Intercity Express Bus Safety Design Issues in Peninsular Malaysia

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Abstract The purpose of this paper is to provide a study on passengers' safety for intercity express bus and road crashes data trends starting from 2003 until 2017. The study focused on the rate of injuries and deaths of intercity express buses passengers. Therefore, this study should be able to reduce the trend rate of injuries and deaths, to improve the safety of passengers and to propose appropriate safety design for intercity express bus passengers in Peninsular Malaysia. The latest accident data and survey on the safety design of the respondent derived from the intercity express bus passengers. This study has found the main cause of the accident bus driver's negligence among others, technical problems of vehicles, road structure and lack of enforcement authorities to the bus operators. Passenger safety design (passenger safety awareness, enforcement and seatbelt awareness) were taken lightly. Therefore, a design for passengers' safety should be prioritized and implemented to reduce the trend rate of deaths and injuries of intercity buses in Malaysia. This research can help to address the issue of death and injury rate trends intercity express buses by declaring accidents as a major problem. Therefore, passenger safety awareness program proposes to improve safety design (seatbelt) as well as enforcement on every intercity bus in Malaysia.

Keywords Safety design, express bus, service innovation, product design

1. Introduction

Road accidents and injuries are a major problem in developing countries such as Malaysia. Statistics by the Polis Diraja Malaysia / Royal Malaysian Police (PDRM) and review of the Malaysian Institute of Road Safety Research (MIROS) show that the average number of death due to road accidents is more than 6,000 per year. In addition, the trend of road accidents involving intercity express buses (IEB) which started in 2003 keep increasing since 2007 until 2017. In 2010 to 2016, the rate of deaths and injuries involving passengers of IEB in public transportation category has increased. 42 accidents that caused 42 victims to be injured and 281 deaths had been recorded during this period of time. Although the rate of accidents is low each year but the impact of injuries and deaths of the passengers is high. These statistics should not be taken lightly because accidents involving injuries and deaths of IEB passengers are alarming and has become a national issue.

Table 1. Number of Accidents and Fatalities Involving Express Busses – Malaysia (based on media report and archives)

Years	Numbers of Accident	Injuries	Deaths
2003	1		14
2004	-		-
2005	-		-
2006	1		11
2007	3		30
2008	1		10
2009	2		16
2010	13		54
2011	1	4	22
2012	1	2	22
2013	4	11	13
2014	4	3	-
2015	3	3	23
2016	6	19	80
Until April 2017	3	-	15

1.1. Intercity Exspres Bus (IEB)

In 2016, there are 199 IEB operators and 4777 buses registered with Suruhanjaya Pengangkutan Awam Darat / Public Transport Commission (SPAD) in Peninsular Malaysia. SPAD is the body which is responsible on supervising and ensuring the bus operators comply with the rules and regulations of SPAD. Licenses for IEB operators are also issued by SPAD.

The Road Transport Department (JPJ) has enforced Rules of 370 Ergonomic Direction which requires all IEB operators to install passengers' safety seat belts in their buses since 2008. Starting from 2013, all new buses registered with SPAD have been installed with this safety device to ensure the passengers and the drivers' safety. However, the numbers of accidents are still increasing due to the attitude of the passengers, drivers and the bus operators. They neglect the safety of their lives by not buckling the safety seat belts provided.

The authorities are more concerned on problems of the drivers, vehicles and structures of the roads as causes of accidents. In actual fact, attention must be focussed on buckling the safety seat belts when remained in the bus as the safety of the passengers rely highly on the use of this safety device.

