PEDESTRIANS' SAFETY MARGIN (PSM) FOR UNPROTECTED ROAD CROSSING

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ABSTRACT

Providing safe and efficient pedestrian facilities is a long-established goal in Indian cities. In developing countries like India, many pedestrian accidents were reported due to unprotected crossings. In this context, the aim of this research is to investigate pedestrian's safety for mid-block road crossings in urban areas. The literature shows that Pedestrian Safety Margin (PSM) time is the dynamic factor that determines pedestrian gap selection behaviour. To analyse the influencing factors for pedestrian's gap selection behaviour, a video graphic survey has been carried out at Ameerpet, Hyderabad in India. Data have been extracted from the video and a model has been developed by using multiple linear regression technique. The data collected includes pedestrian demographic and vehicle characteristics, pedestrian platoon size, pedestrian speed, waiting time, baggage effect, vehicular gap size, and rolling gap (pedestrian roll over the small vehicular gaps). Discrete choice model was also developed to find the probability of safe road crossing at that particular urban mid-block location and examine the factors influencing the crossing behaviour and the probability to cross the road safely. The regression model result indicates that the PSM highly depends on the availability of gap in vehicular flow and pedestrian crossing behaviour. The modelling result also shows that the safety margin value increases with increase in pedestrian speed and decreases due to attempt of rolling gap. The binary logit model shows that the probability of safe road crossing increases with increase in pedestrian speed and gap size. The research of PSM will contribute to improving the understanding of pedestrian's psychology and behaviour which is important to improve pedestrian's safety. The developed PSM models will be useful to identify the most hazardous situations and locations of road crossings and it is also useful to evaluate the pedestrian facilities.

Keywords: safety margin; pedestrian; gap acceptance; mid-block; rolling gap; road crossing.

INTRODUCTION

Non-motorized traffic such as pedestrian and cyclists are vulnerable road users in the world. Due to unprotected crossing of road, pedestrians' vulnerability further increases. (Kumar and Parida, 2011) found that, 54 percentage of pedestrian road accidents involved during road crossing in urban areas. So, providing safe and efficient pedestrian road crossing facilities is a long-established goal in India cities. The behaviour of pedestrian irregularity is more during road crossing when compared to walking on side-walks. In developing countries like India, if there is no foot over bridge (FOB) or subways, pedestrians need to cross at grade with diverse type of mixed vehicles. In addition, the pedestrian jaywalking condition leads to the higher conflicts at mid-block locations and it further leads to severe accidents to the pedestrians. A study carried by IIT Delhi and University of Michigan entitled as "Road safety in India: challenges and opportunities" states that 60% victims in urban areas relate to pedestrians, in this 85% fatalities occur at mid-block locations (Mohan et al., 2009).

Researchers have investigated pedestrian road crossing behaviour, decision making process of pedestrians as well as vehicular characteristics with the help of discrete choice models (Himanen and Kulmala, 1988; Sun et al, 2003; Lassarre et al. 2007), log normal models for minimum gap at mid-block (Yannis and Papidmitrou 2010; Kadali and Vedagiri, 2012). All these studies focusing more on pedestrian gap acceptance behaviour, but the proposed study deals about gap acceptance and safety margin concept. Whereas some studies have been carried out in virtual environment to examine the effect of pedestrian demographic and vehicular characteristics on decision making process before road crossing (Oxley et al., 2005; Lobjois and Cavallo, 2009) and these results are correlated with pedestrian safety, but these are not in realistic. Many studies often investigated the pedestrian decision making process for road crossing which depends on the distance of the vehicle or vehicular speed (Chu et al. 2002; Sun et al. 2003; Yannis and Papidmitrou 2010). As a consequence, pedestrians may select an unsuitable vehicular gap which leads to hazardous crossing. In this line, recent studies shows that both types of data such as speed and distance of the vehicle are important to make crossing decisions (Tung et al., 2008). Studies are also carried on effect of type of vehicle on pedestrian safety and it found that light vehicles more dangerous than heavy vehicles (Lefler and Gabler, 2004). Many experimental studies were carried in actual field context to know pedestrian behaviour at signalized crosswalks (Rosenbloom, 2009; Tiwari et al., 2007) and type of crosswalks (Zegeer et al., 2003; Ragland and Mitman, 2007; Zhuang and Wu, 2012). Moreover, studies are carried on pedestrian safety evaluation indicates age as main impact factor (Chu and Baltes, 2001; Oxley et al., 2005; Holland and Hill, 2007; Cavallo et al., 2009, Holland, 2010). All these existing literature not consider pedestrian behavioural tactics in pedestrian gap acceptance behaviour as well the pedestrian safety analysis. There are very limited studies are carried at unmarked unprotected mid-block location in mixed traffic context with pedestrian behavioural tactics. In this research, PSM evaluated through pedestrian gap acceptance consider the effect of pedestrian behavioural tactics such as rolling gap (Brewer et al., 2006).

