A Study of Occupant Injury Severity with Age and Gender based on KIDAS Data

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Abstract: AResearch on benefits for new safety technologies requires significant amounts of objective data describing both occupant injury and real road accident data configurations. Recently, as part of research project, a pilot KIDAS (Korea In-Depth Accident Study) has been started to collect the detailed accident data. From 4 different regional areas, KIDAS can be collected the accident cases from 2012. In this study, KIDAS (2014-2016) data is evaluated to investigate injury patterns with crash type, gender difference with different age groups. Total 457 accidents cases were collected during the period. From the total 1057 injured occupants of KIDAS dataset, 4 persons can't identify genders. Also, the number of cleared seating position was 729 patients and 309 patients were excluded from dataset due to un-identified age and somatic size (height and weight). Therefore, the final dataset was composed with 420 patients. The average age of all patients was 45.4 years old with 66.4 kg weight and 166.1cm height. The average age, weight and height of male patients was 46.1 years old, 69.9 kgand 170.3 cm.In case of female occupant patients, the average age was 44.1, 59.9 kg and 158.3 cm. Severely injured occupants (AIS 3+) were 76 with 54 male and 22 female patients. Minor or moderate injury (AIS <3) was 311 samples with 188 males and 123 females. From AIS 3+ injured group, elderly occupants were 9 patients and 64 samples were age between 18 to 64.

Keywords: Injury severity, Vehicle occupants, KIDAS, Collision type, Accident types

1 Introduction

Currently, traffic accidents comprise the most common cause of traumatic deaths throughout the world and the most common cause of death and disability. In 2002, about 1.4 million people were killed in road traffic accidents, and by the year 2020, according to WHO data [1], this figure is projected to almost double, making traffic accidents the third leading cause of death and disability worldwide.

Up until now, the most accident research has focused on the behavior of vehicles during crashes and factors related to vehicle shapes, structures and safety devices. Such research [2], [3] has not sufficiently utilized medical treatment and paramedic data that can be obtained from hospitals. Likewise overlooked are accident data linked with emergency treatment data which could enable analyses of the mechanism of injury during an accident from both medical and engineering perspectives. These data can make it possible to investigate methods of effectively reducing the number of injuries and fatalities.Using these data in conjunction with information about injury locations obtained from accident studies, it is possible to integrate the injury mechanism along with real-time information from the attending emergency physician. Furthermore, regarding the methods for utilizing information obtained from the paramedics at the accident site, medical data linked with accident data can be effectively used in a number of ways, making it possible to investigate various safety measures designed to reduce injuries.

The use of such a database will provide detailed analyses of measures for injury reduction based on the injury mechanism clarified by accident conditions. Furthermore, these analyses will help to enhance the safety of vehicle passengers and reduce the number of injuries and fatalities.

In order to obtain detailed information of traffic accidents, research team conducts in-depth accident investigation, collecting crash information with respect to the crash environment, vehicle, occupants and injuries. These data provide detailed information about vehicle damage and the crash environment; however, the data collection system has a limited amount of data on occupant injury outcome.

The main objectives of this study was focus on thevehicle-vehicle collision accidents to find key parameters based on accident analysis that are relevant for vehicle occupants due to accident configuration, occupant's gender and age which should be taken into account in future analysis and possible traffic safety policy in Korea such as regulations and

KNCAP test protocols.

2 National car-to-car accidents data

From the police accident classifications, there are 3 different main collision configurations in Korea, vehicle-pedestrian collision, vehicle-vehicle collision, vehicle only collision. Especially vehicle-vehicle collision classifications may lead misunderstanding of Korea traffic statistics. In 2015, integrated domestic accident report (police, insurance etc.) which counted all non-injury or injury involved road traffic accident, the total numbers of vehicle-vehicle collision accidents were 922,856 cases. The fatality of the total occupants of car-to-car accidents were 1,934 (within 30 days' death), and 8,351 persons were severely injured. The moderately injured who in-patient experienced vehicle occupants were 520,536, and the numbers of pedestrians who claimed or reported that he or she was injured during the accidents while he or she was delivered hospital or not were 2,460,248 as shown in table 1.

Table 1. Integrated domestic car-to-car accident data (2015)

| | Head-on Collision | 90-Degree Side Collision | Rear-end Collisions | | | Other |
			Total	While moving	While station or parking	
# Accident	25,057	164,624	423,780	389,367	34,413	309,395
# Fatality	355	604	546	354	192	429
# Moderate injury	43,162	284,327	725,150	665,999	59,151	509,263
# Severe injury	8,351	33,661	52,006	45,739	6,267	49,002
# Minor injury	22,318	109,299	250,549	215,694	34,855	138,370
# Injury reports	12,493	141,367	422,595	404,566	18,029	321,891

According to police data which only counts reported injury involved accident data, the fatality is same as integrated domestic accident database, but the number of accident, injury data were different.

