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An Assessment of Pedestrian Non-compliance Behavior along Urban Roads: Case Study of Kathmandu

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Abstract:
Safety behaviors (also known as safety-seeking behaviors) are coping behaviors used to reduce anxiety and fear when the user feels threatened. Pedestrians are at risk on the road due to their behavior. The pedestrian safety behavior needs to be assessed to formulate the appropriate safety management in urban roads. This study is aimed at the identification of pedestrian non-compliances of safety practices while walking along the urban roads. As the case study, three urban mid-block road-sections were selected to observe pedestrian walking behavior. A video survey was carried out to observe pedestrian movement while traveling along those roads. The extracted data from the video was used to sort out pedestrian non-compliance behavior while walking along and crossing the road sections. The result shows that the non-compliance behavior practiced by the pedestrians is mainly for crossing the road away from designated crosswalk. The study recommends that the spacing of crosswalk markings and visibility shall be established based on the pedestrian flow rate and the distance between sequential intersections.

Key Word: *pedestrian behaviour, pedestrian non-compliance, urban roads, crosswalk, sidewalk*

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I. Introduction

The term pedestrian is referred to as the person who is traveling by walking for at least part of his/her journey such as running, jogging, hiking, or when sitting or lying down in the roadway. A person using modification aids for walking such as wheelchairs, walkers, canes, skateboards, etc. is also considered as pedestrian [6]. Therefore, pedestrians are vulnerable road users due to their exposure on a higher level during their interaction with heavy or fast motorized vehicles [5]. Safety behaviors are coping behaviors used to reduce anxiety and fear when the user feels threatened. It is also known as safety-seeking behaviors. In Kathmandu valley, about 40% of journeys are made on foot [6].

In many countries, crashes involving pedestrians are poorly reported in official road traffic injury statics. The actual number of pedestrian fatalities and injuries is probably higher than what the official statistics show. The pedestrian's death accounts for 22% out of global road death. Lack of pedestrian facilities and land use planning is one of the risk factors for pedestrian traffic injury [15].

In the Asia Pacific region, one person is killed on road in every 40 seconds, which counts more than 2000 lives a day and more than 15000 lives in a week. Pedestrians, cyclists, and motorcyclists are more vulnerable in this region. Vulnerable road users (VRU) account for more than half (55%) of total deaths in this region [15].

Rapid urbanization in developing countries presents tremendous challenges to the transport systems of expanding cities if they are to meet the access and mobility needs of their communities and provide them with a sustainable, safe and healthy environment. To meet this expansion, many developing cities are increasing the capacity of their road networks, but often at the expense of the safety of the vulnerable road users. As a result, many people die and are injured unnecessarily in road crashes with the consequential social economic and health burdens imposing heavy constraints on sustainable development [4].

The pedestrian behavior under mixed traffic conditions especially in Kathmandu is comparatively different from that of other countries. In developed countries, traffic and pedestrian movements are controlled based on certain priorities, whereas in Kathmandu rules of priority are not fully respected. Even though proper control measures like sidewalk, crosswalk are provided at urban roads, pedestrians tentatively decline to use the sidewalk and avoid using crossing locations which affect the pedestrian as well as the traffic stream characteristics adversely. Many opt for danger during the crossing in a busy road despite the presence of nearby crossing facilities.

As per the traffic police record, 16388 pedestrians were caught who violated the rules in the first two weeks of June, 2019. Very often, pedestrians choose the shortest and direct path to reach their destination by

crossing the roads. Similarly, approximately 23% of victims of fatal crash cases are pedestrian in Kathmandu [19].

The objective of this study is to assess pedestrian non-compliance behavior on selected urban roads.

II. Literature Review

2.1 General

Reduction or elimination of the risk faced by pedestrians is an important and achievable policy goal. Pedestrian collision, like other road traffic crashes, should not be accepted as inevitable because they are, in fact, both predictable and preventable. Pedestrian safety measures improve walking environments and contribute to urban renewal, local economic growth, social cohesion, etc.

One of the key principles of the safe system approach is the recognition of human errors in the transport system. People will make mistakes in traffic that can easily lead to injuries and death. The safe system approach does not ignore road user behavior interventions but the emphasis that behavior is just one of many necessary elements to promote safety on road [15].

