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A Study on the Use and Misuse of Child Restraint System (CRS) in Malaysia

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Abstract – *In car crashes, children are more likely to suffer more severe injuries than adults. For prevention, Child Restraint System (CRS) is normally used. However, inappropriate use of CRS may exacerbate injury risks. This research aims to determine the prevalence of CRS use and misuse among car owners, especially those travelling with children aged 11 years and below. A total of 178 parents were interviewed and 267 children were observed. Overall, only 12.7% children were properly restrained in CRS for their size, with the correct installation and appropriate seating position. Prior to CRS law implementation, initiatives such as awareness campaigns, community based programs and CRS clinics should be introduced.*

Keywords: Child restraint system, child safety seat, child safety, child occupant, passenger car

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1.0 INTRODUCTION

The Child Restraint System (CRS) or child seats have been proven to significantly protect children in vehicular road crashes (Zaza, 2001). With proper use of CRS, the chance of a child occupant death is likely to be reduced by 71% (Starnes & Eigen, 2002). On the other hand, unrestrained 0 to 3-year-old children face up to 5.4 times greater risk of fatal injury compared to those restrained in CRS (Starnes, 2005). In addition, Winston (2000) stated that children aged 2-5 years' old who are restrained with adult seatbelt are 3.5 times more likely to suffer serious injury and more than 4 times more likely to experience serious head injury, as opposed to children of the same age who use CRS.

The CRS vary according to the size of the child it is meant to restrain, the direction the child should face, type of internal restraint, and method of installation. In general, the CRS is designed to provide two links between the vehicle and the child. It is securely attached to the vehicle seat using the vehicle safety belt or ISOFIX system if available; and properly restrains

the child with an attached harness. According to Weber (2000), these two links between the vehicle and the child are critical in preventing injury or death in the event of a crash.

In everyday situations, performance of CRS may be compromised due to suboptimal application mainly attributed to user error or a mismatch between the restrained child and the vehicle. Suboptimal restraint including misuse of CRS (for instance, harness too loose) or inappropriate size, particularly the use of adult seatbelts on smaller children, could lead to significantly higher risk of serious injury to children (Lennon, 2006). Table 1 provides the definitions of CRS Usage Quality as suggested by Brown and Bilston (2007).

Table 1: Quality of use definitions (Brown & Bilston, 2007)

Quality of Use	Definition
Appropriate & correct	Using most suitable restraint for size and using restraint correctly
Appropriate & incorrect	Using most suitable restraint for size but using restraint incorrectly
Inappropriate & correct	Not using most suitable restraint for size and using restraint correctly
Suboptimal	Inappropriate and/or incorrect use

It is widely reported that Malaysia plans to make CRS compulsory in passenger cars by 2019. In order to ascertain parents' understanding of the technical installation of CRS before such a law is introduced, this study was conducted to assess the use and misuse of CRS among vehicle owners in the Central region of Peninsular Malaysia.

2.0 METHODOLOGY

This section shall explain the study participants, procedures and materials.

2.1 Participants

Participants of this study included licensed drivers travelling with children below 11 years old. Such a sample is similar to a study conducted by Lawrence et al. (2006). The participants were chosen using stratified random sampling involving 7 child care centers or kindergartens, 3 government offices and 4 shopping malls located in the Hulu Langat district. The sample size was calculated using a formula by Krejcie and Morgan (1970).

2.2 Procedures

This study comprises both face-to-face interviews with selected vehicle owners and visual inspection of CRS use. Consent was obtained from eligible participants as they dropped off or picked up their children at the identified kindergartens, upon arrival or when leaving the selected shopping malls and after completing their work at several government offices in Putrajaya. Participants willing to take part in the study were asked to complete a consent form before being interviewed.

In the interview, the vehicle owners' age, gender, education level, household income and seatbelt wearing frequency were recorded. In addition, CRS use for children under 11 years old who travelled along with them were also documented, including the children's age, gender, estimated weight and the most frequent seating location in the car. The response options for this question allowed for up to four children per driver (starting with the youngest). Availability

of a front passenger airbag of each vehicle was also noted. Additional questions were asked in the case when the child passengers were unrestrained.