Table 2. National police car-to-car accident data (2015)

| | Head-on Collision | 90-Degree Side Collision | Rear-end Collisions | | | Other |
			Total	While moving	While station or parking	
# Accident	14,488	65,498	47,157	28,349	18,808	309,395
# Fatality	355	604	546	354	192	429
# Injury	25,614	104,991	88,572	52,070	36,502	509,263

As being noticed, it is very difficult to classified distinction of accident types as well as injury severity from both integrated domestic and police data sets. Unlike other counties, from view of these two data set, it may be interpreted the 90-degree side impact accidents were most frequent and sever accidents types. It may also mislead the directions of vehicle safety enforcement agencies. In terms of police view point, it can be understood because of scene of accidents. The logic of police is that it is 90-degree collision type accident and all victims should be counted as side impact accidents. But reality is one vehicle was hit side of vehicle structure (side impact) and striking vehicle was front structure was damaged (frontal impact). If two vehicles were involved in the accident, at least 50% of vehicle should be named as frontal impacted vehicle. The injury patterns of occupants who were side impacted and frontal impacted were also different each other.

3 KIDAS car-to-car accident data

The issues of current traffic accident investigation and data collection from polices in Korea were very limited access for an individual accident event. Also, the lacks of automotive related information which police is not much concerned, are very difficult to analyze the accident involved vehicle's safety problems.

As part of Korea Advanced Safety Vehicle (KASV: 2009-2017) project, the pilot study of KIDAS(Korean In-Depth Accident Study) has been initiated in 2012. The research organizations are consisted KATRI, KoreaTech and 4 Medical schools to collect accident data as well as establishment of KIDAS structures.

Unlike other DBs, on-site investigation is not allowed, all collected accident data were related to in-patient of 4 medical school's hospitals. Once injury involved accidents occurs, the occupants may have been delivered to the emergency departments. After medical treatments, with patient agreement, the research team can search for more information to police station and crash site.
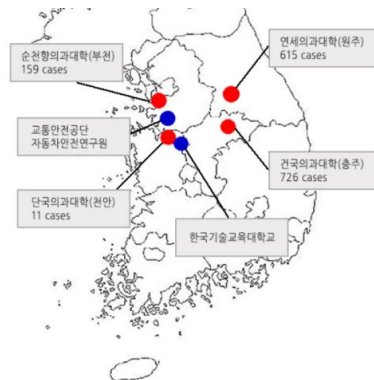

Figure 1. Locations of 3 hospitals for accident data collection

Recently, "iGLAD" (the Initiative for the Global Harmonization of Accident Data) has been initiated by FIA's Mobility Group and ACEA in Europe. Therefore, as the first step, the research team decides to adopt iGLADformat as KIDAS structure as a Korea standards in-depth accident study. It will be continuouslymodified to accommodate regional traffic environment effects, but keeps the fundamental structures of iGLAD.

3.1 Car-to-car accident type data

In this study, KIDAS (2014-2016) data is evaluated to investigate injury patterns with crash type, gender difference with different age groups.

Total 457 accidents cases were collected during the period. In this accident cases, total 768 vehicles were involved crash events and injured occupants were 1,057 peoples as shown in table 3.

Table 3. KIDAS car-to-car accident data (2014-216)

KIDAS Accident Cases		KIDAS Car-to Car Cases	
Total Accident Cases	457	Total Car-to-car Accidents	388
# Vehicles involved	768	Head-on Collision	198
# passenger car	357	90-degree Side Collision	90
# SUV	145	Rear-end Collision (Moving)	33
# Light Truck	117	Rear-end Collision (Parking)	57
# Heavy Truck	70	Other car-to-car	10
# Bus	64		
# Occupants involved	1057		

Among these accident cases, the number of car-to-car accidents were 388 (85%) cases and remaining 69 cases (15%) were vehicle only accidents (rollover, fall, crash to obstacles, etc.). Within the car-to-car accidents, the head-on collision which, classified by police accident type definition, 198 cases (51%), 90-degree side impact accident types were 90 cases (23.2%) and the rear-end collisions were 90 cases (23.2%). Even though this ratio of accident types were different from the national police data, the trends were similar to other countries.