Pedestrian Safety Margin (PSM)

Safety Margin (SM) is defined as the difference between the time a pedestrian crossed the conflict point and the time the next vehicle arrived at the same conflict point (Chu and Baltes, 2001). Suppose a pedestrian reaches a conflict point at time T1, and the next vehicle arrives a same conflict point at time T2, then the SM is T2–T1. It indicates that if the pedestrian is having a slower walking speed (T1 is more time) or the vehicle reaching faster (T2 is less time) it leads to hazardous condition. Necessarily, it is the excess time when deducting the perceived time from available vehicular time gap during road crossing. There are several studies are take over this SM and they defined in different ways (Chu and Baltes, 2001; Oxley et al., 2005; Lobjois and Cavallo, 2007; Tung et al., 2008; Guangxin and Keping, 2009). Researchers found that the increased gap size increase the SM value (Routledge 1975 which is sited in Molen Van Der 1981). In this line, some studies have highlighted the importance of training programme in road crossing to enhance the PSM (Molen Van Der, 1981; Vinje, 1981; Thomson et al., 2005; Dommes et al., 2012). These studies reported experiments with and without trained pedestrians and they identified important factors which need to be considered for training programme. But these studies are not considered the pedestrian behavioural characteristics while crossing the road and effect of this behaviour on pedestrian safety.

Further, most of the above mentioned studies were carried out in developed countries. The transport systems and infrastructure is well developed when implies compliant behaviour of vehicular driver as well pedestrian. As a result, the outcome of these studies cannot be conveyed and used in developing countries like India. Where, the traffic on the roads is highly heterogeneous comprising vehicles of wide ranging static and dynamic characteristics. Due to this wide variety of vehicles, lower crossing facilities and traffic control system leads to noncompliant behavior of vehicular driver as well pedestrians and often risk-taking behaviour. It results in the hazardous pedestrian crossing and increased share of road accidents involving pedestrians. With this background, the objective of this research is formulated to evaluate the pedestrians' safety at unprotected unmarked mid-block location in urban areas.

METHODOLOGY

A typical mid-block site was chosen near Ameerpet, Hyderabad, India. The selected site is suitable for video graphic survey and the roadway characteristics as shown in Figure 1. This unmarked midblock section is 135 m away from the signalised intersection. This two-way road has two lanes on each side and a total width of 14.3 m. Videography survey was carried on 21st December 2011 at unmarked location during working day in a normal weather condition. The video camera was placed on the roof of the building. The vehicular and pedestrian volume extracted from the video, it comprised of 4722 vehicles and 456 pedestrians per hour. The video was captured and thirty JPEG files were obtained for each second with the help of Snapshot Wizard software. From each snapshot, data was extracted which includes PSM, pedestrian behavioural and traffic characteristics.

Figure 1 –Survey location

The extracted data consists of 1008 SM data points. In this research, two SM values were obtained on each side and out of which minimum values are considered for modeling. The extracted data comprises of pedestrian demographic characteristics such as gender and age groups (i.e., <30 young, 30-50 middle and > 50 elders) by visual appearance, platoon, waiting time and SM value. Whereas the traffic characteristics are vehicle speed, vehicle type and available gap sizes. Pedestrian behavioural tactics are considered with rolling gap effect (Pedestrians are rolled over small vehicular gaps to reduce their waiting time with change of crossing paths). In Particular the data was recorded during unprotected pedestrian condition, only during the vehicle green signal of the nearby traffic lights. Moreover, blocking conditions were not included in the data. The recorded data extracted to study SM value was based on two time step process: At the first time step, the pedestrian just crosses the conflict point. In the second time step process, the next oncoming vehicle has just passed through the same conflict point as virtual line indicating the pedestrian's crossing path and vehicular path. So, the differences between these two time steps are considered as SM. In this survey location two lane two way road total four SM values were identified out of these minimal values are reported in the model. The collected variables are presented in Table 1.

