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Heavy Goods Vehicle: Review of Studies Involving Accident Factors

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ABSTRACT

The use of heavy goods vehicles (HGV) has grown locally and globally. In this regard, every road user faces a high accident risk and is susceptible to traffic-related injuries and deaths. There is a substantial focus on law enforcement to prevent overloading, speeding, and illegal substance use among drivers. Nonetheless, evidence about the complex causes of HGV accidents is still scarce. Thus, this paper aims to outline the literature related to HGV study and examine factors of HGV accidents. Several factors that significantly contribute to accidents have been identified in the literature review. The study has established three main HGV accident factors with 15 sub-HGV accident factors. The Human Factor was the most dominant, while the Vehicle Factor was the least acclaimed HGV accident factor. The review also found several areas for further empirical improvements by including diverse data sources, a more extensive database, and more advanced data analysis. Moreover, technology advancements are required to capture more detailed and richer data for future studies on HGV. Future studies related to HGV accidents are essential in reducing the fatality rate in line with the Sustainable Development Goals (SDG) Goal 3 target 6, which reduces the number of individuals killed or wounded in vehicle accidents worldwide.

Keywords: Heavy goods vehicle; accident factors; road safety; road transport; commercial vehicles

INTRODUCTION

A nation's economy relies on the supply of products and services to consumers. In most countries, land-based transport, specifically heavy goods or commercial vehicles, has become the backbone of the goods supply chain.

The term "heavy goods vehicle" (HGV) is defined differently in different countries. It may vary depending on the country's regulation, the license required to operate the vehicle, the vehicle's weight, and the Department of Transportation's (DOT) registration. Large load-carrying vehicles are commonly known as lorries in the United Kingdom and most British Commonwealth countries or trucks in the United States and Australia (Cairney et al., 2011). The National Transport Commission of Australia (NTCA) defines heavy vehicles as those with a gross vehicle mass (GVM) of more than 4.5 tons. These vehicles include articulated trucks, rigid trucks, and trucks pulling hefty trailers (Cairney et al. 2011; Guest et al. 2014). Meanwhile, the European Road Safety Observatory (ERSO) defined HGV as goods trucks weighing more than 3.5 tons and exceeding the maximum allowed gross weight. These vehicles must not exceed the maximum permissible length of 16.50 m for semitrailers and 18.75 m for road trains, with a total weight of 40 tons (Castillo-Manzano et al. 2016).

While vehicle classes are clearly stated in several acts in Malaysia, there is yet a simplified or graphic guideline that can help understand vehicle classifications. According to the (Road Transport Act 2013), a "goods vehicle" is any motor vehicle that is specifically manufactured or modified for the purpose of transporting and carrying goods, as well as any motor vehicle that is not specifically manufactured or adapted for the purpose of transporting and carrying goods in addition to passengers. Meanwhile, "vehicle" is a structure capable of transporting, transporting or moving to carry persons or objects. When in motion, these vehicles should maintain contact with the ground.

In addition, the (Land Public Transport Act, 2010) defines "goods" as any objects or loads, excluding luggage. Hence, "goods vehicle" comprises any motor vehicles or trailers manufactured or adapted to carry goods. This classification also includes motor vehicles or trailers not specifically constructed or adapted for carrying loads but are used for transporting goods only or in addition to passengers. The operator's license to operate or supply goods vehicle service specifies the classification for goods vehicles.

PLUS Malaysia Berhad has provided a simplified graphical guideline on vehicle classification on its website, which serves as a guideline for toll rates. The Malaysian Road Transport Department Malaysia (JPJ) has presented

lists I and II of the permitted vehicle in the "second schedule" in accordance with the weight restriction for Federal Road (Amendment) order 2003. Goods vehicles are categorized into Rigid, Articulated, and Abnormal Vehicles based on their weight and maximum permissible Gross Vehicle Weight (GVW). This classification depends on the number of axles, configuration, spacing, and vehicle dimensions.

The Royal Malaysia Police (RMP) and the Malaysian Institute of Road Safety Research (MIROS) classified HGV into three main classes, lorry trailer/ articulated lorries, rigid lorries with 2 or more axles and the permissible gross weight exceeding 2.5 tons and small lorries which comprise 2-axle small lorries or pick-up with the permissible gross weight of less than 2.5 tons. Example of a vehicle that can be considered an HGV can be seen in Figure 1.

