On Time-Distributions of Traffic Accident and of Its Related Factors: Pilot Study with Data Analysis for an Urban District with Complex Traffic Situation

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Abstract: To arrange effective measures for ensuring traffic safety, it is necessary to know when there is high risk of accidents. So, the time-distribution of road accidents has many practical meanings. But it is difficult to determine this distribution when database is not available. Furthermore, in Vietnam, these time-distributions are paid very few attentions. This paper presents results of a pilot study in cases of an urban area with highly complex traffic situation. By checking remained information in the ledges of police, based on found data, the study tries to find out an all-round time-distribution of accidents and of related factors such as causes, vehicles type and age of driver involving accidents in relations with hours of day, days of week and months of year. These results show that even in case of lacking database as Vietnam, time-distribution could be found and provide useful conclusion for traffic safety efforts.

Keywords: Road accidents; Time-distribution; Accident cause; Driver age; Vehicle type.

I. INTRODUCTION

To arrange effective measures for ensuring traffic safety, it is necessary to know when (and where[1]) there is high risk of accidents. So, the time-distribution (and spatial- one) of road accidents has very practical values. But it is difficult to determine this distribution when database is not available. Furthermore, in Vietnam, even if data are available, usually the distributions are uncovered partly only. To overcome these shortcomings, this paper presents results of a pilot study in cases of Long Bien, an urban area with highly complex traffic situation.

Long Bien is one of districts with high traffic volume of Hanoi, Vietnam. Together with that, land traffic accidents here occur more often than other areas: among 29 districts of Hanoi, it belongs to top 5 (see graph in Appendix No.2). Though many efforts of traffic police have been spent, but the situation could not be improved as wanted. That is why, a study has been carried out in 2011 with the task to clarify special features of traffic accidents here and to propose main orientations for the further activates in ensuring the traffic order and safety here. Special target is to determine time-distribution of accidents and related factors.

[1] But the question "Where" is out of study scope of this paper.

For this study, it is understandable that the availability of traffic accident data plays a very essential role. There are various research works based on data analysis such as (Duc N.H. 2012; Duc N.H. *et al*., 2011) and they provide many interesting information for efforts to curb accidents. Results of analysis with data of Hanoi have been published in JICA (2011), in which the authors concentrate on accident related aspects such as causes, vehicle, and drivers with some time-related conclusions. Before that, in JICA (2009), several conclusions on variations of accidents by time with data of 2001 have been published. Ivan K., *et al* (2012) present a case study to outline the manner in which road accidents are distributed in different moments in time, as well as their location in the city of Cluj-Napoca. With 190 analyzed accidents, between the years 2010 and May 2012, they have registered higher values of accidents during daytime, during rush hours and during spring and autumn. Recently, Zheng Y. et al (2013) uses clustering analysis method to explore time-space characteristics distribution of traffic accidents including month distribution, annual average daily distribution, annual average daily time of occurrence distribution, road type distribution, road alignment distribution by analyzing about 458 thousands road traffic accidents in China from 2009 to 2010.

All these studies have been done under the availability of related traffic accident database. In developed countries, the availability of such database is so good that that any person could access related information, for example, by accessing the Website of the Unites Nations Economic Commission of Europe (UNECE)[2]. But unfortunately, in Vietnam generally, or in the case of Long Bien particularly, the data are not available for the fact that the related database is still in formation process. The information of accidents are written in the stacked ledgers of police and lost a lot. That is why; the local traffic safety authorities believe that no useful conclusions could be found from the available data source. So, the study team has checked every traffic accidents cases in three years 2008-2010 by original ledges and interviewed various eyewitnesses. After collection of data, analysis has been implemented straightforward and various results are presented in this paper.

Time-distribution of traffic accidents and of related factors have useful practical values. It provides usefull information for traffic safety work planning. Based on this time-distribution, it is easier to arrange limited resouces in a better manner by concentrating the efforts on the time with high-risk of accidents and reduce them in low-risk time, though in a careful level. So, these time-distributions shoud be known by the traffic safety stakeholders at all levels, especially, at the police teams who should prepare and implement routine traffic enforcement activities.

However, there are two main obstacles to do that. One is the above-said lacking of database, The second consist of used method. The stakeholders such as policemen, they prefer and can use simple method. In most of cases they can not use these methods that related to complex scientific concepts as the professional researchers. That is why, this paper would like to demonstrate that even straightforward method, could lead to useful conclusions on time-distributions of accident. So, policemen at lower level could deploy for their daily works.

For a better understanding of the situation, the paper begins with some essential information about the Long Bien district. After that, further sections will be used for present various results on:

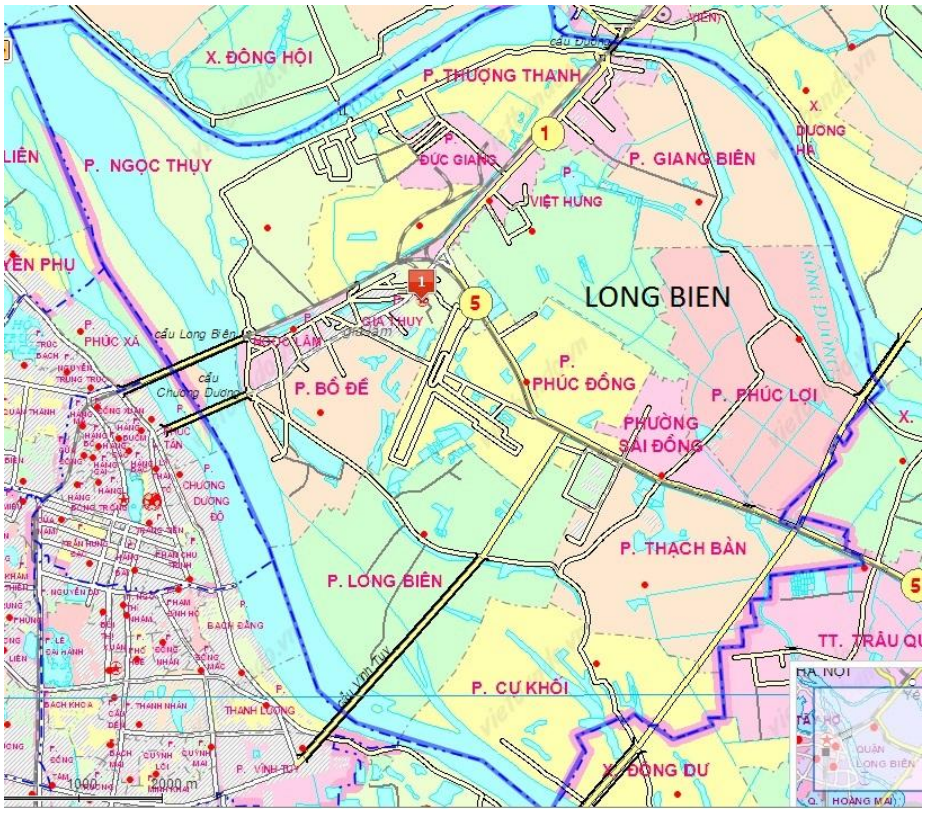
- Time-distributions of traffic accident regarding three indexes: number of cases, fatalities and injuries;
- That of three factors related to accidents: causes, type of vehicle and age of driver involving accident.