Table 1 The variables collected in this study

Variable	**Type**	**Unit or Code**
Gap size	Continuous	Time in sec
Safety margin	Continuous	Time in sec
Waiting time	Continuous	Time in sec
Vehicle speed	Continuous	Kmph
Pedestrian speed	Continuous	m/sec
Gender	Discrete	0-Women; 1:Man
Age	Discrete	0:Elders 1:Middle 2:Young
Pedestrian platoon	Discrete	0:Single 1:Two 2: More than two
Pedestrian rolling gap	Discrete	0-No; 1:Yes
Pedestrian baggage effect	Discrete	0-No; 1:Yes
Type of vehicle	Discrete	0:Heavy 1:Car 2: 2W; 3: 3W

Model Framework

Multiple Linear Regression Model (MLR Model)

The effect of selected variables on minimum SM value carried with MLR. The MLR model is useful to find out the minimum PSM value which is maintained by pedestrians' at unmarked unprotected mid-block location. The minimum PSM value is represented by a regression model with effect of collected variables. The model framework is given below:

$$SM = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots\ldots + \beta_n X_n \qquad (1)$$

Where
SM= safety margin in sec; X_{i-n}= explanatory variables;
β_{1-n}= are estimated parameters from model; β_0= constant;

Binary Logit Model (BLM Model)

The probability of pedestrian safe road crossing carried with binary logit model (BLM) with selected variables. In this study, the pedestrian decision making condition is described with the BLM. The probabilities of selecting an alternative (accept/reject) is based on a linear combination function (utility function) expressed as:

$$U_i = \alpha_i + \beta_{i1} X_1 + + \beta_{i2} X_2 + \beta_{i3} X_3 + \beta_{i4} X_4 + \ldots\ldots\ldots\ldots + \beta_{in} X_n \qquad (2)$$

Where
U_i=the utility of choosing alternative i; i= the alternative (accept/reject) i;
n= number of independent variables; α= constant; β = coefficients;

The utility of alternative i has to be transformed into a probability in order to predict whether a particular alternative will be chosen or not. The probability of choosing alternative i is then calculated using the following function:

$$P(i) = 1/ [1+ \exp(-U_i)] \quad (3)$$

MLR Model

This modelling started with a correlation analysis to know the correlation between the descriptive variables and SM. Chi-square test was carried with help of Statistical Package for the Social Sciences (SPSS 16.0) software package. Multiple linear regression model was developed to find out the minimum SM value in unmarked mid-block locations. Gender positively has been correlated with pedestrian speed ($r = 0.106$, $p < 0.01$) and negatively correlated with pedestrian platoon ($r = -0.09$, $p < 0.05$). It indicates that, speed of men is more than women and they are not making group. Age negatively correlated with waiting time ($r = -0.07$, $p < 0.01$). Pedestrian platoon negatively correlated with SM ($r = -0.128$, $p < 0.01$), gender ($r = -0.09$, $p < 0.05$) and pedestrian speed ($r = -0.384$, $p < 0.01$). In general, with increased platoon size SM will increase. But in this study results shows that due to increased platoon the average pedestrian speed will reduce and SM will reduce. Pedestrian platoon size is positively correlated with waiting time ($r = 0.09$, $p < 0.05$), rolling gap ($r = 0.107$, $p < 0.01$), type of vehicle ($r = 0.08$, $p < 0.05$) and gap size ($r = 0.116$, $p < 0.01$). Increased platoon size increases the use of rolling gap. Due to increased waiting time pedestrian may choose higher gap size or lower gap size. It may lead to wrong judgement of vehicular gaps and hence SM will fall. Rolling gap is negatively correlated with SM ($r = -0.384$, $p < 0.01$), pedestrian speed ($r = -0.384$, $p < 0.01$) and gap size ($r = -0.384$, $p < 0.001$). Vehicle speed is negatively correlated with SM ($r = -0.226$, $p < 0.01$) and gap size ($r = -0.174$, $p < 0.01$). It implies that, if pedestrians' frequently using rolling gap their speed reduces and also they are very dangerous or unsafe. That is, longer waiting time implies increasing pedestrian group, reducing their speed, attempting small gaps by rolling gap and easily attempting heavy vehicle gaps also.

