Requirement of Seat Belt Reminder for Rear Seats in M1 Vehicles

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Abstract: - This study sought to determine the need of seat belt reminder system for rear seat passengers for vehicles particularly in Malaysia. Analysing road crashes involving passenger vehicles, rear seat occupancy was evaluated. Besides, compactness of the rear seat was accordingly assessed. As results, a high rear seat occupancy, with significant number of seats being occupied can be observed. This findings explains that safety features for the rear passengers, should also be emphasized, similar to the front passengers. Accordingly, installation of SBR for the rear passengers is significant. This intervention could assist in improving the seat belt wearing compliance, in tandem with road safety vision to minimise casualties due to road crashes.

Key-Words: - occupancy, road crash, seat belt, seat belt reminder.

1 Introduction
Statistics have shown the effectiveness of seat belt in preventing injuries [1-5], but the actual number of compliance on the road is still low. According to a study conducted by Harrison et al. [6], the main factor of unbelted occupants is forgetting, rather than intentionally deciding not to buckle up. Previous study [7] have demonstrated that one of the effective tools to increase the seat belt wearing rate is seat belt reminder (SBR) system. In principle, SBR triggers a warning light and/or an audible chime in a vehicle, reminding unbuckled seat occupants to fasten their seat belts.

There are a number of preferences available for a SBR system, varying from a simple consistent flashing light with sound to a more aggressive devices such as an engine interlock system for persistent non-users. A study conducted in Sweden [7] showed unbelted occupants were significantly less in vehicles with a combined light and sound reminder, as compared to vehicles without reminder. Nevertheless, no significant difference was found for unbelted occupants in vehicles equipped with only a light signal reminder and those without any reminder at all. Therefore, a more effective reminders, was accordingly suggested, as it might be an effective way to increase seat belt usage rates in the long-term.

Another study conducted in Australia [8] further evaluates the effectiveness of SBR system. The finding suggests a regulation requiring manufacturers to provide a more aggressive SBR system in Australian passenger cars, even given its current high seat belt wearing.

In the existing new car assessment program, car manufacturers have been driven to increase seat belt wearing compliance through installation of SBR. SBRs increase vehicle's rating in Euro NCAP (European New Car Assessment Programme), ANCAP (Australia and New Zealand), JNCAP (Japan), CNCAP (China), KNCAP (Korea) and Latin NCAP (South America and Caribbean region) [9].

Since these reflect the importance of SBR in a vehicle safety system, it is projected to also be included in ASEAN NCAP program. UN Regulation 16 makes it mandatory for manufacturers to fit SBRs for the driver's seat position of M1 vehicles (passenger cars). For a better compliance result, SBR was suggested to be included as compulsory 4-star and 5-star pre-requisites for both front and rear passenger seats (second row and beyond), respectively [10].

However, due to the lack of system in Malaysia previously, that can classify the type of crashes and categorize them in detail, tangible field data is not yet available to support the proposal. For that reason, this study was conducted to explore the need of seatbelt reminder, particularly for rear seat
passengers in Malaysia. Specifically, this study aims:

i. To evaluate rear seat occupancy rate
ii. To assess the compactness of rear seat passengers

Such information is essential to demonstrate the actual vehicle situation on the roads in Malaysia, especially those who encountered in casualty crashes.

2 Methodology
Casualty crashes involving passenger vehicles for a five years period, 2007 until 2010, were analysed. Among the important crash data, occupancy information for all seats in the collided vehicle were obtained.

In addition, seat belt wearing status of each person occupied in the collided vehicle were also acquired during vehicle inspection. A belted occupant can be verified based on the existence of abrasion marks on the seat belt D-ring or webbing. Based on police and post-mortem reports, casualty information were accordingly recorded.

The data presented covers road crashes involving M1 category of vehicle in Malaysia. In spite of cars, this vehicle category also includes the following passenger vehicles such as:

i. MPVs,
ii. SUVs, and
iii. Vans.

The analysed data focuses on frontal collision crashes, which were analysed by the Malaysian Institute of Road Safety Research (MIROS). This includes 99 crash cases involving 244 passenger vehicles and 864 occupants.

3 Results and Discussions
Based on Malaysian crash data, percentage of occupancy for rear seat(s) ($O_{RS}$) was accordingly evaluated. Referring to equation 1, it was calculated in order to determine the existence of rear passengers and their compactness in a vehicle.

$$O_{RS} = \frac{\text{rearseat occupancy}}{\max \text{rearseat occupancy}} \times 100$$  \hspace{1cm} (1)

As a result, 62% of the crashed vehicles have rear passengers, while the remaining 38% were otherwise (see Figure 1).

The high percentage of rear seat occupancy explains that safety features for the rear passengers, should also be emphasized. Accordingly, installation of SBR for the rear passengers is significant.
In details, compactness of the rear passengers can be illustrated in Figure 2. It can be seen that the occupancy rate of 66.7, 33.3% and 100% were significantly higher compared to others. The first two rate are representing one and two rear passengers out of the total three rear passengers. Meanwhile, 100% represents full rear seat occupancy. Again, these results explain the need of safety intervention for the rear, similar to the front passengers.

In a previous study [11], it was revealed that the front seat passengers are proven as statistically significant in terms of seat belt wearing compliance compared to the rear seat passengers. Even though the number of front and rear occupant involved in the investigated crash cases is much equal, the rate of seatbelt wearing was tremendously low for rear passengers, in which only 1% of the total number of rear occupant was belted. Unlike the rear, the frontal occupant is better in terms of seat belt wearing compliance, in which the frontal occupants have an odds of belted about 82.5 times greater than the rear. This further justify the need of SBR for the rear seat passengers in order to improve their seat belt wearing compliance.

Furthermore, the rear seat occupancy rate was classified into four categories, i.e. none, occupied, max and > max. Description for each category was briefed as follows:

i. None – rear passenger is not exist
ii. Occupied – occupied by more than one and less than its maximum capacity
iii. Max – maximum allowable capacity exist
iv. > max – over capacity exist

Referring to Figure 3, it is interesting to note that vehicles with over capacity rear passengers can also be captured (10.7%). The highest over capacity recorded was found in an MPV with five rear seats but occupied with 13 rear passengers (represents 260% occupancy).

The hypothesis of killed or severely injured (KSI) front passengers in accordance to unbelted rear passengers was tested. As result, a positive result of 75% was yield (see Figure 4). This figure is excluding cases with no rear passengers, unknown seatbelt wearing status and unbelted front passengers.

4 Conclusion

In this study, it was revealed that occupancy rate of rear passengers in M1 vehicle category was high. It was shown that 62% of the total analysed crashed vehicles were occupied at the rear. Besides, it is interesting to note that the rear seat compactness is
remarkable. This explains that safety features for the rear passengers, should also be emphasized.

As a proactive safety assistant device, SBR for both front and rear passengers in passenger vehicles could be one of the most effective ways to improve seat belt wearing compliances. This is due to the fact reported by several literatures that occupants are much more likely to wear their belts in cars equipped with SBR than in those without. The fact of low wearing compliance among rear passengers in current Malaysian scenario further justify that SBR is extremely required to be fitted in M1 vehicle category. This modest intervention could yield a great difference and minimise casualties due to the alarming number of road crashes.

References: