# Mobile Phone Use at Un-signalized Mid-block Pedestrian Crossings in Sri Lanka



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# Mobile Phone Use at Un-signalized Mid-block Pedestrian Crossings in Sri Lanka

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**Abstract**: The number of mobile phone users in the world is recorded at 4.77 billion in 2017 resulting in the pedestrians' usage of mobile phones even while crossing the road. Data on pedestrian practices at un-signalized crossings in Sri Lanka were analyzed to find factors that contribute to distracted behaviors caused by mobile phone usage. The distracted crossing pedestrian behaviors were checked using four actions on the crossings with the mobile phone usage type. The percentage of mobile phone uses found on the midblock crossings was 7.45% and pedestrians using applications displayed the most unsafe behaviors with the lowest crossing speed of 1.08ms$^{-1}$. The crossing behaviors by mobile phone usage types was individually determined using the Chi-square tests. The results showed that pedestrians using mobile phones while crossing were more likely to avoid safe behaviors. Methods to improve the pedestrian's crossing safety have also been proposed.

*Keywords*: mobile phone distraction; crossing behavior; pedestrian

## 1. INTRODUCTION

Mobile phone distraction has been a significant reason for motor vehicle- pedestrian crashes around the world. In the United State of America (USA), 60,000 pedestrians are injured and 4,000 killed per year due to motor vehicle- pedestrian crashes (Solah et al., 2016). Among them, more than 1,500 pedestrian injuries were recorded per year as a result of mobile phone distraction. Mobile phones are identified to distract vehicle drivers and there are bans in place when it comes to the usage of mobile phones while driving in Sri Lanka. But the problem of distracted pedestrians due to mobile technology is comparatively new a one. In Sri Lanka during the year 2011, the most road injuries and fatalities were recorded from the pedestrian category which was a percentage of 36% (Bhalla et al., 2011). Most of these crashes involving pedestrians are likely to happen when the pedestrian is crossing the road and most of them seem to happen from the distraction. A study done by Thompson et al. (2013) revealed that a total of 29.8% of pedestrians were using mobile phones while crossing the street and 7.3% were texting while crossing the street in the USA. And those who were texting showed the most distracted behavior with the lowest crossing time. A study done in Taiwan showed 8.4% of pedestrians who were in text messaging failed to look both ways before crossing the street (Chen et al., 2016). Walker et al. (2012) found that pedestrians who were using personal music devices while crossing increased or held a constant level of cautionary behavior and mobile phones reduces the cautionary behavior. When considering the behavior of pedestrians who used mobile phones while crossing the street can also be resulted in some unsafe

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behaviors which are largely gender specific (Hatfield and Murphy 2007). Mobile phone usage while crossing can reduce situation awareness, increases unsafe behavior while putting pedestrians at bigger a risk for crashes (Nasar et al. 2008).

The price of a mobile phone grows cheap every day, and this has resulted in excessive mobile phone purchase in developing countries (The Economist, 2014). This has resulted the number of mobile phone users as same as the number of country's population. A median of 84% people out of the total population was entitled to mobile phone ownership in emerging and developing nations (Poushter et al., 2015). As of 2017, it was recorded that there are more mobile phones than the total population of the world (GSMA, 2017). The high count of mobile phones has led into an increased use of mobile phones by pedestrians while crossing the street. Mobile phone subscribers in Sri Lanka have increased and in 2012, subscribers surpassed the population (Piyawadani, 2016). With the increase of mobile phone devices, the number of people using a mobile phone device while crossing the street has also increased. With this increasing number of pedestrians who use mobile phones in everyday traffic activities suffer from different problems which are highly related to the usage of mobile devices as the use of mobile phones has led into physical and visual distracting behavior among pedestrians. The distraction causes the pedestrians to lose their attention while being on the road. This has become a more difficult issue in the modern world, because pedestrian pay more attention to using mobile phones to chat, text, handle applications, listen to music, and play games.

