

Seatbelt Design Awareness and Factors for Intercity Express Bus in Peninsular Malaysia

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Abstract

Road collisions and injuries are major challenges encountered in developing countries including Malaysia. According to statistics stated by the Royal Malaysian Police (RMP) and reviews from the Malaysian Institute of Road Safety Research (MIROS), more than 6,000 deaths per year were reported due to road collisions. This includes road accidents involving intercity express buses (IEB) which started in 2003 and keeps increasing from 2007 until 2017. In fact, accidents involving IEB and town buses were rated as the highest. Therefore, this study was performed in order to reveal safety factors for safety awareness on intercity express busses. Besides, this paper also provides a study on seatbelt design awareness that focuses on the passengers and enforcement authorities responded by the southern, center, east coast and northern region of intercity express bus passengers. Simultaneously, this study aims to improve the percentage of seatbelt usage by passengers. Evidence found in this study shows that the main cause of seatbelt design awareness is because of passengers themselves have great safety awareness and also enforcement by the authority. Hence, seatbelt design awareness for passengers' safety should be implemented to improve the percentage of seatbelt usage as well as the enforcement by every intercity bus provider.

Keywords: design awareness, safety, seatbelt, transport services, service design

1. Introduction

The intercity express buses (IEB) is the third most common mode of transportation in Malaysia after motorcycles and cars. In Peninsular Malaysia, there are 4777 buses and 199 IEB operators registered with the Public Transport Agency (SPAD) under the Ministry of Transport (MOT) in 2016. According to statistics generated by the Polis Diraja Malaysia or Royal Malaysian Police (RMP) and reviews from the Malaysian Institute of Road Safety Research (MIROS), more than 6,000 deaths per year were caused by road accidents. In addition, the trend of road accidents involving intercity express buses (IEB) which started in 2003 keeps increasing from 2007 until 2017. From 2010 to 2016, the rate of deaths and injuries involving passengers of IEB in the public transportation category has increased. A total of 42 accidents that caused 42 victims injured and 281 deaths had been recorded during this period of time [1]. In Malaysia, injuries and fatalities from road traffic accidents have become a severe challenge to public health. Thus, extensive actions in all areas of road transport have been introduced by the Malaysian government. This includes road safety, appropriate road infrastructure and vehicle ecosystem. Moreover, the specific objective of this research is to improve the percentage of seatbelt usage and to provide seatbelt design awareness for intercity express bus users towards seatbelt usage while on the road.

Seatbelts are known as mainly the most crucial road safety design. It was created to protect vehicle occupants against a risky movement which might occur during road accidents or sudden stops. Numerous findings have reviewed the efficiency of seatbelts in reducing road fatalities and severe injuries in road accidents. As estimated, the light trucks and passenger cars equipped with seatbelts has a risk reduction of 60% and 45%, respectively [2]. The probability of road deaths also reduces by 40-50% for drivers and

front passengers [3]. Furthermore, the risk of death and severe injuries would reduce when previously unbelted car occupants began to use seatbelts. Both IEB and car occupants share similar issues even though absolute compliance poses different challenges.

For the purpose of increasing road safety, safety devices have been installed in all new buses registered with SPAD since 2013. This is to ensure the safety of passengers and drivers. Additionally, in Malaysia, seatbelts are provided for existing seats in almost all vehicles since the rear seatbelt law was implemented in early 2009 [4]. However, the rear seatbelt has yet to be made compulsory. Therefore, immediate law enactment is needed to raise awareness and law-abiding. This is essential because vehicle occupants are still lack of attitude and awareness of the significance of seatbelts in saving lives. Moreover, according to the casualty figures, seatbelt usage by IEB passengers remains as is still the main issue in this country. Until now, the compliance rate of seatbelt usage and awareness/willingness remains as a major challenge to pertinent stakeholders [5].

