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Analysis of Pedestrian Crash Cost by Willingness to Pay Method

(A Case Study of Kathmandu Valley)

by

Sharmila Deshar

A THESIS

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The undersigned certify that they have read, and recommended to the Institute of Engineering for acceptance, a thesis entitled **"Analysis of Pedestrian Crash Cost by Willingness to Pay Method (A Case Study of Kathmandu Valley)"**, submitted by Sharmila Deshar in partial fulfillment of the requirements for the degree of Master of Science in Transportation Engineering.

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ABSTRACT

Road traffic crashes is one of the serious issue in Nepal. Global Status Report on Road Safety (2018) estimated 15.9 road traffic fatalities per 100000 population in Nepal. In the fiscal year 2018/19, due to road traffic crashes 254 fatalities were recorded in Kathmandu Valley. Among 254 fatalities, 93 were pedestrian. In the developing countries like Nepal road safety improvements are very lacking. So this study would help to provide reliable information regarding sufficient fund allocation for road safety improvement.

Annually hundreds of pedestrian are losing their life in road traffic crashes. So there is need of assessment of pedestrian crash cost. In this study the crash cost of pedestrian have been measured in terms of value of statistical life (VOSL). Contingent Valuation approach of Willingness to Pay (WTP) was used to determine the amount of money that pedestrians are willing to pay for risk reduction. The questionnaire consisting of socioeconomic and household characteristics, walking behavior and valuation questions was designed for the survey. In the valuation question section, individuals were asked to quote the maximum amount of money that they would pay to reduce risk of fatality due to road traffic crash. From the study VOSL of pedestrian ranges from 7.61 to 17.46 million Nepalese Rupees.

Keywords: Pedestrian, Crash Cost, Willingness to Pay.

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Sharmila Deshar
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LIST OF ABBREVATIONS

CBS = Central Bureau of Statistics

DoR = Department of Roads

F/Y = Fiscal Year

GDP = Gross Domestic Product

JICA = Japan International Cooperation Agency

MOPIT = Ministry of Physical Infrastructure and Transport

MTP = Metropolitan Traffic Police

No. = Number

RTI = Road Traffic Injury

SS = Sample Size

SPSS = Statistical Package for the Social Sciences

VOSL = Value of Statistical Life

WHO = World Health Organization

WTP = Willingness to Pay

CHAPTER ONE: INTRODUCTION

1.1 Background

The number of annual road traffic deaths has reached 1.35 million and the burden is disproportionately borne by pedestrians, cyclists and motorcyclists (WHO, 2018). About 20-50 million people sustain non-fatal injuries with many incurring disabilities. Road traffic crashes cause significant economic loss to the country. It cost about 1 to 3% of GDP of the country.

In Nepal also road traffic crashes are very high. It has become one of the leading cause of death. Global Status Report on Road Safety (2018) estimated 15.9 road traffic fatalities per 100000 population in Nepal. In the fiscal year 2018/19, 2789 people lost their lives in road traffic crashes. Trend of road traffic crashes and fatality rate is increasing annually (Table 1-1).

Table 1-1: National Statistical Trends in Road Traffic Crashes

Year	Crashes	Fatalities	Serious Injuries	Slight Injuries
2014/15	9145	2004	4053	8127
2015/16	10013	2006	4182	8213
2016/17	10178	2384	4250	8290
2017/18	10965	2541	4144	8247
2018/19	13366	2789	4376	10360

Source: Nepal Police, 2019

In the fiscal year 2018/19, total 8918 crashes were recorded in Kathmandu Valley (Table 1-2). As the registration of vehicles in Kathmandu Valley is very high in comparison of other places and due to large number of vehicles too, road traffic crashes in Kathmandu Valley is very high. Among 254 fatalities recorded due to road traffic crashes, 115 were motorcyclist and 93 were pedestrian; which is about 37% of road traffic fatalities (Figure 1-1). The most vulnerable group of road users are motorcyclist which is followed by pedestrian. According to the study done by JICA in 2012, 40.7% of trip in Kathmandu Valley is done by walking.

Table 1-2: Annual Crash Description of Kathmandu Valley

Year	Crashes	Fatalities	Serious Injuries	Slight Injuries
2014/15	4999	133	233	3643
2015/16	5568	166	275	3901
2016/17	5530	182	201	3914
2017/18	6318	194	219	4333
2018/19	8918	254	317	5913

Source: https://traffic.nepalpolice.gov.np/

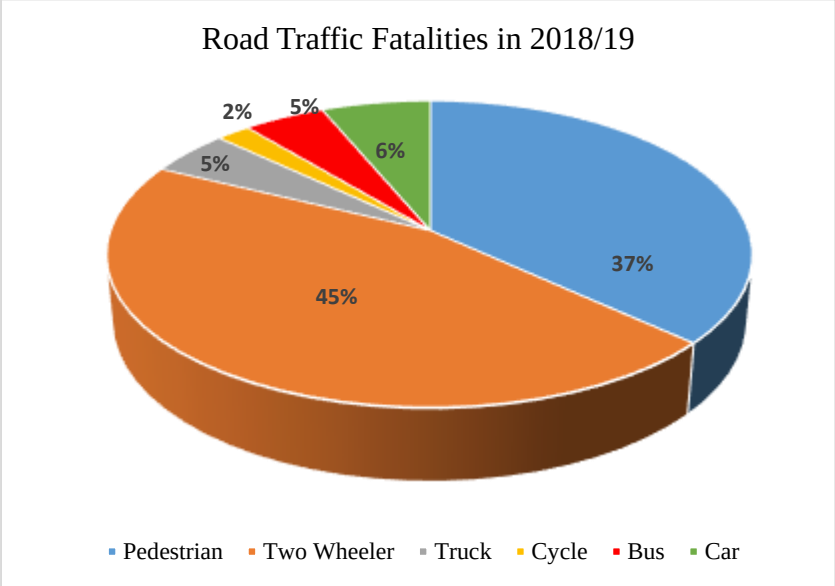

Figure 1-1: Road Traffic Fatalities in Kathmandu Valley (Source: MTP)

Road traffic crashes generate important consequences for human life in terms of physical, psychological, economic, social and occupational. Generally road crash cost includes human cost, property damage cost and general cost. Property damage cost generally refers to vehicle damage cost, vehicle replacement cost whereas general cost refers cost like insurance cost, administration cost. Property cost and general cost can be measured in terms of monetary value. But human cost is related to loss of life and quality of life, which cannot be measured in terms of money. Loss of life and quality of life is measured in terms of Value of Statistical Life (VOSL).

1.2 Problem Statement

In comparison of developed countries, road safety improvements in developing countries is very poor. This lack in road safety improvement is due to unavailability of

the relevant reliable data. Due to road traffic crashes our country is also suffering from serious economic loss. The road traffic crashes cost about 1 to 3% of GDP of the country. So there is need of assessment of road crash cost. This study will help to determine the crash cost as well as it will also help to provide the reliable information in allocating sufficient funds for safety improvements.

Road traffic crashes leave people seriously injured with very low chance of recovery. Few victims are never recovered fully causing permanent physical and mental disability. The road crash cost in developing countries like Nepal have been generally determined using Human Capital Approach Method. Human Capital Approach method estimate the value of productive output of people over their remaining life. But in recent years, human capital approach method have been replaced by Willingness to pay method. Willingness to pay method estimates the value that an individual is willing to pay for certain risk reduction.

1.3 Objectives of Study

The main objective this study is to determine the crash cost of pedestrians using Willingness to pay method.

The specific objectives of the study is to determine the paying nature of pedestrians.

1.4 Scope and Limitation

1.4.1 Scope

The current study is focused on determination of pedestrian's willingness to pay for risk reduction and their paying nature as per socio-economic factors like age, gender, income etc. and as per risk exposure.