There are many types of distractions that can occur when using mobile phones while crossing the street (Hatfield and Murphy 2007). Cognitive distraction can occur when pedestrians are not focused on the act of crossing. Physical distraction can occur when the pedestrian is holding a phone in one's hand because it is likely to interfere with walking. Visual distraction can occur when the pedestrians take of their eyes off the road to look at the phone to dial or text a message. Finally, the auditory distraction occurs when the pedestrian use earphones while crossing the street. These distractions due to mobile phones has become a global matter in road safety. The life of a human being is invaluable and the mobile phone usage while crossing has put it into a threat since vehicle-pedestrian crashes cause a large amount of fatalities around the world. Therefore, this research on unsafe mobile phone usage methods stands out as it helps to identify probably causes for pedestrian crashes in developing countries and ways to minimize them. As per the authors' knowledge, no such research has been conducted in Sri Lanka addressing the problem of mobile phone usage of pedestrians while walking in a marked crossing at the street. A marked crossing is a place designated for pedestrians to cross a road keeping pedestrians together where they can be seen by motorists, and where they can cross safely across the flow of vehicular traffic. It has the alternating dark and light strips on the road surface. In Sri Lanka, the light strips are painted in Wight colour and rest is left unpainted as the surface is dark. Zigsag lines and no-parking lines are painted in the run up to the crossing to warn the vehicular traffic of an approaching pedestrian crossings (Mallawaarachchi and Amarasingha, 2017).

The aim of this research was to determine the percentage of pedestrian mobile phone use at mid-block un-signalized pedestrian crossings in Colombo, Sri Lanka and to determine the influence of mobile phone use on pedestrian crossings. The study also focused on comparing crossing speeds of pedestrians when they distract due to mobile phone and investigating how the use of mobile phones such as holding hand, talking, texting, and listening to music affects the behavior of pedestrians while they are crossing the street and to compare the crossing speed of pedestrians. This study helps to understand the mobile phone use pattern among the street crossing pedestrian in a South Asian country where mixed-traffic are on the streets.

## 2. LITERATURE REVIEW

Earlier studies have provided significant facts about how mobile phones affect the pedestrians crossing behavior at both marked and unmarked crossings. These studies gain a better understanding on the effects of mobile phone use on pedestrian crossing behavior at midblock pedestrian crossings. Nasar et al. (2008) done a research to determine the distraction of pedestrians associated with mobile phone use. This was done by conducting two studies. The first was about distracted attention and the second was about pedestrian street-crossing behavior. Sixty pedestrians were interviewed with a half walking a prescribed route having a conversation on a mobile phone and with the other half simply holding the mobile phone waiting for a potential call. It was found that pedestrians noticed significantly more objects in the 'no conversation' condition than in the 'conversation' condition. The conclusion was that mobile phone users crossed unsafely into upcoming traffic significantly more than other groups.

An observational study on pedestrian behavior at twenty chosen intersections with the highest number of pedestrian injuries that happened during the prior three years was conducted by Thompson et al. (2013). Distractions included listening to music (11.2%), text messaging (7.3%) and using handheld phones (6.2%). The crossing time for texting and talking with companions was higher compared to that of undistracted pedestrians and crossing time for pedestrians listening to music was lower compared to undistracted pedestrians. Pedestrians who were texting were significantly more likely to display unsafe crossing behavior and pedestrians listening to music and text messaging failed to look both ways. Akash et al. (2014) studied the crossing behavior of pedestrians at uncontrolled intersections. More pedestrians crossed the road in a perpendicular direction and the average crossing speed at different locations were varied with respect to various pedestrians' characteristics. Finally, the pedestrian crossing behavior analysis was used to identify the important factors for deciding the assurance of pedestrian safety.

Chen et al. (2016) investigated the effects of mobile phone use on pedestrian street-crossing behaviors by evaluating whether they saw and heard an unusual object (i.e. a clown) nearby. About 8.4% of participants who engaged in text messaging did not look both ways before crossing and took the longest time to cross the street, the least likely to see the clown and were the most disobedient. Those listening to music were the least likely to hear the horn from the clown, and were the fastest to cross the street. Furthermore, female participants were most likely to perform all unsafe crossing practices. The study also contributed to the safety-research community by concluding that phone screens five inches or larger or unlimited Internet access were associated with the unsafe crossing behaviors. Solah et al. (2016) determined the magnitude of the mobile phone distraction among the pedestrians in Malaysia. As a result, females tended to cross the road faster than the males. It was also revealed that the "handheld" and "application usage" were significantly affecting the walk of pedestrians while crossing the road. The researchers recommended that relevant parties should look into growing issues among the road users and provide the necessary countermeasures.