The second part of the study involved intrusive visual inspection in order to provide a closer look at child occupants in participants' vehicle. Trained research staff performed a quick assessment of CRS installation and how the vehicle owners/drivers' restrained the children, based on a standardized checklist. This technique allowed the team to identify CRS characteristics such as type/model, looseness of harness and vehicle safety belt systems, as well as other types of CRS misuse which were difficult to detect from outside of the vehicle. This study also provided an opportunity to collect in-depth data on the various misuse for different types of CRS. Among them were rear facing CRS, front facing CRS, booster seat, vehicle seat belt (either lap and shoulder belt, lap belt only, or shoulder belt only), or totally unrestrained. Upon completion of both interview and CRS inspection, the drivers were handed a brochure on Child Safety Seat Installation and Guidelines for their reference.

2.3 Materials

Prior to data collection and field observation, the research team was briefed on CRS types, its selection, installation and misuse. The CRS misuse standard checklist was adopted from the NHTSA critical misuses list, which was later integrated with a study by Mohd Ariffin et al. (2014). The list includes:

- Age and weight appropriateness of CRS;
- Direction of CRS;
- Placement of CRS in relation to air bags;
- Installation and secureness of CRS to the vehicle seat (tight safety belt/ISOFIX);
- Secureness/tightness of harness straps and crotch strap of the CRS; and
- Defective or broken CRS elements.

3.0 RESULTS AND DISCUSSION

This section shall include demographics and CRS use as well as appropriate CRS usage.

3.1 Demographics and Child Restraint System Use

A total of 178 drivers took part in the study; which also included 267 children aged below 11 years old. The mean of respondents' age was 33.7, with the youngest being 20 years old while the eldest was 63 years old (mode = 34 YO, median = 33 YO, S.D. = 6.125). As shown in Table 2, more than half of the respondents were female (69.1%) and had children (61.2%). Almost two-thirds (74.2%) of the observed vehicles were equipped with frontal passenger airbags. The children involved in this study comprised 56.2% boys and 43.8% girls, with half of them (50.9%) in the age group of 1-3 years old. The age distribution appeared skewed possibly due to a higher number of participants from the selected kindergartens. The mean of children age was 3.3 years old (S.D: 2.27).

Table 2: Driver demographics and CRS use rate (N=178)

Variables	Attributes	Frequency (%)
Driver age	<=25	8 (4.5)
	26-35	120 (67.4)
	36-45	43 (24.2)
	>45	7 (3.9)
Driver gender	Male	55 (30.9)
	Female	123 (69.1)
Relationship with the children	Mother	109 (61.2)
	Father	48 (27.0)
	Guardian	21 (11.8)
Passenger airbag availability	Yes	132 (74.2)
	No	46 (25.8)
Child age	<1	26 (9.7)
	1-3	136 (50.9)
	4-7	92 (34.5)
	8-10	13 (4.9)
Child gender	Boy	150 (56.2)
	Girl	117 (43.8)

Table 3 provides details of CRS use along with the children's weight average of 13.4kg (Min 5kg, Max 40kg, Median 12kg, S.D. 5.26). Judging by weight, almost all children observed in the study would require CRS to travel in a vehicle. However, a large proportion (56.9%) of them were left unrestrained and therefore exposed to injury risks in an event of a road crash. Correspondingly, the figure indicated a common practice among respondents, if not the public, of not ensuring safe travel to children. Such was the case as only 115 out of 267 children (43.1%) were restrained with either CRS or seatbelt.

In terms of CRS type, 11.6% of the children were restrained using rear facing CRS, 19.1% used front facing CRS, 4.5% used booster seats and 7.9% used adult seatbelts (based on age and weight, they were probably not ready to use seatbelts). In terms of seating location — regardless of CRS — one third of the children (34.8%) were seated in the front passenger seat while the rest were in second row seats (mostly behind front passenger seat, possibly to facilitate driver to check on them). Such a situation was self-reported by the respondents.

Table 4 reveals the reasons given by respondents for not restraining their children. The main reason was that the children were perceived as big enough or "grown up" and did not require CRS (23.2%). This was followed by the children's refusal to be restrained (13.9%). Being a "grown up" in many cases meant that the children were deemed to no longer require CRS when travelling (though in actual fact they still require restraint, at least in this study) and was similar to the findings in a previous study (Paiman et al., 2016).