[2] http://w3.unece.org/pxweb/database/STAT/40-TRTRANS/01-TRACCIDENTS/

- These distributions of the above quantities will be considered in relation with hours of day, days of week and months of year.

2. MAIN TRANSPORT RELATED SPECIAL FEATURES OF THE PILOT ZONE

Long Bien, the pilot zone, has an area of 6038.24 hectares (60.38 km²), population of 245,400 people in 2011 (HSO, 2012). From a sub-urban region, it becomes an urban district on November 06, 2003 with a population of 170,706 people at that time (2003). Averaged growth rate of population at 4.64 % is very high in comparison with the nationwide rate at 1.30-1.35%.



Source: Government Office

Figure 1 Long Bien district

Long Bien district has a very important strategic position on political, economic and social culture of Hanoi and the country. It has important traffic routes such as railways, roads, waterways, airways connecting to the northern, north-east. Here there are many important locations such as Gia Lam airport, military areas etc. There are also many industrial ventures with foreign countries such as: the high-tech industry Sai Dong B, Sai Dong industrial Zone A, many of the economic-, cultural-, scientific-, technical-, bodies; vaious factories, production units of the central business city and nationwide. Especially with the advantage of Hanoi's gateway location, it connects to the axis of economic triangle Hanoi - Hai Phong, Quang Ninh, as well as a vibrant economic axis of economic integration in the region and the world.

Regarding transport system, two road routes of Highway No.5 and Highway No.1A (old and new) and a Dyke route are well-known as highly traffic crowded. These routes include 7 bridges with very high traffic density: Long Bien, Chuong Duong, Duong, Phu Dong, Vinh Tuy,Thanh tri, Dong Tru.Together with that, thre are two railway routes: Long Bien-Yen

Vien, Long Bien- Phu Thuy (Gia Lam). So, it could conclude that the transport system here is complex with traffic flow at high density, both in day- and in night-time.

3. TRAFFIC ACCIDENT SITUATION IN 3 YEARS 2008-2010

3.1 General Situation

The values of three main indexes for traffic accidents of this district are shown in the Table 1. It is necessary to note that in this table, the so-called "collision" (accident with slight damage) are not included. All the three first categories of accident in most of cases have fatality. So, the data from table shows that the general level of accidents in Long Bien is serious. Though great efforts have been spent, but there is still high risk to increase.

Table 1: Distributions of road trafic accidents

Categories of Accident (*)	Number of Accident			Total	Rate %
	2008	2009	2010		
Exceptionally serious *(either ≥ 3 fatalities or bad sequences(*))*	7	1	2	10	1.3
Severely serious *(either 2 fatalities or bad sequences(*))*	39	42	50	131	17.0
Serious *(either 1 fatality or bad sequences(*))*	31	10	6	47	6.1
Slightly serious *(no fatality but bad sequence(*))*	169	166	248	583	75.6
Total	246	219	306	**771**	**100**
Population (1000 peo) (see HSO, 2012)	*220.8*	*227.1*	*233.5*		

Note: (*) See classification of traffic accident of Vietnam (in Appendices) Following this classification, at a same category, the number of fatalities could be different. For example, at “Serious” category, it could have either one fatality or nobody dead but bad consequence at defined levels. These levels are different depending on each category.

Source: Study team, except population data

Table 2. Number of fatalities, injuries by traffic accident 2008-2010

Long Bien District	2008	%	2009	%	2010	%	*3 years*
Number of accidents	246	31.9	219	28.4	306	39.7	771
Number of fatalities	53	35.3	44	29.3	53	35.3	150
Number of injuries	228	32.9	190	27.4	276	39.8	694
Number of damage-only cases	56	33.5	56	33.5	55	32.9	167
Number of fatalities per 100,000 persons	*24.00*		*19.37*			*22.70*	

Source: Study team

The Table 2 shows number of fatalities and injuries. From 2008 to 2010 occurred 771 cases: deadly was 150/771, took 19.5%. With 150 fatalities and 694 fatalities in 3 years, each year road traffic accidents caused averaged damage of 50 deaths and 231 injured people. Thus every 100,000 people of the Long Bien district would have about 19-24 people died by traffic accident. This rate is higher remarkably in comparison with the average number nationwide (at number of 15, see JICA, 2009)!

The Table shows that the number of damage-only accidents seems under-reported. It is believable, because, in Long Bien as in nationwide, the data of traffic police have at least five popular shortcomings, especialy, under-reported (Duc N.H. *et al.*, 2011).

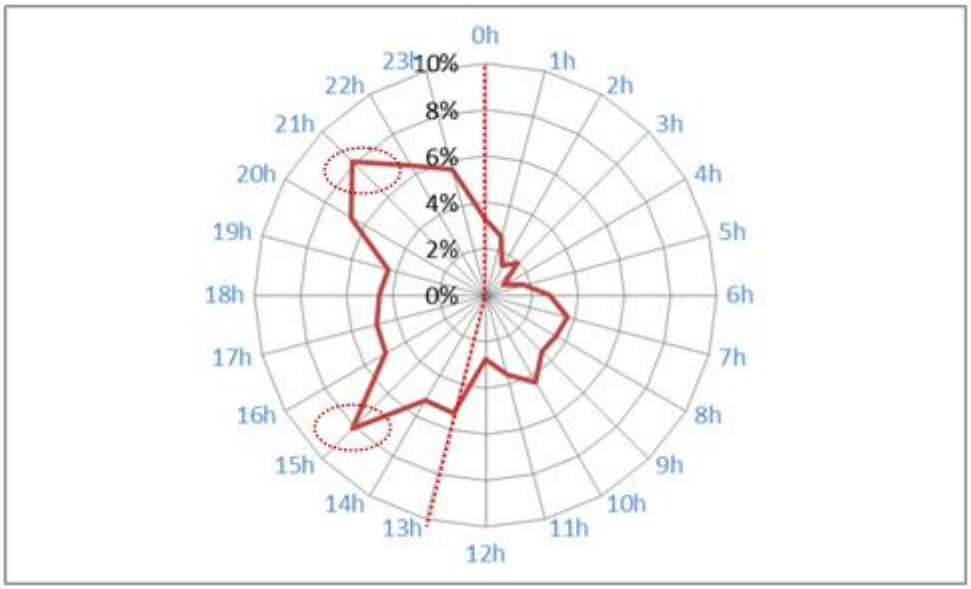
3.2 Time-Distribution of Traffic Accidents

The time-distributions of Traffic Accidents ussually have practical meanings: if the time-interval of high risk for accidents is known, efforts could be mobilized to curb the situations effectively. In this section, following time-distribution will be considered:

- Distribution of accidents with three indexes (number of cases, fatalities and injuries) by hours of day;
- Similar distribution with days of week and months of year.

