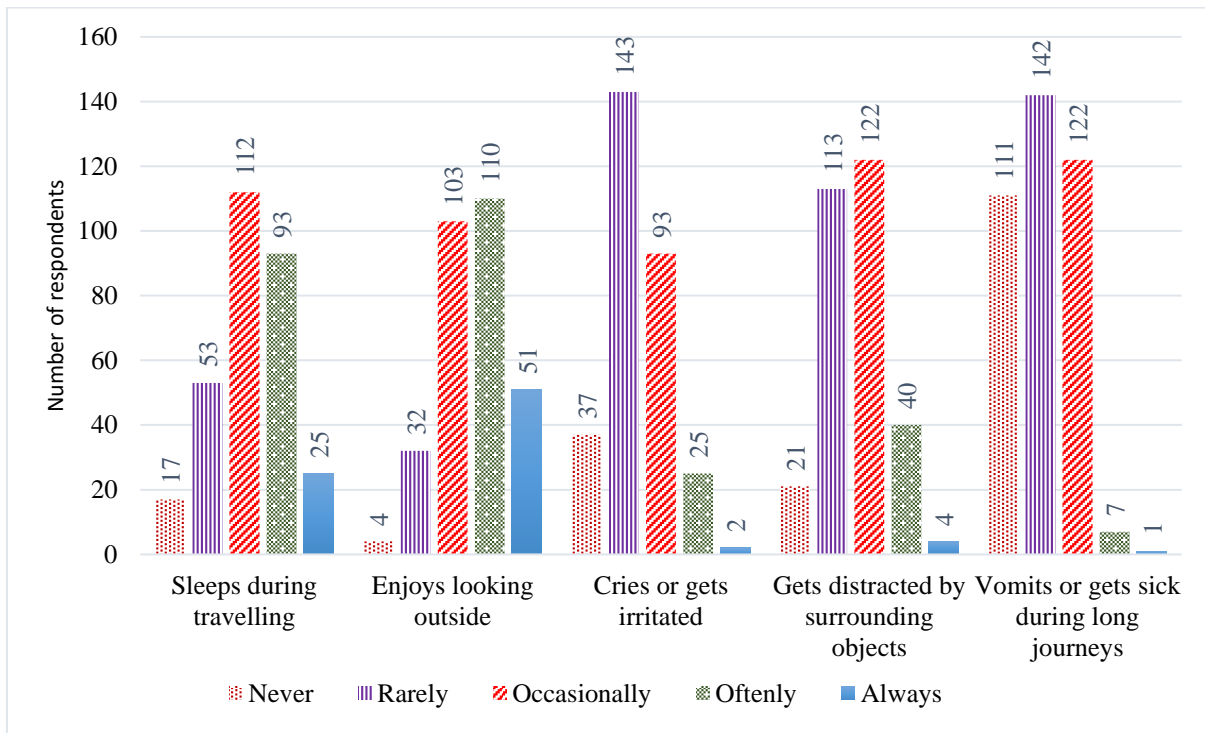

Figure 3. Child behaviour frequency while travelling

5   DISCUSSION

The main objective of this research is to identify the factors that would affect the travel mode choice of families with children aged 0 to 5 years. The most significant factors as per the Likelihood ratio test in Table 2 for the travel mode choice were obtained. They were the age of the child, approximate distance to the location, household monthly income, type of vehicle owned, walking time to the nearest public transport station, habit of securing the child in a car seat if travelling in a private car and the child's familiarity with the use of a car seat if travelling in a private car.

When considering the variable "age," there were six categories representing the ages below five. This can be significant due to several reasons. When the child is very young, such as younger than 1 or within 1-year, parents care more about the child's safety and health. Therefore, parents tend to take

safer, secure, comfortable and less time-consuming travel modes. For example, parents who usually travel by bus may tend to travel in three-wheelers or taxis. Parents with motorcycles also tend to take a different travel mode that is safer and more comfortable. But when the children grow older, parents may travel in their usual travel mode. Parents with private vehicles except motorcycles may travel in the same mode as the safety and comfort is higher.

