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GIS Analysis and Evaluation of Speed Characteristics Causing Crash Accidents in Eastern Province, KSA

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Abstract. Many people in the Kingdom of Saudi Arabia, KSA are suffering because of road accidents in spite of huge efforts to reduce fatalities. A recent study revealed that the most prominent factors leading to road accidents were incorrect behavior by the vehicle driver, failure to follow the regulations and continuous violations. Excessive speed ranks second in the causes of fatal traffic accidents, while crossing a red signal is the third factor. This paper presents the results of an evaluation and analysis of speed at different selected locations in Eastern Province, Kingdom of Saudi Arabia. The study was carried out along two major corridors in Eastern province: GCC and King Fahd highways. 88 site locations were studied thoroughly. The results showed that speed problems exist in some locations. The 85th percentile speeds were used to assess the drivers complains with posted speed. It was found that the percentage of drivers exceeding the posted speed varied according to the location. In some locations it exceeded 20% on average. The results showed that, based on the limited collected data, the posted speed in some locations may not be appropriate. The GIS analysis revealed that in the locations of high speed there is a high percentage of accidents.

Keywords: Saudi Arabia; GIS Analysis; Traffic Safety; Speed Characteristics; Speed Limits and Categories; Drivers.

List of principal symbols:

N: minimum size of sample,

s: standard deviation of the sample,

ε: allowable error, and

K: statistical constant

1. Introduction

Traffic speed analysis is one of the important studies in traffic engineering carried by agencies and governments for traffic safety. Its recommendations have a direct impact on society. Speed is an indication of mobility that can be used to evaluate performance for highways and streets. Speed limits are used to regulate traffic speed in most countries. Speed is an important factor in the assessment of transportation systems as they relate to the safety and efficiency of travel.

A recent study revealed that the most prominent factors leading to road accidents was incorrect behavior by the vehicle driver, failure to follow regulations and continuous violations. Excessive speed ranks second in fatal traffic accidents, while crossing red signals is the third factor. In order to achieve the goals of Vision 2030, which seeks to reach 8 deaths for every 100,000 citizens, with 26 cases in 2015, on all highway of the Kingdom more efforts have to be made. The Ministry of Transport and Logistics Services revealed that the number of traffic accidents deaths on its 68,000 km of roads decreased by more than 33% during 2018, compared to 2017 due to the implementation of a number of initiatives [1].

All over the Kingdom of Saudi Arabia (KSA), motor vehicles are the primary mode of transport between regions and cities. More than six-million motor vehicles navigate the highways of the KSA [2,3]. Historical data denotes that road traffic crashes victims represent 20% of the intake patients at medical-related institutions within the KSA, and 81% of the casualties, at these institutions, are a consequence of road-traffic crashes [2]. A total of 611,000 road-traffic crash victims and 86,000 road-traffic crash fatalities were over the past two decades. Furthermore, 7% of the road traffic crashes survivors subsequently became chronically disabled. Between 1997 and 2002, traffic crash fatalities within the KSA have increased by 31.6% for men and 1.3% for women. The majority of the recent studies in road-traffic crash within the KSA concentrated on young drivers between the age of 18 and 24 years. Mohamed and Bromfield [4] conducted a study to examine the connections between road-traffic crashes, driving behavior, and undeveloped male motorists' mindsets regarding road traffic safety in the Eastern Region of the KSA, using "structural equation modelling" (SEM).

The aims of this paper are to evaluate and analyze traffic speed along the two major corridors in Eastern province, KSA: King Fahad and GCC (Abu Hadriyah) Highways. The research paper will provide value in regards to emphasize driving situation and road safety concerns within the eastern region of KSA that

have an elevated number of traffic crashes. The research will examine the objectives using geographical information system model (GIS).

This paper documents the procedures of speed study carried out by the Saudi ARAMCO Chair for traffic Safety at Imam Abdulrahman bin Faisal University, at Dammam. It provides information on spot speed studies conducted along the two corridors.

2. Literature Review

Crashes can be considered to result from speeding, if the drivers have been charged with the offense of speeding by the police officers, or the officers confirmed that the vehicle was running too fast or exceeding the speed limit or racing [5]. Vehicle speeding is the most common contributing factor in accidents as reported by NHTSA in 2013 [5] and Bucsuházy et al. (2020), [6]. Fig. 1 below shows the distribution of causes of accidents for the Eastern Province. Speeding is among the most frequent traffic violations that contribute to accidents (Source: Ministry of Interior reports) [7].

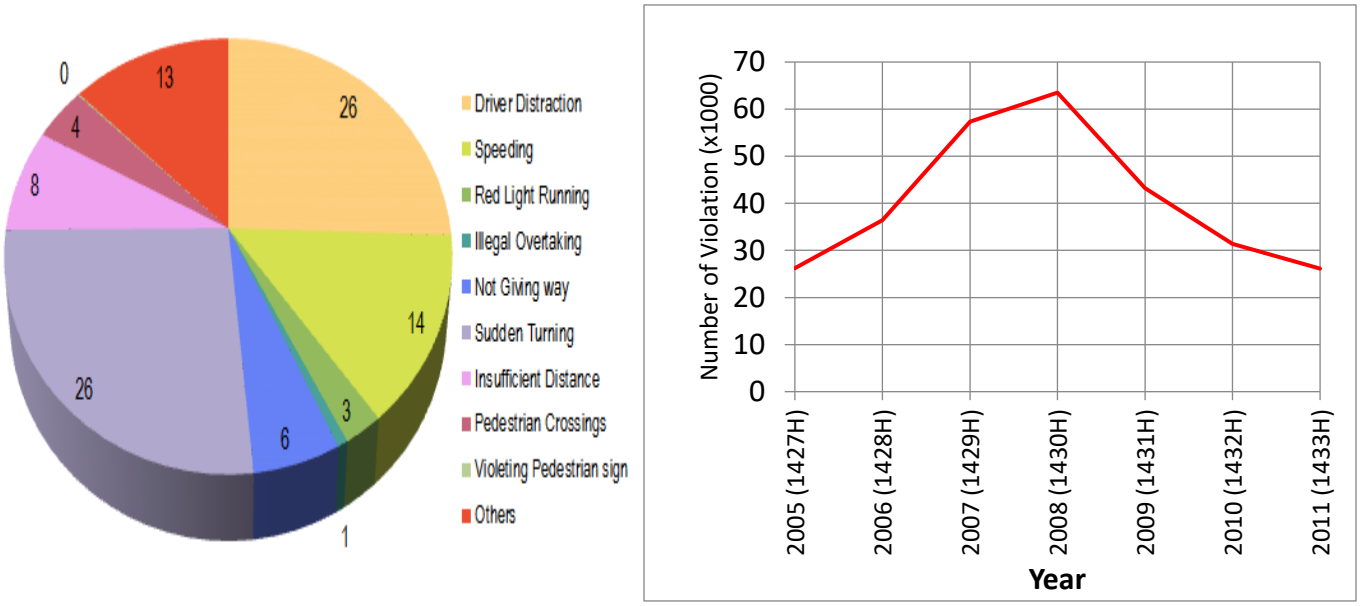


Fig. (1). Percentages of Crash Data and Accidents due Speeding [7].

A study conducted by Syed et al. (2012) [8] and Maji et al. (2018) [9] concluded that, for Malaysian highways, models of the 85th percentile speed on horizontal curves and before vertical curves can be developed successfully. These models highlight importance aspects of traffic speed on highways and vertical and horizontal curves as geometric design elements.

A study conducted by Tommaso et al. (2011) [10] concluded that the models for operating speed for design in Europe and USA were based on the alignment of the highways. The key issue to evaluate traffic safety was prediction of the operating speed at the design stage. With the help of models, engineers can predict the operating speed to enhance traffic safety. Ahmed (2013) [11] carried out research on the effecting of operating speed on traffic speed limit and geometric design. He concluded that the models from Artificial Neural Networks can predict speed with high confidence compared models of regression for predicting V85.

Paul and Sanjay (2005) [12] carried out a study to evaluate the speed camera and its effect on reducing traffic crashes and injuries. They concluded that speed camera has a great effect on reducing traffic crashes and injuries, although they have poor confidence level. It is believed most traffic agencies and municipalities engineers post reasonable speed limits based on their traffic studies (Currin, 2001) [13].

Traffic engineers usually use 50th and 85th speed as a tool to set a reasonable speed limit (Currin, 2001) [13]. For the collected and observed data, the 50th speed represents the median and the 85th speed corresponds to the speed at which 85% of the drivers are travelling. These speeds can be used for the recommendation of speed limits.

Some researchers, however, studied traffic speed and found that posted speed does not reduce traffic accidents or reduce the speed of vehicles [14,15,16,17]. In addition, posting speed below the 85th percent did not reduce traffic accidents or vehicle speed. They said that increasing posted speed does not increase traffic accidents or vehicle speed. They also concluded that, if posted speed is raised, the majority of vehicle drivers did not drive at speeds more than 8 to 16 km/h above limit, and that vehicle speeds will not be reduced even if the speed limit is lowered.

Generally, increasing vehicle speed increases the likelihood of an accident. Most traffic safety researchers try to correlate vehicle speed with traffic accidents. Most of them find good strong relationships between speed and the risk of traffic accident. They also find the likelihood of traffic

accidents increase as the speed differences along the road increase. The risk of traffic accidents increases with faster drivers.

High speed reduces the ability to respond in time when necessary (WHO, 2004) [18]. Mooren et al. (2013) [19] said that driving at speeds higher than the speed limit will affect driver behavior and make it difficult to avoid a serious traffic crash.

Utley (2012) [20] conducted a study on the effectiveness of speed cameras. He concluded that, on main highways and streets speed cameras had more effect on traffic accidents than in minor streets.