3.2.1 Distribution of traffic accident by hours of day

The average distribution of accidents in 24 hours of a day is presented in the Figure 2. It is easy to remark that in a day, there are averagely *two intervals: from 0h00 until 13h00 is the time with fewer accidents, while from 13h00 until 24h00, most accidents occur*. Especially that there are two peak hours for accidents: 15h00-16h00 and 21h00-22h00. *This peak hours are different with peak hours of traffic flow* (06h00-08h00 and 16h30-19h30). In the peak hours of traffic flow, many police, inspectors are on road to control the traffic. But in the peak hours of accidents, the enforcement force reduced while the people try to use the time for completion of their works and hurry to go home.

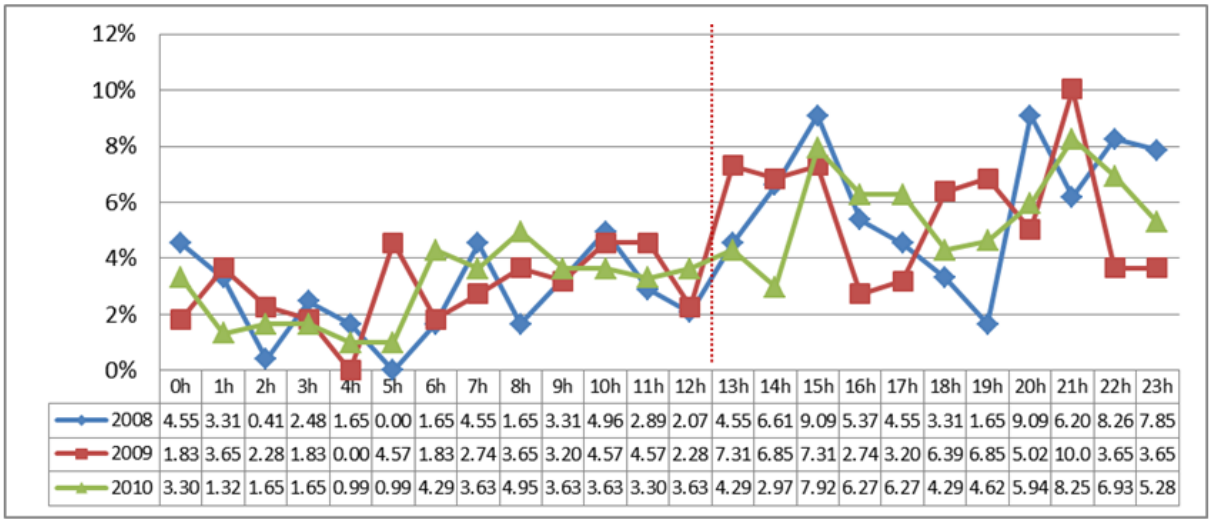


Source: Study team

Figure 2. Average distribution of accidents in 24 hours of a day

Figure 3 presents a comparison of this average distribution of accidents in 24 hours of a day for each year in 2008-2010. Basically, the distribution of every year has similar behavior as said before. In all years, accidents concentrate mainly after 13h00. This means that from year to year, this situation is not improved probably because the local authorities do not know this behavior and there are no special efforts.

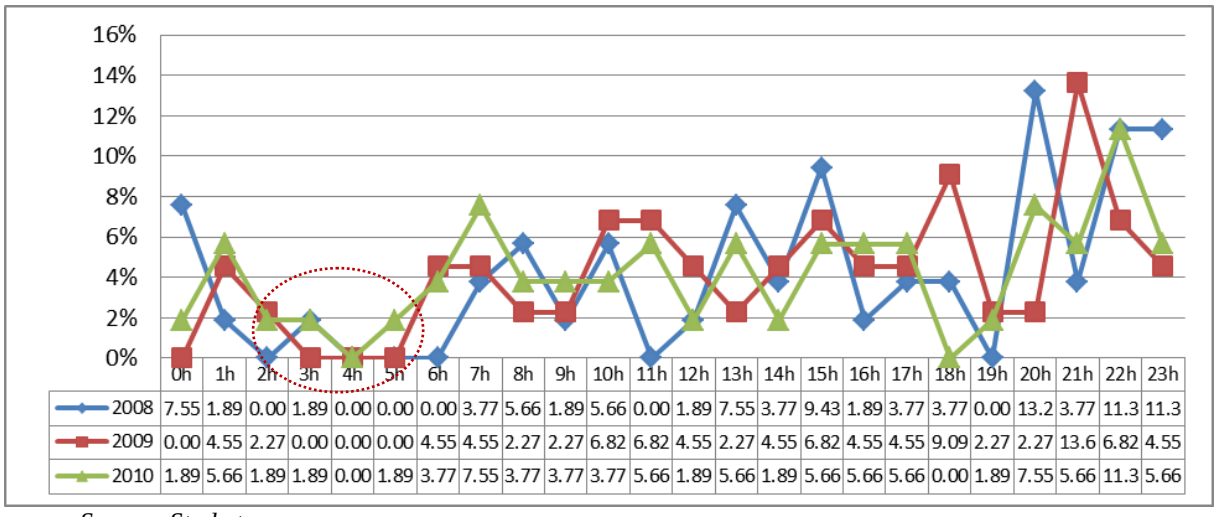
Figure 4 and 5 show average distributions of fatalities and injuries in 24 hours of a day for each year. It is not difficult to remark that they have similar behavior. Especially, both fatalities and injuries are fewest in the time interval from 2h00 until 6h00, it coincides with the lowest traffic volume on road.



	0h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h
2008	4.55	3.31	0.41	2.48	1.65	0.00	1.65	4.55	1.65	3.31	4.96	2.89	2.07	4.55	6.61	9.09	5.37	4.55	3.31	1.65	9.09	6.20	8.26	7.85
2009	1.83	3.65	2.28	1.83	0.00	4.57	1.83	2.74	3.65	3.20	4.57	4.57	2.28	7.31	6.85	7.31	2.74	3.20	6.39	6.85	5.02	10.0	3.65	3.65
2010	3.30	1.32	1.65	1.65	0.99	0.99	4.29	3.63	4.95	3.63	3.63	3.30	3.63	4.29	2.97	7.92	6.27	6.27	4.29	4.62	5.94	8.25	6.93	5.28