1.4.2 Limitation

The study is limited within the Kathmandu Valley only. So the value of VOSL obtained may be little biased.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Among several modes of transport, rod transport is one of the most easy, economic, convenient and popular mode of transport in Nepal. Despite of being one of the most popular mode of transport, the road conditions of Nepal are not so good. Annually thousands of people are losing their lives due road traffic crashes. Maximum number of people die and many of them remain physically injured while some of them are compelled to suffer the whole life as they cannot be brought into normal life. Handicapped life is really a burden not only to the victim of the crash but also to the whole family too. In one hand the rate of road traffic crashes are increasing day by day and in another hand the quality of road is degrading day by day. According to the report published by WHO in 2013, more than three thousand people die daily due to road traffic crashes.

Crash cost can be divided into two categories: material cost and non-material cost. Material cost include property damage cost, administrative cost, medical cost and hospital cost. The non-material cost are related with emotional and social cost of casualties resulting from crash.

2.2 Methodology of Crash Costing

Several method to determine the crash cost are listed below.

- **Human Capital or GDP Method**

  This method is based on the production potential of the fatal or disabled individual during his lifetime in the absence of a road accident. It estimates the value of productive output of people over their remaining life.

- **Court Compensation Method**

  This method considers that society can assess accident costs through indemnity awarded by courts.

- **Life Insurance Method**

  This method is based on the use of the insurance premium that an individual would be willing to pay, coupled with the probability of being killed or injured in a road accident.

- **Willingness To Pay Method**

  This method is based on the maximum amount of money that a person would be willing to pay to reduce the probability of having a crash and being killed or injured.

- **Gross Output Method**

  This method is based on the assessment of economic consequences, usually supplemented by a national sum to reflect the pain, grief and suffering of victims and their family members.

- **Net Output Method**

  This method is similar to that of Gross Output Method but in this method future consumption of individuals killed in road traffic crashes are not included. It reflects a more conservative economic cost to society.

- **Implicit Public Sector Valuation Method**

  This method is based on investment programs that affect road safety.

Among several methods of crash costing Human Capital and Willingness to pay methods, are the two commonly adopted and used methods.

2.3 Willingness to Pay Method

Willingness to pay is the maximum amount of money that an individual would pay inorder to achieve that thing. Willingness to Pay is further classified into revealed preference and stated preference methods (Figure 2-1). Depending upon the type of goods or services in the question as well as availability of time and research resources both revealed and stated preference methods can be useful.

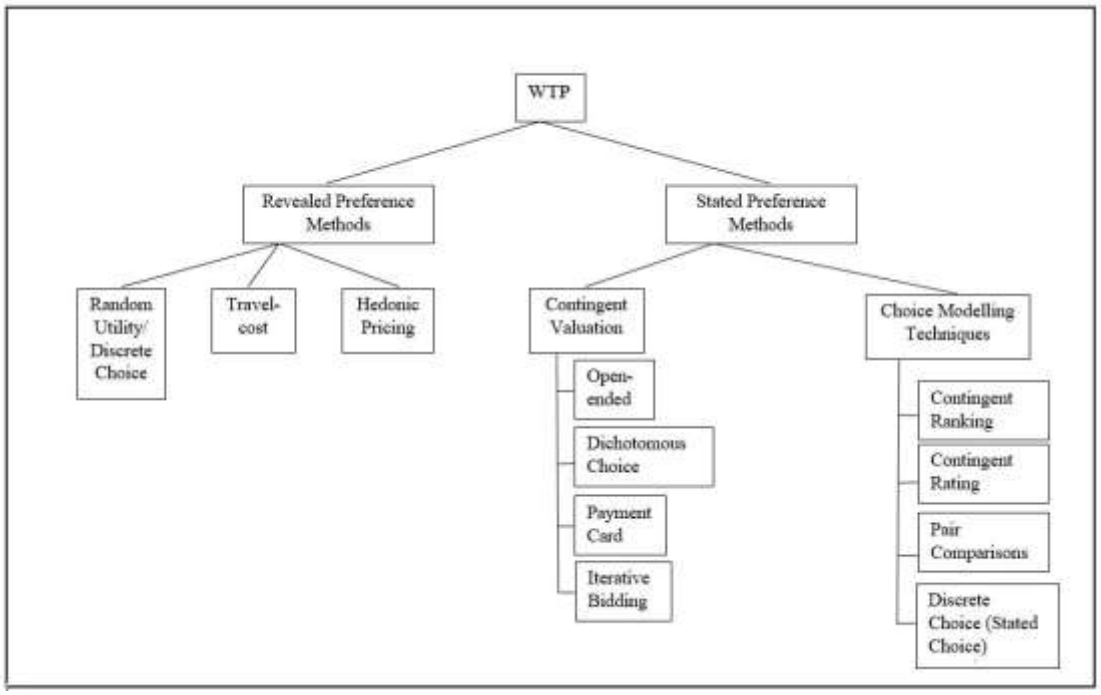

Figure 2-1: Willingness to Pay methods (Source: Bateman et al. (2002), Kjaer (2005))

2.3.1 Revealed Preference Method

Revealed Preference Method is a method in which choices made by individuals are analyzed through the actual market behavior. This method tries to understand the preference of an individual through group of options provided. This method assumes that the preferences of consumers can be revealed by their purchasing habits. A common issue with revealed preference data is the high degree of collinearity among attributes in market data, making it difficult or impossible to predict the effect of independent variation in an attribute (Kroes and Sheldon, 1988).

Revealed Preference method is further classified into four categories.

a) Random Utility/ Discrete Choice method
b) Travel Cost Method
c) Hedonic Pricing Method

2.3.2 Stated Preference Method

Stated Preference Method is a method in which a value for certain thing is obtained by asking hypothetical questions. In this method respondents are directly asked how much they are willing to pay to achieve certain thing.

Stated Preference method is further classified into two categories.

a) Contingent Valuation method
b) Choice modelling method

2.3.2.1 Contingent Valuation Method

This method is used to determine/estimate the economic values for all type of goods and services. Contingent Valuation surveys were first proposed in theory by S.V. Ciriacy-Wantrup in 1947 as a method for eliciting market valuation of non-market goods. The first practical application of this method was done by Davis in 1963 to estimate the value hunters and tourists placed on a particular wilderness area. The contingent valuation is a survey based economic technique for the valuation of non-market resources. The contingent valuation method is based on directly asking the person "how much they are willing to pay?". The contingent valuation method is based on the hypothetical questions. Contingent valuation method is applied by questionnaires. For example we ask "How much are you willing to pay for a change in the quality of good A?"

The Contingent Valuation method is further classified into following categories.

a) Open Ended
b) Dichotomous Choice
c) Iterative Bidding
d) Payment Card

2.3.2.2 Choice Modelling Method

The theory behind choice modelling was developed independently by economist and mathematical psychologists. The origin of choice modelling can be traced to Thurstone's research into food preferences in 1920s and to random utility theory. Choice modelling method attempts to model the decision process of an individual made in a particular context. It attempts to use discrete choice like A over B; B over A etc.

Choice modelling is used in both revealed preference method and stated preference method. Choice modelling approaches provide a more direct route to the valuation of the characteristics or attributes of a good, and of marginal changes in these characteristics rather than the value of the good as a whole. Choice modelling technique does not directly ask for monetary values but rather ask respondents to choose between alternatives.

2.4 Previous Studies

Chaturabong et al. (2011), derived the crash cost of motorcyclist in Thailand using willingness-to-pay method. The crash cost was determined in terms of value of statistical life (VOSL) and value of statistical injury (VOSI). The VOSL ranges between US$ 0.17 to 0.21 million whereas VOSI ranges between US$ 0.08 to 0.10 million US dollars. The study also evaluated whether and to what extent differences in socioeconomic characteristics and riding and risk taking behavior affect the willingness of motorcycle users to pay to avoid crash involvement and risk of death. According to the study, the significant factors affecting motorcycle users' willingness to pay to reduce fatality risk were age, gender, occupation, income and helmet use.

