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Title page

Epidemiological analysis of burn injuries in children during the first COVID-19 lockdown,
and a comparison with the previous five years

Analyse épidémiologique des brûlures chez les enfants pendant le premier confinement
COVID-19 et comparaison avec les cinq années précédentes.

Short title:

Burns in children during the COVID-19 lockdown

Brûlures chez les enfants pendant le confinement de COVID-19

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Epidemiological analysis of burn injuries in children during the first COVID-19 lockdown,
and a comparison with the previous five years

Abstract

Background: Child burns rank among the most frequent domestic accidents in France. COVID-19 lockdown between March 16th and May 11th of 2020 increased time spent at home by children.

Material: This retrospective, observational study described the epidemiological impact of COVID-19 lockdown on child burns in a pediatric surgery department compared with previous five years. Child burns in the previous five years constituted the "before COVID-19 group" as the reference group. Child burns during the first lockdown formed the "COVID-19 group". Demographics characteristics, the delay before first attendance at the surgery department, burns characteristics, the place of the incident, need of skin graft, and child reactions to trauma or isolation were recorded for these two groups.

Results: A total of thirty-seven children were included, 16 of them in the COVID-19 group. In the COVID-19 group, burned children were mainly boys, with a median age of 18 months. The median time before first attendance was four days. Main burns characteristics were to be deep partial thickness burns, involved lower limbs, caused by scalding. All burns occurred at home. Half parents reported child reactions to trauma or isolation among their children before burn injury.

Conclusion: The incidence of child burn injuries in the COVID-19 group was higher compared to the before COVID-19 group, but no increased delay to attendance recorded. Time spent at home and psychosocial impact of lockdown might partially explain this high incidence rate of child burns.

Key words: burn; children, COVID-19; lockdown

Level of evidence: IV

Analyse épidémiologique des brûlures chez les enfants pendant le premier confinement COVID-19 et comparaison avec les cinq années précédentes.

Contexte : Les brûlures figurent parmi les accidents domestiques d'enfant les plus fréquents en France. Le premier confinement lié au COVID-19 entre le 16 mars et le 11 mai 2020 a considérablement augmenté le temps passé à la maison.

Matériel : Cette étude rétrospective et observationnelle décrit l'impact épidémiologique du premier confinement lié au COVID-19 sur l'incidence des brûlures d'enfant dans un service de chirurgie pédiatrique par rapport aux cinq années précédentes. Les brûlures d'enfant lors des cinq années précédentes constituent un groupe de référence nommé "avant COVID-19". Les brûlures d'enfant survenues lors du premier confinement forment le groupe "COVID-19". Pour ces deux groupes, les caractéristiques démographiques, le délai avant la première consultation dans le service de chirurgie, les caractéristiques des brûlures, le lieu de l'incident, la nécessité d'une greffe de peau et les réactions des enfants au traumatisme ou à l'isolement ont été enregistrés.

Résultats : Trente-sept enfants ont été inclus au total, dont 16 dans le groupe COVID-19. Dans le groupe COVID-19, les enfants brûlés étaient principalement des garçons, avec un âge médian de 18 mois. Le délai médian avant la première consultation était de quatre jours. Les principales caractéristiques des brûlures étaient les suivantes : brûlures profondes d'épaisseur partielle, impliquant les membres inférieurs, causées par ébouillement. Toutes les brûlures sont survenues au domicile. La moitié des parents ont signalé des réactions au traumatisme ou à l'isolement chez leurs enfants avant la brûlure.

Conclusion : L'incidence des brûlures dans le groupe COVID-19 était plus élevée que dans le groupe avant COVID-19, mais aucune augmentation du délai de consultation n'a été

enregistrée. Le temps passé à la maison et l'impact psychosocial du confinement pourraient expliquer en partie ce taux d'incidence élevé de brûlures chez les enfants.

Mots clés: brûlures, enfants, COVID-19, confinement

Introduction

Burn injuries in children constitute a major public health issue in France, prompting the organization of a national prevention campaign a few years ago. Children under the age of five are most affected, and account for 28.8% of hospital admissions for burn injuries [1]. The burn injuries are accidental in nine out of ten cases. Scalding water is the leading cause of burn injuries in children under the age of 14, whereas contact with hot solids is the second leading cause in children under the age of four [1]. Children are highly exposed to domestic accidents because of their small size and their frequent failure to comply with safety instructions. The prevention measures initiated in France over the period 2009-2014 reduced the incidence of burn injuries [1]. Although the seasonality and/or time of day of burn injuries has been extensively studied, a clear consensus on seasonal, monthly or daily patterns has not emerged [2–4]. In England and Wales, child burn injuries are most frequent between 4pm and 7pm and are more frequent at the weekend than during the school/work week, i.e. when children are more likely to be at home [5].

According to the World Health Organization, the first case of a new infectious respiratory disease (now referred to as novel coronavirus disease 2019 (COVID-19)) was reported in the Chinese city of Wuhan on December 31st, 2019 [6,7]. Subsequently, COVID-19 has spread across the world. This pandemic has prompted many governments to take exceptional health measures to limit the spread of the disease. In France, the government imposed the first nationwide lockdown period from March 16th to May 11th, 2020. The entire French population was instructed to stay at home as much as possible and to avoid nonessential journeys. Teleworking was promoted for adults. Childcare centers and schools were closed, out-of-school activities were no longer possible, and so children had to spend more time at home.

The objectives of the present study were to describe the characteristics of children treated in our pediatric surgery department for burn injuries during the lockdown period and to compare them with the characteristics of children treated during the same calendar period in the previous five years.

Method

We conducted a retrospective, observational study of all children admitted to Amiens University Medical Center's Pediatric Surgery Department (Amiens, France) for burn injuries between March 16th and May 11th (the lockdown dates) of each year from 2016 to 2020. Our medical center is located in the Picardie region of France, which has the country's fourth highest incidence of burn injuries in the general population (14.9 per 100,000 inhabitants) and the third highest incidence among children under 15 (36.6 per 100,000) in 2014 [1].

Data were extracted by searching our medical center's health information system with specific diagnostic codes, according to the French national "*Programme de Médicalisation des Systèmes d'Information*" (PMSI) classification. The study procedure (a review of the patients' medical records) was approved by the local investigational review board, and all the patients' parents gave their written, informed consent to publication of the present data.

We recorded the child's sex and age, the time interval between the burn injury and first attendance at the pediatric surgery department, the depth of burn injury, the total burn surface area (TBSA), the burn injury site, the type of incident leading to the burn injury, the place where the incident occurred, whether a skin graft was performed or not and child reactions to trauma or isolation.

We identified the depth of burn as superficial, partial-thickness and full-thickness. Among the partial-thickness burns, we distinguished superficial partial-thickness burns, intermediary partial-thickness burns and deep partial-thickness burns. In the case of variable burning

depths, only the deepest has been considered as scald burn is often a mosaic of superficial and indeterminate dermal burns.

In each child, all burn injury sites were considered. If both upper limbs were burned, however, we only counted one upper limb (according to the PMSI's classification). The same convention was applied if both wrists, hands, lower limbs, ankles or feet were burned.

The TBSA was calculated using the Lund and Browder chart for 2016 and the E-Burn CH Saint Luc Saint Joseph mobile application for 2017-2020 [8,9]. Next, the TBSA was classified as >5%, 5%-9%, or 10%-20% of the body surface area.

During an unstructured interview with the patient's parents, we recorded data on the child's reactions to trauma or isolation (e.g. anxiety, depression, nightmares, poor sleep hygiene, discomfort, agitation, inability to concentrate, lethargy, clinginess, irritability, loss of appetite, and loss of social interactions). These reactions appear to have been more frequent during the COVID-19 lockdown [6,10,11].

Patients were excluded if any of the following criteria were met: burn injuries treated fully in an outpatient facility or in the emergency department, burn injuries with a TBSA above 20%, burn injuries with inhalation lesions, age over 16 if the child had not previously been treated in the pediatric surgery department, and age over 18 if the child had previously been treated in the department.

Child burns between 2016 and 2019 constituted the "before COVID-19 group" as the reference group. Child burns during the first lockdown in 2020 formed the "COVID-19 group".

Results

Thirty-seven children (19 boys and 18 girls) were included: 16 in the COVID-19 group and 21 in the before COVID-19 group (three in 2019, four in 2018, seven in 2017 and seven in

2016). The patients' demographic data and the characteristics of their burn injuries are summarized for the COVID-19 group in Table 1 and for the before COVID-19 reference group by year in Table 2. In the COVID-19 group, the median (range) age of the children treated was 1.5 years (11 months to 17 years), and the median time interval between the burn and first contact with our department was 4 days (0-15 days).

Regardless of the year, no superficial burn injuries were reported. In the COVID-19 group, we identified three superficial partial thickness burn injuries (i.e. 18.75% of the total), four intermediate partial thickness burn injuries (25%), eight deep partial thickness burn injuries (50%), and one full thickness burn injury (6.25%). We observed nine (56.25%) burn injuries with a TBSA <5% and seven (43.75%) with a TBSA of 5-9%. No burn injuries with a TBSA of 10%-20% were observed in any year. In the COVID-19 group, we observed four burn injuries to the face (17.4%), four to the thorax (17.4%), four to the upper limb (i.e. 17.4%), three to the hand or wrist (13%), five to the lower limb (21.7%), two to the ankle or foot (i.e. 8.7%) and one to the perineum (i.e. 4.3%). Overall, 24 burn injuries were caused by hot fluids, including ten cases in the COVID-19 group (i.e. 62.5% of the COVID-19 group). Among the burn injuries with other causes, two were due to road traffic accidents (one in 2020 (6.3%) and one in 2016 (14.3%)), and an iatrogenic case (14.3%, caused by cryotherapy) was reported in 2016.

All burn injuries in the COVID-19 group occurred at home or in the immediate neighborhood: seven in the kitchen, three in the dining room, three in the garden, two in the bathroom, and one in the road in front of the home (a road traffic accident after the child had wandered off).

All burn injuries other than those on the face and neck were treated with surgical dressings. Face and neck burn injuries were left exposed to the air [12]. Twenty-one thin skin grafts were performed, to allow complete healing of the injuries. Nine of these thin skin grafts were performed in the COVID-19 group, i.e. in 56% of cases during the lockdown period.

In half the cases, the parents reported that their child had suffered during the lockdown-related isolation prior to the incident causing the burn injury; the main signs and symptoms were anxiety, agitation, inability to concentrate, and irritability.

Discussion

Our results demonstrate that burn injuries in children were frequent during France's COVID-19 lockdown period. There were few differences between the lockdown period and previous years with regard to the children's demographics and the characteristics of the burn. In fact, burn injuries were more frequently reported during the lockdown than during the same calendar periods in previous years, during which the number of burn injuries had decreased. Burn injuries were more than twice as frequent in 2020 than in 2016 or 2017. This increase might have been due to the greater time spent at home by children during lockdown. Every year, the Easter vacations are an opportunity for families to leave the region. Between 2016 and 2020, the Easter vacation consistently occurred in April, so in the periods studied. However, in 2020, the lockdown avoided this migratory phenomenon increasing the number of children at risk of burns who were brought to consult our department. All the burn injuries during the lockdown period occurred at home or in the immediate neighborhood. This hypothesis is especially plausible because the main cause of burn injury was scalding, as is typically the case in domestic accidents experienced by children [1–3,5,12–15]. The higher number of burns at home could be explained by a lack of watching over their child by their teleworking parents.