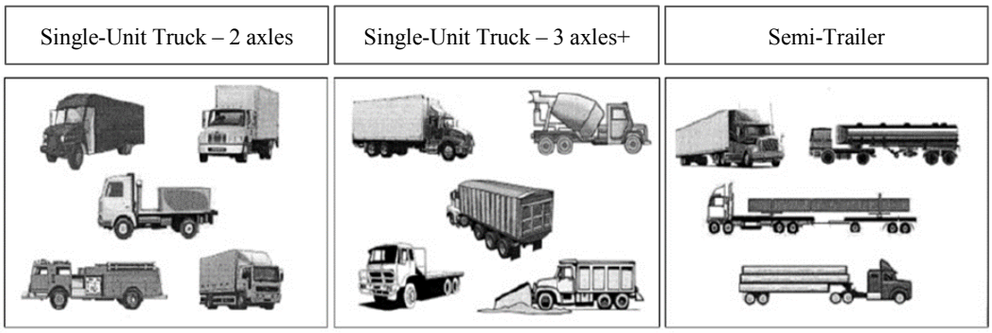

FIGURE 1. Vehicles Considered to be Heavy Goods Vehicle (HGV) (Cerwick, 2013)

ACCIDENTS INVOLVING HGV

Road traffic fatalities are a real concern worldwide. According to World Health Organization (WHO 2018), around 1.35 million people are killed in automobile accidents. This amounts to 3,700 accident-related deaths daily, between 20 and 50 million individuals, with many life-altering injuries with long-term consequences, including disabilities. Road traffic accidents are the eighth leading cause of mortality among adolescents. The figure is projected to rise to fifth place by 2030 (WHO 2018). Road traffic injuries also cause enormous financial damages to individuals and their families. Family members of individuals killed or incapacitated by road traffic injuries must bear the cost of treatment, loss of productivity, and some need to take time off work or study to care for the injured victims.

In most countries, road traffic accidents are attributed to 1-3% of their gross domestic product (WHO 2017). More than 90% of road traffic deaths occur in low- and middle-income nations. Even in high-income countries, people with a lower socioeconomic background are more likely to involve in traffic accidents. Malaysia is not excluded from the increasing rate of accidents yearly, as evidenced by an indicator provided by the Malaysian government (MOT 2020). Because traffic accidents and fatalities significantly affect Malaysian socioeconomics and lives, prompt action on this issue is vital. While it is good that the number of road fatalities has decreased from 6,284 in 2018 to 6,167 in 2019, the number of deaths remains high (MOT 2020).

In recent years, the demand for goods and loads to be delivered and transported has increased, and freight lorry drivers must work long hours to complete multiple trips, contributing to a higher risk of an accident involving HGV. Traffic engineers question how safe and roadworthy these giants are roaming around us because of the severity of crashes and the increased risk of secondary impacts. HGV made up 4.15% of all vehicles on Malaysian highways in 2019 and was involved in 4.55% of all accidents (MOT 2019) 3% of accidents resulted in the deaths of Malaysian HGV drivers and uncountable secondary crash deaths involving HGV accidents. HGV accidents result in a significant impact on logistic costs and the death of other road users.

Thus, it is imperative to understand this group of vehicles better, as they are unique road users with distinct safety needs and characteristics due to their unique characteristics and their different mobility behaviour (Evgenikos et al. 2016).

AIM AND RESEARCH QUESTION

Building on the shortcomings identified from previous studies, this study aims to provide a more definable understanding of HGV accidents and examine factors contributing to HGV accidents. Therefore, this study is determined to answer the following research question: (i) What factors contribute to HGV accidents?

HGV ACCIDENT STUDIES

In HGV accidents, the severity of the injuries tends to be higher than in other accidents due to the vehicles' high mass (ERSO 2016). Consequently, HGV accidents could bring severe injuries or fatalities among drivers or passengers of lighter vehicles such as cars and motorcycles (Gothié 2006). More than 80 per-cent of the second vehicle fatalities are caused by an HGV accident (Hamidun et al. 2019), which shows that fatalities are more likely to occur in HGV accidents when involved in an accident with a smaller vehicle.

TABLE 1. The summary of main and sub-HGV accident factors

No	Sub-HGV accident factors	Number of articles	Main HGV accident factors	Example of references
1	Driver's Background	12	Human Factors (50%)	(Al-Bulushi et al., 2015; Bener, 2012; Chang & Chien, 2013; Evgenikos et al., 2016; Guest et al., 2014; Hatami et al., 2019; Landay et al., 2020; Mehdizadeh et al., 2019; Moomen et al., 2019; Peng et al., 2018; Shams et al., 2020; Yuan et al., 2017)
2	Fatigue and Sleep Deprivation	7		(Alaiakbari & Moridpour, 2017; Cairney et al., 2011; Crizzle et al., 2017; Hao et al., 2016; Howard et al., 2004; Meuleners et al., 2017; Stevenson et al., 2010)
3	Driver's Behavior	6		(Al-Bulushi et al., 2015; Hashim et al., 2016; Islam & Hernandez, 2013; Lemp et al., 2011; Pokorny et al., 2017)
4	Drivers' Mental Health	4		(Crizzle et al., 2017; Hatami et al., 2019; Hilton et al., 2009; Stevenson et al., 2010)
5	Distraction of Drivers	3		(Cairney et al., 2011; Chang & Chien, 2013; Romo et al., 2014)
6	Information Failure	2		(Berrington et al., 2003; Evgenikos et al., 2016)
7	Overloading	5	Vehicle Factors (23.5%)	(Arshad et al., 2020; Cairney et al., 2011; Ismail et al., 2020; Lemp et al., 2011; Zamzamzadeh et al., 2016)
8	Break Defects	3		(Cairney et al., 2011; Mahdzir, 2013; Newnam & Goode, 2015)
9	Blind spots	3		(Daud et al., 2019; Hamidun et al., 2019; Musa, 2017; Richter & Sachs, 2017)
10	HGV Design	3		(Chen et al., 2020; Hamidun et al., 2019; Islam & Hernandez, 2013)
11	Tire Defects	2		(Haq et al., 2020; Larsen, 2004)
12	Road Geometry	8	Road and Environment Factors (26.5%)	(Ahmed et al., 2018; Azahari et al., 2019; Berrington et al., 2003; Véronique Cerezo & Gothie, 2006; Hamidun et al., 2019; Hao et al., 2016; Sanchez Rodrigues et al., 2015; Sim et al., 2017)
13	Location and Road Type	4		(Choudhary et al., 2018; Evgenikos et al., 2016; Ramírez et al., 2009; Sarabi & Moosavi, 2010)
14	Effects of Weather	4		(Ahmed & Ghasemzadeh, 2018; Hao et al., 2016; Mase et al., 2020; Shao et al., 2020)
15	Timing of HGV Operation	2		(Evgenikos et al., 2016; Hao et al., 2016)
	Total	68		

This is a particularly important area of research that needs to be done to describe some consequences of distraction and inattention in driver behavior.

For better prevention and management of HGV accidents, interventions addressing driver behavior adjustment regarding adherence to traffic rules and regulations with strict implementation are required. Road users will benefit from the improvements in future research in either one or all those mentioned areas.

Information failure is another topic that has not been adequately investigated. Information or communication failure usually happens when the driver mistakenly acts following what he believes to be the correct course of action when driving on the roadway. Thus, more research needs to be conducted to explore and understand the circumstances under which a driver has information or communication failure and how it can be prevented.

Based on the review, road geometry is the most common sub-HGV accident factor studied under the road and environment factors, followed by locations and road type, weather effects, and HGV operation timing. Even though road geometry is the most studied, the insufficiency of previous HGV studies focusing on road defects in existing roadways and the absence of remedial action at black spot HGV crash sites are still limited.

Pavement degeneration is heavily linked to its optimum operation and may contribute to HGV fatal crashes with other road users. An investigation into the road environment elements that substantially impact fatal HGV accidents should be conducted in the future.

The timing of HGV operation has received the least attention in previous research. It is imperative to investigate areas where optimal planning of HGV operations reduces the average cost of travel during free flow and congestion and

reduces the number of fatalities during peak and off-peak hours. There should be a study on the effects of prohibiting these massive giants from roaming at specifc times. The signifcance of having strict entry restrictions should also be investigated.

Vehicle factors have received the least amount of research compared to other main HGV accident factors. Future research on HGV should concentrate on the impact of overloading, brake, and tire defects and their safety implications. Thus, to evaluate the vehicle's impact on crash severity, it is necessary to research the correlation between the age of HGV and the severity of crashes.

Understanding and awareness of HGV blind spot zones are still lacking, necessitating a study that will aid in the future prevention of fatal accidents. Overall, with onboard warning systems and crash prevention technologies, the stability and control of vehicles could be enhanced. The use of crash prevention technologies and onboard tracking devices should be expanded to detect the blind spot, vehicle defects, location, movement, and speeds of a vehicle. At the same time, logistic companies should be trained to use their information systems to improve safety protocols.

These studies are benefcial for assessing the effects of initiatives to mitigate hazards and enhance HGV safety to avoid collisions with other road users. While previous research has concentrated on direct and indirect visibility, system-level indicators linked to policy, planning, design, and operations should also be considered. Further empirical enhancements that incorporate more diverse data sources, a more extensive database, and more advanced data analysis are surely needed. Moreover, technology advancements are required to capture more detailed and richer data for future studies on HGV.

Future review studies can be enhanced by adopting more comprehensive approach such as systematic literature review. Systematic literature review enables researchers to evaluate the quality of published evidence while maintaining unbiased as possible. The identifcation of keywords should be performed with rigor to identify related and similar terms. Additionally, search strings should be included in a well establish database not just in science direct and Scopus but extended to Web of Science, dimension.ai and transport research international documentation (TRID).

The good service performance of road transportation benefts individuals, communities, and our nation. On an individual level, it reduces such deaths, serious injuries, hospitalizations, and disabilities affected by families and provides an individual better quality of life. Good road transport supports the Sustainable Development Goals (SDG) Goal 3 target 6, reducing the number of people killed or injured in road traffc accidents worldwide.

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DECLARATION OF COMPETING INTEREST

None

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