

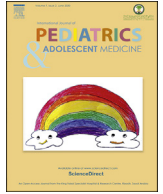
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Original article

Assessing parental awareness and attitudes toward leaving children unattended inside locked cars and the risk of vehicular heat strokes

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ABSTRACT

Background: Vehicular heat stroke is considered as one of the preventable causes of non-crash, vehicle-related deaths among children. The prevalence of parents and caregivers leaving children unattended in enclosed vehicles is non-negligible.

Objective: This paper aims to assess parents' knowledge and beliefs about vehicular heat strokes among children in addition to the prevalence and associated factors of leaving children inside locked cars.

Methods: A cross-sectional study was carried out at King Abdullah Specialist Children's Hospital in Riyadh. Two hundred nine parents completed a self-administered questionnaire addressing vehicular heat strokes.

Results: Among the participants, 24.88% have left at least one of their children unattended inside locked cars during a sunny day; 78.85% of parents have heard about accidental deaths secondary to leaving children in locked vehicles. When assessing parental knowledge of increased sensitivity to heat in infants/children, 81.34% of them knew the correct information. Older age ($P = .0150$), less paternal education ($P = .0157$), and increased number of children ($P = .0020$) were associated with increased incidences of leaving children unattended in enclosed cars.

Conclusion: Considering the high temperatures in the Gulf region, the prevalence of vehicular heat stroke secondary to locking children inside vehicles is nontrivial. Awareness programs for parents and caregivers are strongly encouraged.

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1. Introduction

Vehicular heat strokes are considered as one of the preventable causes of non-crash, vehicle-related deaths among children. The incidence of children suffering from heat-related illnesses has increased during the years [1,2]. According to the No Heatstroke Organization (USA), from 1998 to 2019, at least 809 children have died from heatstroke/hyperthermia in enclosed vehicles. Fifty-four

percent of the incidences occurred when a child was forgotten and left unattended by a parent/caregiver in motor vehicles [3,4].

Children are less able to cope with high temperatures, and they are more susceptible to heat-related illnesses than adults [5,6]. The factors that make children more prone to hyperthermia are greater heat production (i.e., greater metabolic rate and greater surface area-to-body mass ratio), lower blood volume to remove heat, and lower sweat rates [7,8]. It is imperative to point out that there are remarkable differences among geographic regions when it comes to weather temperature changes [6]. For example, in comparison to Europe, the climate of Arab states in the Gulf region including Saudi Arabia is hot in the summer all over the country. The temperature can reach as high as 50 °C (122 °F) [9]. According to reports of Dubai city police, every year, there are a number of cases of unattended children in locked cars. In addition, a number of cases have been

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reported to pediatric clinics of children heatstroke incidences [10].

With regard to vehicle heating dynamics, while the rays of the sun penetrate the car windows, the interior surfaces of the car heat up rapidly, especially with closed windows. In the first 30 min, there is an 80% increase in temperature [7]. This rapid increase in temperature affects the body through interrupting cellular processes, and it can lead to coma and death if there is no immediate attention [11].

Vehicular heat strokes have also been associated with use of child car seats, especially rear-facing seats. Therefore, caution must be taken not to leave the child unattended while driving. Parents/caregivers could unknowingly lock the car and leave their child asleep until they come back. This behavior puts the child at great risk of heat-related illnesses or deaths [12].

Heatstroke tragedies can be prevented by raising awareness and educating parents and caregivers. Additionally, technological interventions such as child reminders might be necessary to reduce the number of children affected.

To the best of our knowledge, no local study has been conducted to shed light on parents' attitudes toward leaving their children unattended inside locked cars. Our study aims to assess parents' knowledge and beliefs about vehicular heat strokes among children in addition to the prevalence and associated factors of leaving children inside locked cars.

2. Materials and methods

2.1. Study design and sampling technique

This cross-sectional study was conducted in May 2018 for a 9-month period on 209 Saudi parents in the waiting areas of the pediatric outpatient clinics at King Abdullah Specialist Children's Hospital (KASCH). KASCH is the first specialized children's hospital in the Kingdom of Saudi Arabia, which provides concentrated pediatric care with a bed capacity of 552. Informed consent was taken before participation in the study. Convenience sampling was used in this study to maximize enrolment of participants.