High numbers of pedestrians are killed and injured each year in urban areas, with about half being considered responsible for the crash. Observations of pedestrian behavior show widespread non-compliance with legal requirements, which are difficult to enforce any case. The research states that there is no information available on the level of crash risk associated with illegal pedestrian behaviors. Pedestrian crashes account for around 15% of fatalities each year in Queensland and about 8% of hospitalized casualties [9]. The number of pedestrian victims is significant among the total number of deaths in Kathmandu.

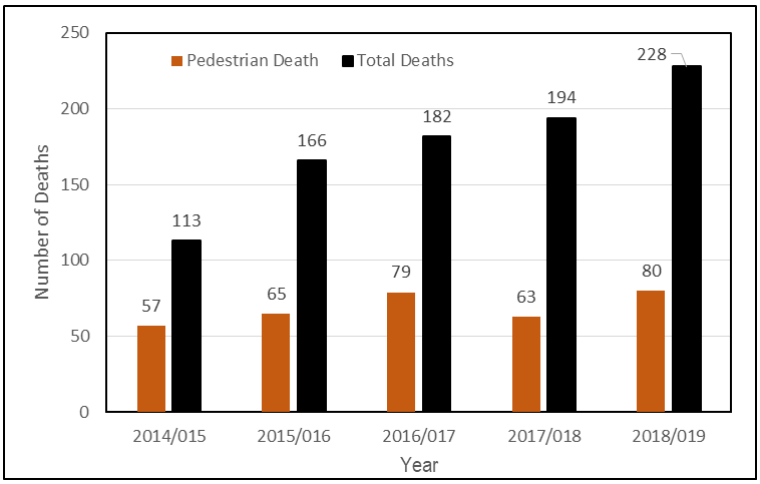

Figure 1: Number of Pedestrian death cases of road crash in Kathmandu (source: Traffic Police Record, 2019)

2.2 Pedestrian behavior

The study about safety regarding pedestrians has been found from the period of 1950s from the United States of America. Empirical results by Varhelyi, 1998 indicated that drivers' willingness to give the right of way to pedestrians at pedestrian crossing is low. Furthermore, drivers did not sufficiently lower their speed to maintain a readiness to react to and unexpected dangerous situation. Moreover, drivers were willing to slow or stop when the speed of their vehicle was low. The study reported that; three out of four drivers maintain the same speed and only one out of four slow down at crossing. The study concluded that drivers have to be influenced before they reached the decision zone (40-50 m before the pedestrian crossing) to prevent risky behavior[3].

Similarly, a study carried out in Italy, Rome analyzes the driver behavior during interaction with a pedestrian crossing into and outside the zebra crossing. Forty-two participants experienced different conditions of driver's pedestrian interactions (no pedestrian, legal and illegal-crossing). The driver behavior was plotted in the last 150 m in advance to the collision point. The result showed that more critical drivers' behavior was revealed for illegal crossings, for which the driver adopted an abrupt yielding maneuver compared to the legal crossing situation. Moreover, a higher accident rate was recorded when drivers interact with jaywalkers. This study reveals that adequate pedestrian paths should be planned to avoid jaywalker conditions and pedestrian detection systems could significantly help drivers in the condition of illegal pedestrian crossing behavior [1].

One of the first studies that focus on legal and illegal mid-block crossings was conducted in Fushun, China. A questionnaire was to determine how to reduce mid-block crossings and evaluate non-compliance with pedestrian overpasses. The question considered trip characteristics, crossing location, demographics,

pedestrian's attitude on the distance to pedestrian crossing infrastructures, attitude on safety of infrastructures, incentives to use pedestrian overpasses and underpasses, attitude on vehicle aggressiveness, attitude on traffic rules, enforcement, attitude on convenience and sensitivity to vehicle volume, attitudes on traffic safety islands, attitude on traffic cameras, attitudes on fines and the use of 1 m high barriers. The results showed that pedestrians are disadvantaged due to: traffic signals that are not calibrated for a reasonable walking speed, right-turning vehicles at intersections that do not stop before turning, relaxed enforcement on aggressive drivers, and long walking distance to an overpass. The authors supported appropriate pedestrian infrastructure to avoid accidents and conflicts potential that come with future traffic demand levels. Survey respondents supported better enforcement on aggressive drivers towards pedestrians' spaces as well as enforcement on pedestrians who invade drivers' spaces as a way to increase safety [14].