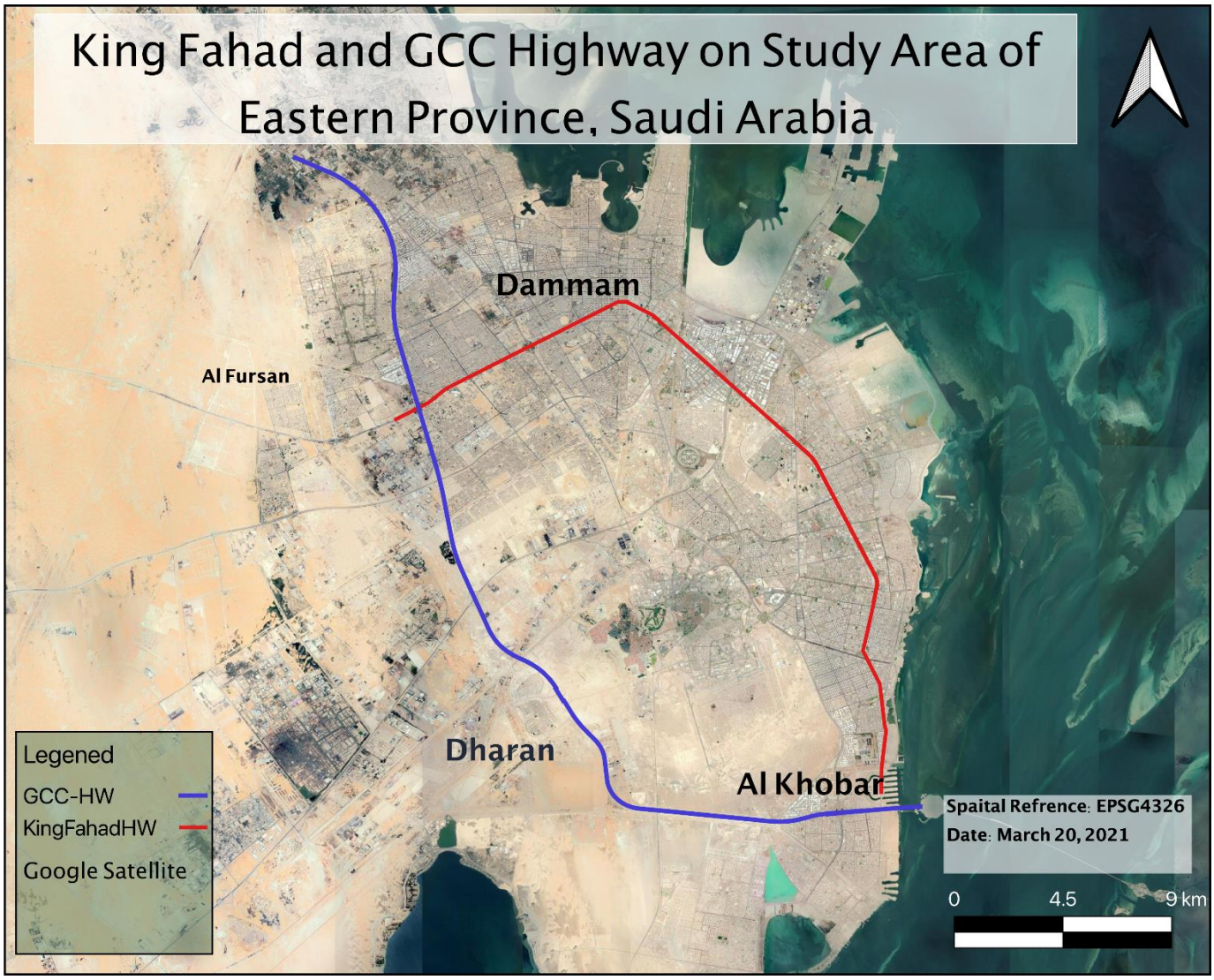


Fig. (2). King Fahad and GCC Highway on Study Area of Eastern Province.

3. STUDY AREA

Fig. 2 below shows the two major corridors in the study area: King Fahad and Gulf Cooperation Council (GCC) Highways. These two corridors had been selected for the study due to their importance and because the number of crashes and accidents fatalities rate are high in Eastern province. Also, there is a variety of land use including urban, suburban and rural areas. The first corridor: is 39 km of the King Fahad Highway (KF) and the second corridor is part of the GCC Highway 42 km in length. The study also covered the interchanges and intersections along the two corridors, with, a buffer distance of 800 m from the corridors to include the main streets, intersections and interchanges.

4. Research Methodology

The speed study was carried out through different tasks: literature review, data collection, field study, accident results analysis, discussions and reporting. Traffic crash data and information were collected for the selected corridors of King Fahad Highway and Abu Hadriyah Expressway (GCC) have been collected.

The study team initiated the speed study by searching for relevant previous studies along the two corridors (e.g., crash history, existing signage, traffic volumes…etc.) to identify the most critical areas along the corridors. Then the study team determined:

1- The types and amount of data to be collected based on previous studies.
2- The approximate locations for the data collection (marked on maps and plan sheets) Locations on straight sections with a level terrain were selected to avoid the longitudinal gradient effect on the speed, as well as to avoid the effect of horizontal curves and intersections traffic speed.
3- The times and days the data should be collected (mostly on working days, morning and afternoon sessions, i.e., peak traffic times)
4- The types of equipment that should be used (e.g., radar, road tube…. etc.) were selected according to their availability in the institution.
5- The person(s) responsible for data collection were assigned for reporting and collecting the data

5. Data Collection

To achieve the objectives of this research different sources and reports were used, e.g., reports from Highway Administration, accident, and speed reports. The collected reports give information that will reflect the traffic flow condition, road performance and operating characteristics of the highways under consideration. The collected reports of accident give more data such as the cause of the accident, collision rates, fatal and injury. A speed study survey was carried out to identify the 85th percentile speed (V85) and the posted speed (PS) at a selected location on the corridors. The objective of collecting the speed data was to analyze speed characteristics in the two corridors and to examine percentage of the drivers in compliance with speed limits and these results will later be correlated with the available traffic crash data in the second phase of the study.

150 vehicles will be studied on each site, or a minimum of one hour's survey incase 150 vehicles are not observed within this time. 88 locations have been coded and studied. The observers recorded the given instructions for completing the Speed Survey Form in case of using speed radar. Site's selection was based on the traffic crash data obtained from the police traffic department (Ministry of Interior) [7] and field visits to the two corridors as shown in Fig. 3.

5.1 Speed Sample Size Estimation

Standard deviation was used to calculate the sample size (FHWA, 2004) [21]. Robertson, 1994 [22] used equation 1 shown below to estimate the minimum size of the sample:

$$\boldsymbol{N = \left(\frac{k \times S}{\varepsilon}\right)^2} \qquad \textbf{(1)}$$

Where: N= minimum size of sample, *s* = standard deviation of the sample, ε = allowable error (assumed as 2km/hr), and *k* = statistical constant (assumed as 1.96 with level of confidence at 95%).

The standard deviation was obtained from a field survey and checked by a study conducted by Alghamdi et al (1998) in Riyadh [23].

According to these assumptions and from the above equation a sample size of 150 vehicles is required for each highway. Otherwise, if 150 vehicles cannot be reached on the site, then a minimum of one hour's speed survey will be carried out. Eighty-eight sites were selected and speed data collected accordingly.