Table 2 Safety margin regression analysis results

Variables	Coefficient	Standard error	t-value	p-value
Constant	-1.973	0.152	-12.976	0.000
Rgap	-0.523	0.051	-10.18	0.000
G_Size	0.272	0.016	17.35	0.000
PS	0.784	0.061	12.75	0.000
Age	0.095	0.033	2.916	0.004

The significance level was consider with 99% confidence interval ($p<0.01$).

SM= -1.973 - 0.523 * Rgap + 0.272 * G_Size + 0.784 * PS + 0.0.95 * Age (4)
Where
SM=safety margin; Rgap- rolling gap; G_Size-vehicular gap size;
PS-pedestrian speed; Age- pedestrian age

A stepwise regression was conducted for all the descriptive variables with SM as dependent variable. The analysis aims to find out most contributing factors among all the listed potential predictors on PSM after considering partial correlations. Table 2 shows the regression analysis results coefficients, t-value and p-value. These independent variables have significant effect on SM. Among these variables, rolling gap is the most important variable. The negative sign of rolling gap indicates that pedestrians have lower SM when they using rolling gap. Pedestrians' speed and age also had significant contribution on SM, younger pedestrians being safer than other age groups. The positive sign of pedestrian speed and gap size shows, increased gap size or pedestrian speed increases the SM. The model calibration was considered with 70 percentage data and remaining 30 percentage for validation of the model. The calibrated model R^2 value, i.e., 0.683 and the graphs were plotted between observed and predicted values and a valid R^2 value, i.e., 0.6 has been found.

Effect of various factors on PSM

Effect of rolling gap on PSM

The effect of rolling gap on SM and pedestrian speed is shown in Figure 2. In general, rolling gap had negative influence on PSM. Results show that the pedestrians' unsafe crossing increases with increased use of rolling gaps. If pedestrians are using rolling gap condition then obviously their speeds will be reduced and it further leads to reduction in the vehicular speeds forcibly while crossing the road. As stated in the correlation analysis, when pedestrians are using rolling gap, they accept very small gaps by rolling over the different vehicular gaps. During this rolling gap process pedestrian adjusted their walking speed; normally pedestrian may walk less than normal walking speed. The available gap size is very less while they use rolling gap, but crossing time is very high and obviously SM leads to undesirable values. In spite of its overall negative effect, rolling gap had a positive effect on reducing their waiting time. However, if the SM falls below zero value and vehicles will come to high speed, it obviously leads to hazard situation to the pedestrians.

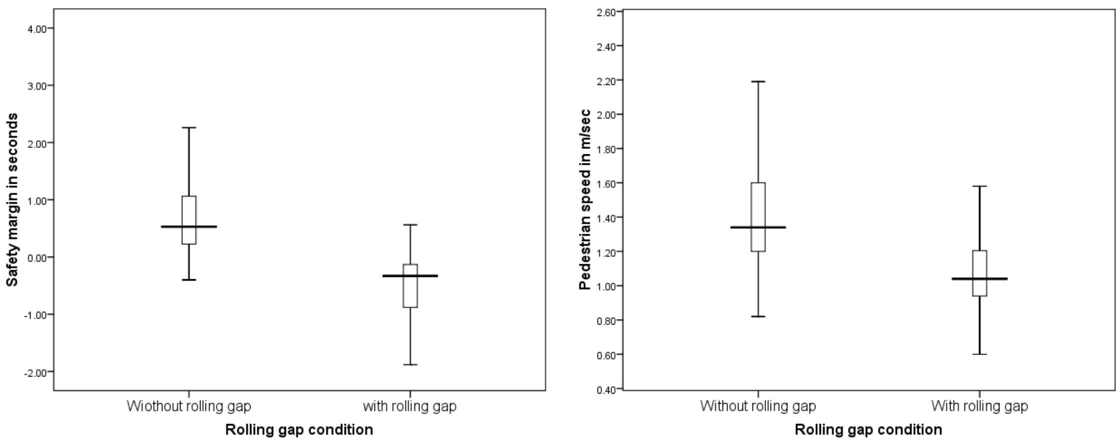

Figure 2 Effect of Pedestrian rolling gap condition on safety margin and pedestrian speed

Effect of age on PSM

Figure 3 show that, elders are usually perceived more unsafe crossing than younger pedestrians. Whereas, younger pedestrian behave abruptly than the elders. Perhaps this age difference variable can explain why elders are more likely to have lower safety, because of the slower walking speed. Earlier studies also observed that, elders have more risk crossing than younger pedestrians (Oxley et al., 2005). Age is positively correlated with SM, it indicates that younger pedestrian more safe also it is associated with pedestrian speed. Basically there is no correlation between pedestrian age and platoon.