A study in Florida asked participants to state their crossing preferences at different locations along different blocks in an urban environment after observing traffic conditions for three minutes. The participants had two options for crossing at signalized intersections and four options for crossing at mid blocks locations. Based on the choice model from the experimental data, roadside walking distance, crossing distance, pedestrians starting at mid-block locations and ending at an intersection, crosswalk markings, the width of near side shoulder/bike lane, width of far side shoulder/bike lane, traffic signals, pedestrian signals, and traffic volumes were important factors in estimating probabilities of crossing at mid blocks rather than intersections. Pedestrians are less likely to illegally cross when crossing distance, roadside walking environment, and traffic volume all increase [2].

Several studies have relied on surveys or interviews in China to evaluate pedestrian crossing behavior. After surveying over 400 pedestrians and presented them with a series of scenarios aimed at identifying their willingness to illegally cross if others are observed participating in that behavior. Controlling for several demographic variables, they found that other's behavior significantly influences their crossing behavior [18].

It was reported that the reason for unsafe crossing was mainly time-related. A need to hurry or desire to keep moving was the main reason behind the lack of compliance with pedestrian signals. The major responsibility of providing physical facilities that encourage pedestrian travel and help protect pedestrians resides with traffic engineers. Such facilities include roadways, sidewalks, traffic control devices (TCDs), medians, etc. Pedestrian-friendly and safe environments involve separation of pedestrian and vehicle traffic, control of the flow of pedestrians, and pedestrians with special needs [13].

The research in Greece examined the pedestrian walking behavior and road safety about motorized traffic flow and administrative ranking in selected streets in the central area of Volos, a medium-sized city. The researcher used video recording for identifying pedestrian legal and illegal behavior. The study reveals that pedestrians walking behavior differs for various urban road types. Pedestrians with the highest rate of 91.8% of legal behavior were found in the main arterial and lowest rates of 53.7% in local streets [5].

To understand the pedestrian behavior in urban streets with mixed traffic conditions, a concept of level of service standards has been developed. Researchers have also explored the effect of pedestrian demographic as well as gap acceptance criteria with pedestrian road crossing behavior [10].

Pedestrian non-compliance increases with relative detour and delay. Delays exceeding 40 seconds at signalized crosswalks and 20 seconds at un-signalized or yield-controlled crosswalks may cause risk-taking behavior. Count down signals and shorter cycle lengths can help to increase compliance, and may be paired with other strategies. Crosswalk spacing criteria should be determined according to the pedestrian network, built environment, and observed desire lines. In general, if it takes a person more than 3 minutes to walk to a crosswalk, wait to cross the street, and then resume his or her journey, he or she may decide to cross along a more direct, but unsafe or unprotected, route. While this behavior depends heavily on the speed and volume of motorists, it is imperative to understand crossing behaviors from a pedestrian's perspective [11].

2.3 Pedestrian Behavior Assessment

There are several research methods for the assessment of pedestrian behaviour. Some of these are mentioned below.

Questionnaire Analysis

The understanding of pedestrian behavior in urban areas may assist in the improved design and planning of the road and traffic environment and consequently to the improvement of pedestrian comfort and safety.

The descriptive analysis of the questionnaire revealed that most of the pedestrians have positive attitudes, preferences, and behaviors (e.g. risk-conscious and complaint); nevertheless, there is non-negligible proportion of pedestrians (around 20-35%) who have negative attitudes and willing to make dangerous actions (cross diagonally or at mid-block). A principal component analysis (PCA) result suggests that there are three dimensions of human factors of pedestrian behavior: the first two concern their risk perception and risk-taking

(one reflecting risky attitudes behavior and the other ne reflecting conservative attitudes and behaviors) and the third one concerns walking motivations [12].

Conjoint Analysis (CA)

Since the pedestrian group is heterogeneous, this research has been conducted to develop an unbiased methodology to evaluate the most vital attributes influencing to evade the sidewalk. This research exemplifies the effectiveness of conjoint analysis (CA) in evaluating the most influencing attributes. CA is a multivariate technique used to understand how respondents develop preferences for products or services. The result of CA interprets the relative importance of each selected attribute and mutually independent level for those attributes. Width of sidewalk, availability of obstacle, opposing pedestrian flow rate, length of safety handrails etc. are attributes for sidewalks.