Hatfield and Murphy (2007) focused on pedestrian's behavior and specifically on the involvement of mobile phone use. Results showed that one-third of participants were using mobile phones and female pedestrians displayed more cautious behavior than males. Furthermore, no observed crossing behavior was influenced by whether a phone was held in the hand, but text messaging involved in a far greater visual distraction. Pedestrian safety may be improved via campaigns that highlight the danger of communication with a mobile while crossing, and that identify techniques for avoiding the behavior. Pešic et al (2016) determined the percentage of pedestrians' mobile phone use at un-signalized intersections and then determined the effect of mobile phone use on pedestrian crossing behavior and the unsafe pedestrian behavior. The pedestrians who were talking on mobile phones and did texting while crossing the street had better chances to behave unsafely. Listening to music did not affect the crossing behavior. Furthermore, this study took all these aspects into account, considering the effect of a number of factors the researchers developed models for forecasting the unsafe behavior of pedestrians.

Solah et al. (2017) done an observation survey to determine the characteristics of pedestrians crossing under five categories: driver factors, pedestrian factors; vehicle factors, roadway/environmental factors, and demographic/social/policy factors. During the observation period, it was revealed that 84.8% pedestrians were distracted with mobile phone usage. And the use of mobile phone among males was higher as compared to that of females. The study recommended the development of proper countermeasures to improve the traffic safety problems caused by the distracted crossing.

## 3. METHOD

This study was conducted in randomly selected three un-signalized pedestrian crossings which are located in Malabe, Kaduwela, and Nugegoda towns in the city of Colombo, Sri Lanka. All these crossings were un-signalized with sufficient pedestrian and vehicle movement. At each crossing, there was a total of four lanes with two lanes on each direction and the effective width of each road was uniform throughout the length considered. The sample size was calculated to be 1,291 so the minimum number of pedestrians for each crossing was selected as 1,300. The data were collected using both direct observations and video recordings during July 2017. The type of mobile phone usage was collected using the direct observational method because it can be readily seen, and the behavioral data were collected using the videos because that needed to be carefully observed. When using video observational method, the camera was fixed in an elevated position to obtain an overall view of the selected crossing locations. The recording was done for an hour at a time during a peak period on a working day and this was repeated four times at each crossing. The recorded videos were used to extract data.

First, the type of mobile phone usage was determined whether it was handheld, on call, text messaging/ application usage, or listening to music. Secondly, the demographic data which were age and gender of each mobile phone user were recorded. Finally, the crossing behavior of each pedestrian who used mobile phones while crossing the street was recorded. The recorded pedestrian behaviors at crossings were, whether the pedestrians looked left and right before crossing, waited for traffic to stop before crossing, looked at the road while crossing, and whether pedestrian used the marked crossing. The average crossing speeds for different mobile phone usage type were determined and tabulated. The association between the different mobile phone usage types by gender and age and the association between the pedestrian crossing behavior by mobile phone usage type, gender, and age category were examined using the Chi-square test. The Chi-square test is a statistical test used to observe differences of categorical variables (Wilson and Joye, 2016). The frequency of one categorical variable is compared with different groups of other categorical variables. The null hypothesis in the Chi-square test can be stated in words as, the distribution of the outcome is independent of the groups. The alternative hypothesis is that there is a difference in the distribution of frequencies to the outcome variable among the comparison groups.

## 4. RESULTS

After data collection, the results are categorized in to three types, namely mobile phone usage type, demographic data, and behavioral data. For each category, the percentages were calculated and the comparisons between each variable were done using Chi-square tests.

### 4.1. Mobile Phone Users

The total number of pedestrians observed at Malabe, Kaduwela, and Nugegoda was 2,104, 2,623, and 1,662 respectively and the number of mobile phone users found while crossing the street were 146 (6.94%), 130 (4.96%) and 173 (9.43%) respectively. An average mobile phone uses found on the midblock crossings was 7.45%. The results were further categorized into four mobile phone usage types. At all three crossings, the most frequent mobile phone usage type was recorded as handheld mode and the least frequent was recorded in listening to music mode as shown in Table 1.

Table 1: Mobile phone types

| Crossing location | Phone use type | Observations | |
|---|---|---|---|
| | | Number | Percentage |
| Malabe | Handheld | 64 | 3.04 |
| | On call | 30 | 1.43 |
| | Massaging/ Application usage | 30 | 1.43 |
| | Listening to music | 22 | 1.05 |
| | Non-mobile phone users | 1958 | 93.06 |
| Kaduwela | Handheld | 80 | 3.05 |
| | On call | 22 | 0.84 |
| | Massaging/ Application usage | 23 | 0.88 |
| | Listening to music | 5 | 0.19 |
| | Non-mobile phone users | 2466 | 94.01 |
| Nugegoda | Handheld | 126 | 6.87 |
| | On call | 25 | 1.36 |
| | Massaging/ Application usage | 12 | 0.65 |
| | Listening to music | 10 | 0.54 |
| | Non-mobile phone users | 1662 | 90.57 |

### 4.2 Mobile Phone Usage Types by Gender and Age.

Table 2 shows the numbers and percentages of male and female mobile phone users while crossing the street.

Table 2. Mobile phone users by gender

| Gender | Malabe | | Kaduwela | | Nugegoda | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Male | 84 | 57.5 | 57 | 43.8 | 92 | 53.2 |
| Female | 62 | 42.5 | 73 | 56.2 | 81 | 46.8 |

The age was categorized as young (approximately age less than 30 years) and elder (approximately age more than 30 years) by visual observation. For all three crossings, young pedestrians were more likely to use more mobile phones than elder pedestrians. According to the collected data, none of the elder pedestrians has listened to music while crossing the street.

The differences of mobile phone usage type and gender/age of the pedestrians who were using mobile phones while crossing the street were investigated using the Chi-square test as shown in Table 3.

Table 3. Mobile phone user types by age and gender

| Gender | Phone-use type | Male | Female | Total | $X^2$ | p |
|---|---|---|---|---|---|---|
| | Handheld | 119 | 151 | 270 | 14.358 | **0.0002*** |
| | On call | 49 | 28 | 77 | 5.643 | **0.0177*** |
| | Texting/application usage | 40 | 24 | 64 | 3.723 | 0.0537 |
| | Listening to music | 22 | 15 | 37 | 1.278 | 0.2583 |
| Age | Phone-use type | Young | Old | Total | | p |
| | Handheld | 207 | 63 | 270 | 5.561 | **0.0184*** |
| | On call | 63 | 14 | 77 | 0.211 | 0.6462 |
| | Texting/application usage | 51 | 13 | 64 | 0.002 | 0.9616 |
| | Listening to music | 37 | 0 | 37 | - | - |

* Significant at 95% of confidence level; Null hypnosis of significant differences between groups is accepted.

Holding mobile phones while crossing the street showed significant differences between males and females and between elder pedestrians and young pedestrians. Males were more likely to hold mobile phones while crossing the street than females. Also, young pedestrians while crossing street were holding mobile phones than elder pedestrians. Also, males were more likely to use mobile phone on call mode while crossing the street than females. It was also noted that elder pedestrians who were listening to music while crossing the street were not observed.

### 4.3 Crossing Behaviors among Different Types of Mobile Phone Users

When considering all three crossings, the crossing behavior of pedestrians who used mobile phones while crossing is shown in Table 4. In the "Yes" represents the safe pedestrians and "No" represents the unsafe pedestrians' behavior due to mobile phones distractions. In the handheld mode, 13% of pedestrians out of pedestrians who were holding the mobile phones failed to look at traffic while crossing and the same percentage of pedestrians failed to use the marked crossing. In, on call mode about 28.6% of users failed look at traffic before they enter the street. The most unsafe behavior was recorded on the text messaging and applications usage pedestrian. About 66.2% of text messaging and application usage pedestrians did not look at the road while they are crossing the street and 41.5% failed to look at the road before crossing the street. When considering the pedestrians who listened to music while crossing the street 29.7% of pedestrians failed to look left and right before crossing the street.

According to the Chi-square values obtained as shown in Table 4, there were significant differences between the pedestrian crossing behaviors of "looking both direction before crossing" and each mobile phone usage type. Pedestrians who use mobile phones while crossings were more likely to fail for looking at left and right before crossing and they were more likely to fail for looking at left and right while crossings.

Table 4. Behavior of pedestrians who use mobile phones while crossings the street by phone-use types