2. Seatbelt Design

The safety of IEB passengers must be the top priority. Therefore, safety seatbelts are essential in buses. The safety seatbelt features include saving the passengers from being thrown out from their seats in order to reduce the rate of injuries and deaths during an accident. 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 [6]. The three-point seatbelt was invented by a Swedish carmaker for Volvo and has been used today as standard equipment. Its significance in protecting car occupants during vehicular accidents have also been confirmed by many studies [7]. In addition, numerous studies had reported that the design of passengers' safety belts can save lives and reduce the risk of injuries and deaths [8]. Although the specially designed passengers' safety belts are prepared for each seat, passengers fail to consider their safety by not buckling their safety seatbelts. A study showed that injuries and deaths can occur to passengers who are unbuckled and also to passengers buckled with a lap belt (2-point) [9]. This study reported that 27 percent most common injuries are head injuries and 19.2 percent injuries are on the chest. Since the rate of accidents, injuries and deaths of IEB passengers in Peninsular Malaysia are increasing every year, therefore the issue of safety for passengers should be reviewed. However, since studies on this matter are lacking in Malaysia, the causes of why this tragedy still occurs in the IEB industry in Peninsular Malaysia remain unknown. Therefore, this study aimed to focus on the design issue of the passengers' safety belts that may increase the risk of injuries or deaths in non-collision and bus collisions categories in Peninsular Malaysia.

Generally, experts have considered four elements as the main cause of IEB accidents; the lack of enforcement on IEB operators, the negligence of the drivers, the vehicle's technical problems and the road structure. Nevertheless, MOT and MIROS performed several studies and reports regarding this issue. However, their focus was merely on the drivers, road structures and vehicles, while the safety of passengers was taken lightly. Unfortunately, the bus operators and authorities are still taking this matter for granted, even though passengers' safety seatbelts have been installed. This is shown by the statistical data and trends of IEB accidents where passengers involved in injuries and death are those who are not wearing safety seatbelts while remaining in the bus during accidents. Therefore, this study is essential in proposing safety design (passengers' safety awareness, enforcement and seatbelt awareness) for the intercity express bus passengers in Peninsular Malaysia in order to reduce the trend rate of injury and death, thus improve passengers' safety. Furthermore, similar studies worldwide have highlighted the significance and effectiveness of this safety design [10]. Though, the inconvenient issues such as socio-technical, socio-economic and ease-of-use might be argued.

2.1. Road Safety Strategic Programs

In 2007, eight strategic programs were performed throughout Malaysia to reduce road fatalities. The strategic programs were outlined by MIROS [11]. These programs were divided into four categories namely Advocacy and Education, Vehicle Safety, Infrastructure (road engineering) and Enforcement. The target of these programs was to cut down approximately a quarter of the sub-7,000 annual deaths by the end of 2010. Adversely, the majority of the intermediate programs (3 to 5 years) were unable to “close-the-loop”. This was due to the various challenges encountered in the implementation phase (Table 1) [11]. Among the challenges faced was the need for support from relevant stakeholders such as the road users regarding the systemic solution. Overwhelming issues including the low willingness of road users to wear rear seatbelts for car occupants and children were highlighted in Table 1.

Table 1. Status of Road Safety Strategic Programs (Adapted from [11])

Category	Program	Description/Status
Enforcement	Rear Seatbelts	Introduction of law in January 2009. Retrofitting campaign by car manufacturers; and standard fit for new cars was ensured via Vehicle Type Approval (VTA) by Road Transport Department (RTD). Low usage rate/awareness (to be discussed).

2.2. Legislative Framework

In Malaysia, laws related to road transport and safety problems are created under the purview of the MOT with agencies such as MIROS and the Road Safety Department (RSD). These agencies work concurrently to ensure the enactment of new laws while evaluating those previously enacted. RTD is responsible for the enforcement of laws as indicated by the MOT with major emphasis on vehicle-related matters and licensing [12]. When it comes to enforcement matters, part of the VTA is also executed by the RMP. This practice is perhaps unique to Malaysia where Traffic Police Contingent is being responsible for enforcement and traffic administration, including investigations on road accidents. In addition, the recently commenced Land Public Transport Agency; replacing the authority of previous agency (Commercial Vehicles Licensing Board), has regulated and enforced policy concerning land-based public and freight transport in Malaysia. Thus, the recent law requirements for seatbelts are as follows: (i) Seatbelt. Since 1979, seatbelt wearing has been made compulsory for the front occupants and among the initial research conducted on taxi drivers in 1993 revealed that the compliance rate was approximately 40% [13]. Subsequently, 30 years later, the rear seatbelt law was employed on the 1st of January 2009, which was six months after a nationwide advocacy campaign was launched.

3. Methodology

The study was conducted among IEB passengers in Peninsular Malaysia. The target population of this study was IEB passengers from four regions throughout Peninsular Malaysia, namely to the North (Perlis/ Kedah/ Penang/ Perak/ Selangor), East Coast (Pahang/ Terengganu/ Kelantan) and South (Johor/ Melaka/ Negeri Sembilan). Sample selection was via a systematic sampling technique. The respondents were notified about the study objectives and the confidentiality of all information provided. Questionnaires were remained anonymous where no name and identification card numbers were recorded during the survey. A self-administered questionnaire was designed for data collection in this study. The national language was used in the questionnaire. The content of the questionnaire was designed based on study needs and literature reviews [14]. It consists of

four major parts: 1) Section A: Personal information, 2) Section B: Seatbelt usage, 3) Section C: Knowledge and IEB information on seatbelts, 4) Section D: Believe usefulness, awareness, enforcement and media influenced towards IEB seatbelt. Apparently, data collection on road accidents in Malaysia is mostly contributed by the RMP. Besides RMP's data, other sources of road accident records were collected by several government agencies or private entities. This includes reports on data collection of the real-world crash investigation by MIROS highway concessionaires; hospital's injury data (Ministry of Health); data from insurance companies; rescue records by the Fire & Rescue Department of Malaysia; and research conducted by universities and other relevant bodies. Besides statistics, other perspectives regarding road traffic accidents should be emphasized.

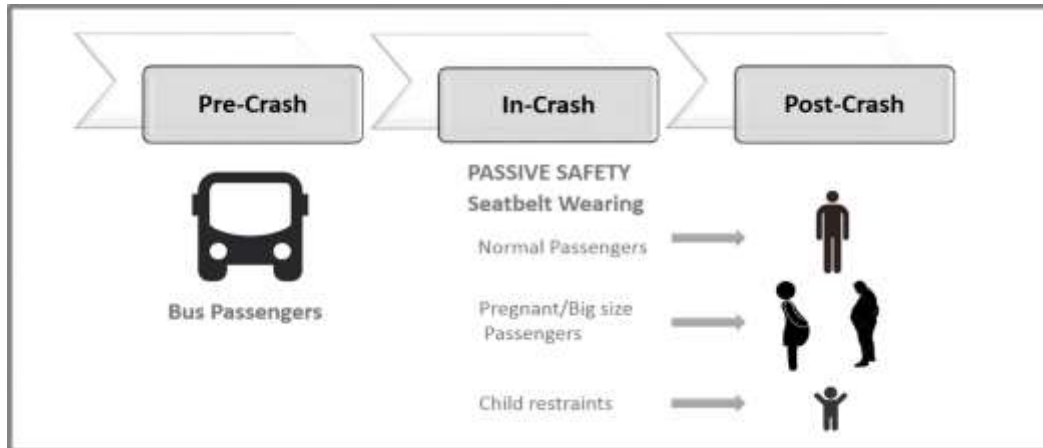


Figure 1. Safety Item Usage Based on Haddon Matrix Conceptual Framework

The author had collected and analyzed relevant published material in order to elucidate the conceptual framework and status quo of IEB passengers' awareness/behavior concerning the usage of seatbelt for IEB users. According to the Haddon matrix, seatbelt functioning as passive safety offers necessary protection during a collision or an impact (Figure 1). Thus, the IEB users need to use them as safety measures to prevent bad or fatal injuries if involved in road accidents.