Data were collected by using a self-administered questionnaire, which was developed based on a comprehensive literature review on pedestrians' sidewalk behavior studies and guidance from experts. The outcome from the conjoint analysis, reveals that the most contributory sidewalk condition to evade using is the availability of obstacles (37.1%) and followed by flow rate (35.9%). The range between the maximum and minimum utility values of these attributes is found to be the widest. It means pedestrians have a high potential to evade sidewalk usage when a higher number of obstacles available (more than 5 obstacles per 50 m stretch) and higher flow rate value (more than 20 ped/min/m). Also, the least touching sidewalk factor to evade using sidewalks is the safety (8.2%). The CA analysis was done using the SPSS tool [17].

Checklist Analysis

The study reveals that pedestrian road traffic accidents (RTAs) are responsible for a substantial number of injuries and deaths in Karachi. To better understand the situations facing pedestrians, selected Karachi's ten highest-risk locations for pedestrian RTAs were identified between December 1995 to January 1996 where 250 pedestrians were observed for each of the three activities- crossing the street, walking on the street, and walking on the sidewalk. The extent and effect of street and sidewalk encroachments were also observed. Result shows that total of 35% of the pedestrians crossing the street caused traffic to swerve to avoid them, pedestrians crossing one lane at a time were 2.9 times more likely to cause the traffic to swerve than pedestrians who crossed the whole street at once. Similarly, pedestrians crossing in a group were 1.8 times more likely to cause traffic to swerve compared to those crossing single. Whereas, 36% ran while crossing and were 1.8 times more likely to cause traffic to swerve than those who walked. An average of 77% of the sidewalk width was blocked by encroachments, which forced pedestrians to step on the road resulting in vehicles swerving. Illegally parked vehicles blocked an average of 33% of the street width. The author claims that pedestrians in Karachi indulge in risky behaviors. Encroachments on streets and sidewalks compound the problem [8].

Visual Analysis

The researchers examined six urban streets of various types in the city of Volos (a medium-sized Greek city, 130,000 inhabitants). The researchers examined six urban streets of various types in the city of Volos (a medium-sized Greek city, 130,000 inhabitants). The researchers were equipped with cameras, street maps, reflective jackets, etc. for their safety. The data was collected between 10:00 to 14:00 hours in a normal working day. This study supports that walking behavior differs for various road-specific route and reveal pedestrians' mobility and safety issues. This study supports that walking behavior differs for various road types. Pedestrians with the highest rate of legal behavior were presented in the main arterials (91.8%) and the lowest one in local street types. Pedestrians with the highest rate of legal behavior were presented in the main arterials (91.8%) and the lowest one in local streets (53.7%). Low level of motorized traffic flow in combination with maintenance and mobility problems in pedestrian infrastructure (53.7%). Low level of motorized traffic flow in combination with maintenance and mobility problems in pedestrian infrastructure incites pedestrians to walk in the street thus underestimating their safety issues [5].

Mathematical Model Analysis

The researcher used the 'Cox Proportional Hazards Model' to study the behavior of pedestrians and was calibrated. The significance variables have been selected based on the Likelihood Ratios and theory of Probability. The research was concluded with two sets of predictors. One suggests pedestrians are likely to accept higher risk and cease their waiting time (male pedestrians, pedestrians crossing in a group, pedestrians going to work and well-educated pedestrians) and another suggests lowering the risk and extending their waiting (older pedestrians, past involvement or witness in pedestrian accidents, access to private vehicles) at pedestrian crossings. Pedestrian oriented training classes along with enforcement by traffic law to the drivers on public vehicles and educational programs for pedestrians through mass media are recommended as policy implications [3].