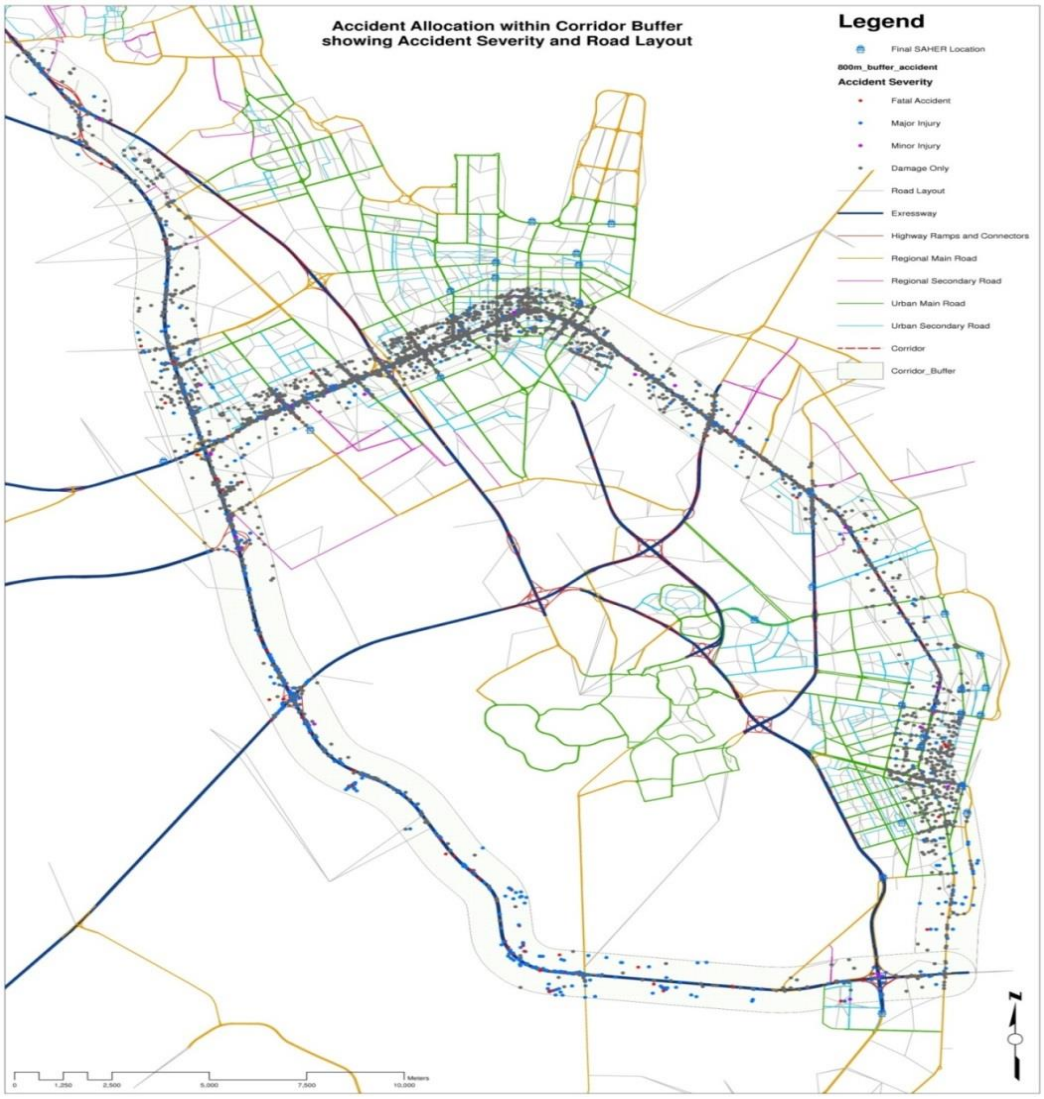


Fig. (3). Accident Occurrence within Corridor Buffer.

5.2 The Equipment used for collecting data:

Speeds were measured by speed gun radar, tubes and other accurate speed measurement techniques using Jamar Radar as shown in Fig. 4 below.

5.3 Presentation of Speed Data:

The data collected by the different means are summarized and tabulated in an Excel sheet for more detail. Different statistical parameters were calculated for each group of speed data using SPSS. Based on these results the 85percentile (V85) and 50percentile (V50) were determined for various site. Table

1 summarizes the statistical speed parameters, such as mean speed 85% percentile standard deviation and the posted speed.

Fig. (4). Jamar Radars and Speed Gun used for Collecting Data.

Table (1). Summary of Speed Study in some Locations, Posted Speed, 85th Percentile and Median Speed.

Site ID	Street Name	Posted Speed (km/h)	85th percentile Speed (Km/h)	Mean Speed (km/h)	Standard Deviation (km/h)
KH120South	King Khalid/AbuHydryi (to Khobar)	110	105	98.2	13.193
KH120North	King Khalid/AboHydryi (to Khobar)	110	110	100.25	14.14
KHP001A	Kornishst. at Khobar (to Khobar)	80	102	82.0	18.162
KHM020A	King Khalid st. (Algeria st.Thogba area)	100	103	95.6	11.632
DMM224	AbuHydriyast	120	132	124.1	15.847
DMM225	King Fahad (before AbuHydriyast)	120	125	115.4	14.978
DMM226	AbuHydriyast (between King Fahad and Riyadh st.)	120	140	128.3	16.918
DMM227	King Fahad (after AbuHydriyast)	120	123	113.8	14.890
DMM228	Riyadh st (East)	120	120	108.6	20.199
DMM229	Riyadh st (West)	120	135	117.3	17.812
DMM230S	AbuHydriyast (between Abgigst. & Riyadh st.)	60	94	79.52	19.843
DMM231	Abgigst. (East)	120	124	116.0	12.449
DMM232	AbuHydriyast (between Abgigst.and first bridge.)	120	140	122.69	18.874
DMM233	Abgigst. (West)	120	130	121.0	14.760

DMM234	AbuHydriyast (after second bridge towards Bahrain.)	120	140	122.8	20.091
DMMP050B	King Fahd (Near Sicceco)	110	107	98.65	10.712
DMMP050A	King Fahd (Near Sicceco)	110	114	107.8	12.845
DMMM100B	King Abdulaziz (from port to Abgig)	120	120	109.5	21.27
DMMM100A	King Abdulaziz (from port to Abgig)	120	130	121.1	14.00
DMMM101B	AbuHydriyast (after Alaziziyia area)	120	119	109.1	19.29
DMMM101A	AbuHydriyast (after Alaziziyia area)	120	135	122.74	19.134
DMMM10B	AbuHydriyast (after Abgig intersection)	120	120	108.1	20.10
DMMM10A	AbuHydriyast (after Abgig intersection)	120	136	110.5	18.27
DMMM103B	AbuHydriyast (near Amn Hospital)	120	118	110.6	20.20
DMMM103A	AbuHydriyast (near Amn Hospital)	120	132	122.74	19.134
DMMM104B	AbuHydriyast (after Jubail-airport intersection)	120	131	126.01	17.473
DMMM104A	AbuHydriyast (after Jubail-airport intersection)	120	135	122.74	19.134

6. Analysis and Discussions

One of the important procedures to study statistical measures on traffic engineering is spot speed. These essential statistical measures such as median speeds, speed distributions, pace, and 85^{th} and 98^{th} speed. This study was carried out along two corridors of more than 81 km in total length on selected locations to assess the required traffic flow conditions. Based on the collected speed data an in-depth analysis and evaluation was carried out on all 88 locations. The collected data showed variations in the 85th speed along the selected locations in "segments with the same posted speed limits".

The results showed the traffic speed under conditions of free flow. The survey of the study areas reveals that the posted speed of the highways and streets under consideration are 120, 110, 100, 90, 80, and 60km/h in various locations. These are the posted speed for national speed limits on highways and urban streets in KSA. Median and 85^{th} speeds are tabulated in Table 2, as well as the standard deviation and operating speed. The difference between operating and posted speed and percentage of vehicle drivers exceeding the limits are also presented in Table 2. Based on the calculated results in Table 2 the following points can be concluded:

- In all locations, 50^{th} speed is lower by almost one standard deviation than the 85^{th} speed. Similar results were found by other researchers [24] and this is a normal distribution
- The posted speed limit is similar in some locations but there is a variation of the 85^{th} speeds.