In France, the incidence of burn injuries is highest in children under the age of five and then falling sharp with age [1,13]. We observed a higher incidence among children under the age of five than in other age groups in all years except 2016. In line with literature data, boys were more frequently injured than girls during the lockdown [1,13–15].

The distribution of burn depths in the COVID-19 group was similar to those recorded in the before COVID-19 group. Burns with a TBSA of 5%-9% were more frequent during the lockdown than in all previous years except 2017. Along with the burn depth, TBSA is another severity marker of burn injury [13]. However, none of the burns observed in the COVID-19 group had a TBSA >10%.

The percentage of skin grafts in the COVID-19 group was approximately the same compared to the before COVID-19 reference group: higher than in 2018 and 2019 but lower than in 2016 and 2017. However, the requirement for skin grafting is also a severity marker, and a marked increase in this indication was observed in the COVID-19 group to the two previous years.

In the literature, the most frequent burn injury sites are the head, thorax and upper limbs [3,15]. This was also true for cases treated in our department between 2016 and 2019. In contrast, the cases treated during the 2020 lockdown often affected the lower limbs; however, these five injuries occurred in various places (the kitchen, the bathroom, the garden, in the dining room, etc.). Scalding was the most frequent mechanism, and accounted for three cases of lower limb burn injury. We cannot see an obvious explanation for these incidents. Moreover, there were five lower limb burn injuries, i.e. one more than for face burns, upper limb burns, and thorax burns - the main burn sites in children [13]. Furthermore, we observed a burn injury at a perineal site, which is usually suggestive of child abuse and punishment. This site might be of relevance during a lockdown period, with a potential increase in physical child abuse. Although this site is suggestive of abuse, it is not pathognomonic. Indeed, we were able to establish that the perineal burn injury studied here was definitely not due to child abuse. The only child-abuse-related burn injury observed in our study was a cigarette lighter burn on the hand.

Children appeared to have reacted to the trauma or isolation experienced during COVID-19 lockdown, with sign and symptoms such as anxiety, depression, nightmares, poor sleep hygiene, discomfort, agitation, inability to concentrate, lethargy, clinginess, irritability, loss of appetite, and loss of social interactions [6,10,11]. The COVID-19 lockdown is perpetuating and even accentuating socio-economic inequalities. These symptoms and inequalities are known risk factors for domestic accidents, such as burn injuries [16,17]. Hence, the psychosocial impact of lockdown on children might explain (at least in part) the greater frequency of burn injuries treated in our pediatric surgical department during the lockdown.

While a diagnostic delay might be expected in the context of lockdown and massive hospital admissions of patients with COVID-19, the time to treatment in the COVID-19 group did not differ markedly from previous years.

None of the patients admitted in 2020 were diagnosed with COVID-19, although fever or symptoms suggestive of the disease would have prompted isolation and screening on admission [10].

Our observations were limited to relatively severe burns requiring hospitalization in a surgery department. Burns fully managed in an outpatient facility or in the emergency department would have to be included for a complete epidemiological analysis of the impact of COVID-19 lockdown on pediatric burn injuries. The same is true for the most severe burn injuries, i.e. those with inhalation injury or a TBSA above 20%, requiring management in the regional specialist burns unit. Lastly, a truly comprehensive study would require a larger, nationwide sample. Therefore, few patients were included, restricting the statistical analysis.

Another study limitation relates to our description of only one burn injury site whether both left and right body sides were affected. Lastly, data on the children's reactions to lockdown were collected in an unstructured interview with the parents, rather than with a validated questionnaire.

Conclusion

We observed an elevated incidence of burn injuries admitted to our pediatric surgery department during the first COVID-19 lockdown period. The time interval between injury and treatment was much the same as in the same calendar period in previous years. The patients' age and sex profiles were consistent with the epidemiological data for France as a whole. In the COVID-19 group, the injury mechanism, the burn depth, the TBSA and the requirement for a skin graft were similar to those observed in the before COVID-19 reference group. We observed an unusually high proportion of lower limb burn injuries in the COVID-19 group..