III. Methodology

3.1 Study area

Three road sections in Kathmandu are taken as the study area which are shown in Figure 2. These road sections are deferent in cross sections with significant volume of pedestrian traffic. The specific parameters of these road sections are given in Table 1. Basic features of study road sections are as:

Table 1: Study road sections

S/N	Road sections	Length, m	Availability of Footpath railings	Availability of median	Number of traffic lanes
1	Shankardev to Putalisadak	380	Yes	No	Two
2	Newroad to Dharmapath	339	yes	No	Two
3	Newbaneshwor to Minbhawan	507	No	Yes	Main road four lane with service roads both sides

- Shankardev to Putalisadak: This urban road section is Central Business District (CBD). It is business area having retail shops along the entire length of the road. The parking and street vending stall are restricted along the sidewalk on both sides. Pedestrian crossing the traffic lanes is restricted by the construction of railings. Two traffic lanes have been separated by the center-line marking. The pedestrians are allowed for crossing only at the crosswalk.
- Newroad to Dharmapath: this road section has sidewalk on both sides. These are not provided with railings. The two-lane road has been separated by the center-line marking. Pedestrians have been allowed to cross at the crosswalk.
- Newbaneshwor to Minbhawan: The sidewalk is not provided with the railing. However, the four-lane main road and two service roads on both sides, which are separated by the raised medians. Pedestrian crossing is allowed at the intersection and designated crosswalks.

3.2 Data Collection

The self-recording video graphic survey was carried out for the study road sections. The survey was conducted between mid-March 2019 to mid-June 2019 on fair weather and normal working hours for three days. To capture pedestrian behavior in a wider area and for the ease, the road segment was further divided into sections and video recording was carried out for the divided sections. The observed data from different sections were summarized to represent specific road segment pedestrian behavior. Similarly, the data related to the sidewalk width, absence or presence of railings were also collected.

The self-recorded video survey was taken for vehicles and pedestrians during three times of the day (9:30 to 10:30, 13:00 to 14:00 & 17:00 to 18:00) for 3 days. Video observation was carried out splitting the road segment into different sections to capture a wide range of pedestrian behavior. The sidewalk width and the presence of railings were noted on both sides of the road sections. Pedestrian and traffic flow were counted from the video record. The data of the specific parameters have also been noted from the field observation.

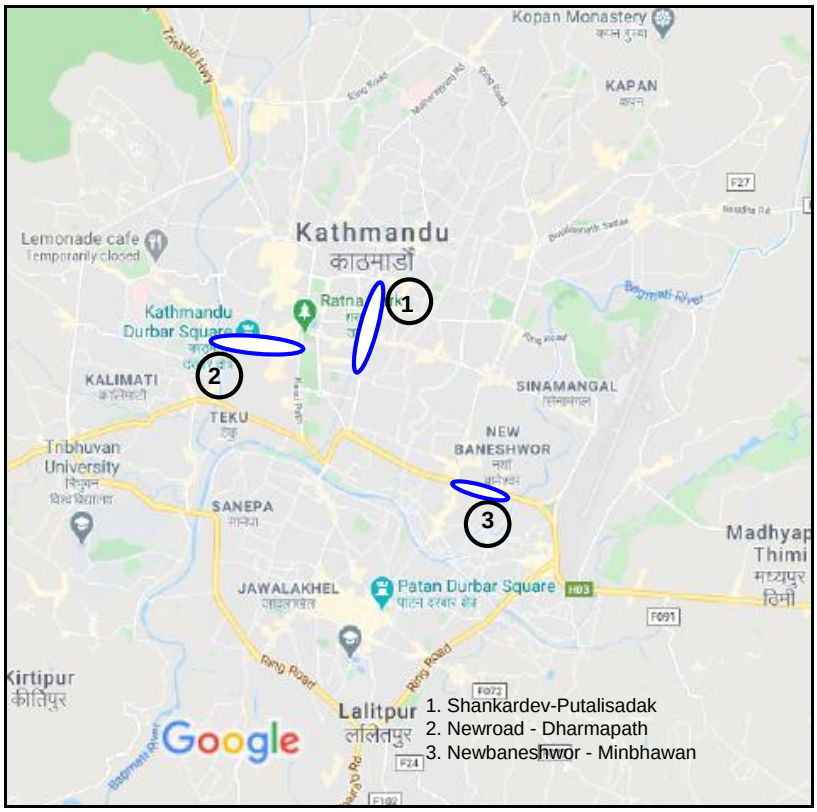

Figure 2: Study Road Sections

3.3 Data Analysis

The collected data (primary and secondary) was summarized in an excel spreadsheet. MS Excel & SPSS-23.0 was used for data entry and coding the extracted data from the video recording. Then, the data was analyzed as per requirement using SPSS-23.0.