| Phone-use type | Look left and right before crossing | | | Chi-square test | |
|---|---|---|---|---|---|
| | No (%) | Yes (%) | Total | $X^2$ | *p* |
| Handheld | 14 (5.2%) | 256 (94.8%) | 270 | 5.377 | **0.0204*** |
| On call | 22 (28.6%) | 55 (71.4%) | 77 | 35.183 | <**0.0001*** |
| Texting/application usage | 27 (41.5%) | 38 (58.55%) | 65 | 82.528 | <**0.0001*** |
| Listening to music | 11 (29.7%) | 26 (70.3%) | 37 | 18.869 | <**0.0001*** |
| **Phone-use type** | **Wait for traffic to stop before crossing** | | | **Chi-square test** | |
| | No (%) | Yes (%) | Total | $X^2$ | *p* |
| Handheld | 26 (9.6%) | 244 (90.4%) | 270 | 0.096 | 0.7563 |
| On call | 16 (26.2%) | 61 (79.2%) | 77 | 12.856 | **0.0003*** |
| Texting/application usage | 20 (30.8%) | 45 (69.2%) | 65 | 23.093 | <**0.0001*** |
| Listening to music | 9 (24.3%) | 28 (75.7%) | 37 | 10.431 | **0.0012*** |
| **Phone-use type** | **Look at traffic while crossing** | | | **Chi-square test** | |
| | No (%) | Yes (%) | Total | $X^2$ | *p* |
| Handheld | 35 (13.0%) | 235 (87.0%) | 270 | 14.248 | **0.0001*** |
| On call | 20 (26.0%) | 57 (74.0%) | 77 | 41.465 | <**0.0001*** |
| Texting/application usage | 43 (66.2%) | 22 (33.8%) | 65 | 343.581 | <**0.0001*** |
| Listening to music | 6 (16.2%) | 31 (83.8%) | 37 | 4.587 | **0.0322*** |
| **Phone-use type** | **Use the marked crossing** | | | **Chi-square test** | |
| | No (%) | Yes (%) | Total | $X^2$ | *p* |
| Handheld | 35 (13.0%) | 235 (87.0%) | 270 | 1.032 | 0.3097 |
| On call | 15 (19.5%) | 62 (80.5%) | 77 | 1.147 | 0.2842 |
| Texting/application usage | 5 (7.7%) | 58 (92.3%) | 65 | 2.830 | 0.0925 |
| Listening to music | 2 (5.4%) | 35 (94.6%) | 37 | 2.741 | 0.0978 |

* Significant at 95% of confidence level; Null hypnosis of significant differences between groups is accepted.

When considering the pedestrian crossing behavior of "waited for traffic to stop before crossing", significant differences were found when the mobile phone type was on call, text messaging/application, or listing to music. In these mobile use types, pedestrians were more likely to fail for waiting for traffic to stop before crossing. Considering the crossing behavior of "use the marked crossing", it was determined that there were no significant differences between that behaviors and any of mobile phone usage type.

### 4.4 Crossing Speed of Pedestrians

The average crossing speeds of on call, listing to music, hand held, messaging/application use were compared using ANOVA test. The p-values for all the crossings were less than 0.05 showing the significance differences in different type of mobile phone use. Figure 1 shows the average crossing speed of different type of mobile phone users and non-mobile phone users on the un-signalized crossings. The crossing speed of pedestrians who used mobile phones were compared with that of pedestrians who did not use mobile phones while crossing. From the obtained results the average crossing speed of non-mobile phone users was found to be $1.17ms^{-1}$ for all three crossings combined.