Table 2. Number of expres bus operators

Years	Numbers Of Express Bus Operators	Numbers of registered buses
2014	192	4300
2015	198	4733
2016	199	4777

1.2. Safety design

Safety of IEB passengers must be the top priority, therefore safety seat belts is essential in the buses. The safety seat belts features includes saving the passengers from being thrown out from their seats, in order to reduce the rate of injuries and deaths during an accident. According to the review by G. Belingardi (2005), the design of the revolving belt/shoulder (3 point) can prevent head injuries among the passengers and lap belt design (2 point) enhanced the security of passengers. This has been proven in several studies that have been made by Mark R. L., S.J. Dwyane, Eero Ajarvi (1998), Fredrick M.S. (1994), Ignasi F., Joaquim H. (2005) showing that the design of passengers' safety belts can save lives and reduce the risk of injuries and deaths. Although the specially designed passengers' safety belts are prepared for each seat, passengers failed to consider their safety by not buckling their safety seat belts. There were studies that have been carried out by Stace K.A., Patricia J.N., James C., Michael, D.A. (1999) and Wan N.H., Mohamad G.M., Akehsan D., Khairil A.M. I, (2015) showing that injuries and deaths can occur to passengers whom are unbuckled and also to passengers buckled with a lap belt (2 point) as alleged by Lagwiederet al. (1985) showed that 27% most common injuries is head injuries and 19.2% injuries are on the chest. The rate of accidents, injuries and deaths of IEB passengers in Peninsular Malaysia is increasing every year, therefore the issue of safety for passengers should be reviewed. However, since studies on this matter is lacking in Malaysia, the causes on why this tragedy still occurs in IEB industry in Peninsular Malaysia remain unknown. Therefore, this study aimed to look at the issue of the design of the passengers' safety belts that may increase the risk of injuries or deaths in the of non-collision and bus collisions categories in Peninsular Malaysia. The focus in this study is to take into account the design of the passengers' safety belts whilst in IEB.

Generally, the authorities regard these four elements as the main cause of IEB accidents; the negligence of the drivers, the vehicles technical problems, roads structure and lack of enforcement on IEB operators. Several studies and reports have been made by the Ministry of Transport (MOT) and Malaysian Institute of Road Safety Research (MIROS) but they focused merely on the vehicles, drivers and road structure, while the safety of passengers are taken lightly. Although the passengers' safety seat belts have been installed but authorities and bus operators are still making light about this matter. Based on statistical data and trends of IEB accidents, each accident would involves injuries and the death of the passengers whom are not

wearing safety seat belts while remaining on the bus on reaching their destination. Therefore, this study should be to reduce the trend rate of injury and death to improve the safety of passengers and to propose appropriate safety design (passengers' safety awareness, enforcement and seatbelt awareness) for intercity express bus passenger in Peninsular Malaysia.

2. Literature Review

Intercity express buses accident trend has become an issue since 2006 until today. Though the accident rates are low, but the numbers of injured victims and passengers deaths are high. Arowolo, 2015, wrote that accidents involving express buses and town buses are rated the highest in Malaysia under the public transport service category. In order to make an improvement on the safety of IEB passengers in Peninsular Malaysia and to reduce the rates of injuries and deaths during an accident, studies on safety design for passengers has to be made.

Study made by Wan Noor Haida W.A.K., Mohamad G.M., Akehsan D., Khairil A.M.I. (2015) stated that 100% of adolescents who are well-educated (university) in the city knew about the passengers' safety system (safety seat belts) in their vehicles but are still exposed to high injury risk during the drive as a result for not using the safety seat belts when remaining in the moving vehicles. That being said, the issue should also be associated with IEB passengers with the same risk. Therefore a relevant study focusing on the design issues in terms of IEB passengers' safety awareness, rules and regulations enforcement by the authorities and the awareness of safe use of safety seat belts by the IBE passengers should be done so that they can reached the desired destinations safely. There are some researches stated by Fredrick M. S., (1994), Stacey K. A, Lawrence J. C, Patricia J. N, Lenora M. O, James C. Reading A. J. Michael D. A (1999) indicating that the combinations of these two safety seat belts design safety belts (2-point) and lap/shoulder safety seat belts (3-point) are safe and highly effective in ensuring the passengers' safety. However, the issue of children's safety on buses should also be our priority as stated by Ignasi F., Joaquim P. (2005). They mentioned that a new concept is needed for a 3-point motorized safety seat belts design to control and minimize the fatal injuries for school buses.