Such an attitude also stems from lack of information and knowledge on CRS utilization and possibly due to lack of CRS awareness campaigns. Other scenarios including placing children on the passenger's lap (4.9%) and children left unrestrained during short travels (5.2%) further underlined road user's lackadaisical attitude as regards safety, as in the case of allowing children to ride a motorcycle without helmet (Paiman et al., 2014). Also, excuses ranging from no CRS (6%) and CRS placed in another car (4.1%) to space constraints (1.5%) implied that the cost of owning CRS may be an economic burden to individuals from certain income groups.

Table 3: CRS use among children (N=267)

Child Weight (kg)	Frequency (%)	CRS Type					Seating Location			
		Rear Facing	Front Facing	Booster	SB	Unrestraint	Front Passenger	2nd Row Left	2nd Row Centre	2nd Row Right
0-9.0	58 (21.7)	24 (41.4)	8 (13.8)	1 (1.7)	1 (1.7)	24 (41.4)	32 (55.2)	18 (31.0)	1 (1.7)	7 (12.1)
9.1-18.0	159 (59.6)	7 (4.4)	39 (24.5)	10 (6.3)	10 (6.3)	93 (58.5)	47 (29.6)	53 (33.3)	33 (20.8)	26 (16.4)
18.1-36.0	48 (18)	-	4 (8.3)	1 (2.1)	10 (20.8)	33 (68.8)	8 (16.7)	20 (41.7)	6 (12.5)	14 (29.2)
>36.0	2 (0.7)	-	-	-	-	2 (100)	-	2 (100)	-	0
Total	267	31 (11.6)	51 (19.1)	12 (4.5)	21 (7.9)	152 (56.9)	87 (32.6)	93 (34.8)	40 (15.0)	47 (17.6)

Table 4: Reasons for unrestraining children (N=152)

Reason for Unrestraining	Frequency (%)
Do not have CRS	16 (6.0)
Placed on passenger lap	13 (4.9)
Child has grown up	62 (23.2)
Child refuses to be restrained	37 (13.9)
Short distance travel	14 (5.2)
CRS in the other car	11 (4.1)
Space constraint	4 (1.5)
Others	5 (1.9)

3.2 Appropriateness of Child Restraint System Usage

The focus of the CRS intrusive observation and inspection is to identify appropriateness and correctness of CRS use among the drivers who restrained their children while travelling. The result of CRS appropriate usage is tabulated in Table 5. From the observation, 91.5% (86) of the CRS used complied with UNECE Regulation No.44 (UN R44). This reflected that parents who use CRS to secure their children were willing to invest on CRS certified as UN R44 compliant. Most of the rear facing (77.4%) and front facing (84.3%) CRS were appropriately used, with the weight of child suiting the type of CRS. Nonetheless, looking at the bigger picture, the interviewed drivers failed to choose appropriate CRS for 41.7% of the restrained children. All the drivers inappropriately used booster seats for their children. A booster seat is only recommended for children ranging from 18 to 36 kg in weight. 18% of the children were restrained with adult seatbelt although none of them had reached the required weight to use such a seatbelt.

The findings indicated that drivers have little knowledge of the use of booster seat or the limitations of adult seatbelt. It can also be said that older children are being prematurely graduated from front facing CRS to booster seats and then from booster seats to wearing adult seatbelt. Such a situation must be addressed as older children, inappropriately restrained according to their age and weight, were found to be over-represented in serious injury and fatality in motor vehicle accidents (MVA) (Koppel et al., 2008, Vesentini & Willems, 2007).

Table 5: Proportion of children restrained according to appropriateness of CRS usage

		Appropriate (%)	Inappropriate (%)	Total
CRS type	Rear facing	24 (77.4)	7 (22.6)	31
	Front facing	43 (84.3)	8 (15.7)	51
	Booster seats	0	12 (100.0)	12
	Seatbelt	0	21 (100.0)	21

Among the children who were restrained using CRS, 94 of them were further observed to determine CRS misuse. Five items related to misuse of CRS were examined as shown in Table 6. Most of the drivers (66.0%) allowed infants less than two years old (or 24 months) to sit facing the front of the vehicle, which could possibly pose additional injury risk in case of MVA. One third of the children was allowed to ride in the front seat, which was installed with airbag. It must be understood that airbags could inflate rapidly, cushioning the occupants and preventing or reducing their contact with parts of the vehicle that would cause injury such as the dashboard.