Buddha Maharjan (2012), also derived crash cost of motorcyclist of the Kathmandu Valley using willingness to pay method. The contingent valuation (CV) approach was adopted to determine WTP. The crash cost derived in terms of VOSL and VOSI were NRs. 5652283.78 and NRs. 1608606.55 respectively. According to his study gender, occupation, household income, household number, riding frequency, riding against traffic, crash experience and the behavior of alcohol-impaired riding were the significant factors affecting the WTP to reduce fatality risk whereas gender, education, occupation, income, household number, crash experience and behavior of alcohol-impaired riding were the significant factors affecting WTP to reduce severe injury risk.

Abdallah et al. (2016), derived crash cost in Egypt using willingness to pay method. The respondents were asked contingent valuation questions that probe willingness to pay risk reduction in two different scenarios. In the first scenario the reduction in risk of being killed was 50% and that in second scenario was 30%. The VOSL for first scenario was 5964000 LE and for the second scenario it was 8433033 LE. The estimated road traffic crash cost in Egypt was approximately 52 billion Egyptian Pounds (about $US 6.6 billion) for the year 2014, about 2.27% of GDP. Also suggested willingness to pay research is an important prerequisite to investment in road safety measures.

Mofadal et al. (2015), estimated crash cost of pedestrian in Sudan using willingness to pay method. The VOSL was determined for five different scenarios related to pedestrian facility. The estimated VOSL for Sudanese pedestrians ranged from US$ 0.019 to US$ 0.101 million. The impact of socioeconomic factors, risk levels and

walking behaviors of pedestrians on their WTP for fatality risk reduction was also evaluated. According to his study, WTP to reduce fatality risk tens to increase with age, household income, education level, safety perception and average time spent on social activities with family and community.

Balakrishnan et al. (2019), conducted a study on willingness to pay to reduce traffic risk in India. The questionnaire survey was conducted on two wheeler riders of selected roads in Calicut City. Travel cost, crash rate of the route selected, age, occupation, personal income and the number of household members had significant impact on decision making process. For two wheeler WTP for traffic risk reduction was found to be Rs 0.53/person/trip.

Wijnen et al. (2019), estimated road crash cost in 31 European countries. The valuation of preventing serious injury ranged from 2.5% to 34% of the value per fatality and the valuation of preventing slight injury ranged from 0.03% to 4.2% of the value of a fatality. The total road crash cost was about 0.4-4% of GDP.

Michigan Department of Transportation (2012) published a report on crash countermeasure and mobility effects. The countermeasures were presented for intersection and signal improvements, roadway improvements and operations/enforcement. According the study, construction of overpass or underpass as an alternative to providing a pedestrian crossing, reduced crashes to 60-95%. Similarly when sidewalks were added to the roadway, the number of pedestrian crashes reduced by 88% while adding shoulders reduced pedestrian crashes by 70%. Improving roadway illumination at intersections reduced crashes by 42% to 78% than that associated with low light conditions. When pedestrian countdown signals were added to the existing signalized intersections, it resulted in 25% reduction in crashes. On roadways with three or more lanes, no median and more than 15000 vehicles per day, marked crosswalks were shown to have 4.9 times fewer crashes per million crossings than unmarked crosswalks. On roadways with three or more lanes with medians and more than 15,000 vehicles per day, marked crosswalks were shown to have 4.3 times fewer crashes than unmarked crosswalks. On multilane roadways with no medians and between 12,000 and 15,000 vehicles per day, marked crosswalks were shown to have 4.2 times fewer crashes.

Under reporting of injuries and fatalities resulting from road traffic crashes is a global problem faced by developing as well as developed countries. According to study done by Dandona et al. (2015) regarding under reporting of road traffic injuries in urban India only 17.2% and 2.3% of non-fatal road traffic injuries requiring treatment as inpatient and outpatient respectively, in the population based study were reported to the police and 24.6% of the non-fatal RTI cases admitted in the hospital based study were reported to the police. 22% fatalities in the population based study were not reported to the police.

Rosman et al. (1994) compared hospital and police road injury data. The overall linkage rate from hospital to police was 64% but varied from 29% for motorcyclists in single-vehicle accidents to 79% for motor vehicle drivers. The linkage rate increased with increasing levels of injury severity and was substantially lower for casualties of certain ethnic groups.

A report on Cost of Road Traffic Accidents in Nepal (2008) mentioned that based on global experience, a fatal to injury ratio than 1:10 indicate under-reporting.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

Kathmandu Valley comprises of three districts: Kathmandu, Lalitpur and Bhaktapur. The area covered by three districts is 899 square kilometers in which the area covered by valley as a whole is 665 square kilometers. The valley covers the entire area of Bhaktapur district, 85% of Kathmandu district and 50% of Lalitpur district. Kathmandu Valley is the most developed and populated place in Nepal.. The majority of offices, educational institution, hospitals are located in the Kathmandu Valley making it the economic hub of Nepal. According to CBS 2011, the population of Kathmandu Valley is 2517023. By 2021, the projected population of Kathmandu Valley is 3264532. The framework of the study is as in Figure 3-1.

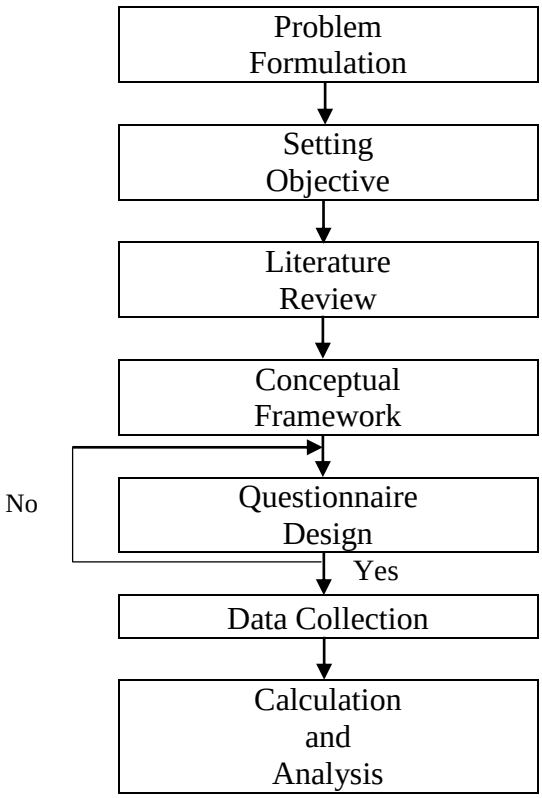

Figure 3-1: Framework for Study

3.2 Literature Review

Different thesis, journals, books and contents in internet were reviewed to get information and knowledge regarding Crash Cost Analysis by Willingness to Pay method.

3.3 Conceptual Framework

As literature review is the continuous process during any research process, during this phase problem statement and objective of the study are set out and prepared conceptual framework. Conceptual framework helped to make the survey questions.

3.4 Sample Size Determination

Sample size for the survey was determine using the formula derived by Kish (1995).

$$n = \frac{\bar{n}}{\left[1 + \left(\frac{\bar{n}}{N}\right)\right]}$$

Where, N = Total Population

n = sample size from finite population

$\bar{n}$ = sample size from infinite population

The sample size from infinite population is calculates using the following equation.

$$\bar{n} = \frac{S^2}{se(\bar{x})^2}$$

Where, S^2 = Variance of population elements

$se(\bar{x})$ = standard error of sampling population

For 95% confidence interval and 10% error, the sample size can be calculated as a function of coefficient of variation cv.