Conflict of Interest: No authors reported conflict on interest in the clinical study or on this submission.

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Table 1 - Characteristics of the patients and the burn injuries in the COVID-19 group.

	Number (n)	Percentage (%)
Gender		
Boys	11	69%
Girls	5	31%
Sex ratio (Boys/Girls)	2.2	
Age (years)		
0 to 4 years	10	63%
5 to 14 years	5	31%
>14 years	1	6%
Minimum	0	
Maximum	17	
Mean	4.19	
Median	1.5	
Time to consultation (days)		
Minimum	0	
Maximum	15	
Mean	4.4	
Median	4	
Burn depth		
Superficial	0	
Superficial partial-thickness	3	
Intermediate partial-thickness	4	
Deep partial-thickness	8	
Full-thickness	1	
Total burn surface area		
<5%	9	56%
5% to 9%	7	44%
10% to 20%	0	0%
Burn injury site		
Face	4	17.4%
Thorax	4	17.4%
Upper limb	4	17.4%
Wrist / hand	3	13.0%
Lower limb	5	21.7%
Ankle / foot	2	8.7%
Perineum	1	4,3%
Cause of burn		
Scalding	10	62,5%
Contact with a hot solid object	3	18,8%
Fire, flame or smoke	2	12,5%
Other cause	1	6,3%
Skin graft	9	56%

Table 1 - Characteristics of the patients and the burn injuries in the before COVID-19 reference group, by year.

	2019		2018		2017		2016		
	Number (n)	Percentage (%)							
Gender									
Boys	2	67%	2	50%	1	14%	3	43%	
Girls	1	33%	2	50%	6	86%	4	57%	
Sex ratio (Boys/Girls)	2		1		0.17		0.75		
Age (years)									
0 to 4 years	2	67%	3	75%	7	100%	3	43%	
5 to 14 years	1	33%	1	25%	0	0%	4	57%	
>14 years	0	0%	0	0%	0	0%	0	0%	
Minimum	2		1		1		1		
Maximum	7		8		2		11		
Mean	4.33		3.50		1.14		4.86		
Median	4		2.5		1		6		
Time to consultation (days)									
Minimum	0		0		0		0		
Maximum	15		9		10		8		
Mean	6.7		3.8		4.6		2.7		
Median	5		3		7		3		
Burn depth									
Superficial	0		0		0		0		
Superficial partial-thickness	0		1		1		0		
Intermediate partial-thickness	1		2		2		2		
Deep partial-thickness	1		1		4		3		
Full-thickness	1		0		0		2		
Total burn surface area									
<5%	3	100%	4	100%	4	57%	5	71%	
5% to 9%	0	0%	0	0%	3	43%	2	29%	
10% to 20%	0	0%	0	0%	0	0%	0	0%	
Burn injury site									
Face	0	0%	1	16.7%	2	15.4%	0	0%	
Thorax	0	0%	0	0%	3	23.1%	1	12.5%	
Upper limb	1	33.3%	0	0%	5	38.5%	1	12.5%	
Wrist / hand	1	33.3%	2	33.3%	2	15.4%	4	50.0%	
Lower limb	1	33.3%	2	33.3%	1	7.7%	2	25.0%	
Ankle / foot	0	0%	1	16.7%	0	0%	0	0%	
Perineum	0	0%	0	0%	0	0%	0	0%	
Cause of burn									
Scalding	1	33,3%	2	50,0%	7	100%	4	57.1%	
Contact with a hot solid object	1	33,3%	2	50,0%	0	0%	1	14.3%	
Fire, flame or smoke	1	33,3%	0	0%	0	0%	0	0%	
Other cause	0	0%	0	0%	0	0%	2	28.6%	
Skin graft	9	56%	1	33%	1	25%	5	71%	5 71 %