Source: Study team

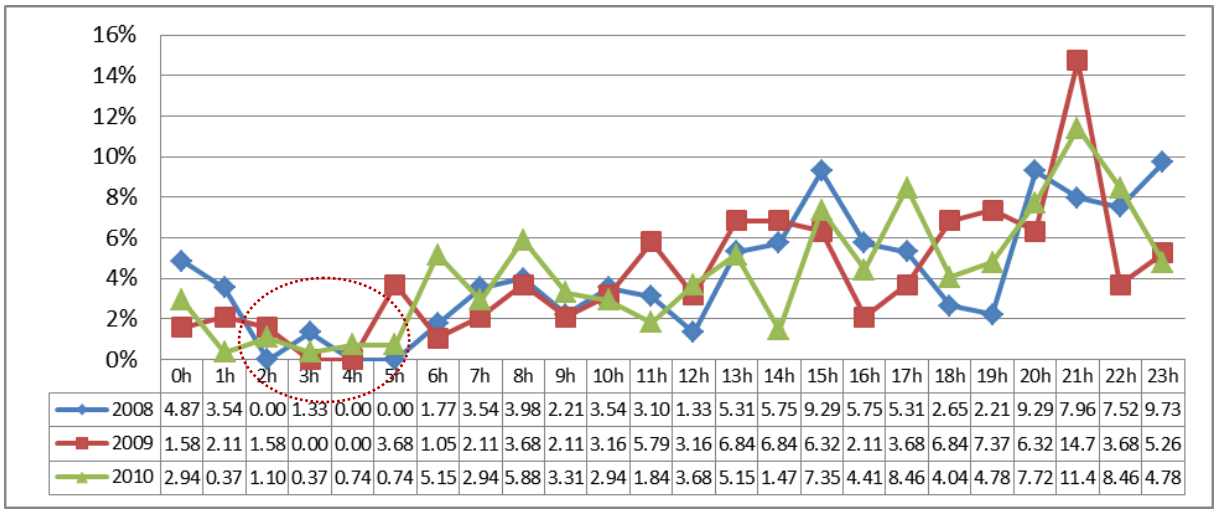
Figure 3. Variation of distributions of accidents in 24 hours of a day



	0h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h
2008	7.55	1.89	0.00	1.89	0.00	0.00	0.00	3.77	5.66	1.89	5.66	0.00	1.89	7.55	3.77	9.43	1.89	3.77	3.77	0.00	13.2	3.77	11.3	11.3
2009	0.00	4.55	2.27	0.00	0.00	0.00	4.55	4.55	2.27	2.27	6.82	6.82	4.55	2.27	4.55	6.82	4.55	4.55	9.09	2.27	2.27	13.6	6.82	4.55
2010	1.89	5.66	1.89	1.89	0.00	1.89	3.77	7.55	3.77	3.77	3.77	5.66	1.89	5.66	1.89	5.66	5.66	5.66	0.00	1.89	7.55	5.66	11.3	5.66

Source: Study team

Figure 4. Number of fatalities of traffic accident in 24 hours of a day



	0h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h
2008	4.87	3.54	0.00	1.33	0.00	0.00	1.77	3.54	3.98	2.21	3.54	3.10	1.33	5.31	5.75	9.29	5.75	5.31	2.65	2.21	9.29	7.96	7.52	9.73
2009	1.58	2.11	1.58	0.00	0.00	3.68	1.05	2.11	3.68	2.11	3.16	5.79	3.16	6.84	6.84	6.32	2.11	3.68	6.84	7.37	6.32	14.7	3.68	5.26
2010	2.94	0.37	1.10	0.37	0.74	0.74	5.15	2.94	5.88	3.31	2.94	1.84	3.68	5.15	1.47	7.35	4.41	8.46	4.04	4.78	7.72	11.4	8.46	4.78

Source: Study team

Figure 5. Number of injuries of traffic accident in 24 hours of a day

3.2.2 Distribution of traffic accident by days of week

The distribution of traffic accidents by days of week could be useful because the traffic police could know, on what day of week they should enhance their activities.

The next table shows that a curious result that on traffic safety point-of-view, *Monday seems the best* with lowest number of cases, fatalities and injuries. This could be explained by the fact that the people feel better after weekends.

It is remarkably that there are difference behaviors among three accident indexes: numbers of cases, of fatalities and of injuries. The *numbers of traffic accident cases* and *number of fatalities* varies not so much. A little higher number reaches in Saturday but value of Chi-squared test shows that there is no significant difference between days of week.

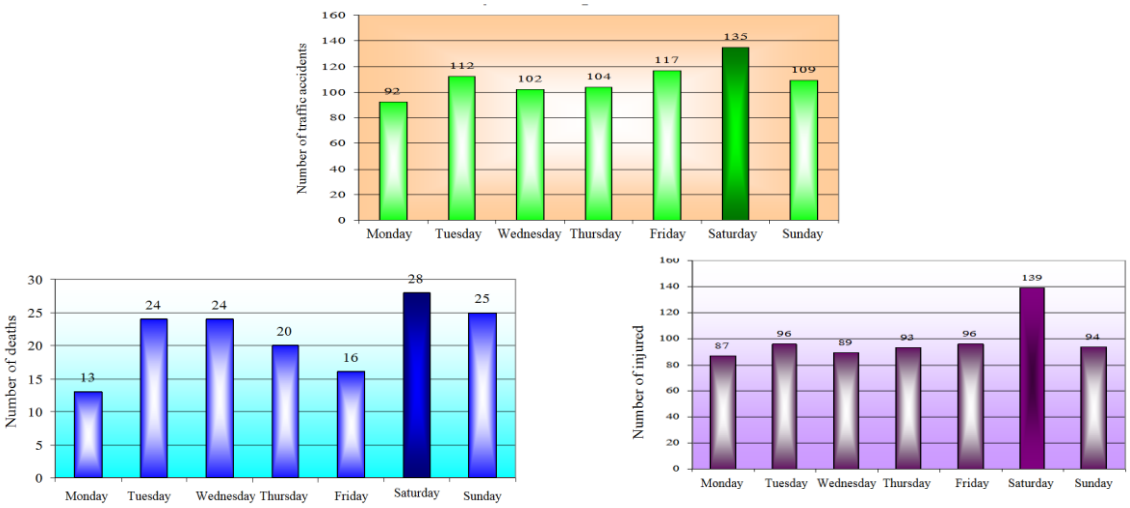
In the contrary, the *number of injuries* in Saturday is significantly higher than other days (p=0.00355 only).

Table 3. Distribution of traffic accidents by days of week

Day	Accident cases		Fatalities		Injuries	
	Number	%	Number	%	Number	%
Monday	92	11.93	13	8.67	87	12.54
Tuesday	112	14.53	24	16.00	96	13.83
Wednesday	102	13.23	24	16.00	89	12.82
Thursday	104	13.49	20	13.33	93	13.40
Friday	117	15.18	16	10.67	96	13.83
Saturday	135	20.00	28	18.67	139	20.03
Sunday	109	14.14	25	16.67	94	13.54
Total	771	100.00	150	100.00	694	100.00
χ^2 statistic	*10.01297*		*8.01333*		*19.39481*	
p (*)	*0.12411*		*0.23713*		*0.00355*	

Note: (*) p is calculated by the function Chisq.test. It is the probability that a value of the χ^2 statistic at least as high as the value in the table could have happened by chance under the assumption of independence.