Safety belts have been proven can save passengers but never the less, there are several factors that can cause injuries by the same device such as stated by Eero Arajarvi. (1998), tests had been done on a total of 207 revolving safety seat belts users and the tests had proven that the leading factor that caused fatal death when a collision and convergence occurs is chest injuries. Zhigang Li, Hao Ge, Jinhuan Zhang, Yonghua Zhu. (2014) stated that neck injuries assessment should also be taken into consideration so that a system and an appropriate design of safety seat belts for children in school buses can be planned. This being said, the design of passengers' safety belts must be suitable for all IBE passengers regardless of their sizes and ages.

It is essential to disseminated information through mass media, brochures and posters regarding the safety of passengers while in IEB. Passengers should know that by buckling their safety belts they can reduce the risk of injuries and deaths during an accident. Thus the passengers, drivers, drivers' assistant, IEB operators and authorities such as MOT, JPJ, PDRM, SPAD, MIROS must play an important role in eradicating issue on the IEB passengers safety in Peninsular Malaysia.

3. Problem Statement

In 2010 to 2016, the rate of deaths and injuries involving passengers of IEB in public transportation category has increased. 42 accidents that caused 42 victims to be injured and 281 deaths had been recorded between the years of 2006 to 2016. Although the rate of road accidents is low each year but the impact of injuries and deaths of the passengers is high. Arowolo, 2015 in his research said, accidents involving express buses and town buses were rated the highest. Therefore, this study must be carried out in order to unsure the strategy in improving safety factors on commercial buses becomes a reality. Zhigang Li, Hao Ge, Jinhuan Zhang, Yonghua Zhu. (2014) stated that school bus regulations, injuries criteria and assessment procedures on heads, chests and femurs should be evaluated, however, assessment on neck injuries is top priority so that a system and design of safety seat belts appropriate for children in school buses must be reviewed. Based on the review made by these researchers, it has been proven that design on passengers' safety should be reviewed in terms of passengers' safety awareness, law enforcement and IEB operators' awareness to ensure all the users to buckle up the safety seat belts either driver or assistant and

not to forget, passengers.

4. Methodology

4.1. Data collection and analysis results

By using secondary data and statistics from Malaysian government agencies such as PDRM, MIROS, SPAD, MOT Jabatan Pengangkutan Jalan Malaysia (JPJ) and the media reports, IEB accident trends that caused injuries and deaths of passengers can be comprehended.

A survey has been conducted on 563 IEB passengers in Puduraya and other bus stations around Selangor. This survey covers passengers traveling throughout Peninsular Malaysia, namely to the North (Perak/Selangor/Penang/Kedah/Perlis), East Coast (Kelantan/Terengganu/Pahang) and South (Negeri Sembilan/Melaka/Johor) in order to find out the passengers frequency in using the IEB service, passengers safety matters, passengers safety design (passengers' safety awareness, law enforcement and safety seat belt awareness) and the factors leading to IEB accidents.

4.2. Users of Intercity Express Bus Service

Table 3. BEA Passengers in Peninsular Malaysia

Article		Passengers (%)
Sex	Men	48.1
	Female	51.9
Age of	< 20 years	40.5
	21-29 years	44.4
	30-49 year FD	14.0
	> 50 years	1.1
Marital status	Single	80.1
	Married	19.5
	Others	4.0
Level of education	Primary school	5.0
	Secondary school	32.3
	Diploma	40.1
	Bachelor	23.3
	Master	3.4
	PHD	4.0
Use of IEB services	First time	7.0
	Every week	4.3
	Each month	20.6
	Three (3)/six (6) months	31.6
	During the festive season only	17.8
	Final options	25.0
Passengers destination	To the North	33.0
	To the South	29.5
	The East Coast	37.5

