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A survey of parental knowledge, attitude and practice of child car seat restraint use in Singapore with a literature review

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INTRODUCTION

Motor vehicle accidents are associated with significant mortality and morbidity in adults and children. The annual number of accidents with injury in Singapore remained at over 7600 for the past 5 years⁽¹⁾ with a recent prospective observational study documenting 123 cases of paediatric head injuries from road traffic accidents over a 51-month period.⁽²⁾

Children are especially vulnerable to road traffic accidents because of several factors.⁽³⁾ The comparatively larger head and shorter neck of a child increases risk of head and neck injuries⁽⁴⁾ and infants below eight months may not have achieved stable head control and independent sitting. Children may not comply with restraints and rely on adults to restrain them correctly.⁽⁵⁾ In essence, children are prone to injury in traffic accidents because of their physical characteristics and cognitive development with the risk compounded if unrestrained.^(6,7)

The use of appropriate child car restraints has long proven to be crucial in reducing the number of deaths and severity of injuries sustained in road traffic accidents. Guidelines in developed countries and the World Health Organization consistently support the proper use of car restraints and seat belts that are appropriate for the child's age and height.

The main objective of our study was to explore the knowledge, attitude and practice of parents of newborn babies regarding infant or child car restraints during their homeward trip from the hospital. The secondary aim was to evaluate the reasons behind non-compliance to infant and child car restraints amongst those who intended to travel home in a motor vehicle, and compare our findings with a literature review of child car seat restraints.

METHODS

We conducted a cross-sectional survey of parents of newborns in a neonatal unit at the Singapore General Hospital. Ethical approval was granted by the Singhealth Centralised Institutional Review Board (CIRB 2019/2895). Respondents included parents of newborns

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who were admitted to the well-baby or high-dependency nursery between December 2019 and March 2020. Parents of babies who were admitted to Neonatal Intensive Care for any duration, transferred elsewhere or died were excluded. Mothers with postpartum complications were not approached. A 22-item questionnaire was distributed to a convenience sample of 200 parents during office hours on weekdays. The study team approached parents who were awaiting discharge of the newborn and agreed to a self-administered anonymous questionnaire in English. Completion of the questionnaire was imputed as consent. The questionnaire could only be answered by either parent to avoid duplicate forms. On completion, forms were reviewed to ensure validity and rejected if incomplete, illegible or blank.

Demographic characteristics of the parents included age, ethnicity, educational attainment and household income. Parental age was categorised by age group as: 21-25, 26-30, 31-35, 36-40, 41-50 and >50 years. Household income data was collected as ordinal variables in S\$2000 intervals and analysed as lower (≤S\$4000) or higher income (>S\$4000) groups.

Questions relating to parental *knowledge* and *attitude* included awareness of the local legislation for child car restraints, location within the motor vehicle and direction of placement. Questions relating to parental *practice* included current usage of child car restraints as well as intended mode of transport when parents were physically ready to bring home.

The primary outcome was the car seat compliance of parents whose babies who were about to be discharged. Factors associated with compliance were examined. Categorical data was presented in terms of frequency and proportion. Univariate analysis was conducted using the chi-squared test for the binary outcomes of either compliance or non-compliance with child car restraint ownership or usage. The outcomes were reported as relative risk with 95% confidence interval. Statistical analysis was performed using IBM SPSS Statistics version 25 (SPSS Inc, Chicago, USA).

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RESULTS

Altogether 200 questionnaires were completed, with none rejected. Table I shows demographic characteristics of the study population. The respondents' ethnicity consisted of 44.5% Chinese, 34.5% Malay, 12.5% Indian and 8.5% of other races. Most parents (32%) were aged 31 to 35 years. Altogether, 87 respondents (43.5%) were first-time parents while 113 (56.5%) had at least one older child. Three-quarters had obtained at least diploma education.

Nearly three-quarters of respondents (148, 74%) were aware of the Singapore Road Traffic Act (Chapter 276) which mandates that persons below the height of 1.35meters are required to be secured with an approved child car seat restraint. This knowledge was attained through word of mouth (41, 27.7%), social media (26, 17.6%), private-hire drivers (25, 16.9%), educational efforts of the Singapore Traffic Police (18, 12.2%) or newspaper articles (13, 8.8%). 3 (2%) came across the Act through their readings, and 18 (12.2%) respondents learnt through a combination of the above factors. 4 did not indicate how they learnt about the Act. 187 (93.5%) correctly chose the centre back seat as the ideal location to secure an infant or child car restraint. A majority (72%) were aware that the ideal orientation of an infant car restraint is rear-facing, 25.5% thought it should face forwards, while 2.5% were unsure.

Most parents felt that using child car restraints made transportation "safer" (168, 84.5%) and deemed it "necessary" for their child whilst travelling in a motor vehicle (166, 83%). Notably, a significant proportion felt that cradling their baby (47, 23.5%) or using a baby carrier (59, 29.5%) were equally safe alternatives to a child car restraint.

The majority (197/200) of respondents intended to bring their newborn home via a motor vehicle, be it personal or private-hire car (122, 61%), or taxi (75, 38%). Only 2 (1%) parents chose public transport such as bus or train. Of 197 parents, 106 (54%) already owned a child car restraint. Yet, only 81 of 106 (76%) parents intended to use them, while the remainder (25, 24%) did not plan to use at all. Those who did not own a child car restraint

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(91/197, 46.2%) had no plans to use one. Therefore, amongst those who planned to return home via a motor vehicle, only 41% (81/197) intended to use a child car restraint.

Reasons given by 25 parents who did not intend to use a child car restraint *despite* owning one were explored. They ranged from a belief that the baby was "too delicate" or "too young" (10, 40%), "the mode of transport (taxi) did not require a child car restraint" (5, 20%), "inconvenience of usage" (4, 16%), logistical issues that "an infant car seat had not yet been delivered" (3, 12%), the parent is "not the owner of the car" (2, 8%) to the perception that "the travel distance is too short to use a child car restraint" (1, 0.5%). Of 113 respondents who had at least one older child, more than half (61, 54%) recalled not having utilised any child car restraint when they were bringing the older child home from hospital.

The reasons for 91 of 197 respondents (46.2%) not being in possession of a child car restraint despite intention to return home by car, were similarly explored. More than half of the respondents (54/91, 59%) did not purchase a child car restraint, either because they did not own a car or had intended to return by taxi which is not legally required to install one.

Parental intention to use a child car restraint for the homeward trip was positively correlated with an income level exceeding S\$4,000 (RR 3.44, 95% CI 1.64 - 7.19) and possession of such a seat (RR 4.16, 95% CI 2.09 - 8.27). Parents were much more likely to use child car restraints when travelling by personal or private-hire motor vehicle, as compared to taxi (RR 9.20, 95% CI 4.80 - 17.56). Respondents who were aware of the Road Traffic Act were more familiar with seat orientation and recognised that a rear-facing is safer than a forward-facing direction (RR 2.82, 95% CI 1.39 - 5.69).

DISCUSSION

As far as we are aware, this is the first survey of unselected parents of newborns regarding their knowledge, attitude and practice of using child car restraints in Singapore. Our study

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population differed from two other local reports of road traffic safety. Chong et al included children presenting with head injury at either of two local emergency departments following road traffic accidents. Tan et al recruited parents who responded to a social media web-link to conduct focus group discussions on road safety. We chose to survey unselected parents of babies nursed at a well-baby or high-dependency nursery but not intensive care unit. This ensured that respondents had similar baseline concerns, in contrast to parents of intensive care neonates who presumably face additional anxiety over medical issues during a homeward trip. This study also examined reasons behind non-compliance with car restraint use for newborns on discharge, in the hope of providing actionable proposals for improved compliance.

Although nearly all parents (197/200, 98.5%) intended to bring their newborn home in a motor vehicle, less than half (81/197, 41.1%) intended to place in an infant car restraint during the trip. This is similar to a previous study that reported a rate of 51.1%. (17) The 41.1% compliance rate in our study was compared with a literature review of published articles since 1997. (16,18-32) Results of the literature review show wide variation in compliance rates that were dependent on the local legislation, parental knowledge, educational level, socio-economic factors and individual prejudice (Table II). Compliance to car seat usage in our study was much lower than that of the United Kingdom and United States, where usage was reported to be 90% and above. (18,19) On the other hand, our compliance rate of 41.1% was comparable to that in Eastern Europe, Middle-east and Asia. Child car restraint compliance was reportedly 23.5% in Turkey, (20) 51.4% in Greece, (21) 56.7% in Saudi Arabia (22) and up to 65% in China, (23) but generally low in Africa and Nigeria. (24)