2.2. Questionnaire

A structured questionnaire was designed after literature review for data collection. The questionnaire consisted of two sections: Section A was designed to collect parents' demographic data, and Section B was designed to assess parental knowledge and attitudes toward vehicular heat strokes as well as their awareness of the dangers of leaving the child alone in a locked car. Parents were asked to either self-complete or answer questions after the informed consent. After completion of the questionnaires, a short presentation was given by medical students, shedding light on heat strokes in children and the dangers of leaving the child alone in a locked car.

2.3. Statistical analysis

Statistical analysis was conducted using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). The data of 209 participants were summarized as frequencies and averages to characterize the study participants. Our primary outcome variable was leaving a child alone in the car where we asked the participants "Have you ever left any of your children alone in the car during a sunny day?". To determine the factors associated with leaving children in the car, categorical and continuous variables were tested using chi-square statistic and *t*-test, respectively, with the outcome variable. Then, we modeled the probability of leaving the child in the car using univariate logistic regression for each variable and obtained the unadjusted odds

ratios with 95% confidence interval. Further, we modeled the probability of leaving the child in the car using multivariate logistic regression including all factors. Level of significance was declared at $\alpha = 0.05$.

2.4. Ethical considerations

Ethical approval was obtained from the institutional review board of King Abdullah International Medical Research Center, National Guard Health Affairs, Riyadh, Saudi Arabia.

3. Results

3.1. Demographics and characteristics of participants

One hundred sixteen (57.71%) participants were mothers, with a mean age of 36 (SD \pm 8.72) years for both mothers and fathers. When asking about the education for both parents in the same family, almost half of the parents had an education level of college and higher: mothers (52.68%) and fathers (53.96%). The mean number of children the parents had was 4 (SD \pm 3.61), and their monthly income was a mean of 9638 Saudi Riyal (SD \pm 5994.3) (Table 1).

The majority of parents have never left any of their children in a locked car during a sunny day (75.12%). Seventy-nine percent of participants heard about accidental deaths secondary to leaving children inside locked cars. When assessing parents' knowledge, the majority of them knew that infants/children are more sensitive to heat (81.34%). Furthermore, 77.40% had the knowledge of temperature increase inside vehicles. The majority of the parents in our cohort did not use a car seat (56.52%). Almost half of the parents (55.02%) had concerns regarding females driving and increased incidences of forgetting children inside locked cars. Table 2 summarizes participants' answers to main questionnaire items.

3.2. Characteristics of participants with regard to leaving children inside the car

We found that older parents were more likely to leave the child in the car. The mean age of those who have left their children alone in locked cars was 38 (SD \pm 8.16) years compared to that of 35 (SD \pm 8.75) years of those who have never left their children. Moreover, paternal education also had an impact on the likelihood of leaving children alone in the car. Our results have shown that the higher the educational level of the father, the lower was the reported incidence of children being left in the car. An increased number of children were also found to be associated with the risk of leaving their children in the car. The mean number of children of parents who left their children in locked cars was 4.8 (SD \pm 3.8), whereas

Table 1
Baseline characteristics of participants.

Variable	N (%)
Age, years, mean \pm SD	36 \pm 8.72
Relationship with child	
Mother	116 (57.71)
Father	85 (42.29)
Maternal educational background	
College and higher	108 (52.68)
High school or less	97 (47.32)
Paternal educational background	
College and higher	109 (53.96)
High school or less	93 (46.04)
Number of children, mean \pm SD	4 \pm 3.61
Monthly income in Saudi riyal, mean \pm SD	9638 \pm 5994.31

Table 2
Answers to main questionnaire items.