The study was mainly divided into two parts, in the first part, the focus of the study of pedestrian non-compliance behavior while walking and crossing the different urban roads during different time of the day. Secondly, its correlation between the pedestrian volume, vehicular flow volume, time of the day, and the presence or absence of side railings.

IV. Results And Discussion

4.1 Pedestrian and vehicular flow

The three road sections have their specific side conditions for intensity of the pedestrian and traffic volume. Various types of vehicles have been converted into the Passenger Car Unit (PCU). The pedestrian and vehicular traffic volume was taken as the sum of both directions. The traffic and pedestrian traffic volume are shown in **Table 2**.

Table 2: Pedestrian and vehicular traffic flow along study road sections

Duration	Shankardev - Putalisadak		Newroad - Dharmapath		Newbaneshwor-Minbhawan	
	pedestrian Volume (ped/hour)	Traffic Volume (PCU/hour)	pedestrian Volume (ped/hour)	Traffic Volume (PCU/hour)	pedestrian Volume (ped/hour)	Traffic Volume (PCU/hour)
Morning (9:30 – 10:30)	2292	4477	3091	2111	1846	6239
Daytime (13:00 – 14:00)	3236	4400	4982	3591	1946	5337
Evening (17:00 - 18:00)	2167	4471	4368	2603	1914	5999

Shankardev – Putalisadak: Highest traffic volume observed in morning time and highest pedestrian volume is observed in day time at this section. This area is the traditional business/shopping center and there are not any shopping malls. Therefore, pedestrian flow is higher for shopping during the day-time for retail market visitors.

Newroad – Dharmpath is the central business district in Kathmandu. It has wide range of shopping opportunities starting from small retail shops to the supermarket. Due to the lack of parking in this area, people come to shopping on foot after parking their vehicle at the off-road parking lots or people come to this area from the nearest transit station on foot. Therefore, pedestrian volume is higher all the time of day than the traffic volume.
Newbaneshwor – Minbhawan road section is arterial urban corridor in Kathmandu. The road is four-lane main traffic lane and service roads are separated by the construction of raised medians on both sides. This area is famous for institutional setup and the business complexes. This road is one of the most-busiest roads in Kathmandu.

4.2 Pedestrian non-compliance behaviour

After the analyzing the pedestrian waking behaviour, it has been noted that pedestrians do not comply with the common movement path while traveling along the urban roads. Further, pedestrian non-compliances have been categorized into two types as: (a) pedestrian not waking on the sidewalk i.e. walking on the carriageway, and (b) pedestrian crossing the road elsewhere but not at the designated crosswalks.
Pedestrian non-compliances for study road sections during different time of the day are shown in **Table 3**.

Table 3: Pedestrian non-compliance

Pedestrian behaviour (Non-compliances)	Shankardev - Putalisadak			Newroad - Dharmapath			Newbaneshwor - Minbhawan		
	9:30-10:30	13:00-14:00	17:00 - 18:00	9:30-10:30	13:00-14:00	17:00 - 18:00	9:30-10:30	13:00-14:00	17:00 - 18:00
Walking on the carriageway: not on the sidewalk (ped/hr)	8 (0.35%)	12 (0.37%)	10 (0.46%)	14 (0.45%)	60 (1.20%)	55 (1.26%)	2 (0.11%)	1 (0.05%)	0 (0.00%)
Crossing the road not at the designated crosswalk (ped/hr)	107 (4.66%)	223 (6.89%)	137 (6.38%)	125 (4.04%)	238 (4.78%)	210 (4.81%)	28 (1.52%)	43 (2.21%)	26 (1.36%)
Pedestrian traffic flow (ped/hr)	2292	3236	2147	3091	4982	4368	1846	1946	1914

Note: percentage shown in the brackets are the portion of total traffic flow

The results of pedestrian non-compliance behavior identified in the study are described as below:

- It has been found that the pedestrian non-compliance behaviour of type (a) is very rare with respect to the noncompliance of type (b). Because of unsafe feeling created by vehicles, pedestrians walk on the carriageway only in the case of emergency.
- In general, the case of pedestrian non-compliances are increasing with the increase in pedestrian volume. However, the case of non-compliances in the evening are less in comparison with the morning and daytime.
- Shankerdev-putalisadak road: In this road section, non-compliance behavior was mainly noted as of type (b). During the morning and evening hours pedestrians represent the commuters for work purpose but in the daytime they travel for the shopping purpose in the market area. The faded crosswalk markings in this road section and retail shops on both sides contributed for the non-compliance behave for road crossing.
- Newroad -Dharmapath road: In this road section, dominant non-compliance is of type (b) because of the limited width of the sidewalk. Furthermore, most of the places it is occupied by the street vendors. Traffic volume is relatively less than other road sections. Similarly, traffic speed is also lower. Therefore, pedestrian intend to cross the road not only at the designated crosswalk but elsewhere. The pedestrian movement is restricted to cross the road by installation of railings along the kerb.
- Newbaneshwor – Minbhawan road section: the left-side of the pedestrian sidewalk is wide enough and clear walking space. Due to the Government institutions located along this side, pedestrians move steadfastly and do not intend to violate the rule of road crossing. On the right side of the road, there are retail shops, hospital, institutions and business complexes. Due to the median between service lane and carriageway, pedestrian are restricted to cross haphazardly and they cross only at the designated cross-walk.

4.3 Statistical Tests

Test for normality

Since statistical test depends on upon normal distribution of data, it is necessary to identify its deviation from normal. These tests are helpful is using a parametric test or non-parametric test for the analysis. The observed mean data for pedestrian's compliance and non-compliance behavior were analyzed through the SPSS software for the normality test. The Shapiro-Wilk (S-W) test significance is used to test normality at a 95% confidence level. The rejects the hypothesis of normality when S-W value is less than or equals to 0.05.

Table **4** gives the results of the normality test for the data set using SPSS for all three study road sections.

Table 4: Test for normality for three road sections

Variables	Shapiro-Wilk test Significance at a 95% confidence interval		
	Shankardev -Putalisadak Road	Newroad–Dharmapath Road	Newbaneshwor- Minbhawan
Pedestrian on sidewalk	0.001	0.074	0.001
Pedestrian outside sidewalk	0.000	0.000	0.000
Pedestrian crossing outside zebra marking	0.000	0.005	0.036

The result of normality test shows that the data are non-normal for Putalisadak-Shankardev and Newbaneshwor- Minbhawan road sections. Similarly, for Newroad-Dharmapath road section two variable-test is significant while one variable test is not significant. This implies that majority of data set are non-normal. Therefore, the data set is considered as non-normal for Newroad-Dharmapath road section.

Correlation

The bivariate correlation was conducted for pedestrian non-compliance behavior with total pedestrian volume, vehicular flow volume, time, and side railings. The Spearman's correlation coefficient and significance value will determine the correlation among variables. The test was carried out at 95% confidence level. The result shows that there is moderate correlation of non-compliance behaviour with pedestrian volume. Similarly, the vehicular flow and time of the day do not have influence in non-compliance behaviour. Moreover, presence of side railings, do not show significant impact; this may be due to the partial installation of railings on road sections.

V. Conclusions

This study focuses on the identification of pedestrian non-compliance behavior in selected urban roads in Kathmandu by analyzing the data extracted from the video image and the data set from the field observation and measurements. The study unveiled the two types of non-compliances for pedestrian movement along urban roads. Following conclusions are derived from the study:

- The non-compliance of pedestrian walking along the sidewalk (waking on the carriageway) is not significant movement. The main non-compliance was noted as the pedestrian crossing the road elsewhere not at the designated crosswalk facilities.
- The pedestrian non-compliance can be reduced by the construction of physical barrier for the pedestrian movement.
- The physical environment including the width and the clearance affects cases of non-compliances i. e. the installation of railing or the construction raised medians reduces the non-compliance cases.
- The time of the day for the pedestrian behavior is related to the purpose of the travel which may influences on the non-compliance behaviour.
- Pedestrian non-compliance walking outside sidewalk and crossing the road was not influenced by vehicular flow volume and time of the day.
- Condition of crosswalks such as spacing and contrast of the marking colour affect the cases of non-compliances by the consultant.

The pedestrian non-compliances for crossing the road could be improved by fairly maintaining the crosswalk painting. Which could reflect to the reduction of pedestrian safety. Urban arterial with the heavy traffic flow shall be provided with the wide and clear sidewalk facilities. This could improve the pedestrian behaviour for observance of the general rule of the pedestrian crossing. The study recommends that the spacing of crosswalk markings shall be established based on the pedestrian flow rate and the distance between sequential intersections.

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