$(\bar{x}) = \frac{0.1\mu}{1.96} = 0.051\mu$

$\bar{n} = \left(\frac{S}{0.051\mu}\right)^2 = 384cv^2$

As the value of $\bar{n}$ is very small comparing with N thus the ratio of $\left(\frac{\bar{n}}{N}\right)$ is very small.

Thus the sample size of finite population n can be taken as the same value of $\bar{n}$. For cv =1 the minimum sample size is 384.

3.5 Questionnaire Design

The questions were designed in three sections. The first section includes socio-economic and household characteristics of respondents such as age, gender, marital status, monthly income, family income, occupation, education.

The second section include questions relating to walking behavior, perception of risk exposure, perception of safety such as purpose of trip, frequency of trip, average walking distance, any crash experience.

The third section is the main section which include valuation questions. In this section the respondents have to evaluate the risk reduction for six different walking and crossing condition and then quote the amount of money that they are willing to pay to use that particular pedestrian facility for fatality risk reduction. The crash reduction for different scenarios was estimated according to the study done on crash countermeasure and mobility effects by Michigan Department of Transportation in 2012.

In the first scenario, the respondents are given hypothetical scenario of crossing on a congested road without any crossing facility in which 100 people lose their life annually in road traffic crashes. Then the respondent is asked to quote the maximum amount of money that he/she would pay to use marked zebra-crossing facility due to which the number of people losing their life in road traffic crashes will fall to 22. The risk reduction in this scenario is about 78%.

In the second scenario, the respondents are given hypothetical scenario of crossing on a congested road without any crossing facility in which 100 people lose their life annually in road traffic crashes. Then the respondent is asked to quote the maximum amount of money that he/she would pay to use pedestrian countdown signal facility due to which the number of people losing their life in road traffic crashes will fall to 75. The risk reduction in this scenario is about 25% only.

The third scenario is also related to the crossing facility. In this scenario, the respondents are given hypothetical scenario of crossing on a congested road without any crossing facility in which 100 people lose their life annually in road traffic crashes. Then the respondent is asked to quote the maximum amount of money that he/she would pay to use pedestrian overhead bridge facility due to which the number of people losing their life in road traffic crashes will fall to 0. The risk reduction in third scenario is assumed to be 100%.

In the fourth scenario, the respondents are given hypothetical scenario of walking on a road without any walking facility in which 100 people lose their life annually in road traffic crashes. Then the respondent is asked to quote the maximum amount of money that he/she would pay to use footpath/ paved side walking facility due to which the number of people losing their life in road traffic crashes will fall to 15. The risk reduction in this scenario is about 85%.

In the fifth scenario, the respondents are given a hypothetical scenario of walking at night time on a road without any street light facility in which 100 people lose their life annually in road traffic crashes. Then the respondent is asked to quote the maximum amount of money that he/she would pay to use street light facility due to which the number of people losing their life in road traffic crashes will fall to 40. The risk reduction in this scenario is about 60%.

In the last scenario, the respondents are given a hypothetical scenario of walking in a city in which a pedestrian safety program does not exist. The respondents are informed that 100 pedestrian fatalities occur every year. Then the respondent is asked to quote the maximum amount of money that he/she would pay so that the city implements pedestrian safety facilities and conducts pedestrian safety programs due to which the number of people losing their life in road traffic crashes will fall to 50. The risk reduction in this scenario is 50%.

3.6 Data Collection

Both the primary data and secondary data are required for the study purpose. Primary data of WTP was collected from questionnaire survey. The questionnaire survey was done by interview method and through internet. The interview was conducted in locations such as streets, markets, government offices, private offices, households. The questionnaire survey was done on 400 respondents.

Secondary data required for the study was collected from Central Bureau of Statistics, Metropolitan Traffic Police, Police Headquarter, Department of Transport Management, also through different websites, journals, articles etc.

3.7 Crash Cost Analysis

The crash cost is determined in terms of Value of Statistical Life. The VOSL is determined using the following formula.

$$VOSL = \frac{Mean\ WTP}{Change\ in\ Fatality\ Risk}$$

The mean WTP value of respondents is determined from simple arithmetic calculation.

The change in risk is calculated by taking percentage of risk reduction multiplied by risk of fatality.

Risk of fatality is determine using the following formula.

$$Fatality\ Risk = \frac{No.\ of\ Pedestrian\ Fatality}{No.\ of\ Pedestrian}$$

CHAPTER FOUR: ANALYSIS AND RESULT

4.1 Descriptive Analysis

The questionnaire survey was done on 400 respondents. The socio-economic and household characteristic and walking behavior and risk exposure perception of respondents are summarized in Table 4-1 and 4-2 respectively.

Table 4-1: Socio-economic Characteristics of Sample

Socio-Economic and Household Characteristics		Frequency	Percentage
Gender	Male	234	58.5
	Female	166	41.5
	Total	400	100
Marital Status	Married	254	63.5
	Unmarried	146	36.5
	Total	400	100
Age	<21	8	2
	21-30	189	47.25
	31-40	111	27.75
	41-50	43	10.75
	51-60	45	11.25
	>60	4	1
	Total	400	100
Education	PHD	1	0.25
	Masters	82	20.5
	Bachelors	176	44
	Intermediate	53	13.25
	SLC	27	6.75
	Below SLC	51	12.75
	Uneducated	10	2.5
	Total	400	100
Occupation	Government	65	16.25
	Private	181	45.25
	Own Business	70	17.5
	Student	33	8.25
	Labor	20	5
	Housewife	24	6
	Others	7	1.75
	Total	400	100
Individual Monthly Income (NRs.)	Upto 5000	32	8
	5000 - 10000	66	16.5
	10000 - 25000	150	37.5

Socio-Economic and Household Characteristics		Frequency	Percentage
	25000 - 50000	110	27.5
	Above 50000	42	10.5
	Total	400	100
Monthly Family Income (NRs.)	Upto 5000	4	1
	5000 - 10000	7	1.75
	10000 - 25000	111	27.75
	25000 - 50000	128	32
	Above 50000	150	37.5
	Total	400	100

Table 4-2: Walking Behavior and Risk Exposure Perception of Sample

Walking Behavior and Risk Exposure Perception		Frequency	Percentage
Trip Purpose	Working	232	58
	Shopping	23	5.75
	Recreation	51	12.75
	Others	71	17.75
	Study	23	5.75
	Total	400	100
Frequency of Trip	Daily	253	63.25
	Once in a week	43	10.75
	More than once in a week	75	18.75
	Less than once in a week	29	7.25
	Total	400	100
Average Walking Distance (km)	<1	100	25
	1 - 2	141	35.25
	2 - 3	93	23.25
	3 - 4	26	6.5
	>4	40	10
	Total	400	100
Pedestrian Crash Experience	Never	314	78.5
	Once	62	15.5
	More than Once	24	6
	Total	400	100
Pedestrian Crash Experience of Family Members	Never	316	79
	Once	53	13.25
	More than Once	31	7.75
	Total	400	100
	Not Safe	130	32.5

Walking Behavior and Risk Exposure Perception		Frequency	Percentage
Safety perception as Pedestrian	Low	240	60
	Medium	29	7.25
	High	1	0.25
	Total	400	100

4.2 Determination of WTP

During the questionnaire survey, the respondents were asked to quote maximum amount of money that they are willing to pay for each risk reduction scenario. The mean value of WTP amount for reduction in fatality risk for each scenario is determined using simple arithmetic calculation.

The mean WTP values for all the scenarios is summarized in Table 4-3.