Focus group discussions conducted in Singapore and China reported that the main factors contributing to non-compliance to child car restraints was a lack of parental knowledge in terms of road safety awareness and perception of risk, aggravated by child behaviour and lack of cultural norms.^(16,25) In our study, the chief reason for parents not using a child car

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restraint was simply because they did not own a car (91, 46%), similar to that reported in China. Other reasons included the intent to use a mode of transport where child car restraints was not mandatory (10, 10.8%), logistical difficulties due to lack of time to purchase (9, 9.7%), followed by a perception that it was "unnecessary", "unsuitable" or posed "significant inconvenience" (16, 17.2%). Mandatory legislation on child safety restraint use had been identified as an effective approach to increase usage in Shantou, China. (25)

Worryingly, the study revealed that 25 parents who were already in possession of a child car restraint had no intention of using it, because of personal belief that the newborn was "too delicate" or "too young" (10/25, 40%), followed by the chosen mode of transport not requiring child car restraint usage by law (5/25, 20%). This finding was previously reported in a local survey, where 78% of 513 parents owned child car restraints, but only 55% used them regularly, (33) citing discomfort experienced.

It was heartening to note that most (74%) parents were aware of the local legislation and knew that the correct position for an infant car restraint was the centre back seat with a rear-facing orientation.(Figure 1) Our results contrast with the high rates (up to 95%) of car seat misuse in North America. (34) Knowledge gaps included respondents (23.5%) who believed that holding or cradling a newborn in their arms was appropriate, or assuming the use of a baby carrier was safe (29.5%). Parental education is vital to correct misconceptions. Given that social media is an effective communication tool, electronic media can be employed to educate parents on the proper use of child car restraints.

We believe a multi-faceted approach is needed to improve child car restraint compliance. Table III lists suggestions to improve infant car restraint compliance in Singapore, including measures to tackle parental knowledge deficit, lack of ownership, regulatory requirements, as well as parental misperception. Monthly household income exceeding S\$4000

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in our study was associated with an increased likelihood of owning and using a child car restraint, hence pricing needs consideration in families with financial difficulties. (23,26,27)

We acknowledge several limitations in our study. The survey was conducted on a sample population of 200 based on a convenience sampling administered during office hours, with a risk of selection bias that may affect the generalisability to the local population. Amongst respondents, there was slightly higher representation of the minority races, which may affect the generalisability of results to the whole population. Thirdly, the questionnaire was worded only in English and excluded parents who were not fluent in English. Lastly, the methodology meant that actual compliance and proper use of approved child car restraints could not be directly confirmed through inspection, irrespective of parental replies.

In conclusion, our study showed that while parental knowledge on child car restraints for discharged newborns at our hospital was high, the practice was inconsistent. A significant proportion of parents did not intend to use a child car restraint for their newborn, despite owning one. Compliance to the use of child car restraints was not solely due to parental knowledge deficit, but also involved personal beliefs, misperception of risk and socioeconomic factors which require practical and affordable solutions. Although legislation for the use of child car restraints is currently applicable to transport in personal or private-hire cars, extending it to transport in taxis may be beneficial. Parental education utilising a variety of communication methods before the infants' discharge is key. It is never too late to implement these solutions of road safety for the protection of future generations of children travelling on Singapore roads.

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Table I: Demographic characteristics of the study population (n=200)