Source: Study team



Source: Study team

Figure 6. Distribution chart of traffic accidents by days of week

The above-conclusions could be explained by the traffic volume on Saturday. On the first day of weekend, more people move in- out of Hanoi through Long Bien gate and the traffic volume increases approximately at a critical threshold. The police usually enhance

enforcement activities on Saturday more than others so that the numbers of accidents and of fatalities are under control, but the risk of strong collisions is higher that leads to higher number of injuries.

These conclusions seem different with published results, for example in JICA (2009) and JICA (2011), where there was no significant difference between days of week. Such difference could be explained by the fact that in this reference, data are of 2001 and of nationwide.

3.2.3 Distribution of traffic accident by months of year

The data of next table and figure describes the distribution of traffic accident by months of year. It is not difficult to notice that December has highest risk of accidents in terms of *number of cases*. The result of Chi-squared test in the Table 4 justifies that. This could be explained by the fact that the fiscal year ends on December 31 and all agencies would hurry up to complete their action plan targets. Another thing is related to preparation works for Tet holidays (Lunar New Year) that normally occur later, in January or February.

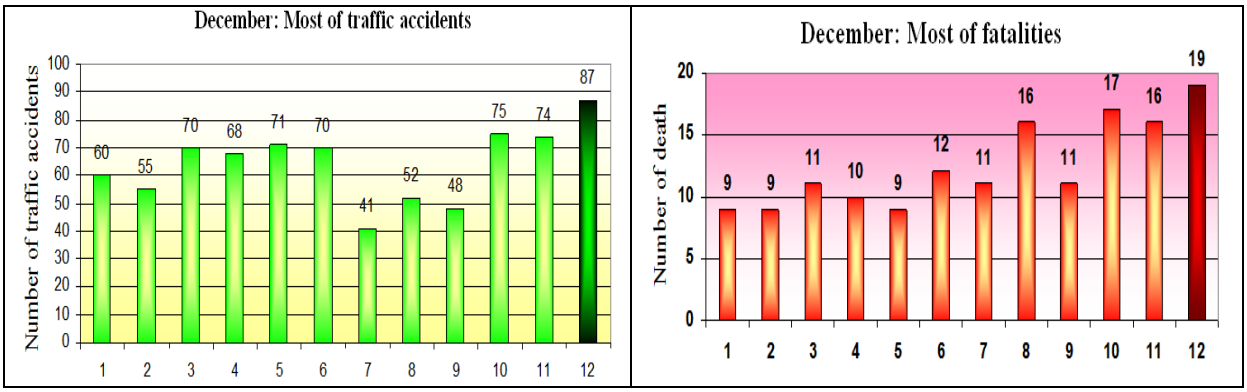
Regarding *number of fatalities*, the associated number in December is a little higher than other months, but the difference is insignificant as shown by the relevant value of Chi-squared test. In contrary to that, the Chi-squared test so a very small probability in case of *injuries number* and there are months with very few injuries as July and September. In term of traffic safety, *July and September seems the best*. It could be related to the weather situation. It is usually, these months have very good weather conditions: not too hot, not too cool etc. Together with that, in July there are summer-holidays of many universities and a great percentage of students stay at their home outside of Long Bien while September is usually traffic-safety month with many actions of local authority.

Once again, these conclusions seem different with other published results, for example in JICA (2009) and JICA (2011), where February has greatest risk of accident. As said-before, such difference could be explained by the fact that in this reference, data are of 2001 and of nationwide.

Table 4. Distribution of traffic accidents by months of year

Month	Case		Fatalities		Injuries	
	Number	%	Number	%	Number	%
January	60	7.78	9	6.00	59	8.50
February	55	7.13	9	6.00	52	7.49
March	70	9.08	11	7.33	60	8.65
April	68	8.82	10	6.67	53	7.64
May	71	9.21	9	6.00	72	10.37
June	70	9.08	12	8.00	74	10.66
July	41	5.32	11	7.33	33	4.76
August	52	6.74	16	10.67	54	7.78
September	48	6.23	11	7.33	36	5.19
October	75	9.73	17	11.33	71	10.23
November	74	9.60	16	10.67	61	8.79
December	**87**	**11.28**	19	12.67	69	9.94
Total	771	100.00	150	100.00	694	100.00
χ^2 statistic	*29.76265*		*10.96000*		*33.57349*	
p (*)	*0.00173*		*0.44662*		*0.00042*	

Note: (*) see note of the Table 3.
Source: Study team



Source: Study team

Figure 7. Distribution chart of traffic accidents by month of year

4. FACTORS RELATED TO TRAFFIC ACCIDENT AND THEIR TIME--DISTRIBUTION

In this section, time-relations of following factors will be considered: traffic accident causes; type of vehicles involving accident and age of the driver involving accident.

4.1 Time-distribution of traffic accidents causes

4.1.1 Traffic accident cause types

From the details of collected data and because for one accident there would be one or more causes, with 631/771 cases (82%), the study team has identified 862 reasons. The results of analysis are shown in the Table 5 and Figure 8.

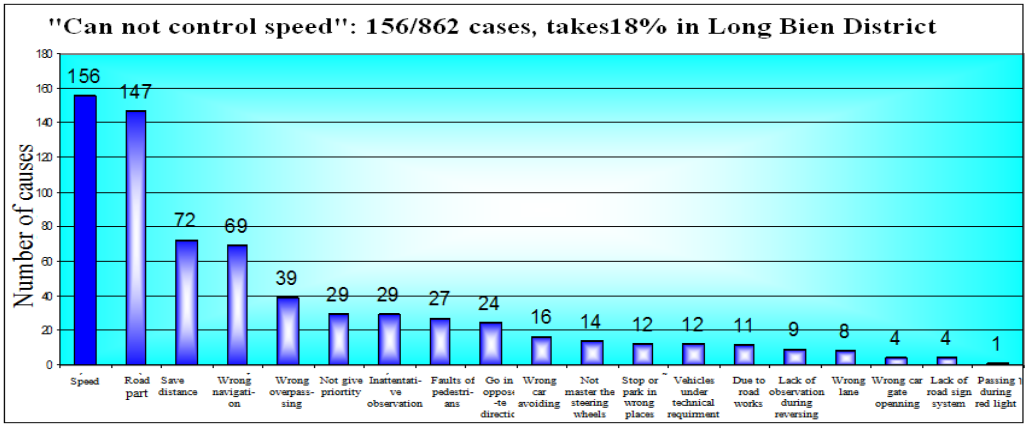


Figure 8. Types of traffic accident causes

From the table, there are 19 main causes that lead to about 80% cases of accidents. Among them, there are two top causes that contribute 17-18% of accidents. They are "Can not control speed" and "Driving on wrong part of road". It is remarkably that while the first cause leads to more accidents, the second leads to more serious sequences, especially, the number of cases with fatalities by the second cause is double the first cause. This “Driving on wrong part of road” is considered by police as one of major violation, for it could lead to high risk of accident and impact badly on traffic order. It is the case, for example, when the

car/motorcycle driver either run on road part special for pedestrian or even on sidewalk or when a motorcycle driver runs on expressway dedicated for high-speed car only.