Table 4-3: Mean WTP for all scenarios

Scenario	Crossing with Marked Zebra Crossing	Crossing with Pedestrian Countdown Signal	Crossing with Overhead Bridge	Walking with Sidewalk /Footpath	Walking with Street Light Facility	Walking with Pedestrian Safety Program
Risk Reduction	78%	25%	100%	85%	60%	50%
Mean WTP for risk reduction (NRs.)	451.27	331.77	638.35	494.65	423.6	321.62

From these value of WTP for all the scenarios, it is clearly seen that higher the fatality risk reduction higher is the value of WTP. Respondents are willing to pay higher amount of money for higher value of risk reduction.

4.3 Determination of Value of Statistical Life

Value of Statistical Life (VOSL) is expressed as the willingness to pay for change in risk divided by the change in risk.

$$VOSL = \frac{Mean\ WTP}{Change\ in\ Fatality\ Risk}$$

The mean WTP for risk in all the scenarios is obtained using simple arithmetic calculation. The mean WTP for all scenarios is summarized in Table 5.

Fatality risk is calculated by dividing number of fatalities of pedestrian from number of pedestrians in Kathmandu Valley.

$$Fatality\ Risk = \frac{No.\ of\ Pedestrian\ Fatality}{No.\ of\ Pedestrian}$$

According to CBS report, the population of Kathmandu Valley in 2011 was 2517023 and the projected population for 2016 and 2021 were 2877255 and 3264532 respectively. From these data the population of Kathmandu Valley in 2019 is assumed to be 3106015. According to the JICA report 53.1% of trip in Kathmandu Valley was done by walk in 1991, in 2012 it reduced to 40.7% and by 2022 it will reduce to 38.8%. On the basis of these data, the number of pedestrian of Katmandu Valley in 2019 is assumed to be 1222839.Therefore the fatality risk of pedestrian in Kathmandu Valley is found to be 0.000076.

The change in fatality risk is calculated taking percentage of risk reduction multiplied by risk of fatality. The risk reduction for each scenario is listed in Table 5. For the first scenario, the fatality risk reduction is about 78%. Hence the change in fatality risk for first scenario is obtained by multiplying above mentioned fatality risk with 0.78 which gives a value of 0.0000593. Similarly the change in fatality risk for all the scenarios is calculated.

The mean WTP for the first scenario is NRs. 451.27. Therefore VOSL for first scenario is obtained by dividing mean WTP with change in fatality risk for first scenario which gives a value of NRs.7612601.21. The VOSL for all the scenarios is summarized in Table 4-4.

Table 4-4: Value of Statistical Life of Pedestrian (in million)

Scenario	Crossing with Marked Zebra Crossing	Crossing with Pedestrian Countdown Signal	Crossing with Overhead Bridge	Walking with Sidewalk /Footpath	Walking with Street Light Facility	Walking with Pedestrian Safety Program
VOSL	7.61	17.46	8.39	7.65	9.28	8.46

4.4 Variables Definition

Dependent Variables

As there was six different scenarios for crossing and walking for valuation questions, so there are six different dependent variables for the study.

WTP1: It is the amount of money that a pedestrian would pay to use the zebra crossing facility for crossing a road. The risk reduction for this case is 78%.

WTP2: It is the amount of money that a pedestrian would pay to use the pedestrian countdown signal facility for crossing a road. The risk reduction for this case is 25%.

WTP3: It is the amount of money that a pedestrian would pay to use the overhead bridge facility for crossing a road. The risk reduction for this case is 100%.

WTP4: It is the amount of money that a pedestrian would pay to use sidewalk/footpath facility for walking on a road. The risk reduction for this case is 85%.

WTP5: It is the amount of money that a pedestrian would pay to use the street light facility while walking on a road. The risk reduction for this case is 60%.

WTP6: It is the amount of money that a pedestrian would pay to implement pedestrian safety programs in a city. By implementation of safety awareness programs, the fatality risk is assumed to be lower by 50%.

Independent Variables:

Table 4-5 : Definition of independent variables used in regression analysis

Variables	**Definition**
GENDER	Gender (1 if Male, 0 otherwise)
Age	Age (Continuous Variable)
STATUS	Marital Status (1 if married, 0 otherwise)
Education_Higher	Higher (1 if university level education, 0 otherwise)
Education_Medium	Medium (1 if intermediate level education, 0 otherwise)
Education_Lower	Lower (1 if below SLC level education, 0 otherwise)
Occupation_1	Government (1 if government, 0 otherwise)
Occupation_2	Private (1 if private, 0 otherwise)
Occupation_3	Own Business (1 if own Business, 0 otherwise)
Occupation_4	Other Occupation (1 if others, 0 otherwise)
Income_Low	Low Income (1 if income < 25000, 0 otherwise)
Income_Medium	Medium Income (1 if income = 25000 to 50000, 0 otherwise)
Income_High	High Income (1 if income > 50000, 0 otherwise)

Variables	Definition
Family_Income_Low	Low Family Income (1 if family income <25000, 0 otherwise)
Family_Income_ Medium	Medium Family Income (1 if family income = 25000 to 50000, 0 otherwise)
Family_Income_High	High Family Income (1 if family income > 50000, 0 otherwise)
Purpose_Work	Working (1 if working, 0 otherwise)
Purpose_Shop	Shopping (1 if shopping, 0 otherwise)
Purpose_Recreation	Recreation (1 if recreation, 0 otherwise)
Purpose_Others	Others (1 if others, 0 otherwise)
WLKDIST1	Walking Distance 1 (1 if walking distance = 1-2 km, 0 otherwise)
WLKDIST2	Walking Distance 2 (1 if walking distance = 2-4 km, 0 otherwise)
WLKDIST3	Walking Distance 3 (1 if walking distance > 4 km, 0 otherwise)
CRSEXP	Crash Experience (1 if having at least 1 or more crashes, 0 otherwise)
Frequency	Frequency (1 if more than once in a week, 0 otherwise)
CRSEXPFMLY	Family Crash Experience (1 if having at least 1 or more crashes, 0 otherwise)
Perception	Perception (1 if perception of safety is low, 0 otherwise)

4.5 Analysis of Factors Influencing WTP

The factors affecting the willingness-to-pay to avoid risk of fatality was determined using linear regression model. The independent variables considered in the analysis included socioeconomic characteristics of respondents such as age, gender, marital status, occupation, education, income, family income and walking behavior and safety perception such as purpose of trip, frequency of trip, average walking distance, crash experience, crash experience of family members. The SPSS output of linear regression model coefficients for all the scenarios are shown in table 4-6 to 4-17 **.**

Table 4-6 : Result of Regression Model for WTP1

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	469.585	335.622		1.399	.163
	GENDER	-13.263	74.797	-.010	-.177	.859
	Age	9.016	4.444	.138	2.028	.043
	STATUS	-203.490	82.949	-.144	-2.453	.015
	Education_Higher	332.181	131.672	.234	2.523	.012
	Education_Medium	153.608	127.044	.091	1.209	.227
	Occupation_1	234.439	141.034	.127	1.662	.097
	Occupation_2	-9.599	117.182	-.007	-.082	.935
	Occupation_3	14.246	126.789	.008	.112	.911
	Income_Medium	21.361	102.628	.015	.208	.835
	Income_High	238.702	158.606	.108	1.505	.133
	Family_Income_Medium	-887.830	209.608	-.642	-4.236	.000
	Family_Income_High	-776.397	219.588	-.554	-3.536	.000
	Purpose_Work	-62.972	180.353	-.046	-.349	.727
	Purpose_Shop	693.587	224.296	.238	3.092	.002
	Purpose_Recreation	90.560	188.286	.045	.481	.631
	Purpose_Others	96.561	187.583	.054	.515	.607
	WLKDIST2	-3.794	76.907	-.003	-.049	.961
	WLKDIST3	-124.222	119.059	-.055	-1.043	.297
	CRSEXP	-245.358	84.020	-.149	-2.920	.004
	Frequency	282.645	101.518	.160	2.784	.006
	CRSEXPFMLY	14.073	87.560	.008	.161	.872
	Perception	119.841	124.844	.047	.960	.338

Table 4-7 : SPSS Output of WTP1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.455[a]	.207	.161	622.337

a. Predictors: (Constant), Perception, WLKDIST2, Family_Income_Medium, Purpose_Shop, Age, Occupation_1, Purpose_Others, GENDER, CRSEXP, Education_Medium, Frequency, WLKDIST3, CRSEXPFMLY, Occupation_3, Income_Medium, Purpose_Recreation, STATUS, Income_High, Occupation_2, Education_Higher, Purpose_Work, Family_Income_High

Table 4-8 : Result of Regression Model for WTP2

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	238.413	290.636		.820	.413
	GENDER	23.018	64.771	.019	.355	.723
	Age	7.369	3.849	.131	1.915	.056
	STATUS	-175.415	71.831	-.144	-2.442	.015
	Education_Higher	206.918	114.023	.169	1.815	.070
	Education_Medium	82.785	110.015	.057	.752	.452
	Occupation_1	203.510	122.130	.128	1.666	.096
	Occupation_2	28.580	101.475	.024	.282	.778
	Occupation_3	-44.058	109.795	-.029	-.401	.688
	Income_Medium	3.467	88.872	.003	.039	.969
	Income_High	376.330	137.347	.197	2.740	.006
	Family_Income_Medium	-554.716	181.512	-.465	-3.056	.002
	Family_Income_High	-536.007	190.155	-.443	-2.819	.005
	Purpose_Work	-58.291	156.178	-.049	-.373	.709
	Purpose_Shop	669.923	194.232	.266	3.449	.001
	Purpose_Recreation	64.670	163.048	.037	.397	.692
	Purpose_Others	65.579	162.440	.043	.404	.687
	WLKDIST2	83.223	66.598	.065	1.250	.212
	WLKDIST3	-68.650	103.100	-.035	-.666	.506
	CRSEXP	-192.536	72.758	-.135	-2.646	.008
	Frequency	191.818	87.911	.126	2.182	.030
	CRSEXPFMLY	79.369	75.824	.055	1.047	.296
	Perception	71.724	108.110	.032	.663	.507

Table 4-9: SPSS Output of WTP2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.448[a]	.201	.154	538.920

a. Predictors: (Constant), Perception, WLKDIST2, Family_Income_Medium, Purpose_Shop, Age, Occupation_1, Purpose_Others, GENDER, CRSEXP, Education_Medium, Frequency, WLKDIST3, CRSEXPFMLY, Occupation_3, Income_Medium, Purpose_Recreation, STATUS, Income_High, Occupation_2, Education_Higher, Purpose_Work, Family_Income_High

Table 4-10: Result of Regression Model for WTP3

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	58.452	382.639		.153	.879
	GENDER	87.884	85.275	.055	1.031	.303
	Age	4.858	5.067	.065	.959	.338
	STATUS	-155.784	94.569	-.096	-1.647	.100
	Education_Higher	359.673	150.117	.220	2.396	.017
	Education_Medium	157.965	144.841	.081	1.091	.276
	Occupation_1	368.608	160.791	.174	2.292	.022
	Occupation_2	2.088	133.597	.001	.016	.988
	Occupation_3	76.724	144.551	.037	.531	.596
	Income_Medium	45.130	117.005	.028	.386	.700
	Income_High	295.053	180.825	.116	1.632	.104
	Family_Income_Medium	-260.000	238.972	-.163	-1.088	.277
	Family_Income_High	-109.425	250.350	-.068	-.437	.662
	Purpose_Work	53.034	205.618	.033	.258	.797
	Purpose_Shop	828.583	255.717	.247	3.240	.001
	Purpose_Recreation	427.650	214.662	.183	1.992	.047
	Purpose_Others	434.934	213.862	.213	2.034	.043
	WLKDIST2	-88.701	87.681	-.052	-1.012	.312
	WLKDIST3	-100.965	135.738	-.039	-.744	.457
	CRSEXP	-125.372	95.790	-.066	-1.309	.191
	Frequency	311.864	115.740	.153	2.695	.007
	CRSEXPFMLY	13.414	99.826	.007	.134	.893
	Perception	-158.342	142.333	-.053	-1.112	.267

Table 4-11 : SPSS Output of WTP3

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.472[a]	.223	.178	709.519

a. Predictors: (Constant), Perception, WLKDIST2, Family_Income_Medium, Purpose_Shop, Age, Occupation_1, Purpose_Others, GENDER, CRSEXP, Education_Medium, Frequency, WLKDIST3, CRSEXPFMLY, Occupation_3, Income_Medium, Purpose_Recreation, STATUS, Income_High, Occupation_2, Education_Higher, Purpose_Work, Family_Income_High

Table 4-12 : Result of Regression Model for WTP4

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	47.644	339.807		.140	.889
	GENDER	113.483	75.730	.081	1.499	.135
	Age	6.813	4.500	.103	1.514	.131
	STATUS	-186.057	83.983	-.130	-2.215	.027
	Education_Higher	288.155	133.313	.200	2.161	.031
	Education_Medium	83.263	128.628	.048	.647	.518
	Occupation_1	296.000	142.792	.159	2.073	.039
	Occupation_2	7.198	118.643	.005	.061	.952
	Occupation_3	-35.922	128.370	-.020	-.280	.780
	Income_Medium	31.149	103.908	.022	.300	.765
	Income_High	260.672	160.584	.116	1.623	.105
	Family_Income_Medium	-405.808	212.221	-.290	-1.912	.057
	Family_Income_High	-237.504	222.326	-.167	-1.068	.286
	Purpose_Work	-13.006	182.601	-.009	-.071	.943
	Purpose_Shop	604.722	227.093	.205	2.663	.008
	Purpose_Recreation	144.567	190.633	.070	.758	.449
	Purpose_Others	289.971	189.922	.161	1.527	.128
	WLKDIST2	50.478	77.866	.034	.648	.517
	WLKDIST3	-85.418	120.543	-.037	-.709	.479
	CRSEXP	-160.405	85.068	-.096	-1.886	.060
	Frequency	185.274	102.784	.104	1.803	.072
	CRSEXPFMLY	53.731	88.652	.032	.606	.545
	Perception	74.955	126.401	.029	.593	.554

Table 4-13 : SPSS Output of WTP4

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.455[a]	.207	.161	630.096

a. Predictors: (Constant), Perception, WLKDIST2, Family_Income_Medium, Purpose_Shop, Age, Occupation_1, Purpose_Others, GENDER, CRSEXP, Education_Medium, Frequency, WLKDIST3, CRSEXPFMLY, Occupation_3, Income_Medium, Purpose_Recreation, STATUS, Income_High, Occupation_2, Education_Higher, Purpose_Work, Family_Income_High

Table 4-14: Result of Regression Model for WTP5

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	497.287	374.460		1.328	.185
	GENDER	79.539	83.452	.052	.953	.341
	Age	4.765	4.959	.066	.961	.337
	STATUS	-147.145	92.548	-.094	-1.590	.113
	Education_Higher	302.108	146.908	.192	2.056	.040
	Education_Medium	100.955	141.745	.054	.712	.477
	Occupation_1	335.563	157.354	.165	2.133	.034
	Occupation_2	4.106	130.742	.003	.031	.975
	Occupation_3	67.991	141.461	.034	.481	.631
	Income_Medium	-92.060	114.504	-.059	-.804	.422
	Income_High	49.545	176.959	.020	.280	.780
	Family_Income_Medium	-956.592	233.863	-.625	-4.090	.000
	Family_Income_High	-744.441	244.999	-.480	-3.039	.003
	Purpose_Work	238.642	201.223	.157	1.186	.236
	Purpose_Shop	913.932	250.251	.284	3.652	.000
	Purpose_Recreation	249.545	210.074	.111	1.188	.236
	Purpose_Others	371.361	209.290	.189	1.774	.077
	WLKDIST2	71.761	85.806	.044	.836	.404
	WLKDIST3	69.037	132.836	.028	.520	.604
	CRSEXP	-136.380	93.743	-.075	-1.455	.147
	Frequency	89.476	113.266	.046	.790	.430
	CRSEXPFMLY	39.852	97.692	.022	.408	.684
	Perception	67.402	139.291	.024	.484	.629