Categories	Frequency (Percentage)
Age	
21-25	15 (7.5)
26-30	61 (30.5)
31-35	64 (32.0)
36-40	48 (24.0)
41-50	11 (5.5)
Above 50	1 (0.5)
Ethnicity	
Chinese	89 (44.5)
Malay	69 (34.5)
Indian	25 (12.5)
Others	17 (85.0)
Nationality	
Singaporean	162 (81.0)
Permanent Resident	22 (11.0)
Foreigner	16 (8.0)
Marital Status	
Married	192 (96.0)
Single	8 (4.0)
Divorced/Separated/Widowed	0
Highest Level of Education	
Up to Primary 6	3 (1.5)
Up to 'O' Levels	14 (7.0)
Up to 'N' Levels	9 (4.5)
Up to 'A' Levels	1 (0.5)
Institute of Technical Education Certification (ITE)	22 (11.0)
Diploma	51 (25.5)
Degree	82 (41.0)
Post-Graduate and above	18 (9.0)
Monthly Household Income (in SGD)	
Below 2000	12 (6.0)
2000 - 4000	40 (20.0)
4000 - 6000	43 (21.5)
6000 - 8000	27 (13.5)
8000 - 10,000	29 (14.5)
Above 10,000	47 (23.5)
Nil response	2 (1.0)
Type of Household	
HDB flat	4 (2.0)
1-room	4 (2.0)
2-room	7 (3.5)
3-room	31 (15.5)
4-room	80 (40.0)
5-room	41 (20.5)
Executive Maisonette	6 (3.0)
Executive Condominium	5 (2.5)
Condominium/Private Apartment	21 (10.5)
Landed Property	4 (2.0)
Others	1 (0.50)

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Table II: Literature review of Compliance Rates of Infant / Child Car Seat Restraints

First author	Year of Paper	Research method	Country (locality)	Sample size	Compliance rate of car seat restraint (%)	Contributing factors to non-compliance
Present study	2020	Cross-sectional survey, convenience sampling	Singapore	200	41.1	Do not own child car seat; no legislation for car seat restraint in taxi; Parental misperception
Tan(16)	2020	Qualitative focus group, convenience sampling	Singapore	33	-	Knowledge deficits; child behaviour; cultural norms (or lack of)
Al Sallum(22)	2019	Cross-sectional survey, convenience sampling	Kingdom of Saudi Arabia (Unaizah city)	350	56.7	Knowledge deficit; local practice
Tavakoli(28)	2019	Observational survey, convenience sample	Iran (Gorgan)	204	13	Knowledge deficit; cultural norm; lack of legislation
Ojo(29)	2018	Observational survey, convenience sample	Cape Coast Metropolis, Ghana	1922	13.2	Child position in rear seat; Male driver
Krepis(21)	2018	Cross-sectional survey, convenience sampling	Athens, Greece	444	51.4% ^a	Children < 4 yrs; Male drivers, drivers who were educated about child seat restraints had higher odds of using
Scully(18)	2016	Cross-sectional survey, convenience sampling	Limerick, Ireland	107	89.9	_
Mathieu(30)	2014	Roadside survey, convenience sampling	Belgium	1461	90% ^b	Low attention level to safety (inattention, time pressure, short distance); child behaviour; problems with child restraint system
Karbakhsh(26)	2014	Multi-stage cluster sampling	Mashad, Iran	590	6.3	Low-income families; lower parental education; received less advice; older age of child
Chen(25)	2012, 2014	Cross-sectional survey, convenience sampling	Shantou City, China	3333	0.6% (child car seat); 8.7% (seatbelts)	Parental education level; lack of legislation

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Kanburoglu(20)	2013	Cross-sectional survey, convenience sampling	Ankara, Turkey	98	26	Misperception that child too small for unit
O'Neil(19)	2012	Cross-sectional survey, convenience sampling	Indianapolis, USA	1758	98	Knowledge deficit
Sai Ma(31)	2012	Roadside survey, convenience sampling	Lipetskaya Oblast, Russia	580	11	Driver age < 30 yrs; college degree or higher education
Olufunlayo(24)	2011	Cross-sectional survey, convenience sampling	Lagos, Nigeria	566	10.8	Numerous children in vehicle; cultural norm
Purc- Stephenson(23)	2010	Cross-sectional survey, convenience sampling	Beijing, China	843	64.8	Difficulty finding safety seat; cost; preference to hold child
Yoon(32)	2010	Cross-sectional survey, convenience sampling	Korea	2209	53	Mother's level of education; number of children per household; child's age; knowledge deficit
Kostarisdou(27)	1997	Cross-sectional survey, convenience sampling	Athens, Greece	1556	0-6m: 10.4%; 7-12m: 37.6%; 1-2yr: 40.9%; 3-4y: 12%	Maternal age; number of children; socioeconomic status

^a 48.6% were fastened in an improper seat for their age ^b 50% were not correctly restrained

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Table III: Suggestions to improve infant and child car seat compliance.