4. Results and Discussion

Table 2 exhibits the summarized statistics of the survey respondents. Out of 600 questionnaires distributed, 563 (93.8%) were completed. Amongst 563 respondents, 48.1% were males and 51.9% were females. The age distributions were predominantly represented by the younger age group with the overall mean (SD) age of 30 below. The primary school education level was underrepresented (0.5%) as compared to the tertiary educated group which represented the highest (67.2%) in the survey. The respondents acquired a high score for belief and buckling awareness. Conversely, only (3.4%) and (17.9%) of respondents responded to 'always' and 'sometimes' in wearing passenger seatbelt, respectively.

Table 2. Summary Statistics of the Survey Respondents (n = 563)

Variables	Category	Mean n (%)
Gender	Male	271(48.1)
	Female	292(51.9)
Age Group	>20 years	228(40.5)
	21-29 years	250(44.4)
	30-49 years	79(14.0)

	>50 years	6(1.1)
Education level	Primary school	3(0.5)
	Secondary school	182(32.3)
	Tertiary education	378(67.2)
Passengers seatbelt use	Always	19(3.4)
	Sometimes	101(17.9)
	Never	443(78.8)
Knowledge score	Yes	299(53.1)
	No	264(46.9)
Belief score	Low	57(10.1)
	Moderate	78(13.9)
	High	428(76.0)
Passengers safety design awareness	Low	3(0.6)
	Moderate	49(8.7)
	High	511(90.8)
Enforcement	Yes	88(15.6)
	No	475(84.4)
Seatbelt design	2-point	297(52.8)
	3-point	187(33.2)
	4-point	47(8.3)
	5-point	32(5.7)
Influence factors	Television	13(2.3)
	Posters	86(15.3)
	Pamphlet	13(2.3)
	Seatbelt instruction	85(15.2)
	No media	366(64.8)

Table 3 shows the results of the belted and 'unbelted' analysis where the awareness status of buckling seatbelts was the dependent variable. The analysis outcome showed that seven variables (education level, age, knowledge, belief, awareness of seatbelt buckling, enforcement and influence factors) were significantly correlated to IEB passenger's seatbelt wearing after controlling the other variables. Under the category of reinforcing factors for IEB seatbelt wearing, both variables associated with enforcement activities (buckling awareness, seatbelt wearing enforcement) exhibited negative results where 'unbelted' had the highest respondents. Media such as poster and seatbelt instructions can influence IEB passenger's seatbelt usage. However, respondents who answered 'yes' to media as one of the factors influencing the seatbelt wearing status had a higher seatbelt usage, belief and knowledge as compared to those who responded 'no' to media.

Table 3. IEB Seatbelt Wearing

Variables	n belted (%)	n unbelted (%)
Gender		
Male	23.2	76.8
Female	19.5	80.5
Age Group		
>20 years	43(59.7)	185(41.8)
21-29 years	57(22.8)	193(77.2)
30-49 years	19(24)	60(76)
>50 years	1(16.1)	5(83.3)
Education level		
Primary school	2(2.0)	1(0.2)
Secondary school	35(56)	147(44)

Tertiary education	83(14.7)	295(85.25)
Knowledge score		
Yes	104(34.8)	195(65.2)
No	16(6.1)	248(93.9)
Belief score		
Low	4(7.01)	53(92.9)
Moderate	19(24.1)	60(75.9)
High	97(22.7)	330(77.3)
Passengers safety design awareness		
Low	1(33.3)	2(66.7)
Moderate	10(20.4)	39(79.6)
High	109(21.8)	402(78.2)
Enforcement		
Yes	56(63.6)	32(36.4)
No	64(13.3)	411(86.7)
Seatbelt design		
2 point	46(15.5)	251(84.5)
3 point	46(24.6)	141(75.4)
4 point	17(36.2)	30(63.8)
5 point	11(34.4)	21(65.6)
Influence factors		
Television	7(53.8)	6(46.2)
Posters	36(41.9)	50(58.1)
Pamphlet	9.(69.2)	4(30.8)
Seatbelt instruction	48(56.5)	37(43.5)
No media	20(5.5)	346(94.5)

Table 4 shows several variables that were considered as main factors that could cause an individual to decide to wear seatbelts or not. The variable factors are instructions in wearing a seatbelt, knowledge on the benefits of wearing seatbelts, belief towards wearing seatbelts and enforcement from the authority.

Further analysis performed on the media and enforcement influence exhibited lower seatbelt usage scores and lower knowledge scores. Besides that, awareness is another essential factor associated with IEB seatbelt wearing in this research. The group wearing IEB seatbelts due to buckling awareness had a higher knowledge of seatbelt usage. However, IEB passengers still need more to enforce on buckling seatbelts. Media influenced, awareness of seatbelt usage and enforcement are the main factors to remain enforcement by the authority.

Table 4. Scores Difference Between Group Who Responded ‘Yes’ and ‘No’ to Media, Awareness and Enforcement as Factors That Led Them to Wear IEB Seatbelts

Media Influenced That Led Them to Wear Seatbelts					p Value*
	Yes		No		
	n	Mean (SD)	n	Mean (SD)	
Seatbelt use	120	0.213	443	0.786	0.000
Knowledge score	229	0.41	264	0.47	0.000
Belief score	427	0.76	136	0.24	0.002
Awareness That Led Them to Wear Seatbelts					p Value*
	Yes		No		
	n	Mean (SD)	n	Mean (SD)	
Seatbelt use	299	0.53	264	0.47	0.827
Knowledge score	299	0.53	264	0.47	0.827

Belief score	52	0.09	511	0.091	0.000
Seatbelt design	511	0.91	52	0.09	0.635
Enforcement Influenced That Led Them to Wear Seatbelts					p Value*
	Yes		No		
	n	Mean (SD)	n	Mean (SD)	
Seatbelt use	88	0.156	474	0.84	0.000
Knowledge score	88	0.156	474	0.84	0.390
Belief score	88	0.156	474	0.84	0.310
Seatbelt design	88	0.156	474	0.84	0.02

5. Conclusion

This research focused on the current situation pertaining to the usage and design awareness of passengers IEB seatbelts. Though these seatbelts are crucial to protect passengers from the impact of a road collision, Malaysia's IEB passengers still demonstrated a lack of attitude in wearing seatbelts. It is a concern that IEB passengers are taking their safety for granted even though Malaysia remains amongst the unsafe countries in the world as referred to previous road safety records. This 'below than satisfactory compliance level' attitude is obviously a threat to the sustainability of Malaysia's road transportation system. Therefore, a more inclusive seatbelt design awareness solution is required for every discussed item. It is high time to select other solutions such as the use of social media technology to persuade or force IEB passengers to wear seatbelts. Seatbelt Reminder (SBR) is one of the examples, whereby research had shown that drivers in vehicles fitted with SBR were two times more likely to wear seatbelts than those in vehicles without any sign or reminder [16]. Another approach to increase the probability to wear seatbelts is by introducing supplementary elements for IEB passengers. Evidently, the law should be updated in order to progress to the next level. Generally, a genuine systemic seatbelt design awareness solution is needed for IEB passengers to ensure the achievement of self-driven and self-enforcements. Social media is always a preferred method to comprehend seatbelt knowledge, benefit and enforcement as the passengers should be convinced that the seatbelt wearing law is for their own benefits. Even though seatbelt design awareness via media influence is indirectly related to seatbelt wearing, it has important values not only to enhance knowledge but also to emphasize in changing the majority of people's perception regarding fastening seatbelts.

