Children left unattended in parked school vehicles: Internet content analysis and systematic literature review of case series.

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Abstract

Purpose: Childhood injuries resulting from being left in vehicles are an important cause of pediatric mortality. However, no previous study has primarily focused on this occurrence in parked school vehicles. The aim of this study was to investigate the incidence and characteristics of children left unattended in parked school vehicles in Thailand, and systematically review the nature and causes of children being left unattended in parked school vehicles in the peer-reviewed published literature.

Methods: We conducted a systematic literature review of three databases including PubMed, Scopus, and Web of Science using the specific search terms "parked vehicles" and "child", and an online search of Thailand published news in websites for incidents that occurred over the 10 year period from January 2010 to December 2020.

Results: We found five studies of 96 incidents of children left in parked vehicles; 10 cases occurred in school vehicles. From internet content analysis in Thailand, among 20 cases of children left unattended in parked vehicles, eight cases occurred in school vehicles. All cases were left more than 2 hours and resulted from being forgotten by the teacher or school driver. The median age of children was three. The majority of incidents occurred in the wet or summer season during the first school semester.

Conclusion: Children left unattended in parked school vehicles occurred in children slightly older than those occurring in private vehicles, and they show a notable seasonal effect that is not driven by temperature alone but by occurring early in the academic calendar.

Introduction

When pediatricians and parents consider prevention strategies for motor vehicle-related injuries in children, most assume that children are at high risk of a serious traffic injury [1]. As a result, they often focus on discussing and researching the appropriate car seat type and position according to the child safety prevention guideline for traffic injury [2,3].

However, motor vehicle-related injuries and fatalities, such as falling from a vehicle, incidents with power glass windows, and heat stroke due to being left unattended in a vehicle, that occurs outside the context of traffic injuries account for a high number of incidents [4]. Despite an increase of such injuries, there are no specific guidelines for prevention [5].

Hyperthermia among Children Left Unattended in a Parked Vehicle(CPV) is the most prevalent cause of non-traffic motor vehicle-related injuries [4]. Each year in the US, an average of 38 children die from hyperthermia as a result of being left unattended in motor vehicles; there has been an increasing trend every year [6]. This may be attributable to the lack of clear evidence-based information or specific prevention strategies to mitigate the problem.

Although CPV most commonly occurs as a result of parents unintentionally leaving their children in personal vehicles, a few cases have occurred after being left in school vehicles [5,6]. Leaving children in school vehicles may be more likely to cause death than leaving children in personal cars.

Children may be left in a vehicle for more than 6 hours because school vehicles are typically only operated in the morning and afternoon. It may also be difficult for a child to call for help from inside a large school vehicle. Moreover, the doors of school vehicles are not designed to be easily opened when the engines are turned off. These factors may lead to the differing circumstances and preventive measures for these types of incidents.

To our knowledge, this is the first study to focus on Children Left Unattended in School Vehicles (CSV). We have reviewed the case series with individual data on CPV to extract the information specific to CSV to determine the incidence of CSV and their characteristics.

We additionally reviewed all CPV incidents in Thailand identified using internet searches, because no published report exists on the incidence of CPV and CSV in Thailand. It is important to study this subgroup of incidents to provide practitioners with information for identifying potential preventive measures to effectively protect children from being left in school vehicles in the future.

Materials and Methods

Systematic literature review

We conducted a systematic search for all case series of CPV reported in peer-reviewed journals. We searched the PubMed,

Scopus, and Web of Science databases using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework (Figure 1) using the keywords "parked vehicles" and "child".

Duplicate studies or populations were eliminated. Both authors independently screened the full text of identified articles to evaluate them for inclusion. Any differences were resolved by discussion and consensus between the authors.

Final included articles were reference-screened for related works not captured in the initial search.

The quality of a case series was deemed high quality with a low risk of bias if all 10 questions were answered by "yes". A response of "no" to any of the questions negatively impacts the quality of a case series.

Internet content analysis in Thailand

Internet search strategies were conducted to identify published news over the 10-year period from January 2010 to December 2020 using Google news and Google search. We used different combinations of the keywords "child/children/boy/girl", "left/
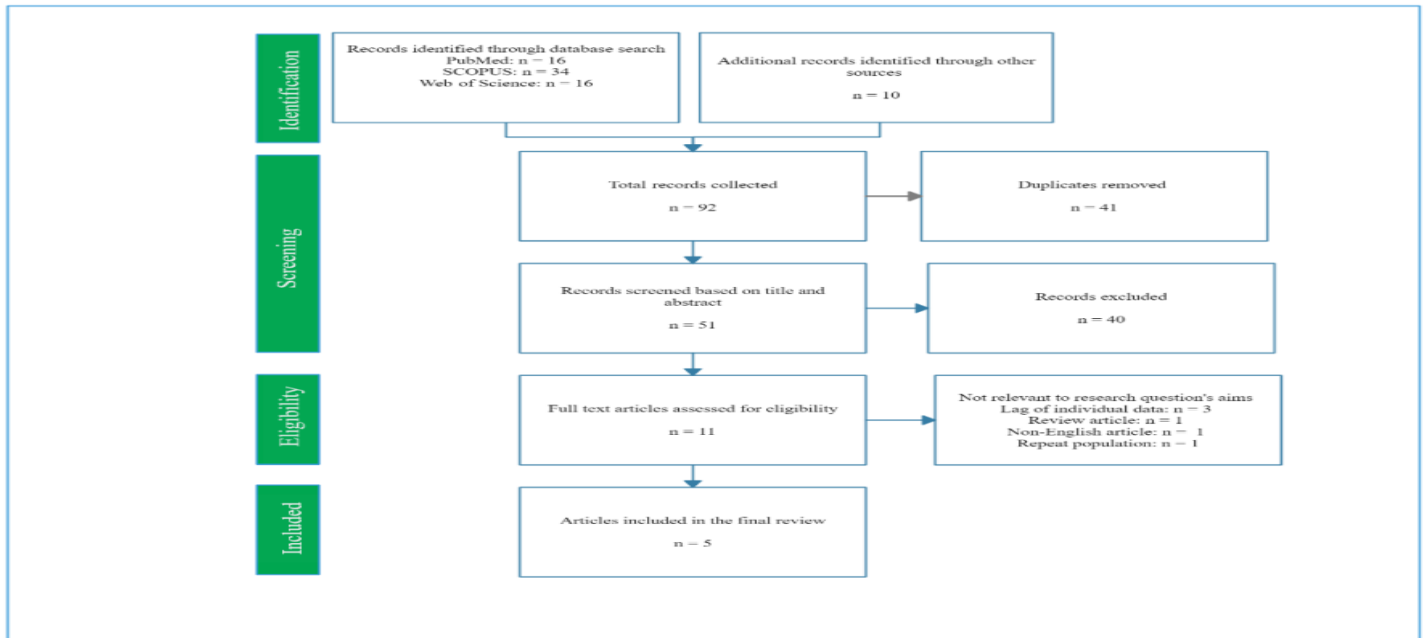

Figure 1. PRISMA search strategy.

Eligibility criteria for study selection

Our inclusion criteria consisted of any texts describing primary cases of CPV. Cases were excluded in the absence of sufficient individual demographic information, injury description, or consequences of the incidents.

Data extraction and quality assessment

The following data were extracted: authors, dates of publication, study designs, number of cases, age and sex of children, drivers, types and characteristics of vehicles, when the incidents occurred, whether the incident was an intentional or unintentional, duration the child was left inside, consequences of the incidents (injuries or fatalities).

We adopted the Joanna Briggs Institute (JBI) quality assessment tool for case series to assess the quality of the included studies [7]. The resultant quality assessment is represented in 10 binary (yes/no) questions. The quality of the case series was described based on answers to these questions.

forgotten", "vehicle/car/bus", "injury/heatstroke/ hyperthermia", and "death/fatalities" in both Thai and English. The child's, drivers, vehicle, and incident data were also extracted according to the coding for the systematic literature review.

Results

Systematic literature review

Of a total of five published studies (Table 1) of 96 incidents of CPV, 10 cases were CSV and included in the final systematic review (Table 2) [8-12]. The evaluated quality of included studies is shown in Table 3. Two studies included only fatal cases, while the others included injury cases as well [8-10].

This can be evaluated that both case series have incomplete inclusion of participants [11,12]. However, all studies provided sufficient information with acceptable quality for analyses. Three studies of CPV, same population with difference time points, from the US were excluded because individual data from the studies were not available for analysis [6,13,14].