Table 5. Main types of traffic accident causes

No.	Cause	Total of cases		With fatalities		With injuries	
		Number	Rate %	Number	Rate %	Number	Rate %
1	Can not control speed	156	18	15	9.3	141	18
2	Driving on wrong road part	147	17	30	19	168	21
3	Safe distance	72	8.4	5	3.1	29	3.7
4	Wrong navigation by regulations	69	8	14	8.6	63	8
5	Wrong overpassing	39	4.5	12	7.4	27	3.4
6	Do not give the priority	29	3.4	13	8	40	5.1
7	Inattentive observation	29	3.4	7	4.3	19	2.4
8	Fault of pedestrians	27	3.1	11	6.8	26	3.3
9	Driving in the opposite direction	24	2.8	4	2.5	33	4.2
10	Wrong car avoiding	16	1.9	1	0.6	15	1.9
11	Cannot control the steering wheels	14	1.6	0	0	8	1
12	Stop or park in wrong place in contravention of the regulations	12	1.4	2	1.2	9	1.1
13	Vehicles not meet technical requirements	12	1.4	1	0.6	10	1.3
14	Due to road works	11	1.3	2	1.2	4	0.5
15	Lack of observation during reversing	9	1	0	0	3	0.4
16	Wrong lane	8	0.9	3	1.9	4	0.5
17	Wrong car gate opening by regulations	4	0.5	0	0	4	0.5
18	Lack of road sign system	4	0.5	1	0.6	5	0.6
19	Passing during red light	1	0.1	1	0.6	1	0.1
20	Unknown	179	21	40	25	174	22
	Total	**862**	100	**162**	100	**783**	100

The lessons from this table consist of the fact that efforts of traffic police should be paid specially to the two above-said causes and the propaganda activities should be enhanced to the people that they would get high risk if they could not control the speed and drive in wrong part/lane of road.

4.1.2. Distribution of accidents causes by hours of day

This distribution is important for they would provide transport authorities what time intervals they should concentrate their enforcement to limit the risk of accident.

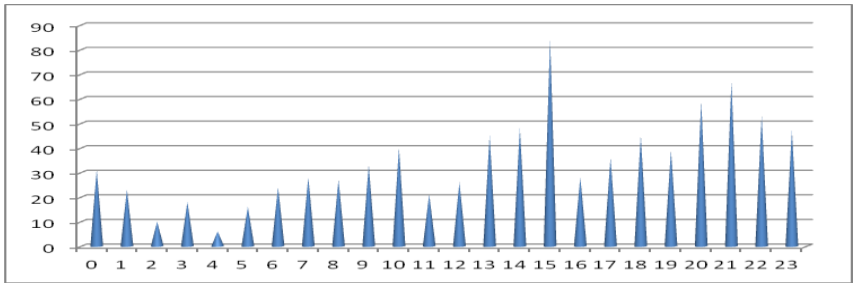


Figure 9. Number of traffic accident cases by hours a day (2008-2010)

The full distribution of accidents with all causes by time of day is summarized in the Appendices The above figure 9 shows that the period often occurring accidents in a day are: 15h00-15h59 and 21h00-21h59 with 62/771 accidents (about 8%). But from 21h00 to 21h59 there were 77/694 injuries with the highest rate of 11% and from 22h00 to22h59 there were15/150 deaths (10%). The accident did not happen during peak hours, but after the lunch, dinner time. Typically, during this period the traffic density is lower, the driver operates with higher speed. Besides that, in evening time the light conditions are insufficient. This situation together with vision limitation and the carelessness of driver are also the cause of traffic accidents.

The above-said conclusions demonstrate that enforcements by police should be enhanced in night-time and the safety facilities for night-time in infrastructure should be improved.

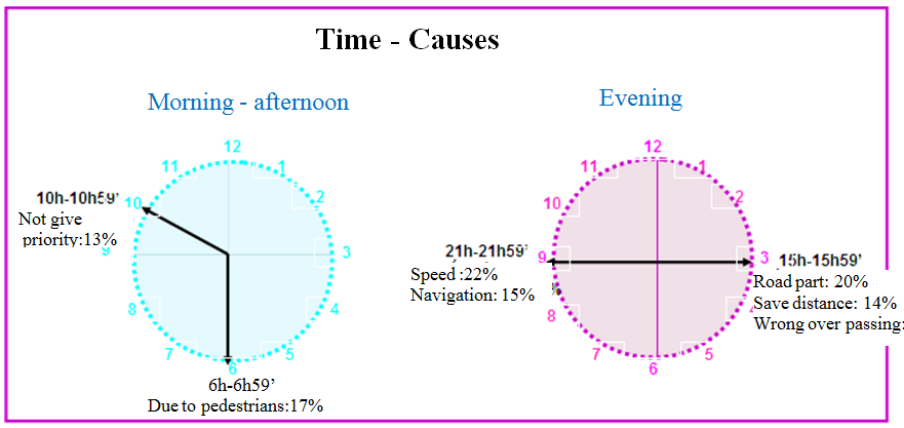


Figure 10. Time with high risk in relation with causes

Figure 10 shows that different causes are concentrated in different time of day: In earlier morning (6h00 am) many people go outside to do morning exercises and that could lead to risk of accident. At 10h00-11h00 is the time for light trucks run and they often ignore priority regulation on road. In night-time, many trucks run on Highway and over-speed is occurred often.

4.2 Type of vehicles involving traffic accident

Regarding vehicle composition, registration data by police gives a percentage of 81.12% for motorcycle and 13.56% for car and truck while the rest 5.32% is for other types[3]. But for their geographic location, a great number of vehicles running in Long Bien territory, especially, on National Highway No.1A and No.5 come from other areas. That is why, survey in JICA (2011) also shows a greater percentage for car and truck (48.46%) and less for motorcycle (45.11%) and 6.43% for other types of vehicle.

The analysis of collected data in this district shows that as usual; motorcycles and car are two main types of vehicle involving accidents. This is quite understandable because they form a majority of vehicle in traffic circulation, too. But it could be considered as unusual, that the rate of motorcycle is approximately with that of car: 711/1413 cases, accounting for 50, 32%. Nationwide, the rate of motorcycle is larger remarkably, at 70% (see JICA, 2009). This could be explained by the above-said fact that in Long Bien, there are more cars than motorcycles on highways where a majority of traffic accidents occur.