3.2 CDC code car-to-car accident type data

In KIDAS, during the accident investigations, the principle direction of impact, deformation patterns were recorded with CDC code system. This code consists with 7 digit codes and first 2 digit indicates the principle direction of impact with clock count method.

The 11-01 o'clock was defined as frontal collisions with next 3rddigit's F character. Side impact was defined with 02-05 o'clock and 08-10 o'clock having R or L character in 3rd digit of CDC code. The rear-end collision was defined with B character on 3rd digit of CDC code within 06 o'clock direction.

Table 4. KIDAS car-to-car accident data (2014-2016)

CDC-Frontal		CDC-Side		CDC-Rear	
Total	252	Total	83	Total	39
Passenger car	125	Passenger car	52	Passenger car	20
SUV	42	SUV	16	SUV	9
Light Truck	55	Light Truck	8	Light Truck	8
Heavy Truck	7	Heavy Truck	0	Heavy Truck	0
Bus	22	Bus	7	Bus	2

As shown in table 4, damaged frontal structural of vehicles were 67% and damaged side structure vehicles were 22% and remains was rear end collided vehicles. Compared with accident type, the percentages of head-on collision case were 51%, but more vehicles were experienced frontal impact according to CDC code.

Based on the CDC code, the side impacted vehicle ratio was 22.1%. From car-to-car accidents, more than half of vehicles were passenger size vehicles.

3.3 Injured occupants in KIDAS

From the total 1057 injured occupants of KIDAS dataset, 4 persons can't identify genders. Also, the number of cleared seating position was 729 patients and 309 patients were excluded from dataset due to un-identified age and somatic size (height and weight). Therefore, the final dataset was composed with 420 patients.

The average age of all patients was 45.4 years old with 66.4 kg weight and 166.1cm height. The average age, weight and height of male patients was 46.1 years old, 69.9 kg and 170.3 cm.In case of female occupant patients, the average age was 44.1, 59.9 kg and 158.3 cm.

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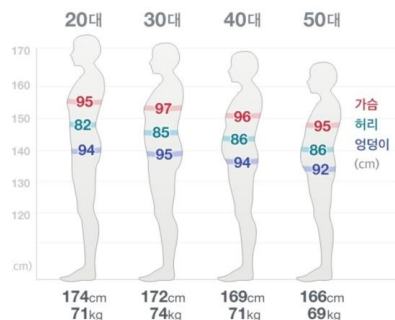

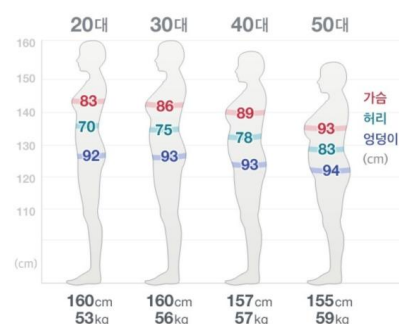**Figure 2. National statistics of male age groups**

Figure 3.National statistics of female age groups

For AIS 3+ injured patients case, the thorax (40%) is mostly severely injured body part and abdomen (16.8%), lower extremity (16.8%) injuries were followed. Main cause of injury on the head was only 12.6%. It was due to

installation of airbag system as well as seat belt restraint system except light truck, heavy truck and bus.

In terms of somatic size, small feature (less than 170cm height) is also experienced more severe injury than taller size. The 69.7% of all AIS 3+ occupants were fall in this category. This trend was also shown similar patterns for weight of occupants. The 65.1% of AIS 3+ patients were less than 70 kg weights. It may result from the principle of building vehicle to meet safety standards as well as NCAP requirements which used Western size of demographic standards such as Hybrid III.

4 Limitations and Conclusions

In this study, injury patterns of domestic car-to-car accidents was examined based on KIDAS data (2014 – 2016). The analysis of accident data underlies a variety of limitations, as follows:

1. This KIDAS data analysis includes only 4 local hospitals data that collected from Emergency Care Centre can't be representable national accident trends.
2. The KIDAS dataset is relatively small and all data may not have completed form

From national police data, the most frequent accident is 90-degree side impact accident type that caused the largest numbers of fatality as well as injury. However, even though, limited data available from KIDAS dataset, the frontal impact type of collisions was major type of accidents like other countries.

Basically all passenger vehicles are developed under the current safety regulations, the safety is focus on the standard somatic size of Westerns.   Since average height and weight of Korean are smaller and lighter than Hybrid III dummy. But, recent adoption of Hybrid III 5% female dummy in both driver and passenger sides may improve the vehicle safety problems.

Acknowledgement

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