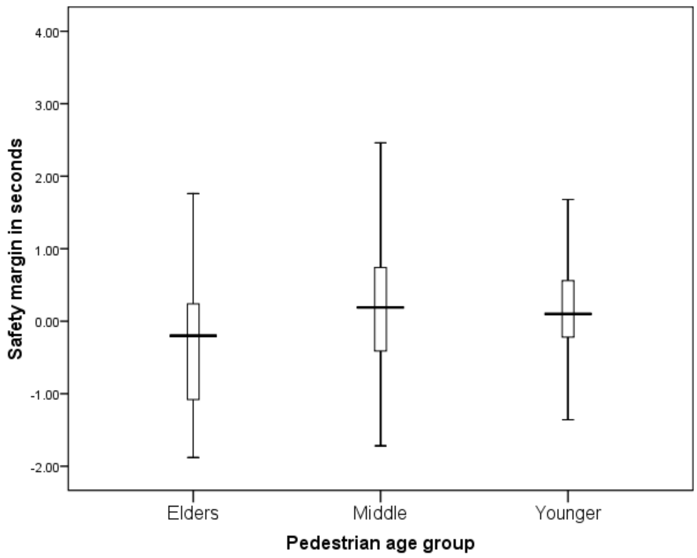

Figure 3 Effect of Pedestrian age on safety margin

Effect of platoon size on PSM

Normally, platoon size has positive effect on SM. Leden (2002) found that pedestrians' risk decreased with increasing pedestrians platoon size. Whereas present study has found quite different results, that there is no correlation between platoon size and SM. Moreover, at unmarked unprotected mid-block location pedestrian may perform individual gap acceptance behaviour than the platoon. It also indicates, at these locations pedestrian non-compliant behaviour is more by using rolling gaps and obviously it leads hazardous crossing. When pedestrians increase the use of rolling gaps then they try to accept small vehicular gaps and in this condition drivers are alerted by reducing their vehicle speeds. Pedestrian platoon size had a negative effect and it affected by pedestrians' speed. So again due to reducing pedestrian speed, they will take more time to cross the road and pedestrian SM value may fall below zero while they are in group. But most of the pedestrians behave as individual and they follow up with rolling gap.

Effect of vehicular gap size on PSM

Vehicular gap size has positive effect on SM. Increased gap size increases the SM and pedestrian may choose leisure walking speed. The gap size is negatively correlated with rolling gap, which indicates that reducing gap size increase with use of rolling gap. Whereas pedestrian speed has positive impact on SM, gender and age. It is negatively correlated with platoon size and rolling gap.

BLM Model

For the purpose of choice analysis (probability of safe or unsafe crossing), a binary logit model (BLM) was performed in NLOGIT 4; the choice opportunities for pedestrian crossings in unmarked unprotected midblock section in mixed traffic was analysed with pedestrian behavioural characteristics. The descriptive statistics of BLM test are summarized in Table 3. The utility equation (5) is given here for the probability of safe crossing condition, i.e., U1. The significance of independent variables are considered with the effect of t-values and p – values at both locations. The model results shows that the pedestrian safe road crossing highly influenced with rolling gap, due to this the constant value shows insignificant. The model is calibrated with 70 percentage data (706 data points) and validated with 30 percentage data. Also the model validation is considered with success prediction table.