Variable	N (%)
Have you ever left any of your children alone in the car during a sunny day?	
No	157 (75.12)
Yes	52 (24.88)
If yes, where did you go while you left your child in the car?	
Minimarket	23 (69.70)
Hospital	5 (15.15)
ATM	3 (9.09)
Pharmacy	2 (6.06)
If yes, why did you leave the child?	
I was away for a very short time.	36 (67.92)
Unspecified reason	10 (18.87)
The child was sleeping	7 (13.21)
Have you heard of death accidents due to leaving children in locked cars?	
No	44 (21.15)
Yes	164 (78.85)
Do you know that children must not be left alone in a locked car even for a couple of minutes?	
No	80 (38.28)
Yes	129 (61.72)
How do you expect the temperature inside the locked car to change?	
Increased	161 (77.40)
I do not know	47 (22.60)
Who is more sensitive to heat?	
Infants/Children	170 (81.34)
Adults	2 (0.96)
No difference	24 (11.48)
I do not know	13 (6.22)
Do you use a child car seat?	
No	117 (56.52)
Yes	90 (43.48)
Are you concerned about females driving and increased incidences of leaving children in cars?	
No	94 (44.98)
Yes	115 (55.02)

the mean of parents who have never left their children was 3.2 (SD ± 2.2). We found that the socioeconomic status had no significant impact on leaving the children alone in the car (Table 3).

Table 4 shows that in the parent group where children were never left alone in the car, 51.7% of the parents knew that children must not be left alone in locked cars even for a couple of minutes, while in the parent group where children have been left alone in a locked car, only 10.1% (21) of the parents knew about this. Awareness of increased temperature in locked cars was higher among participants who have never left their children alone in the car than among those who have left their children, i.e., 60.58% and 6.48%, respectively. Among participants who have left their children in the car, 38 (18.2%) were concerned about the rising incidence of leaving

children in locked cars after women driving. Use of car seats was higher among parents who have never forgotten their child inside a locked car than among those who have forgotten their child inside the car, i.e., 37.2%, and 6.28%, respectively (See Fig.1).

3.3. Univariate logistic regression analysis of leaving children inside locked cars

Age was associated with increased incidence of leaving children unattended in locked cars in the univariate analysis. There was no association between maternal educational background and leaving children inside the car. However, paternal educational background was significantly associated with leaving children inside a car, with increased incidence among fathers with education of high school or less (OR 2.225; 95% CI 1.163 to 4.258). In addition, increased number of children was related to leaving children alone in a locked car (OR 1.153; 95% CI 0.959 to 1.388). Table 5 shows detailed univariate analyses of leaving children inside a locked car.

3.4. Forward stepwise multivariate logistic regression analysis of predictors of leaving children inside a locked car

In this analysis, age, maternal and paternal educational background, and number of children were not predictors of increased incidences of leaving children inside a locked car. Parents who were not knowledgeable about the fact that children must not be left alone in a locked car (even for a couple of minutes) had double the risk of leaving children inside a locked car (aOR 2.788; 95% CI 1.333 to 5.828). Table 6 details the results of forward stepwise multivariate logistic regression analysis of leaving children inside a locked car.

4. Discussion

The incidents of vehicular heat strokes are unfortunately still occurring [1,2]. This behavior of leaving children unattended by their parents inside an enclosed vehicle increases the risk of heat strokes and even death [4]. Therefore, it is important to investigate parental factors that contribute to this problem.

The purpose of this study was to assess parents' awareness and attitudes toward vehicular heat strokes and the risk of leaving children unattended inside a locked car. A self-administered questionnaire was completed by the parents. Our results suggest that the prevalence of leaving children inside vehicles was 24.88% among mothers and fathers. Comparing this result with a study conducted by Roberts et al., [13] in which 50 mothers were interviewed and asked if they ever left their infants/children inside a

Table 3
Association of baseline characteristics with leaving children inside cars.

Variable	Have you ever left any of your children alone in the car during a sunny day?		P value
	No (n = 157) N (%)	Yes (n = 52) N (%)	
Age, years (mean ± SD)	35 ± 8.75	38 ± 8.16	.0127
Relationship with child			
Mother	86 (42.79)	30 (14.93)	.7055
Father	65 (32.34)	20 (9.95)	
Maternal Educational Background			
College and Higher	86 (41.9)	22 (10.8)	.0828
High School or less	67 (32.68)	30 (14.63)	
Paternal Educational Background			
College and Higher	89 (44.06)	20 (9.90)	.0145
High School or less	62 (30.69)	31 (15.35)	
Number of Children (mean ± SD)	3.2 ± 2.2	4.8 ± 3.8	.0004
Monthly Income (mean ± SD)	9638.4 ± 6067.2	9636.8 ± 5856.6	.9988

Table 4
Association of questionnaire answers with leaving children inside cars.

Variable	Have you ever left any of your children alone in the car during a sunny day?		P value
	No (n = 157) N (%)	Yes (n = 52) N (%)	
Have you heard of death accidents due to leaving children in locked cars?			
No	35 (16.83)	9 (4.33)	.4329
Yes	121 (58.71)	43 (20.67)	
Do you know that children must not be left alone in a locked car even for a couple of minutes?			
No	49 (23.4)	31 (14.8)	.0003
Yes	108 (51.7)	21 (10.1)	
How do you expect the temperature inside the locked car to change?			
Increased	126 (60.58)	35 (16.38)	.0444
I do not know	30 (14.42)	17 (8.17)	
Do you use a child car seat?			
No	78 (37.7)	39 (18.9)	.0019
Yes	77 (37.2)	13 (6.28)	
Are you concerned about females driving and increased incidences of leaving children in cars?			
No	80 (38.3)	14 (6.7)	.0025
Yes	77 (36.8)	38 (18.2)	

parked car, 12 admitted that they have left their children.

The present study has looked into the association between leaving children inside a locked car and parental age, education, and number of children. We found out that older age, less paternal education, and increased number of children were associated with higher occurrences of children being left in enclosed vehicles in the univariate analyses. To the best of our knowledge, no other studies have investigated this association before.

A survey conducted by Safe Kids Worldwide [14] found out that fathers are three times more likely to leave their children alone in parked cars than mothers, i.e., 23% and 8%, respectively. However, our results show that 14% of mothers compared to 10% of fathers left their children inside locked cars. This result could be attributed to the circumstance that the percentage of female participants was slightly more in our study because most children are accompanied

by their mothers to the pediatric clinics.

In Saudi Arabia, women were not allowed to drive until 24 June 2018 [15]. Many women and mothers are undergoing a drastic change. Previously, they have been sitting in the back with the child on their lap or next to their side. Now, they have to focus on navigating through the roads; a new experience for them that can be stressful. We asked the participants in our study about their thoughts toward females driving and concerns of increased incidences of mothers leaving children in the future, and interestingly, almost 55% of participants were concerned about this matter. Hence, we recommend that driving schools for women in Saudi Arabia implement educational strategies (about vehicular heat strokes) for new women drivers upon issuing driving licenses.

The present study showed that parents who used car seats were less likely to leave their children inside locked cars. Inconsistent with this result, Kids and Cars organization [12] have mentioned that there is increased incidence of leaving children in enclosed vehicles with car seat use. Our results could be explained by the fact that parents who use car seats are more concerned with the safety of their children.

Checking the car before closing it has to become an automatic reflex, and to develop this learned behavior, it is important to teach and encourage the need for rituals such as always checking the back of the car even when the driver knows he or she did not bring a child in the car. It is beyond the scope of this article to discuss the pedagogical way in which to integrate this issue in the time-limited driving schools. However, one way is through educating the drivers about the need for ritually checking the car and making it an absolute rule to never leave any child alone in the car for any amount of time, even a minute, as the parent can forget and stay longer at the location (store, etc.) outside of the car.

As several published studies concerning vehicular strokes in children have suggested implementing educational programs and awareness campaigns [2,7,13,16–20], we operated an awareness campaign at King Abdullah Specialist Children's Hospital in Riyadh. The campaign focused on raising awareness and giving accurate

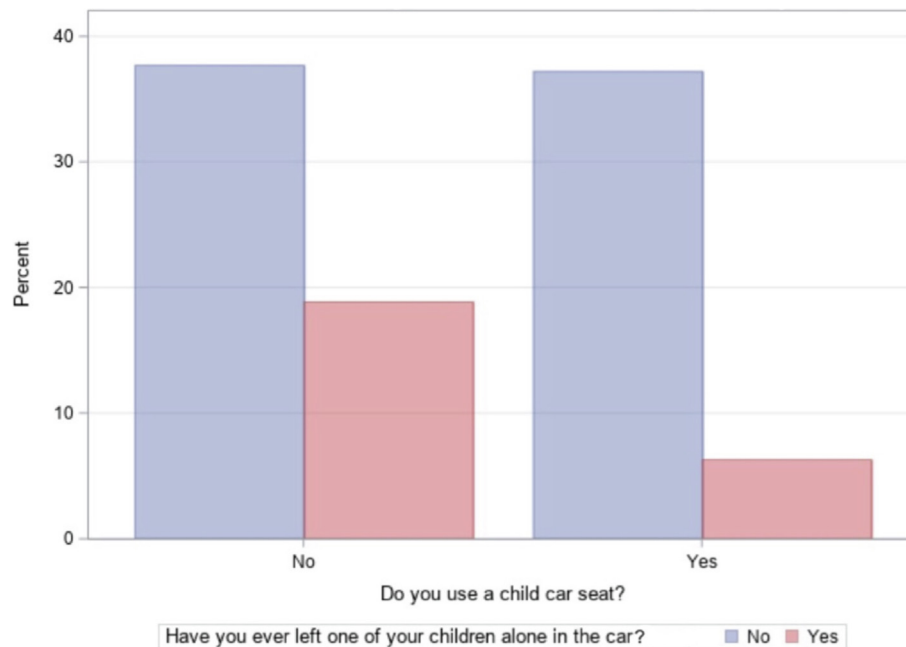


Fig. 1. Percentage of parents leaving their children inside cars who are car seat users. The right bars show parents who use a car seat and the percentage of parents leaving their children inside a car, and the left bars show parents who do not use a car seat and the percentage of parents leaving their children inside a car. This figure shows that there is a lesser incidence of leaving the children inside a locked car among parents who use a car seat.

Table 5
Univariate logistic regression analysis of leaving children inside locked cars.

Variable	Leaving Children Inside Cars OR (95% CI)	P value
Age	1.048 (1.009–1.088)	.0150
Maternal Educational Background		
College and Higher	Reference	
High School or less	1.750 (0.926–3.306)	.0846
Paternal Educational Background		
College and Higher	Reference	
High School or less	2.225 (1.163–4.258)	.0157
Number of Children	1.237 (1.081–1.416)	.0020
Do you know that children must not be left alone in a locked car even for a couple of minutes?		
Yes	Reference	
No	3.254 (1.701–6.224)	.0004
How do you expect the temperature inside the locked car to change?		
Increased	Reference	
I do not know	2.040 (1.010–4.121)	.0469

Table 6
Multivariate regression analysis of predictors of leaving children inside locked cars.

Variable	Adjusted OR (95% CI)	P value
Age	1.013 (0.962–1.067)	.6196
Maternal educational background		
College and higher	Reference	
High school or less	1.116 (0.474–2.628)	.8012
Paternal educational background		
College and higher	Reference	
High school or less	1.314 (0.563–3.069)	.5282
Number of children	1.153 (0.959–1.388)	.1304
Do you know that children must not be left alone in a locked car even for a couple of minutes?		
Yes	Reference	
No	2.788 (1.333–5.828)	.0064
How do you expect the temperature inside the locked car to change?		
Increased	Reference	
I do not know	2.084 (0.923–4.704)	.0771

information about the dangers of leaving children unattended inside enclosed vehicles. The program consisted of approximately 300 brochures, 12 educational speakers, and a couple of posters in front of the pediatric outpatient clinics. When parents were asked about the usefulness of the information, the majority of them appreciated our efforts.

As with most studies, our study had limitations, considering that it is the first study to investigate Saudi parents' awareness of vehicular heat strokes in addition to the prevalence and predictors of leaving children unattended inside enclosed vehicles. A limitation of our study was the convenience sampling of participants, which might limit its generalizability. Nevertheless, further studies on larger populations and from different countries are recommended.

5. Conclusions

In brief, the present study shows that the prevalence of leaving children unattended inside enclosed vehicles is non-negligible. Universal educational programs and awareness campaigns concerning vehicular heat strokes are encouraged. Integrating such a program in the new driving schools for Saudi women drivers is particularly important due to the change in attention and stress presented on women who will start driving.

Author contributions

Writing - original draft, F.A. and S.A.; Writing - review & editing, O.A., O.D., S.J.; Investigation, F.A. and S.A.; Methodology, F.A., S.A.

O.A. and S.J.; Formal analysis, O.D.; Supervision, S.J. All authors edited and approved the final manuscript.

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Declaration of competing interest

The authors declare no conflict of interest.

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