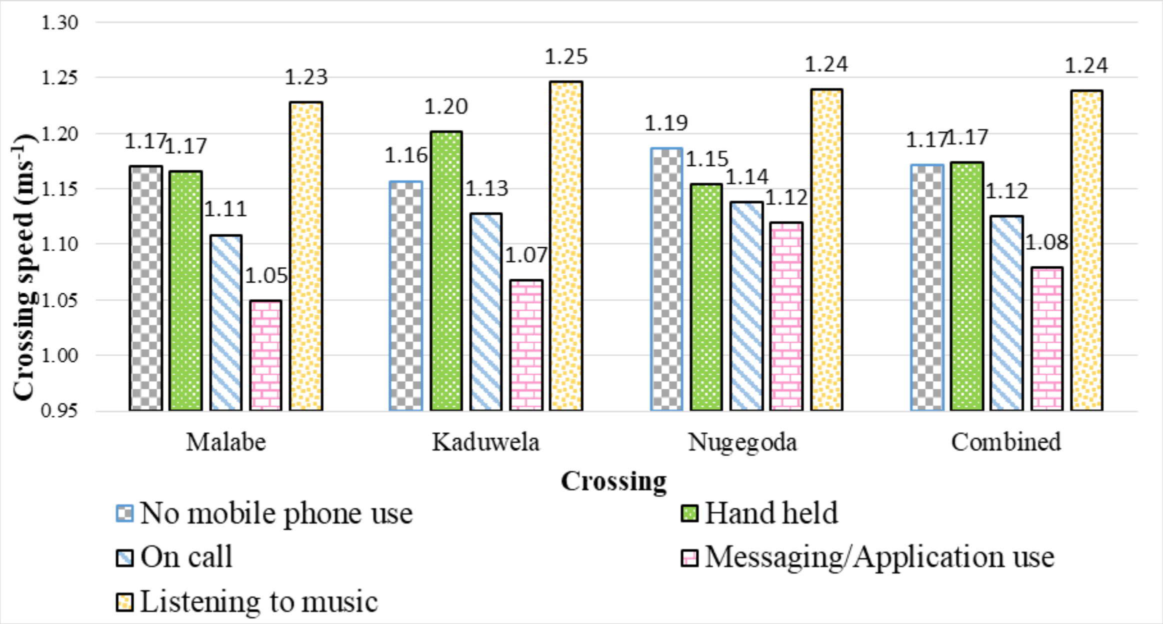


Figure 1: Crossing Speed of Pedestrians

At all three crossings, the lowest pedestrian crossing speed was found in the text messaging/application usage which was $1.08ms^{-1}$. The crossing speed of handheld mode was similar to crossing speed of non-mobile phone users. Pedestrian who were talking on mobile phones or who were on text messaging/applications while crossing had a slower crossing speed than non-mobile phone users. Listening to music showed the highest crossing speed from all pedestrian types in all three crossing.

## 5. CONCLUSIONS AND RECOMMENDATIONS

In this research, the crossing behaviors of pedestrian at un-signalized crossings situated in Colombo were investigated in order to find the factors that contribute to distracted behavior caused by mobile phone usage. Video surveillance was obtained at each crossing location for a period of one hour on four days during the month of July, 2017. Based on the results of this study, the percentage of mobile phone uses found in Malabe, Kaduwela and Nugegoda were 6.94%, 5.99%, and 9.43% respectively. The results obtained from the type of mobile phone usage showed that most used mobile usage type was handheld mode and lowest usage type was listening to music. Out of all mobile phone usage types, texting and applications usage showed the most unsafe behavior before and while crossing the street. When considering crossing speeds, texting and applications users had the lowest crossing speed of $1.08ms^{-1}$ and listening to music users had the highest crossing speed of $1.24ms^{-1}$.

When considering the significant differences of mobile phone usage by gender, males were more likely to holding the mobile phones while crossing the streets than females. Also, males were more likely to talk on mobile phones whole crossing the street. The young people were more likely to hold mobile phones while crossing the street that elder people. More than 66% of pedestrians in texting and applications failed to look at the road while they were crossing the street and more than 41% of them failed to look at the road before crossing the street. Finally, the significant values of behavior by mobile phone usage type were determined using the Chi-square test and the results showed mobile phone users were on risky behaviors, irrespective of the type of use. They were more likely to fail for looking both directions before crossing and be aware of traffic while crossing than others. However, the Chi-square test may be too simple and other statistical analysis models such as logistic regression or multiple linear regression would be given more comprehensive results. Research is extended to develop models collective more data.

With the obtained results from this research it was evident that more than 66% of pedestrians who were engaged in texting and application usage displayed unsafe behavior while crossing. Furthermore, other mobile phone usage types also displayed unsafe behaviors to a certain level while crossing the street. Therefore, mobile phone usage may lead to pedestrian crashes while crossing the road. To reduce the crashes of pedestrians while crossing the road there were infrastructure related countermeasures that can be taken; such as introduction of roundabouts, speed bumps, pedestrian refuge islands, multilane stop signs, and in-pavement flashing lights. Examples of pedestrian and vehicular traffic flow related countermeasures include reduced speed limits, leading pedestrian intervals, exclusive pedestrian phases, adequate traffic signal timing and pedestrian prompting devices. Sri Lanka has already banned the mobile phone use while driving to reduce road crashes due to use of mobile phones. But with the increase of mobile phones, the number of pedestrians who use mobile phones while crossing the street is getting higher. This will lead to more road crashes even if divers obeyed the law. Therefore, it is recommended that all countries should introduce a law making it illegal for pedestrians to "cross a street while using a mobile electronic device."

These would, however, be of no value if pedestrians are not attentive to these measures and the risks they are aimed at avoiding. To avoid that situation, there can be advices given through education campaigns to pedestrians while crossing the street. These may be but not limited to pedestrians should always be alert and watch for traffic while crossing; pedestrians and especially young pedestrians should limit cell phone use while crossing streets; pedestrians should not walk and talk or text on mobile devices while crossing; and pedestrians should be fully aware of their surroundings and not let music take attention away from the sound of oncoming vehicles, hooting or sirens. The enforcement should be strengthen forcing pedestrians to prohibiting the mobile phone use while crossing the streets. Also, it would be better to policy makers to consider signalized crossings which could enhance the safe system.

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