	Factor(s) Contributing to Non- compliance to Child Car Restraints		oposed Suggestions
Par	rent does not apply a child car restraint because:		
1.	He/she does not have a car	1.	Consider loan programs in obstetric hospitals (for parents to loan and return later)
2.	The cost of purchase is too expensive for the family to afford	2.	Consider subsidies for sale of child car restraints or moderate sale price to increase affordability.
3.	The infant/child is exempted from having to use child car restraint when travelling by taxi	3.	Consider re-examination of the law (the Singapore Road Traffic Act) by transport and legal authorities
4.	Misperception that the infant is too delicate or too young to use a child car restraint	4.	Initiate parental education by healthcare professional before discharge; Display of educational videos in waiting areas; Release of educational videos on social media; Education for private-hire drivers.
	rent is in possession of a child car restraint but does use it for the trip because:		
1.	Misperception that the infant is too small and delicate to be placed in child car restraints	1.	Initiate parental education by healthcare professional before discharge; Display of educational videos in waiting areas; Release of educational videos on social media; Education for private-hire drivers.

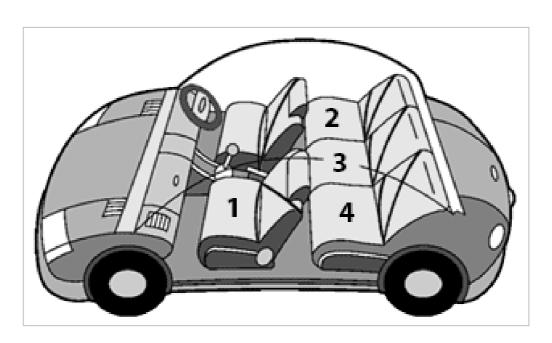


FIGURE 1. Diagram shows that the ideal location for restraining an infant or child in a motor vehicle on Singapore roads is the middle of the rear seat (*marked as 3*) with the restraint facing backwards.

Appendix A: Study Questionnaire Knowledge, Attitudes and Practices of Parents on Transport Safety Upon Discharge from a Singapore Neonatal Unit

Please check the appropriate box

	is your age? 21-25 26-30 31-35 36-40 41-50
A2. What i	Indian
A3. What i	
	is your marital status? Single Married Divorced/Separated Widowed
A5. What i	is your educational qualification? No formal qualifications Up to Primary 6 Up to 'N' Levels Up to 'O' Levels Up to ITE Levels Up to 'A' Levels/IB or equivalent Diploma Degree Post-graduate and above
A6. What i	is your total household income per month? Below \$2000 Between \$2000 to \$4000 Between \$4000 to \$6000 Between \$6000 to \$8000 Between \$8000 to \$10,000 Above \$10,000
A7. Which	best describes your household? HDB – please specify 1-room 2-room 3-room 4-room Executive/Maisonette Executive Condo Condominium/Private Apartment/HUDC Landed property (including terrace, semi-D, bungalow) Others

A8. How many children do you have (including biological, adopted and step-children	n)?				
☐ 1 − please move on to Section B.					
☐ More than 1 – please move on to question A9.					
A9. Did you transport your other children in child car seats when they were infants (vehicle?	i.e. less than 1 year old)	while tra	aveling in	ı a motorized	
☐ Yes – please move on to Section B.					
□ No – please move on to question A10.					
A10(a) How did you transport your other children when they were infants (i.e. less the You may select more than one option. Held in arms Portable bassinet/Moses basket Baby carrier (e.g. sling/wrap/pack) Others - please specify:	han 1 year old) while tra	velling in	a motori	zed vehicle?	1
A10(b) Please share the reasons for your answer to question 9. You may select mo	re than one option.				
 Child car seats are too costly. I am unsure of where to obtain a child car seat from. It is inconvenient to use (e.g. takes too much time to fasten). I did not intend to travel long distances in a motorized vehicle with my child used it when my child was more than 1 year old (please specify the I believe that my child will remain safe without one. Others - please specify: 		e car sea	at was us	sed:)	
Section B Question		Yes	No	Unsure	
B1(a) Is it safe to hold an infant in arms while travelling in a motorized vehicle?		res	INO	Ulisure	
B1(b) Is it safe to place an infant in a portable bassinet/Moses basket while travelling vehicle?	ig ili a iliotolizeu				
B1(c) Is it safe to hold an infant in a baby carrier (e.g. sling/wrap/pack) while travellivehicle?	ng in a motorized				
B1(d) Is it safe to place an infant in a child car seat while travelling in a motorized ve	ehicle?				
B1(e) Is it safe to buckle an infant into a passenger seat with a seat belt while travel vehicle?	lling in a motorized				
B1(f) Is it safe to place an infant on a passenger seat with no restraints while travell vehicle?	ing in a motorized				