- Variation of exceeding posted speed varies from 3%, as in site DMM231 to 60%, in location KH100. Generally, an average of 20% drivers exceeds the posted speed. Number exceeding the posted speeds varied based on the site conditions, location and type of highway.
- The speed results showed that, in spite similar classification of the sites, there are differences in the 85^{th} speed. The deviation and variance for the observed data of drivers exceeding the posted speed will be clarified by considerations of geometry design, such as width of shoulders or pavement. However, development of the relationships between straight section characteristics and 85^{th} speed will be discussed later on crash model development.

Moreover, the study results showed that the posted speed in the majority of the street may not be appropriate for specific sites. Some researchers said that cautious drivers usually drive based on the traffic conditions and do not depend on the posted speed. Therefore, the actual speed on site should be observed in order to set efficient and comfortable speed limit taking into account the characteristics of the traffic and roadway.

Normally, most agencies in KSA use the 85th speed as a key factor for setting the posted speed. However, the results in Table 2 showed that drivers in highways tend to drive at high-speed exceeding the posted limit. In the case of sharp curves in horizontal alignment interrupting drivers' momentum, speed homogeneity forced them to run with or below posted speed. All these factors can increase the risk of potential accidents. A study conducted by Milton and Mannering (1998) [25] found similar results. According to some agencies and standards, the selected design speed is virtually equal to the 85^{th} speed [26].

The results showed that only a few vehicle drivers obey and commit to the speed limit if it is below the 85^{th} speed. Vehicle drivers tend to drive at a speed that is comfortable to them, usually above the speed limit Traffic accidents may increase as a result of speed differences. Fig. 5 shows the $85\%^{th}$ percentile for different locations with the same posted speed (120km/h). It seems that there are only two sites that drivers complain about the posted speed. In 4 sites the 85^{th} percentile speed (operation speed) is 140km/h with an increase of 17% from the posted speed. Similar results were also obtained at sites with a posted speed of 60km/h as shown in Fig. 6. However, for most sites of posted speed of 80 and 110km/h drivers complains about the posted speed. They drive mostly at speeds equal to or below the 85^{th} percentile speed (Fig. 7).

Table (2). Speed Analysis and Driver that obey Posted Speed.

Site	Speed limit, SL (km/h)	Standard deviation (km/h)	V50 – Median speed (km/h)	V85 – Operating speed (km/h)	Absolute difference. bet. SL and V85	% exceeding Speed Limit (SL)	% exceeding (1–10) km/h above SL	% exceeding (10–20) km/h above SL	% exceeding >20 km/h above SL
KH100	60	18.368	80	96	36	60			60
KH101	60	8.935	51	60	0				
DMM230S	60	19.843	70	94	34	57			57
DMMP053	80	9.964	64	74	6				
DMMP053	80	13.171	70	86	6	8	8		
KHP001B	80	11.763	64	75	5				
KHP001A	80	18.162	82	102	22	28			28
KHP001B	80	12.158	62	74	6				
KHP001A	80	20.576	76	96	16	20		20	
DMM223	80	15.386	80	97	17	21		21	
KH119S	110	15.026	97	113	3	3	3		
KH119N	110	12.403	95	109	1				
DMM221	120	21.27	102	120	0				
DMM224	120	15.847	117	132	12	10		10	
DMM225	120	14.978	107	125	5	4	4		
DMM226	120	16.918	120	140	20	17		17	
DMM227	120	14.89	106	123	3	3	3		
DMM228	120	20.199	103	120	0				
DMM229	120	17.812	113	135	15	13		13	
DMM231	120	12.449	110	124	4	3	3		
DMM232	120	18.874	115	140	20	17		17	
DMM233	120	14.76	116	130	10	8	8		
DMM234	120	20.091	114	140	20	17			
DMMM10	120	17.473	113	131	11	9		9	
DMMM10	120	19.134	120	135	15	13		13	

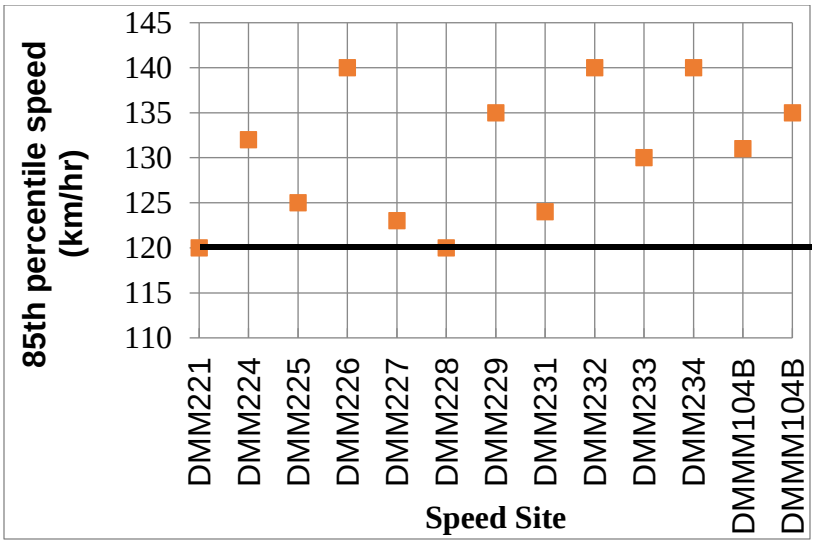


Fig. (5). Speed Study Survey for Streets with 120 km/h Speed Limit.