[3] Source: JICA (2011)

It is interesting that vehicles registered in other provinces accounts 23% (including military vehicles accounted for 0.1%), registered in Hanoi accounts 65%. So for each 10 vehicles driving on the road, only 7 vehicles registered in Hanoi

The accident happened time with each object is statistically as follows:

- Morning-Noon:
  - 7h00'-7h59: 'bicycle:8/40 cases, accounting for 20%
  - 8h00'-8h59: bus, passenger car: 7/54 cases, accounting for 20%
  - 11h00'-11h59: train: 4/19 cases, accounting for 21%.
- Afternoon-Evening:
  - 15h00'-15h59 ': cars under 9 seats, taxi, and truck: 51/523, accounting for 10%.
  - 20h00'-20h59 ': pedestrians; 7/55 cases, accounting for 13%.
  - 21h00'-21h59 ': motorcycles. 72/711

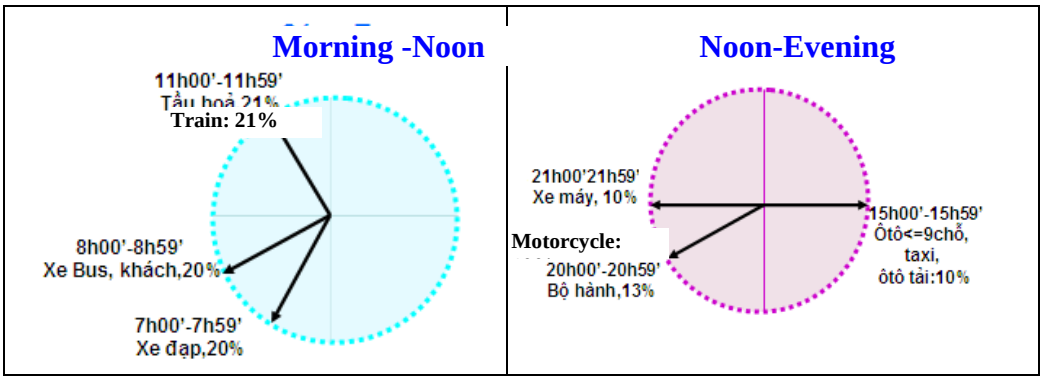


Figure 11. Chart of 24h in day of vehicle types involving most accidents

4.3 Age of the driver involving accident

By statistical calculation, the relation of traffic accident occurred time with the age of the driver could be found and presented in the Table 6.

Followings are various useful conclusions:

- Time from 10h00'-10h59: age from 60 upwards: 5/38, accounting for 13%;
- Time from 15h00'15h59: ages from 30-59: 50/710, accounting for 24%;
- Time from 21h00-21h59: ages from 16-24: 25/318, accounting for 17%;
- Time from 22h00'-22h59: ages from 25-29: 22/279, accounting for 8%.

So, it seems that *in the day time, traffic accidents focus on middle-aged or older and at night focus on the youth*. This fact could be explained that during night-time, younger people run with fewer care on road for their leisure while in the day-time, the older road users take a higher proportion in traffic flow for their living actions. The traffic police could improve their affectivity by concentrating their enforcement efforts on different kinds of road users on different time intervals.

In addition to the above time-relation, the types of accident causes in relation with the age of the driver are shown in the appendices.

Table 6. Relation between hours in a day with the age of the drivers

Time interval	Below 15	From 16-19	From 20-24	From 25-29	From 30-39	From 40-49	From 50-59	From 60 upwards	Unknown	Total	Rate %
00h00'-00h59'	0	2	10	8	10	6	2	0	10	**48**	3
01h00'-01h59'	0	0	6	8	4	5	2	0	1	**26**	2
02h00'-02h59'	0	0	3	2	6	3	2	0	2	**18**	1
03h00'-03h59'	0	0	6	4	6	2	1	0	1	**20**	1
04h00'-04h59'	0	0	2	2	1	0	1	0	3	**9**	1
05h00'-05h59'	0	0	4	5	3	4	1	4	1	**22**	2
06h00'-06h59'	1	3	4	5	7	6	5	3	3	**37**	3
07h00'-07h59'	1	2	6	7	13	10	5	4	4	**52**	4
08h00'-08h59'	0	1	5	5	16	11	5	2	5	**50**	3
09h00'-09h59'	1	4	3	5	11	12	5	3	2	**46**	3
10h00'-10h59'	0	2	13	10	17	9	5	**5**	3	**64**	4
11h00'-11h59'	1	2	8	6	13	9	5	1	3	**48**	3
12h00'-12h59'	1	1	8	6	14	6	1	1	5	**43**	3
13h00'-13h59'	0	3	11	11	15	14	5	1	2	**62**	4
14h00'-14h59'	1	4	9	12	18	6	6	4	4	**64**	4
15h00'-15h59'	1	4	13	15	**22**	**17**	**11**	2	4	**89**	6
16h00'-16h59'	1	5	5	10	19	13	2	1	4	**60**	4
17h00'-17h59'	0	6	5	11	18	14	2	1	6	**63**	4
18h00'-18h59'	0	5	12	12	12	8	4	2	2	**57**	4
19h00'-19h59'	1	4	10	10	13	11	4	1	2	**56**	4
20h00'-20h59'	1	4	16	14	20	15	2	1	9	**82**	6
21h00'-21h59'	1	**8**	**17**	15	17	16	7	1	3	**85**	6
22h00'-22h59'	0	6	14	**22**	14	7	7	1	8	**79**	5
23h00'-23h59'	0	6	11	12	18	8	3	0	1	**59**	4
Unknown	0	7	38	62	62	30	6	0	18	**223**	15
Total	**11**	**79**	**239**	**279**	**369**	**242**	**99**	**38**	**106**	**1462**	**100**
Rate %	**1**	**5**	**16**	**19**	**25**	**17**	**7**	**3**	**7**	**100**	

5. CONCLUSIONS

The paper has main following outcomes. First of all, it demonstrates that by a simple and straightforward method that anyone could use, traffic safety stakeholders could have practical information on time-distribution of accidents and use them in their work planning.

Secondly, it shows that although that database is not ready, at least in the case of Vietnam or similar countries, by efforts in collecting original information in the ledges of traffic police in a complex traffic pilot zone, the time-distributions could be determined comprehensively. Concretely, they are:

- Distributions of traffic accidents (with three indexes such as number of cases, fatalities, injuries) by hours of day, days of week and month of years;
- Similar distributions of three main related factors: accident causes, type of vehicle and age of drivers involving accidents.

Thirdly, from the found distributions, there are various interesting find-outs such as:

- The peak hours of accidents are different with peak hours of traffic flow.
- In a day, there are averagely two intervals: from 0h00 until 13h00 is the time with fewer accidents, while from 13h00 until 24h00, most accidents occur.
- The accident cases and fatalities occur without significant difference by days of week, but the day with most injuries in week is Saturday.