Table 3 shows that out of 563 respondents, 451 (80.1%) are single, followed by 110 (19.5%) married and a total of 2 people (4.0%) had divorced. The highest education level is Diploma, 226 (40.1%) respondents, followed by secondary school, 182 (32.3%), Bachelor, 131 (23.3%), Masters, 19 (3.4%), primary school 3 (0.5%) and PhD, 4 (0.4%). In terms of frequent use of the service, findings showed a total of 178 (31.6%) respondents used IEB services every three or six months, followed by final options 141 (25%), using the service monthly 111 (20.6%), using during the festive season 100 (17.8%), using the service on each week 24 (4.3%) and for the first time 4 (0.7%). For the destination, the East Coast, 37.5% (211), followed by to the North 186 (33.0%) and to the South was 166 (29.5%) respectively. The usage of IEB service frequency and respondents destination demographic were referred in order to see the importance of the IEB service in today's society. As the conclusions, the findings indicate the use of express buses service is important in today's society and it is essential to ensure the safety of passengers using the IEB service by reducing the rates of accidents.

4.3. Safety of passengers

Table 4. Safety of IEB passengers in Peninsular Malaysia

Article		Passengers (%) of
BEA secure	Yes	78.0
	No	22.0
Characteristics of passenger safety	Yes	53.1
	No	46.9
Application of belt instructions	Yes	15.6
	No	84.4
how to buckle the safety seat belt	Television	2.3
	Poster	15.3
	Flyer	2.3
	Pictorial instructions on the rear seats	15.1
	There are no posters/flyers/photo instructions	65.0
The use of belt	Always	3.4
	Sometimes	17.8
	Never	78.8

In terms of passengers' safety instructions findings, table 4 shows that majority of the respondents, 84.4% said that there are no instructions displayed on how to buckle their safety seat belts in the express buses and only 15.6 % expressing there are instructions application on buckling

their safety seat belts in express buses. The role of the media in delivering information has also shown findings in table 4 found 65% of respondents do not have information on how to buckle the safety belts, whilst 2.3% information were gained from the aspect of media channel and another 2.3% were from brochures, , followed by posters, 15.3% and pictorial instructions ,15.1% respectively. 78.8% of these respondents never buckled the safety seat belts while remaining on the express bus, followed by 17.8 % respondents who sometimes buckled their safety belts and only 3.4 % frequently buckled up their safety belts during the express buses ride.

4.4. Passanger safety design (passanger safety awareness, enforcement and seatbelt awareness)

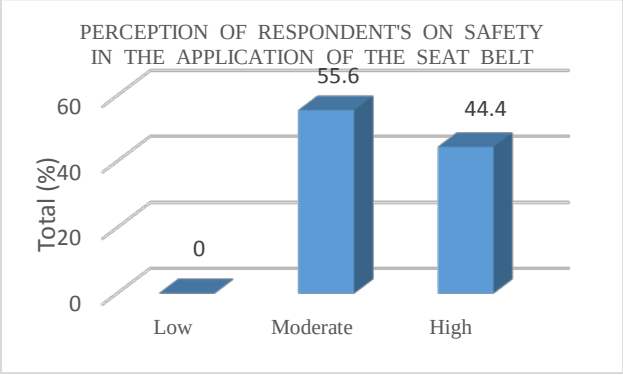

Figure 1. Perception of respondents on safety in the application of the seat belt

In the field of application of the passenger safety belts, Figure 1 shows a total of 55.6 % of the respondents were moderately aware of the safety in buckling the belts. Another 44.4 % of the respondents were highly aware of the safety aspects in buckling their safety seat belts.

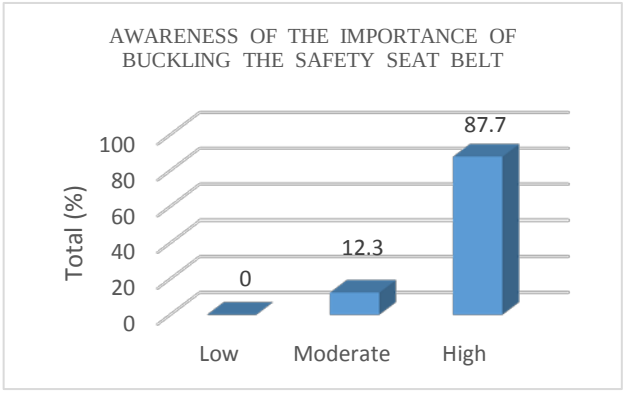

Figure 2. Awareness of the importance of buckling the safety seat belt.

Figure 2, in the awareness of the importance of buckling the safety seat belts section, findings showed a majority of respondents have a high awareness of the importance of the use of belts which 87.7 % and only 12.3 % of the respondents had only moderate awareness of interest the use of belts.

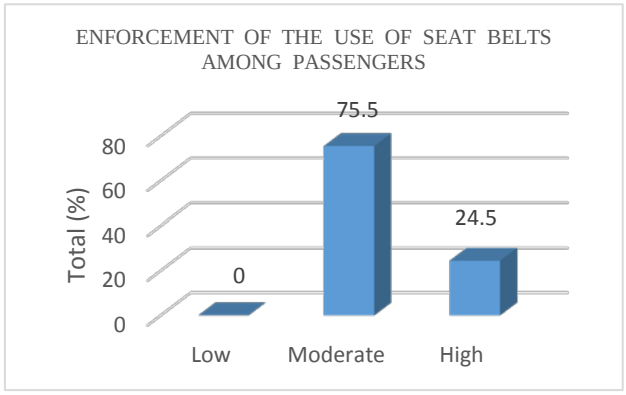

Figure 3. Enforcement of the use of seat belts among passengers

Figure 3 above chart showed that the enforcement of the strap in terms of consumption was moderate, 75.5 %**.**

4.5. The design of the belt according to the passenger's perception

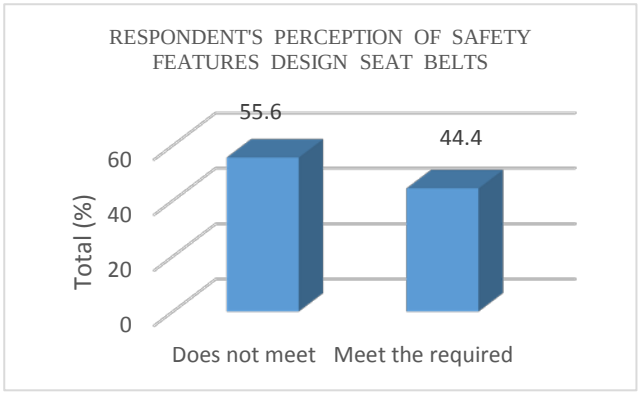

Figure 4. The respondent's perception of safety features design seat belts

Majority of respondents in figure 4 showed 55.6 % stated that the safety features of the belt do not meet the security features and only 44.4 % feel that the safety belts meet the required safety features.

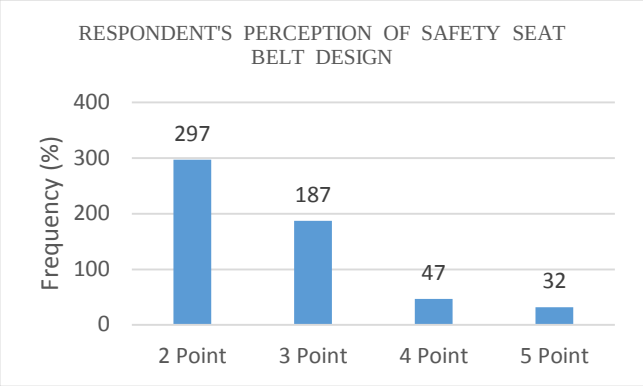

Figure 5. The respondent's Perception of safety seat belt design

Findings in figure 5 shows a total of 297% choose 2 point safety belts design in guaranteeing security in the consumption of express buses, followed by 187% choosing 3 point design, 4 point design, 47% and 5 point design 32 %.

4.6. The cause of the accident BEA

Table 5. Perception of respondents in the cause of an accident

View Question	Agree	Indifferent	Disagree	Total Frequency
The negligence of the driver (default/sleepy/using a mobile phone/cutting vehicle/driving on high speed)	94.6%	4.3%	1.1%	563
Technical problems bus (the system brakes/tires/engine)	88.7%	9.9%	1.4%	563
The structure of the road/Highway (its winding streets/roads/steep)	85.1%	12.8%	27.7%	563
Lack of enforcement on the bus operators by the authorities (The bus driver's license/Regulations/conditions of approval journey)	81.3%	13.9%	4.8%	563

Table 5 shows the perception of respondents in the cause of an accident. Findings found a total of 533 respondents felt the cause of the accident was due to negligence of the drivers, followed by 499 due to technical problems and 479 arising from structural aspects of road or highway.

5. Result and Discussion

The study has revealed data analysis survey of respondents based on tables and graphs on:

5.1 Safety and enforcement to all passengers.

Passengers expressed that IEB are safe to be boarded and has safety features for passengers but passengers still do not buckle up their safety seat belts because there is no enforcement, no instructions from the drivers and also there are no posters and illustrated brochures on the importance of buckling their safety seat belts inside the bus. This caused the passengers to overlook on the importance of buckling the safety seat belts in the IEB.

5.2 Awareness of the importance of safety in the application of the belt.

The passengers are fully aware and know of the safety in buckling their safety seat belts but remain adamant in the aspects of the application of the belt.

5.3 Perceptions of respondents against security features design safety seat belts.

55.6% of the respondents expressed that the safety features of the safety seat belts design do not meet the safety design features, while 44.4% say that they do meet the safety design features. This may be caused by the fact that the passengers were not exposed to the features of a more secure design to reduce the risk of injury and death during an accident.

5.4 The perception of respondents against the safety belt design.

Most of the passengers choose *2 point* safety belts compared to *3 point* as passengers were not aware of the most up-to-date *3 point* belts are safer than *2 point* belts.

5.5 Respondents' perception on the cause of an accidents

Based on table 5, respondents' perception on the cause of the accident is highly rated on these 4 factors, namely, the negligence of the bus driver, technical problems on the vehicles, the structure of the road/highway and lack of law enforcement towards the bus operators. This analysis supports the report of the Malaysian Consumer Associations (FOMCA), 2011.

On the whole, this study revolves on awareness about the safety of IEB passengers, designing a more secure safety seat belts for various sizes of passengers and age, mass media press releases/print related to the importance of safety belts and enforcement to bus operators and fines to passengers who do not follow the instructions. The proposed programme is hope to reduce the risk of injuries and deaths of IEB passengers in Peninsular Malaysia.

6. Conclusion

Overall, the research showed that IEB passengers did not buckle their safety seat belts while in the IEB and only 15.6% comply with the directions of application of passengers' belts. This findings showed that no enforcement in terms of announcements, brochures and instructions on the safety awareness of passengers are disseminated from the bus operators, drivers, passengers and Malaysian authorities such as MOT, JPJ, PDRM, SPAD and MIROS. The authorities merely focused on the problems of the drivers, vehicles and roads structure, which are said to be the cause of accidents, injuries and deaths of IEB passengers, and not focusing on passengers' safety design in buses. This study has proven that these IEB safety seat belts design could not fully guaranteed the safety of IEB passengers. Furthermore, the passengers feel that the existing design is too restricting and uncomfortable. Therefore, the proposal is to establish a safety awareness program that will improve the design of passengers' safety belts and the implementation to all IEB in Peninsular Malaysia.

6.1 Recommendations

Recommendations to address the issue of passengers' safety design is to provide IEB passengers with safety awareness (passenger safety awareness, law enforcement and seat belts awareness) in the mass media, brochures and posters pertaining to safety of passengers while in the bus and fine will be imposed to those who do not comply with the safety instructions. This program is to improve the passengers' safety seat belts design that can be adjusted according to the size and age of the passengers. Enforcement by the authorities needs to be accordingly adjusted to the agencies responsible for the sake of passenger safety in Malaysia.

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