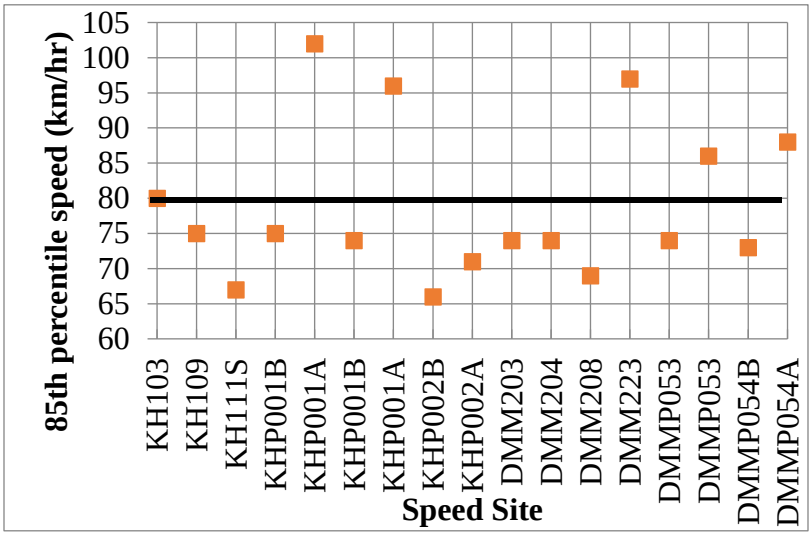


Fig. (6). Speed Study Survey for Streets with 80 km/h Speed Limit.

6.1 Speed and Crash Data Analysis

Figure 8 shows speed accident heat map drawn from locations where 10 accidents occurred within a diameter of 100m over 3 years. From these maps is apparent that speed accident densities are higher among several intersections in the King Fahd and GCC highway corridor. Although high density areas are visible to the north of the KFH, due to the speed variability our study concentrated on these two highways only. In line with the density of accidents, black-spots are shown along the two corridor areas, especially adjacent to some big intersections as shown in Fig. 8 and 9.

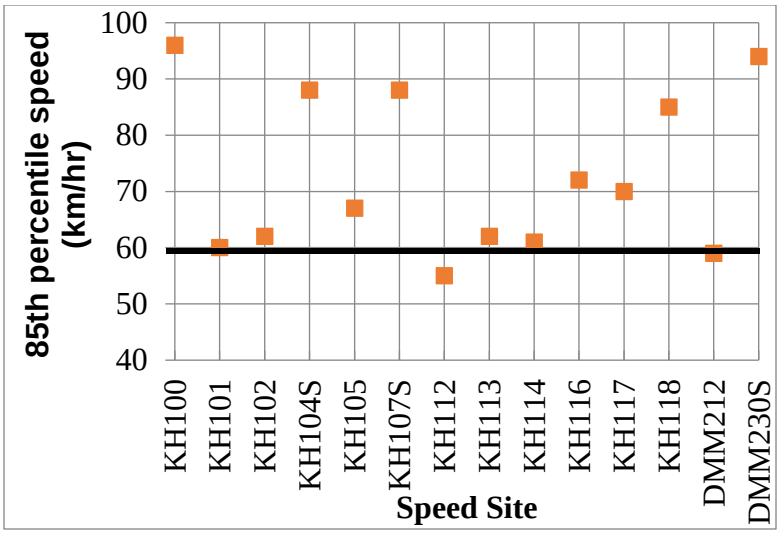


Fig. (7). Speed Study Survey for Streets with 60 km/h Speed Limit.

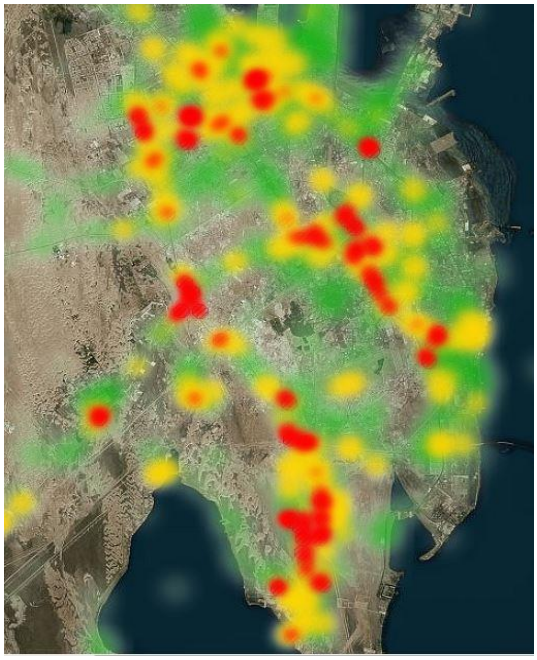


Fig. (8). Speed accidents heat map for 2009-2013.

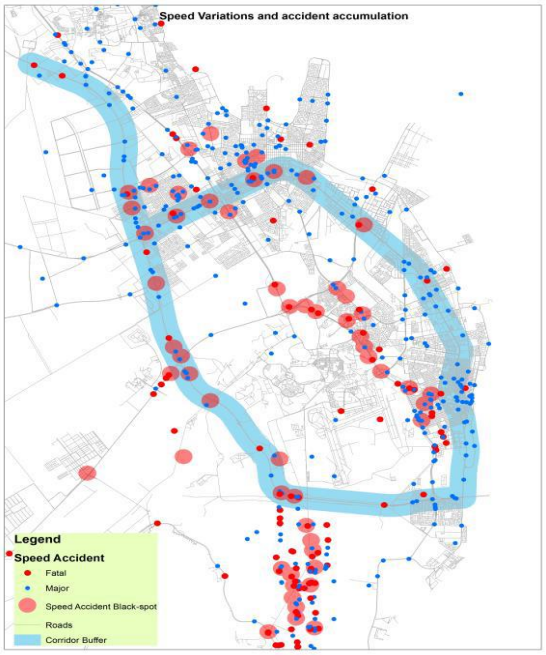


Fig. (9). Speed accident black-spots for 2009-2013.

6.2 Speed Variations

Speed variations from the direct speed count have been taken into consideration to establish the variations of speed along different highway segments, as depicted in Fig. 10. 85th percentile speeds from the observed speed data have been assigned for different sections of the Dammam network. It has been observed that GCC highway, AlJubail street and King Abdul Aziz streets are the highest speed (130kph and above) segments of the network and likewise the major accident severity areas. King Fahd highway in this case, shows a low speed affected area although significant numbers of major accidents occur. At the same time North of the Dammam and Khobar area some fatal and major accidents are also observed, although speed variations are limited to 55 to 90kph.

GIS software was used for the correlation between accidents occurrence and speed. This is a trial of using ArcGIS software to correlate traffic crashes with the 85th percentile speed as shown in Fig. 11. The findings from the correlation showed that, whenever a location had a higher speed, the number of traffic crashes increased. The trend of data shows a higher propensity of crashes in the higher speed stretches of the Dammam network. By applying GIS techniques, the speed data was summarized in different bands with the corresponding mean speed. Plotting this data in a chart, the relationship shows a sharp increase in the number of traffic crashes up to the speed band of 100 – 120 kph.

By applying statistical methods, the findings shows that numbers of crashes are positively correlated with speed, with a correlation value of 0.43 up to the 120kph speed limit. However, if we include the speed band of 130- 140kph the data distribution shows a lower positive correlation with lower a level of significance, at 0.21. The possible reason for this variation may be there is not enough crash data beyond the 120kph speed limit as the observed speed band from 120 – 140kph has fewer readings to correlate. For both range of speed variations (100-120kph and 130 – 140kph), the number of observed crashes is charted in Fig. 12.

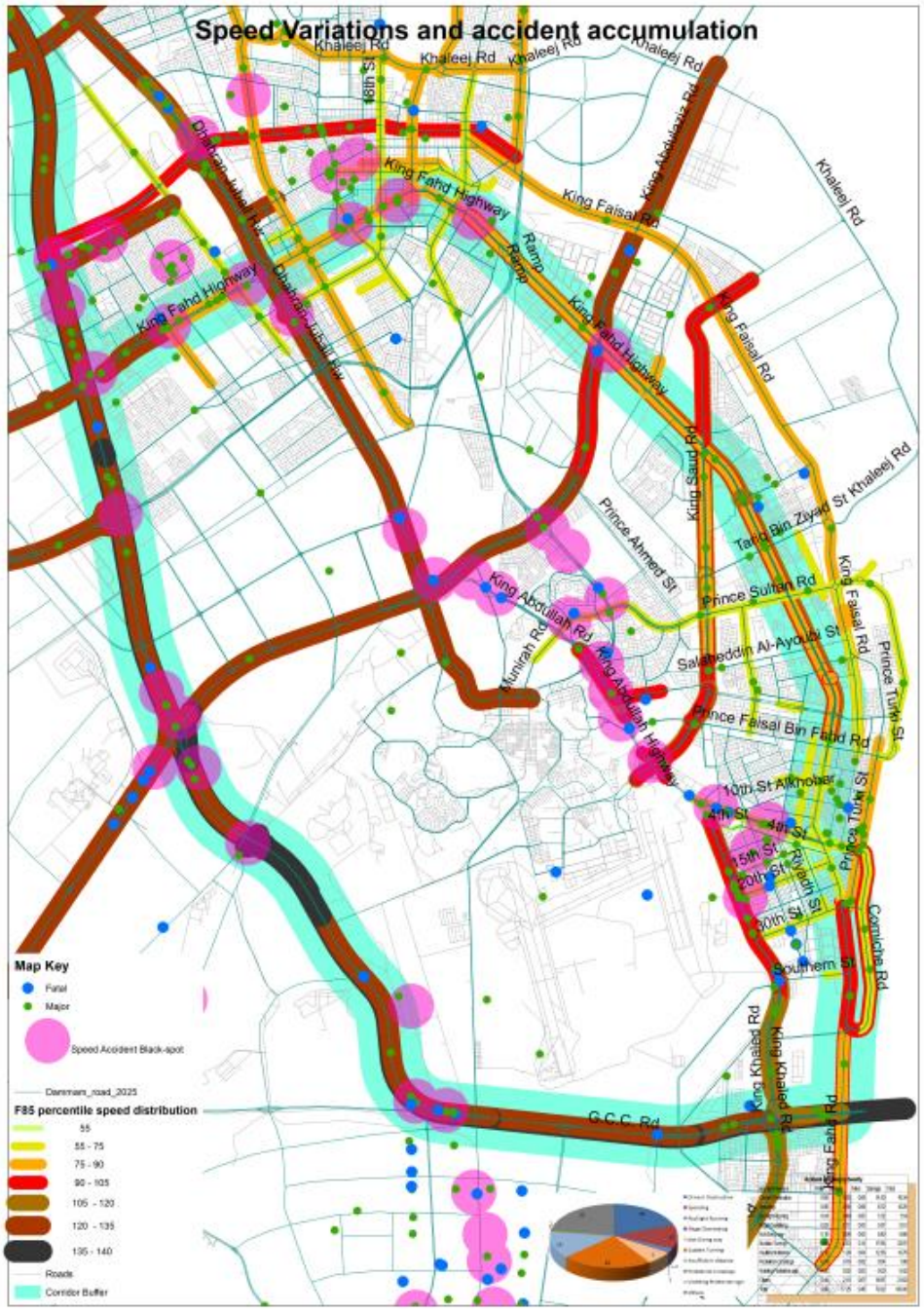


Fig. (10). Speed Variations from Direct Speed Count along Different Highway Sections.