The pedestrian's demographic characteristics (age and gender) are found as insignificant in binary logit model. It has been found that when the pedestrians' are using rolling gap there is no much difference in their gap acceptance behaviour with gender as well age. Then, probability of unsafe crossing increases due to rolling gap. The signs of coefficients in Table 3 show that all included variables are logically significant. The gap size shows positive sign which is indicates that increasing of gap size leads to the increase of probability of complaint behaviour which results safe pedestrian crossing. The highest factor is the rolling gap and when the pedestrians' are using it then the probability of non-compliant gap accepting behaviour increases it results in hazardous crossing. The pedestrian speed condition also has a higher contribution in the probability of increase safe crossing. In a sense, if they increase their speeds while crossing then then the probability of safe crossing increases. The validation of the present model was done with success and prediction table as shown in Table 4. For modelling total 70 percentage data (706 data points) were considered and the 30 percentage was used for validation by success and prediction table. The overall correctly predicted data come to be 97.26% in the modelling process. Correctly predicted unsafe crossing values are 191 out of 196 and predicted safe crossings are 271 out of 297 gaps. So it may be concluded that the proposed model is strong enough to predict the probability of safe or unsafe crossing at unprotected unmarked midblock location under mixed traffic condition by BLM.

Table 3 Estimated Coefficients

Parameter	β	Standard Error	t-Value	p-value
Constant	0.106	1.431	0.075	0.940
G_Size	0.8399	0.2034	4.129	0.000
PS	0.7632	0.3206	2.38	0.000
Rgap	-6.9292	0.716	-9.676	0.000

$$U1 = 0.106 + 0.8399 * G\_Size + 0.7632 * PS - 6.9292 * Rgap \qquad (5)$$

Where
U1= Utility equation for safe crossing; G_Size-vehicular gap size;
PS-pedestrian speed; Rgap- rolling gap;

Table 4 Success and prediction table

Actual Values	**Predicted values**		**Total Actual**
	0	**1**	
0	191	5	196 (41.3%)
1	8	271	297 (58.7%)
	199 (41.9%)	276 (58.1%)	**475**
	Overall Prediction is 97.26 %		

Effect of Rolling Gap on Safe Crossing

Earlier studies have explained the gap acceptance behaviour of the pedestrian with their gender and age group. These studies have not attempted pedestrian safety while crossing the road. This study found that irrespective of their gender, age and pedestrian platoon they tend to behave quite differently with vehicular gap size, pedestrian speed and rolling gap effect. But it obviously shows that, as the gap size increases the probability of the safe crossing increases. Probability of safe crossing with and without rolling gap is shown in Figure 4.

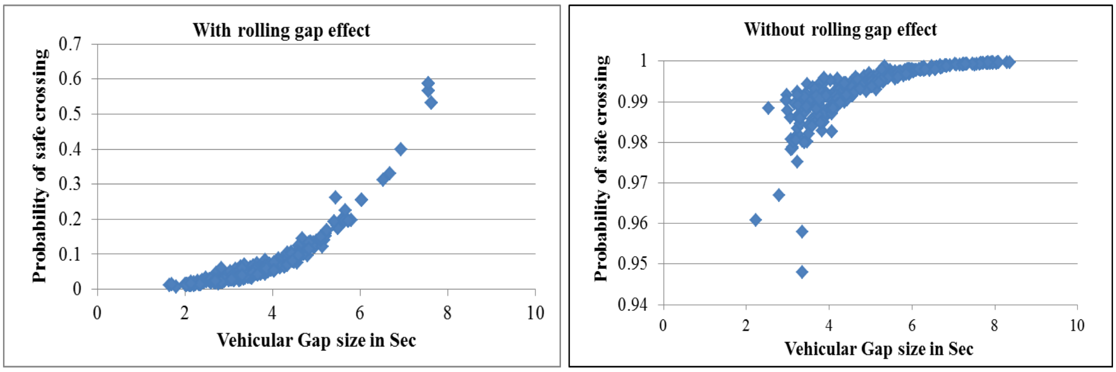

Figure 4(a) Figure 4(b)

Figure 4 Effect of rolling gap on probability of safe crossing

It shows that even if the available gap is less than the mean gap a few pedestrian tend to cross the road safely without rolling gap because of their increased crossing speed. In the case of with rolling gap, if the available gap is less than the mean gap pedestrian tend to cross the road unsafely. In this case it is very hard to predict the actual behaviour of pedestrians', because pedestrian may adjust their speed in each second. In Figure 4 (a) probability of safe crossing is considered with rolling gap and it illustrates that with increase of available gap size the probability of safe crossing increases. Figure 4 (b) indicates that, without using rolling gap the probability of safe crossing is 0.96 even if minimum accepted gap is 2.6 sec. It shows that when a pedestrian increases their speed then they may cross the road safely. In fact, from the real scenario during field survey it was observed that many pedestrians cross the road regardless of the gap size, gap type (far or near), baggage effect by adjusting their speeds with available gap sizes. It indicates that they may accept the minimum gaps or maximum gaps with rolling gap. If they are choosing minimum gaps with rolling gap, such pedestrians are classified as potentially dangerous.