Author	Year	Country	Cases in total vehicle: school vehicle	Non-fatal: fatal cases	Age range (months)
Koul et al. [8]	2010	Oman	03:01	03:00	45-84
Ferrara et al.[9]	2013	Italy	16:01	14:02	3-132
Costa et al. [10]	2016	Brazil	31:05	11:20	4-120
Ho et al. [11]	2020	Canada	06:01	00:06	12-36
Siddiqui et al. [9]	2020	India	40:02	00:40	24-120

Table 1. Study included in systematic review.

Children left unattended in parked school vehicles: Internet content analysis and systematic literature review of case series.

Patient characteristics	Current case series N=8	Literature case series N=10
Male	4(50.0%)	5(50.0%)
Female	4(50.0%)	5(50.0%)
Median age (range)	36 months (24-72)	36 months (36-72)
Age range (years)		
0-1	0	0
1-2	1	2
3-4	5	4
>5	2	4
Outcome		
Fatal	8(100.0%)	5(50.0%)
Non-fatal	0	5(50.0%)
Circumstances		
Forgotten	8(100.0%)	10(100%)
Intentionally left behind	0	0
Gained access	0	0
Responsible adult		
Childcare or teacher	5(62.5%)	6(60.0%)
Driver	3(37.5%)	4(40.0%)
Months		
January–March	0	2(20.0%)
April–June	4(50.0%)	4(40.0%)
July–September	4 (50.0%)	3(30.0%)
October–December	0	1(10.0%)
Season		
Dry and cold or winter	0	1(10.0%)
summer	3 (37.5%)	3(30.0%)
Wet	5 (62.5%)	6(60.0%)
Vehicles		
Van or SUV	4 (50.0%)	1(10.0%)
Bus	0	4(40.0%)
Modified pickup	4 (50.0%)	0
No data	0	5(50.0%)
Duration (hours)		
0-2	0	1(10.0%)
3-5	5 (62.5%)	2(20.0%)
>6	3 (37.5%)	2(20.0%)
No data	0	5(50.0%)

Table 2. Summary description of the current case series and the literature case series.

Quality assessment questions	Koul et al. 2010	Ferrara et al. 2013	Costa et al. 2016	Ho et al. 2020	Siddiqui et al. 2020
Were there clear criteria for inclusion in the case series?	Yes	Yes	Yes	Yes	Yes
Was the condition measured in a standard, reliable way for all participants included in the case series?	Yes	Yes	Yes	Yes	Yes
Were valid methods used for identification of the condition for all participants included in the case series?	Yes	Yes	Yes	Yes	Yes
Did the case series have consecutive inclusion of participants?	Yes	Yes	Yes	Yes	Yes
Did the case series have complete inclusion of participants?	Yes	Yes	Yes	No	No
Was there clear reporting of the demographics of the participants in the study?	Yes	Yes	Yes	Yes	Yes
Was there clear reporting of clinical information of the participants?	Yes	Yes	Yes	Yes	Yes
Were the outcomes or follow up results of cases clearly reported?	Yes	Yes	Yes	Yes	Yes
Was there clear reporting of the presenting site(s)/ clinic(s) demographic information?	Yes	Yes	Yes	Yes	Yes
Was statistical analysis appropriate?	Yes	Yes	Yes	Yes	Yes

Table 3. Quality assessment of included case series.

Child characteristics

We found 10 incidents of CSV from difference countries (Table 1). Five cases resulted in fatalities and five cases resulted in recovery with long-term disability. Children in all cases were older than 1 year of age, and 80.0% (8/10) were older than 3 years of age. There was a balance between male and female children.

Circumstances

Children in all 10 cases were left in the vehicle at drop-off at a school or a daycare center by a school driver or teacher/ childcare worker. No children were intentionally left behind or became trapped after gaining access to a school vehicle. The duration of time elapsed until children were discovered was

known in only five cases, all of which were more than 2 hours. The majority of cases occurred from April to September. Seasonal impact was evident, as almost all (9/10) cases occurred in either the summer or the wet months in their respective areas. The summer months contributed three cases (30.0%) while six cases (60.0%) occurred in the wet months.

Case Series in Thailand

Child characteristics

We identified 20 cases of CPV in Thailand between December 19, 2012 and August 30, 2018. Eight cases of CSV were included in our study (Table 4). Table 1 shows that the majority of these were older than 3 years of age (87.5%; 7/8) and more than half were 3 to 4 years of age (62.5%; 5/8). There was a balance between male and female children (4/4).