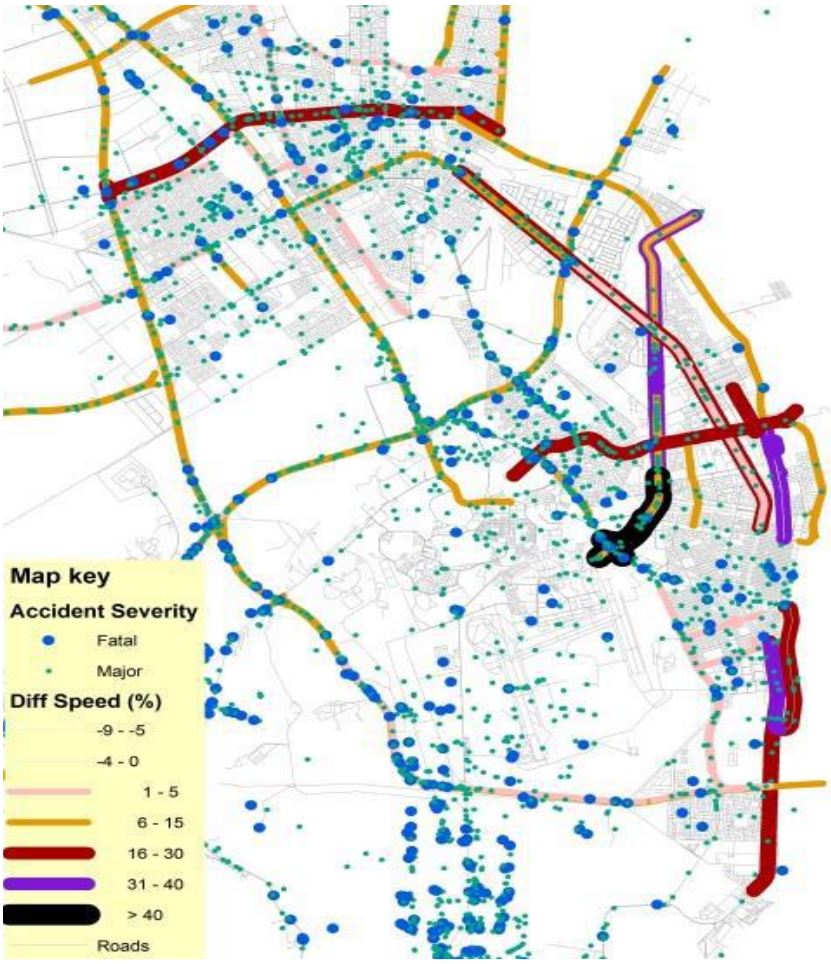
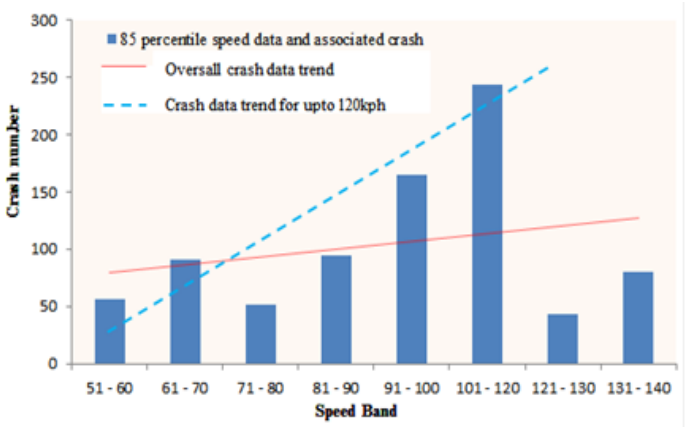


Fig. (11). Speed Data Overlaid with Crash Data.

Table (3). Correlation Table.



n	$\alpha = .05$	$\alpha = .01$
4	.950	.999
5	.878	.959
6	.811	.917
7	.754	.875
8	.707	.834
9	.666	.798
10	.632	.765
11	.602	.735
12	.576	.708
13	.553	.684
14	.532	.661
15	.514	.641
16	.497	.623
17	.482	.606
18	.468	.590
19	.456	.575
20	.444	.561
25	.396	.505
30	.361	.463
35	.335	.430
40	.312	.402
45	.294	.378
50	.279	.361
60	.254	.330
70	.236	.305
80	.220	.286
90	.207	.269
100	.196	.256

Fig. (12). 85 Percentile Speed Bands and Associated Crashes.

7. Conclusions and Recommendations

7.1 Conclusions

Based on speed data, survey and analyses for the selected sites along the two corridors to address the characteristics of speed in Eastern Province, KSA, the most important findings are:

1. The number of drivers exceeding the posted speed varies from site to site. On average, the proportion exceeding the posted speed is around 20%.
2. Based on the limited collected speed data, in some locations the posted speed is not appropriate.
3. For homogenous highway and street zones, the 85^{th} percentile speed can be used as a factor in setting the posted speed.
4. For the traffic safety analysis, the GIS tool is a powerful tool to overlay traffic crashes with traffic data such as speed and volume.
5. A good correlation was found between 85^{th} percentile speed when overlaid with traffic crashes. This indicates that sites with higher speeds have more fatal crashes.

7.2 Recommendations

From the report of data collection and analysis of the results, the following recommendations can be made:

- Highly recommend increasing awareness campaigns, as well as a center for traffic operation for related traffic data and safety issues. Enforcement level will also be increased.
- Increase the number of signboards posting speed limits on the road in highways and some streets
- Increase mobile radar cameras on the roads.
- Due to the high risk of crash casualties, reviewing the penalties for speeding is essential.
- The enforcement level of the 60 and 120 km/h speed limits should be increased.
- Increasing the public awareness of speeding is necessary to develop a culture of compliance with speed limits.

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تحليل نظم المعلومات الجغرافية وتقييم خصائص السرعة المسببة لحوادث الاصطدام بالمنطقة الشرقية بالمملكة العربية السعودية

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ملخص البحث: يعاني الكثير من الناس في المملكة العربية السعودية من حوادث الطرق على الرغم من الجهود الكبيرة المبذولة لتقليل الوفيات بسبب حوادث التصادم. كشفت الدراسة الحديثة أن أهم الأسباب والعوامل المؤدية إلى حوادث الطرق هي السلوك الخاطئ لسائق المركبة وعدم اتباع الأنظمة والمخالفات المستمرة. تحتل السرعة الزائدة المرتبة الثانية في حوادث المرور المميتة، بينما يعد تجاوز الإشارة الحمراء هو العامل الثالث. استجابةً لتحقيق أهداف رؤية 2030 التي تسعى للوصول إلى 8 وفيات لكل 100 ألف ، مع 26 حالة في عام 2015 ، على جميع الطرق السريعة بالمملكة ، يجب بذل المزيد من الجهود. قدمت هذه الورقة نتائج تقييم وتحليل السرعة في مواقع مختلفة مختارة في المنطقة الشرقية، المملكة العربية السعودية. أجريت الدراسة على طريقين رئيسيين في المنطقة الشرقية هما طريق طريق مجلس التعاون الخليجى السريع (GCC) و طريق الملك فهد. تمت دراسة 88 موقعًا بدقة و أظهرت النتائج وجود خطورة بسبب السرعة في بعض المواقع. تم استخدام السرعة المئوية 85 لتقييم شكوى السائقين من السرعة المعلنة. وجد أن نسبة تجاوز السائقين للسرعة المعلنة تختلف باختلاف المواقع. لوحظ في بعض المواقع تتجاوز متوسط 20٪ . أظهرت النتائج، بناءً على البيانات المجمعة المحدودة ، أن السرعة المعلنة في بعض المواقع قد لا تكون مناسبة. كشف استخدام تحليل نظم المعلومات الجغرافية عن وجود نسبة عالية من حوادث التصادم في المواقع ذات السرعة العالية.