Another significant factor in the travel mode choice is the approximate distance to the location. This factor can affect the choice of travel mode in several ways. Especially, when considering current economic conditions and fuel crisis, people tend to travel in public transport modes for long distances even though they own a private vehicle. People who do not own vehicles can take different modes depending on the distance. For example, for destinations within 5 km they could take a three-wheeler or a taxi and for destinations more than 10km, they could take a bus or trains as the cost of a three-wheeler/taxi prices are way higher than the bus or trains. The comfort of the travel modes can also be a factor in this as some parents consider higher comfort when travelling longer distances with children, especially parents with motorcycles.

Household monthly income is another factor that is significant in travel mode choice with children under five years. Income was divided into five categories in the model. Income will be directly proportional to the cost of travelling, which most people consider. It is significant as parents consider the cost of travelling if there are no other factors to be considered by the parents whereas the low-income parents will tend to travel in travel modes with low costs and higher income parents would not consider cost a significant factor when choosing a travel mode when travelling with children.

The type of vehicle owned has also been significant on the model. This variable could also affect in different ways when travelling with a child aged below five years. There were five categories such as motorcycle, three-wheeler, car, van, and others in the model. Some parents may have a vehicle that is not appropriate for family travelling. Also, the vehicle type could also affect the choice. When travelling with a young child, parents may consider taking more comfortable and safe travel modes. These reasons could affect the parents when choosing a travel mode. Families with cars and vans will mostly go in their own vehicles with children. However, it could also depend on the availability of the vehicle.

Walking time to the nearest public transport station is also another significant factor in the model. This factor will not be very applicable to parents with private vehicles as they mostly travel in their own vehicle. But it could also vary as in the previous vehicle ownership factor. When a family lives near a public transport station such as a bus or railway station they tend to travel using that mode. But if the distance is too far to walk, parents will choose another method such as three-wheelers or taxis. They could even split the trip into two different modes. For example, one transport mode from home to the nearest public transport station and from there another transport mode. Therefore, it is clear that the walking time to the nearest public transport station is another significant factor when choosing a travel mode for children.

The other two remaining factors that the model represents are the habit of securing the child in a car seat and the child's familiarity and likelihood of using a car seat that concerns the safety while travelling with children. These factors only affect families with private cars as child safety car seats are only possible to be used with private cars. With the samples, a majority of 29% car users placed their child in a car seat. Even though there is a car seat in their vehicle, the usage of it depends on factors, such asparents' habit, and child's familiarity/likelihood/preference?. This is a safety concern while travelling with children aged 0-5 years.

Compared with other studies, with an analysis carried out with data from several databases (McCarthy, et al, 2017), identified that structural factors such as quality of cycling, pedestrian and public transport infrastructure have had an impact on the travel mode. But this will not be much applicable to the Sri Lankan scenario because these infrastructures are not available, or they are not in good condition. Therefore, these factors were not tested in this analysis. Increasing travel distance has also been determined as a factor that impacts the travel mode choice mainly with taxis and private cars. Similarly, this study also identified distance to the location as a significant factor. Also, household income, characteristics related to children such as age, child related safety equipment such as car seat usage are several other factors that are similar to the results in this study. In addition, the number of dependent children, cost of transport, child's physical capabilities are some other factors (McCarthy, et al, 2017) that have not been identified as significant in this study.

A study done in Netherlands (Van den Berg et al, 2020) with children between 7 to 12 years identified age of the child, income, perceptions of neighborhood infrastructure and social cohesion as the most influential factors in children's travelling mode choices. The survey was done with both parents and children there. There are similar factors in this study such as age and income of the child's family. However, neighborhood infrastructure does not apply to the Sri Lankan context and social cohesion is not valid for children aged 0 to 5 years.

When considering studies done in Sri Lanka by Gunathilake et al. (2021), Pathirana and Sirisoma (2022), Amarasingha and Piantanakulchai (2009), Damsara et al. (2021), Madduwanthi, et al, (2016), they were done for persons more than five years old. Therefore, it is not realistic to compare this study with the above mentioned studies.. Nevertheless, , income, vehicle ownership, safety and comfort have been identified as the main considerable factors that influence the travel mode choice from the previous studies as well. Therefore, all the factors here are almost identical to the findings of this study. Vehicle ownership can be paralleled with the types of vehicles owned and safety can be considered as the use of car seat even though there is an age limit in the study, the factors are nearly the same.

There are some other studies that have identified that parents will determine their travel mode choice based on the traffic infrastructure and accidents (Nevelsteen, et al, 2012). The traffic infrastructure condition will not be considered in the Sri Lankan context and many Sri Lankan parents do not pay much attention to accidents when the travel mode choice is made. .

When looking at the safety equipment used for children, most of the motorcycle users use helmets for their children. But when compared with age, there is a higher percentage of children under one year who are not wearing helmets. When considering the usage of child safety car seats, it is very low. Only 52% use helmets for their children. In this case, the rate of casualty will be high if there is an accident. Using size appropriate and age-appropriate seat belts, children travelling in the rear seats, and educating parents and children with safety measures will be more effective measures to increase child safety (Dissanayake and Amarasingha, 2016). Also, with infrastructure developments (Nevelsteen, et al, 2012) safety of travelling can be improved.

Child behavior is also a factor that parents would consider. Common behaviors of children were also identified in the study. Theory of planned behavior related attitudes trigger intentional travel behaviors but not evidence based and emotional attitudes of children (Stark and Hössinger, 2018). Also, travel satisfaction is one of the indicators (Van den Berg, et al, 2020) of the trip's contribution to the subjective wellbeing of the traveler. Therefore, a child's behavior is also an important factor in travelling mode choice.

6   CONCLUSIONS

This study was done with the main objective of finding the factors affecting the travel mode choices of families with children aged below five years. Also, the study was focused on the safety and travel behavior of children while travelling. The data for the study was collected via questionnaire surveys for 400 samples from the Western Province of Sri Lanka. The study covered all the travel modes used to travel within the country. Before conducting the main survey, a pilot survey was conducted with 100 samples to validate the questionnaire. The analysis of the study was done using the Multinomial Logistical regression analysis. Before the analysis the assumptions for the model were checked and verified. The dependent variable for the study was taken as the "travel mode choice" and initially 27 independent variables were used for the analysis. Using the Likelihood ratio test in the outputs, the significant factors of the model were identified. They were age of the child, approximate distance to the location, household monthly income, type of vehicle owned, walking time to the nearest public transport station, habit of securing the child in a car seat if travelling in a private car and the child's familiarity with the use of car seats if travelling in a private car. The parameter estimates how each category of independent variable is affected on the reference category that was observed. Also, a comparison on child safety equipment and child travel behavior was made.

The obtained results were justified with similar research identifying the major concerns. Finally, the recommendations were provided to policy makers, relevant authorities, and parents for making the transportation sector safer, comfortable, economical, and sustainable.

6.1 Recommendations

Findings of this study can be used by the policy makers to make informed decisions on the transportation sector that will enhance the safety, comfort, economics , sustainability and the overall quality of transportation including travelling. Also, the legal terms can be updated in support of these conditions. Relevant authorities such as vehicle manufacturers, accessory providers etc. should also consider these aspects. Also, if any changes can be made to the safety gear such as making age-appropriate seat belts and helmets. Parents should consider the above factors while travelling with children. Parents can be advised/educated with some information regarding these concerns by experts in this field.

In addition, these findings can be used for future studies. This research was conducted to get an initial understanding of the factors that could affect the travel mode choices of parents with children aged 0-5 years. Subsequently, this research can be improved with wide categories such as how the transportation system can be improved to make the children travel safer and more comfortably, specially school children. Also, the research could be improved with larger samples sizes, collecting more detailed information etc.

7   ACKNOWLEDGEMENTS

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