- The month with most accident cases and injuries in year is December while July and September seem the best under traffic safety point-of-view.
- There are 19 main causes that lead to about 80% cases of accidents. Among them, two top causes that contribute 17-18% of accidents are "Cannot control speed" and "Driving on wrong part of road".
- Car and motorcycle are two main types of vehicles involving accidents with approximate rate, while nationwide; motorcycle is the type of vehicle with remarkably higher percentage than car.
- In the day time, traffic accidents focus on middle-aged or older and at night focus on the youth.

It recommends that the proposed analysis could be extended for other areas and for spatial-distribution, too.

For the further development of the study in this paper, based on the analyses, certain models can be developed to forecast or predict severity or severity or rate of accidents for future scenarios. This could need additional data such as the vehicle fleet, driving licenses, traffic enforcement and others. Another orientation for next phase of study is the comparison of conclusions from traffic accident data as in this paper with the situation of traffic violations and of enforcement activities. This comparison could lead to useful comments on the efficiency and the effectiveness of police action planning.

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APPENDICES

No 1. Definition and classification of traffic accidents in Vietnam (MOPS, 2009)

1. Traffic accident is an event caused when road users, while in the road network violate traffic safety regulations or face unexpected occurrence resulting in specific damages to human lives, health, or properties of agencies, organization, individuals. Traffic accident includes:
    a. Traffic collision;
    b. Slightly serious traffic accident;
    c. Serious traffic accident;
    d. Severely serious traffic accident;
    e. Exceptionally serious traffic accident.
2. Traffic collision is an event caused when road users, while in the road network violate traffic safety regulations or face unexpected occurrence resulting in specific damages to health, or properties of agencies, organization, individuals less than slightly serious traffic accident.
3. Slightly serious traffic accident

Is a Traffic accident that does harm to health, property for people in at least one from followings?

a) Do harm to one person's health with degree of disablement from 11% to 31%;

b) Do harm to many people's health with each one's degree of disablement of fewer than 11%, but total degree of disablement of from 21% to fewer than 41%;

c) Causing property damage costing from 5 million VND to 50 million VND.

4. Serious traffic accident

Is a Traffic accident that does harm to health, property for people in at least one from followings:

a) Cause one dead.

b) Do harm to one or two persons' health with degree of disablement of more than 31% per one.

c) Do harm to many people's health with each one's degree of disablement of fewer than 31%, but total degree of disablement of from 41% to fewer than 100%.

d) Do harm to one person's health with degree of disablement of from 21% to 30% and cause property looses costing from 30 million VND to less than 50 million VND.

e) Do harm to many people's health, degree of disablement of under 21% per person, but total degree of disablement of these people are from 30% to 40% and cause property looses costing from 30 million VND to 50 million VND.

f) Cause property damages costing from 50 million VND to less than 500 million VND.

5. Severely serious traffic accident;

Is a Traffic accident that does harm to health, property for people in at least one from followings:

a) Causing 2 persons dead

b) Cause 1 person dead and bring about consequences as mentioned in sub-items b, c, d, f, and f of item 4 in this Article;

c) Do harm to three or four people's health with the degree of disablement of more than 31% per one.

d) Do harm to many people's health with total degree of disablement of from 101% to 200%.

e) Do harm to one or two people's health with degree of disablement of more than 31% per one and cause consequences as mentioned in sub-items b, c, d, đ, and e of item 4 in this Article

f) Cause property damages costing from 500 million VND to less than 1,500,000,000VND.

6. Exceptionally serious traffic accident.

Is a Traffic accident that does harm to health, property for people in at least one from followings:

a) Cause more than 3 people dead.

b) Cause 2 people dead and consequences as mentioned in sub-items b, c, d, e, and f of item 4 in this Article;

c) Cause one person dead and consequences as mentioned in sub-items b, c, d, đ, and e of item 5 in this Article;

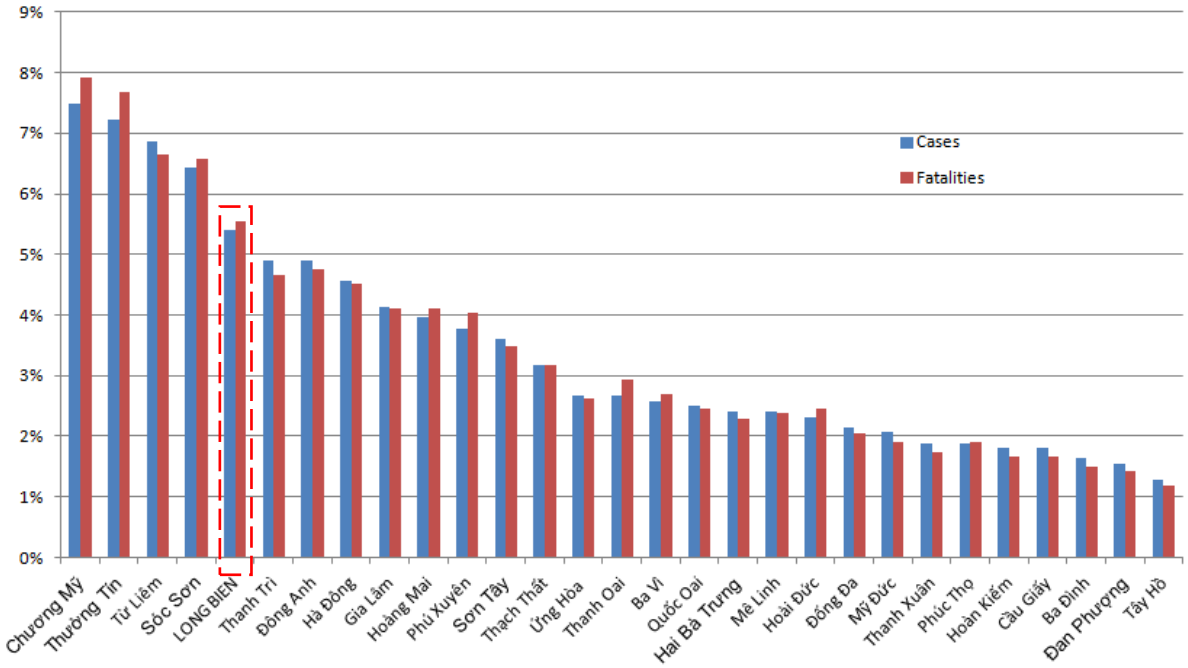
d) Do harm to more than 5 people's health with degree of disablement of more than 31% per one.

e) Do harm to many people's health with total degree of disablement of more than 200%.

f) Do harm to 3 or 4 people's health with degree of disablement of more than 31% per one and cause consequences as mentioned in sub-item e of item 5 in this Article.

g) Cause property damages costing more than 1,500,000,000 VND.

No 2. Percentage of traffic accident cases and fatalities among all districts of Hanoi (2008-2010)



Source: Study team

Figure A1. Percentage of traffic accident cases and fatalities of all 29 districts of Hanoi (2008-2010)

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