B2. If you answered 'Yes' more than once to questions 1(a),(b),(c),(d),(e) and (f) please state which

	6	
method is the safest.		
☐ Holding in arms		
□ Portable bassinet		
☐ Baby carrier (e.g. sling/wrap/pack)		
☐ Child car safety seat		
□ Buckled with seat belt		
□ With no restraints		
□ Others:		
B3. Is it necessary for a child car seat to be secured to the passenger seat (e.g. using seatbelt or		
ISOFIX)?		
DA Warran and in the second that he have a second to be a second t		\
B4. Were you previously aware that by law, passengers below 1.35 metres in height need to be properly secured by an approved child restraint?		
Secured by an approved child restraint?		
B5. If you answered 'Yes' to guestion 4, how did you find out about this law? You may select more than		
one option.		
□ Newspaper articles (either print or online)		
☐ Magazines or other forms of written media		
□ Social media (e.g. Facebook, Instagram, YouTube)		
□ Email		
□ Television		
☐ Word of mouth (e.g. from family, friends, neighbours, colleagues)		
□ Whilst travelling in a private hire car (e.g. Grab, Gojek)		
□ Personally informed by Road Traffic Police		\
☐ Others (please specify:		\
B6. Do you believe that using a child car seat when travelling in a motorized vehicle is necessary?		
· ·		

Section C

C1. Below is a picture of a 5-seater car. Where is the safest place to put a child's car seat in a car (assuming there is no other child requiring a safety seat)?



(1) Front passenger seat

0	(1) Fron
	(2) Back seat behind driver
	(3) Centre of back seat
	(4) Back seat behind front passenger seat
	There is no difference in the child car seat's location
C2. Which	direction should a child car seat for a newborn face? Forward
	Backward
	Sideways It does not matter which direction the child faces

C3. On discharge, which mode o	f transport do you pla	lan to use to bring your	newborn home?
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	reisonal motorized verilcie (e.g. car, truck, van, iorry)
	Private hire (e.g. Grab, Gojek)
	Taxi
	Bus
	MRT
	Motorcycle
	Walking
П	Others - please specify:

C4. Do you currently have a child car seat for your newborn?

	Yes – please move on to question 5.
	No – please move on to question 6.
C5. Will	you be using the child car seat to bring your newborn home from the hospital?
	Yes
	No – please specify the reason(s) why. You may select more than one option.
	☐ I do not intend to travel long distances in a personal/private hire car with my child.
	☐ It is inconvenient to use (e.g. takes too much time to fasten).
	□ I believe my child will remain safe without one.
	□ I believe my child is too delicate for a car seat.
	□ I am only going to use it when my child is older (please specify the child's age at which the car seat will be used:)
	□ I will be travelling in another vehicle which is not fitted for the car seat (e.g. relative's car, taxi).
	□ I will be taking a mode of transport which does not require a child car seat (e.g. Bus, MRT, motorcycle, walking).
	□ Others - please specify:
C6 Plea	se share the reason(s) why you do not have a child car seat. You may select more than one option.
	I have not had time to obtain a child car seat.
П	Child car seats are too costly.
П	I am unsure of where to obtain a child car seat from.
	It is inconvenient to use (e.g. takes too much time to fasten).
	I do not intend to travel long distances in a personal/private hire car with my child.
	I believe my child will remain safe without one.
	I believe my child is too delicate for a car seat.
	I am only going to use it when my child is older (please specify the child's age at which the car seat will be used:)
	I will be taking a mode of transport which does not require a child car seat (e.g. Bus, MRT, motorcycle, walking)
	Others - please specify:

===Thank you very much for your time! Please have a safe journey home. ©===