In order to provide protection, airbags will fully inflate in less than one second, expanding at around to 160 mph. This means that the airbag inflates with considerable force. Thus, many researchers believe children aged 12 and below should never ride in the front seat with an active passenger airbag. Regrettably, as the number of child occupants exceeded the rear seat capacity, the oldest child would normally occupy the front seat. In such a case, parents must adjust the seat as far as possible from the airbag compartment. A rear facing CRS must never be placed in the front seat as explosion of airbag could topple the CRS and therefore lead to an infant being suffocated.

From the observation, only 3.2% of the children used CRS with at least one sign of damage. Almost 80% of the drivers installed the CRS in a proper way in their vehicle, which meant the CRS was securely fitted in the vehicle seat. Nevertheless, only 12.7% of the children was placed in an optimal way, whereby the CRS was appropriately and correctly used without any sign of misuse. About one third of the children were restrained in suboptimal condition, indicating misuse of CRS or adult seatbelt. Lastly, more than half of the children were unrestrained when travelling in a vehicle. The appropriateness and correctness of CRS usage can be found in Table 7.

The finding of this observation suggests that the rate of CRS use was still low. This was likely due to the absence of a policy on its usage in Malaysia. It has been proven that child restraint law can effectively increase the rate of CRS usage. In New Zealand, introduction of CRS law managed to increase its usage by 15%, culminating in 89% CRS usage by 2015 (New Zealand Ministry of Transport, 2017). In Australia, implementation of CRS law had resulted in a surge of its use rate to 99% (Brown et al., 2010). However, it should be noted that implementation of such law did not contribute to optimal CRS usage.

Even though the use rate of CRS was high in Australia, 79% of inspected CRS revealed at least one misuse and inappropriate use (Koppel et al., 2013). In addition, Iwase et al. (2003) found that increase of CRS usage did not significantly reduce child casualties in motor vehicle accidents after CRS law was implemented. One of the main factors stems from incorrect use of CRS. This is further supported by a study by Paine and Vertsonis (2001) which found that incorrect and inappropriate installation of CRS may reduce or nullify its safety benefits.

Table 6: Proportion of children restrained in the incorrectly used CRS

Type of Misuse	No	Yes
Child riding in front seat with airbag	65 (69.1)	29 (30.9)
Infant <2YO facing the front of the car	32 (34.0)	62 (66.0)
CRS has damage sign	91 (96.8)	3 (3.2)
Harness strap buckle	71 (75.5)	23 (24.5)
CRS installation	75 (79.8)	19 (20.2)

Table 7: The appropriateness and correctness of CRS usage

	Frequency	Percentage
Optimal	34	12.7
Suboptimal	81	30.3
Unrestraint	152	57.0

4.0 CONCLUSION

Such low rates of CRS use brings about a dispute on the need to impose preventive measures in Malaysia. Promotion of CRS use across the board necessitates consideration and attention from various stakeholders. In order to increase CRS usage, comprehensive promotion and awareness campaigns must be conducted, targeting both children and their guardians. Only through such campaigns can the safety benefits associated with CRS correct and appropriate use and seating position be conveyed.

On the other hand, the high rate of CRS misuse may result in further injury risk suffered by child car occupants. Thus, installation check and periodic inspection by trained technician on the correct CRS usage is crucial. By minimizing or eliminating the chances of CRS misuse, perhaps parents' appreciation of the benefits of CRS can be further enhanced.

Last but not the least, it is without doubt that awareness and educational intervention programs for parents are urgently needed in Malaysia, along with new regulations on mandatory CRS use. Various parties such as government agencies, road authorities, healthcare provider and Non-governmental organizations (NGOs) must be included in a collaboration to promote CRS usage among vehicle owners in the country.

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