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References

- [1] Royal Malaysian Police (RMP), "RMP Annual Accident Statistics 2015", (2016).
- [2] C. J. Kahane, "Lives saved by the Federal Motor Vehicle Safety Standards and other vehicle safety technologies, 1960-2002-Passenger cars and light trucks-with a review of 19 FMVSS and their effectiveness in reducing fatalities, injuries and crashes". Technical Report No. HS-809 833, National Center for Statistics and Analysis, Washington DC, (2004).
- [3] R. Elvik, A. Høyve, T. Vaa and M. Sørensen, "Vehicle Design and Protective Devices", in The Handbook of Road Safety Measures". Emerald Group Publishing Limited, England, (2009), pp. 543-731.
- [4] M. R. Ridzuan and N. A. S. A. Rahman, "Rear Seatbelt Policy in Malaysia and the United Kingdom (UK): An Endeavour of Mitigating the Gap". Journal of Administrative Science, 15(2), (2018), pp. 41-55.

- [5] A. Hamzah, Y. Ahmad and W. S Voon, "Child helmet efficacy for motorcycle use in Malaysia", Technical Report No. MRev 04/2009, Malaysian Institute of Road Safety Research, Selangor, (2010).
- [6] G. Belingardi, P. Martella and L. Peroni, "Coach passenger injury risk during rollover: Influence of the seat and the restraint system". 19th Int. Technical Conf. The Enhanced Safety of Vehicle, (2005), pp. 1-13.
- [7] S. N. A. Atikah, A. A. Abdul and R. I. Ahmad, "A Descriptive analysis of factors contributing to bus drivers performances while driving: A case study in Malaysia". International Journal of Automotive and Mechanical Engineering, 11, (2015), pp. 2430-2437.
- [8] M. R. Lehto and D. S. James, "Safety knowledge of users and non-users of the lap belt on two-point motorized belt systems", Accident Analysis & Prevention, 29(6), (1997), pp. 739-744.
- [9] N. H. Wan, G. M. Mohamad, D. Akehsan and A. M. I. Khairil, "Seat belt compliance and quality of life among educated young adults in an Urban university", Procedia-Social and Behavioral Sciences, 202, (2015), pp. 442-447.
- [10] Z. M. Jawi, M. H. M. Isa, N. Mohamed, A. Awang and M. R. Osman, "A Systemic Analysis on the Usage of Safety Items among Malaysian Private Vehicle Users: Where to from now?", 3rd International Conference on Recent Advances in Automotive Engineering & Mobility Research, (2016), pp. 1-13.
- [11] R. S. U. Radin, "Integrated Approach of Road Safety in Malaysia", 7th Malaysian Road Conference, (2007), pp. 1-11.
- [12] R. Sarani, H. H. Hashim, W. F. W. Yaakob, N. Mohamed and R. U. R. Sohadi, "The effect of rear seatbelt advocacy and law enforcement in reducing injuries among passenger vehicle occupants in Malaysia", International Journal of Public Health Research, 3(1), (2013), pp. 267-275.
- [13] Z. M. Jawi, A. N. S. Z. Abidin, Y. Ghani and M. R. Osman, "News and Newsworthiness Factor in In-Depth Crash Investigation and Reconstruction", Conference of ASEAN Road Safety, (2015), pp. 290-297.
- [14] Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (SWOV), "Ouderen in het verkeer", (2010), <https://www.swov.nl/sites/default/files/publicaties/rapport/r-94-75.pdf>.
- [15] N. Mohamed, M. M. Fadhli, H. Othman, R. Sarani, and W. S. Voon. Fatigue among commercial bus drivers in Malaysia: Role of driving hours and single versus two driver approach. Technical Report No. MRR 07/2008, Malaysian Institute of Road Safety Research, Selangor, (2008).
- [16] N. F. Paiman, S. M. Syazwan, H. A. Aqbal, M. Isa, M. Hafzi, K. R. Mohd, Z. M. Jawi, H. Azhar, A. Kassim, K. Anwar and N. Mohamed, "Prevalence of carrying multiple pillion riders on the route to school", Advanced Engineering Forum, 10, (2013), pp. 351-356.