Effect of Pedestrian speed on Safe Crossing

The effect of pedestrian speed while crossing the road on probability of safe crossing indicates that even if available gap size is less, increase in speed increases safe crossing. It also suggests that they accept small gaps. However, if the pedestrians do not increase speed, then the probability of safe crossing may decrease with available gaps and also it upholds that they are using rolling gap in hazardous situation. The possible explanation for their increase in speed is the purpose of the trip and hurry with their needs. If pedestrians are increasing the speed regardless of their demographic characteristics they may even accept the small gap size with safe crossing.

CONCLUSIONS

This paper analyses the PSM at unmarked unprotected mid-block location under mixed traffic condition and eventually it indicates the probability of pedestrians' safe crossing behaviour at unmarked mid-block location. The main outcomes are factors correlated with PSM and associations of some significant factors. Eleven factors were considered in the initial model; out of these four are identified to be significant enough to be included into the regression model and three for the BLM. The result indicates that pedestrians' minimum PSM value while crossing the road depends on the vehicular gap size, pedestrian speed, age and rolling gap. Whereas, probability of safe crossing mainly depends on the gap size, rolling gap and pedestrian speed. It can also be concluded that PSM is dynamically associated with the pedestrian rolling gap condition and pedestrian speed.

It is also found that there is no significant effect of pedestrian demographic characteristics on PSM while they are using rolling gap. It is found that they perceived more crossing time and due to increase in crossing time it causes reducing their speeds and finally it leads to less hazard condition to the pedestrians'. Whereas some studies found that, males are usually observed as valiant than females. In general, pedestrian platoon size had positive effect on PSM. Leden (2002) found that pedestrians' risk decreased with increasing pedestrians platoon size. In spite of its overall positive effect, pedestrian platoon size had a negative effect on pedestrians' speed. Whereas present research found that pedestrians behave individually rather than the platoon at unprotected unmarked mid-block locations. Due to this rolling gap effect pedestrians behave more dynamically and their non-compliant behaviour also increase at these particular locations under mixed traffic condition and it results in unsafe crossing.

The outcomes this study recommends several applications, development of pedestrian warrants for mixed traffic conditions. Furthermore, this study result drawn major factors associated with PSM which useful for the training of both vehicular drivers and pedestrians. The regression model suggests the important variables to control the pedestrian safety. BLM model findings suggested that the crossing skills training and education for pedestrians is required to reduce the probability of safe crossing to attempt small vehicular gaps by rolling and it states that it needs to form platoon of pedestrian. The author brings more attention pedestrian usual behaviour in mixed traffic condition by attempting of pedestrian rolling gap gaps. This pedestrian rolling gap behaviour makes an attention of designer, planners and policy makers in mixed traffic condition in Indian context. Pedestrian making crossing at unmarked roadway, need to be paid attention on vehicular gaps and they should not show non-complaint behaviour by rolling gap. There is also a need to improve the driver behaviour at this type of location by giving proper signs, to make drivers to be alert before approaching severe conflict zones. The developed PSM models will be useful to identify the most hazardous situations and locations of road crossings and it is also useful to evaluate the pedestrian facilities under mixed traffic condition. The identified pedestrian road crossing behaviour parameters like rolling gap and speed change condition were the main contribution of this study in mixed traffic condition.

This study analysed PSM at unprotected mid-block location under mixed traffic condition. This study has some limitations, the age of pedestrian's was taken three major groups depends on the visual appearance. But the individual pedestrian age may improve the present model with consideration of the elderly people and children. The speed of the vehicle was consider within the length of video coverage section (40m) is limited, due to this the behaviour of vehicular drivers are not predicted. There is necessity to assess the driver behaviour with unprotected pedestrian road crossing. The findings of the current study were limited to two lane two-way road. Hence, the authors are presently working on the study of effect of pedestrian road crossing behaviour and safety evaluation for various typical roadway conditions usual Indian mixed traffic context.

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