Case	Year	Month	Age (years)	Gender	Responsible Adult	Vehicle	Duration (hour)	Outcome
1	2020	8	2	Male	A school driver and a teacher	Van	6	Fatal
2	2018	8	3	Female	A school driver	Van	3	Fatal
3	2018	6	5	Female	A teacher as school driver	Modified pickup	3	Fatal
4	2017	8	6	Male	A school driver	Modified pickup	6	Fatal
5	2016	5	3	Female	A school driver and a teacher	Van	7	Fatal
6	2014	9	4	Male	A school driver	Modified pickup	6	Fatal
7	2013	5	3	Male	A teacher as school driver	Modified pickup	7	Fatal
8	2013	4	3	Female	A school driver and a teacher	Van	5	Fatal

Table 4. Cases of children left in school vehicles in Thailand.

All identified cases of CSV in Thailand occurred when children were forgotten or left in vehicles for more than 2 hours. All incidents occurred from April to September, which are the summer and wet seasons in Thailand. Seven incidents occurred in the first school semester (from May to September), while the other occurred during the summer break in April. Three of the eight school vehicle-related cases were under the supervision of two responsible adults (a school driver and a teacher; Table 4)

Discussion

This study is the first to primarily highlight the issues specific to CSV. Our data suggest that CSV make up around 15% (18/116) of all CPV. We documented eight cases in Thailand, and 10 cases occurred in Oman [8], Italy [9], Brazil [10], Canada [11], and India [12]. All studies provided sufficient information with acceptable quality for analyses.

Half of CSV (9/18) involved children of 3–4 years of age, indicating an average age of CSV slightly older than that of CPV in general [6]. Surprisingly, we identified six CSV involving children were older than 5 years old, who should already have a high degree of situational awareness [15]; that is, they should already be able to comprehend circumstances and project the situation into the near future. However, children of this age are still developing the physical and cognitive skills necessary to escape from the vehicles. Thus, our study highlights the importance of training pre-school and school-aged children to recognize everyday hazardous situations regarding school vehicles, including how to escape them. They should be able to easily unlock, honk the horn, and open the doors of parked school vehicles.

We found that all identified cases of CSV occurred by children being forgotten, and almost all incidents occurred from April to August, which are months in the summer or wet season in Thailand, Brazil, and India. This is similar to previous reports in the US, where 70% of CPV cases occurred in the summer

[6,13,14]. Authors have explained that peak temperatures in this season rise rapidly in enclosed vehicles, which can prove fatal [13]. However, based on the fact that the incidents we studied occurred in the tropics where seasonal temperature remains relatively high throughout the year, we hypothesize that the peak of incidents of CSV may be the result of school semester, not season alone.

In our case series from Thailand, the data show that almost all CSV (7/8) occurred in the first semester of the Thailand school system (from June to September). The teachers and school drivers may have been less familiar with the children for whom they are responsible during this time compared with the second semester. Unfamiliarity with children could cause lack of awareness of children when arriving at school. Other factors that can occur in conjunction with a less familiarity with the children are ongoing habitual activity (autopilot mode) and the absence of an explicit reminder cue in school vehicles [16]. It can be assumed that health advocation strategies that primarily focus on educate the dangers of leaving a child unattended in school vehicle are not enough [17]. Teachers and school drivers may be aware of the danger, but easily forget the child is in the vehicle, especially in the first semester. We suggest to develop prevention strategies that are more universal such "child reminder systems" in school vehicles which may be more successful [18].

We acknowledge the potential limitations and biases in this study, in particular that all included studies were retrospective and published in English. We excluded large cohorts of children left in parked vehicles in the US because individual information of each cases could not be extracted [6,13,14]. Other potential biases include the publication bias resulting from using internet databases from news agencies, which are more likely to report on incidents that have greater severity. The proportion of published reports of fatalities versus non-fatal cases may higher than in reality because of this bias.

Conclusion

Children being forgotten by teachers or school drivers are the predominant cause of reported cases of CSV around the world. These events occur in children slightly older than those occurring in vehicles in general, and they show a notable seasonal effect that is not driven by temperature alone but by occurring early in the academic calendar. The characteristics of the cases documented in Thailand and other hot-climate countries reveal that seasonal public-education campaigns may miss part of the root problem, offering a basis for future work in developing prevention strategies.

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