Table 4-15 : SPSS Output of WTP5

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.439[a]	.193	.146	694.352

a. Predictors: (Constant), Perception, WLKDIST2, Family_Income_Medium, Purpose_Shop, Age, Occupation_1, Purpose_Others, GENDER, CRSEXP, Education_Medium, Frequency, WLKDIST3, CRSEXPFMLY, Occupation_3, Income_Medium, Purpose_Recreation, STATUS, Income_High, Occupation_2, Education_Higher, Purpose_Work, Family_Income_High

Table 4-16 : Result of Regression Model for WTP6

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	207.039	260.827		.794	.428
	GENDER	66.313	58.128	.063	1.141	.255
	Age	3.494	3.454	.070	1.012	.312
	STATUS	-123.945	64.464	-.114	-1.923	.055
	Education_Higher	98.701	102.328	.090	.965	.335
	Education_Medium	1.289	98.731	.001	.013	.990
	Occupation_1	319.506	109.604	.226	2.915	.004
	Occupation_2	25.269	91.067	.024	.277	.782
	Occupation_3	-23.186	98.534	-.017	-.235	.814
	Income_Medium	6.106	79.757	.006	.077	.939
	Income_High	205.030	123.260	.120	1.663	.097
	Family_Income_Medium	-300.979	162.896	-.283	-1.848	.065
	Family_Income_High	-186.276	170.652	-.173	-1.092	.276
	Purpose_Work	-94.088	140.160	-.089	-.671	.502
	Purpose_Shop	411.099	174.311	.183	2.358	.019
	Purpose_Recreation	21.436	146.325	.014	.146	.884
	Purpose_Others	105.245	145.780	.077	.722	.471
	WLKDIST2	50.674	59.768	.044	.848	.397
	WLKDIST3	-96.864	92.526	-.056	-1.047	.296
	CRSEXP	-54.360	65.296	-.043	-.833	.406
	Frequency	120.730	78.894	.089	1.530	.127
	CRSEXPFMLY	64.432	68.047	.050	.947	.344
	Perception	42.338	97.022	.021	.436	.663

Table: 4-17 : SPSS Output of WTP6

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.438[a]	.192	.145	694.352

a. Predictors: (Constant), Perception, WLKDIST2, Family_Income_Medium, Purpose_Shop, Age, Occupation_1, Purpose_Others, GENDER, CRSEXP, Education_Medium, Frequency, WLKDIST3, CRSEXPFMLY, Occupation_3, Income_Medium, Purpose_Recreation, STATUS, Income_High, Occupation_2, Education_Higher, Purpose_Work, Family_Income_High

Table 4-18 : Summarized Result of Regression Model for all the WTP Scenarios

	WTP1		WTP2		WTP3		WTP4		WTP5		WTP6	
Variables	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
(Constant)	469.585	1.399	238.413	.820	58.452	.153	47.644	.140	497.287	1.328	207.039	.794
GENDER	-13.263	-.177	23.018	.355	87.884	1.031	113.483	1.499	79.539	.953	66.313	1.141
Age	9.016	2.028	7.369	1.915	4.858	.959	6.813	1.514	4.765	.961	3.494	1.012
STATUS	-203.490	-2.453	-175.415	-2.442	-155.784	-1.647	-186.057	-2.215	-147.145	-1.590	-123.945	-1.923
Education_Higher	332.181	2.523	206.918	1.815	359.673	2.396	288.155	2.161	302.108	2.056	98.701	.965
Education_Medium	153.608	1.209	82.785	.752	157.965	1.091	83.263	.647	100.955	.712	1.289	.013
Occupation_1	234.439	1.662	203.510	1.666	368.608	2.292	296.000	2.073	335.563	2.133	319.506	2.915
Occupation_2	-9.599	-.082	28.580	.282	2.088	.016	7.198	.061	4.106	.031	25.269	.277
Occupation_3	14.246	.112	-44.058	-.401	76.724	.531	-35.922	-.280	67.991	.481	-23.186	-.235
Income_Medium	21.361	.208	3.467	.039	45.130	.386	31.149	.300	-92.060	-.804	6.106	.077
Income_High	238.702	1.505	376.330	2.740	295.053	1.632	260.672	1.623	49.545	.280	205.030	1.663
Family_Income_ Medium	-887.830	-4.236	-554.716	-3.056	-260.000	-1.088	-405.808	-1.912	-956.592	-4.090	-300.979	-1.848
Family_Income_High	-776.397	-3.536	-536.007	-2.819	-109.425	-.437	-237.504	-1.068	-744.441	-3.039	-186.276	-1.092
Purpose_Work	-62.972	-.349	-58.291	-.373	53.034	.258	-13.006	-.071	238.642	1.186	-94.088	-.671
Purpose_Shop	693.587	3.092	669.923	3.449	828.583	3.240	604.722	2.663	913.932	3.652	411.099	2.358
Purpose_Recreation	90.560	.481	64.670	.397	427.650	1.992	144.567	.758	249.545	1.188	21.436	.146
Purpose_Others	96.561	.515	65.579	.404	434.934	2.034	289.971	1.527	371.361	1.774	105.245	.722
WLKDIST2	-3.794	-.049	83.223	1.250	-88.701	-1.012	50.478	.648	71.761	.836	50.674	.848
WLKDIST3	-124.222	-1.043	-68.650	-.666	-100.965	-.744	-85.418	-.709	69.037	.520	-96.864	-1.047
CRSEXP	-245.358	-2.920	-192.536	-2.646	-125.372	-1.309	-160.405	-1.886	-136.380	-1.455	-54.360	-.833
Frequency	282.645	2.784	191.818	2.182	311.864	2.695	185.274	1.803	89.476	.790	120.730	1.530

	WTP1		WTP2		WTP3		WTP4		WTP5		WTP6	
Variables	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
CRSEXPFMLY	14.073	.161	79.369	1.047	13.414	.134	53.731	.606	39.852	.408	64.432	.947
Perception	119.841	.960	71.724	.663	-158.342	-1.112	74.955	.593	67.402	.484	42.338	.436

The summarized result from regression analysis for all the six scenarios is shown in the Table 4-18. The regression analysis results revealed that some variables have significant effect on WTP for fatality risk reduction.

Age is found to be a significant factor affecting WTP1. The positive sign associated with age indicates that higher the age of pedestrian higher the amount of money they are willing to pay to reduce fatality risk.

Marital status is another significant factor affecting WTP. Marital status found to have significant effect on WTP1, WTP2 and WTP3. In all the three scenarios marital status found to have negative effect on WTP. The negative associated with marital status refers that married respondents are less willing to pay for risk reduction than that of unmarried respondents. Similar type of finding was found in a study conducted in Sudan on pedestrian by Mofadal et al. (2015).

Education is another significant that affects WTP values. Education have positive significant effect on WTP1, WTP4 and WTP5. The positive sign on education_higher indicates that respondents with higher education background are willing to pay more money to be safe.

Occupation also significantly affects WTP values. Occupation_1 have positive significant effect on WTP3, WTP4, WTP5 and WTP6 which reveals that respondents with government job are more willing to pay for safety.

Family income is another significant have that affects WTP values. Family income have significant effect on WTP1, WTP2 and WTP5. The negative sign on family income for all three WTP indicates that respondents coming from higher income family tends to pay less for their safety. The result is contradictory to the expectation. This might be because higher the family income, people would tend to prefer private vehicle rather than walking.

Another significant factor that affects the WTP values is purpose of trip. The respondents who make trip for shopping purpose found to have positive significant on WTP2, WTP3, WTP5 and WTP6. Similarly the respondents who are making trip for recreation and other purposes also found to have positive significant effect on WTP3. Hence the respondents

who are travelling for shopping, recreation purposes are willing to pay more than who are travelling for working purpose.

Frequency is another significant factor that affects respondent's willingness to pay to reduce fatality risk. Positive sign associated with frequency reveals that respondents who travel daily or more than once in a week are more willing to pay for risk reduction.

Similarly another significant which affects WTP value is crash experience. Crash experience have negative significant effect on WTP1 and WTP2. Similar result was found by Budhha Maharjan in crash cost analysis of motorcyclist. In his study also the motorcycle riders who had experienced crash in past were less willing to pay to reduce risk. In crash cost analysis of motorcyclist in Thailand too, respondents who had experienced crash were less likely to pay when compared with those who have never experienced crash.

The R Square value of 0.207, 0.201, 0.233, 0.207, 0.193 and 0.192 for WTP1, WTP2, WTP3, WTP4, WTP5 and WTP6 respectively indicates that there is 20.7%, 20.1%, 23.3%, 20.7%, 19.3% and 19.2% relationship between dependent and independent variables in the respective models.

4.6 Validation

According to World Bank, the road crash cost is about 1 to 3 % of GDP for developing countries. In the study of crash cost analysis of motorcyclist by willingness to pay method (Buddha Maharjan, 2012), the ratio for cost of serious injury to fatality was taken as 0.3 and similarly that for cost of minor injury to fatality was taken as 0.03. So taking the same ratios in this study also.

In the fiscal year 2018/19, total 13366 crashes were recorded. In 13366 crashes, 2789 people lost their life, 4376 people sustain serious injury whereas 10360 people sustain minor injury.

If X is the crash cost per fatality, then total crash cost for fiscal year 2018/19 is obtained as:

Total Crash Cost = 2789*X + 0.3*4376*X + 0.03*10360*X

= 4412.6*X

As per Nepal Rastra Bank, the GDP of Nepal for fiscal year 2018/19 is NRs. 3464319 Million.

The lowest value of VOSL is for first scenario. For the first scenario, the VOSL is NRs. 7612601.21. Similarly the highest value of VOSL is for the second scenario which is NRs. 17461842.11. The total crash cost for first scenario is NRs. 33591364119 and that for the second scenario is 77052124474. The total crash cost for first scenario is about 0.97% of GDP whereas the total crash cost for second scenario is about 2.22% of GDP.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The crash cost of pedestrian is determined in terms of Value of Statistical Life (VOSL) using CV approach of WTP method. The VOSL of pedestrians in this study ranges from NRs. 7.61 to 17.46 million. The road traffic crash cost for the fiscal year 2018/10 was found to be 0.97% to 2.22% of GDP. Since the crash cost is determined without consideration of under reporting of road traffic crashes. With consideration of under reporting of road traffic crashes the total road traffic crash cost will be higher than the obtained value.

Apart from pedestrian crash cost, the paying nature of pedestrians for risk reduction is also determined on the basis of socio-economic and household characteristics and their walking behavior. Some major findings of the study are discussed below:

i. Respondents with higher level of education background are more willing to pay to reduce risk.
ii. Married respondents are less willing to pay than married respondents
iii. Respondents with higher family income are less willing to pay to be safe.
iv. Respondents who travel frequently i.e. daily or more than once in a week are more willing to pay to be safe.
v. Respondents with government job are more willing to pay to reduce fatality risk.
vi. Respondents who had experienced crash at-least once before are less willing to pay
vii. Respondents who travel for shopping and recreation purpose are more willing to pay than those who are travelling for working purpose.

5. 2 Recommendation

The study is limited to crash cost analysis pedestrian only. Further study can be done to determine overall road crash cost using WTP method.

The study is done using CV approach of WTP method. It is recommended to determine crash cost of pedestrian using other methods too.

From the study, the road crash cost of Nepal for F/Y 2018/19 was about 0.97%-2.22% of GDP. For a developing country like Nepal economic loss of 0.97-2.22% of GDP due to

road traffic crashes is a very huge amount. So DoR should take necessary actions regarding this and implement appropriate road safety measures to prevent road traffic crashes.

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ANNEX

Questions for Survey

Socio-Economic and Household Characteristics of Survey Respondents

1. Gender
    a) Male
    b) Female
    c) Others
2. Age ……..
3. Marital Status
    a) Married
    b) Unmarried
4. Education
    a) PHD
    b) Masters
    c) Bachelors
    d) Intermediate
    e) SLC
    f) Below SLC
    g) Uneducated
5. Occupation
    a) Government
    b) Private
    c) Own Business
    d) Student
    e) Specify if any other…….
6. Individual Monthly Income (NRS)
    a) Upto 5000
    b) 5000-10000
    c) 10000-25000
    d) 25000-50000
    e) Above 50000

7. Household Income (NRS)
    a) Upto 5000
    b) 5000-10000
    c) 10000-25000
    d) 25000-50000
    e) Above 50000

Walking Behavior of Survey Respondents

1. Trip Purpose
    a) Working
    b) Shopping
    c) Study
    d) Recreation
    e) Others (specify)……..
    f) No response
2. Frequency of trip
    a) Daily
    b) Once in a week
    c) More than once in a week (specify)……..
    d) Less than once in a week (specify)…….
    e) No response
3. Average Walking Distance (Km)
    a) <1
    b) 1-2
    c) 2-3
    d) 3-4
    e) >4
    f) No response
4. Pedestrian Crash Experience
    a) Never
    b) Once
    c) More than once (specify)……
    d) No response
5. Pedestrian Crash Experience of family members
    a) Never
    b) Once
    c) More than once (specify)……..
    d) No response
6. Perception of safety level as pedestrian
    a) Not Safe
    b) Low safety level
    c) Medium safety level
    d) High safety level
    e) No response
    f)

Valuation Questions

1. Suppose you are crossing a road without any crossing facility in which number of fatalities due to road traffic crashes is 100 per year. On provision of marked zebra crossing facility the number of fatalities will reduce to 12. How much are you willing to pay per year to use this facility?

   _____

2. Suppose you are crossing a road without any crossing facility in which number of fatalities due to road traffic crashes is 100 per year. On provision of pedestrian countdown signal facility the number of fatalities will reduce to 75. How much are you willing to pay per year to use this facility?

   _____

3. Suppose you are crossing a road without any crossing facility in which number of fatalities due to road traffic crashes is 100 per year. On provision of pedestrian overhead bridge facility the number of fatalities will reduce to 0. How much are you willing to pay per year to use this facility?

   _____

4. Suppose you are walking on a road without any walking facility in which number of fatalities due to road traffic crashes is 100 per year. On provision of sidewalk/footpath facility the number of fatalities will reduce to 15. How much are you willing to pay per year to use this facility?

   _____

5. Suppose you are walking on a road without any street light facility in which number of fatalities due to road traffic crashes is 100 per year. On provision of street light facility the number of fatalities will reduce to 40. How much are you willing to pay per year to use this facility?

   _____

6. Suppose you are walking in a city in which any pedestrian safety awareness program does not exist and number of fatalities due to road traffic crashes is 100 per year. On implementation of pedestrian safety awareness program the fatality will reduce to 50. How much are you willing to pay per year for this facility?