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Hospitalisations with burns in children younger than five years in Portugal, 2011–2015

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ABSTRACT

Introduction: Paediatric population still represents a high burden of hospitalisations among burns inpatients. Children under five years old have a distinct aetiology distribution comparing to other age groups, representing in Portugal a fifth of all hospitalisations with burns. We aimed to describe the demographic and clinical burden of burns requiring hospitalization, as well as hospitalization charges, among this age group in Portugal.
Methods: We performed a retrospective study including inpatients younger than five years-old and discharged between 2011 and 2015 in a public Portuguese hospital with a main or secondary diagnosis of burns (ICD-9-CM: 940.xx-949.xx). Clinical and demographics characteristics were assessed, as well as hospital reimbursement charges.
Results: A total of 1217 hospitalisations with burns were found, with a hospitalization rate of 54.6 hospitalisations/100,000 inhabitants/year, higher among boys. Ninety percent of them were due to hot liquid or objects. There were three in-hospital deaths. There was a median length of stay of 9 days and a mean hospitalization reimbursed charge of 3073 Euros (4918 I$). Non-rural: rural hospitalization rate ratio was of 0.42:1. Évora and Bragança were the districts with higher hospitalization rate with 116 and 107, respectively.
Discussion: This Portuguese nation-wide study on hospitalisations with burns highlights that 90% of all burns were due to hot liquid or object and a major impact of patients younger than 2 years old in this age group. Urban vs rural difference in hospitalization rate should also be considered for further health inequalities' studies. As conclusion, ongoing attention needs to be dedicated to paediatric burn prevention and safety cost-effective strategies, particularly in relation to scalds, to further reduce the incidence of burn hospitalisations in children and the associated hospital costs.

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1. Introduction

Fire and heat are among the Top 25 global causes of deaths in the 50 most populous countries among those with ages from 0–19 years and, although it has been decreasing in that same age group, this trend is not followed in children under five years old [1]. In fact, there is clear differentiation in the aetiology of burns between children younger and older than five years of age (U5) [2].

In Europe, the paediatric population represent high proportions of burn hospitalisations [3–10]. They face a greater risk of burn injuries due to their developing natural behaviour, with significant consequences for their future, including implications for treatments, length of hospital stay and readmissions [11,12]. The majority of the burn injuries in children can be prevented [4,13] and epidemiological data (e.g. hospitalisations) can help the design of public health programmes.

In Southern Europe, there are still only few epidemiological studies focusing on paediatric burns. There is a need for more epidemiological studies in this area as they provide essential information for the creation of programmes and strategies that reduce the frequency and severity of burns in this age group [14–22].

In Portugal, children below the age of five years represent one-fifth of burn injury hospitalisations, with a hospitalization rate of 75.7/100.000 U5 inhabitants/year [10]. Although our recent estimation of the number of beds needed and the most useful location for a paediatric burn unit in Portugal [23], to date there is not a specialist Portuguese paediatric burn care unit with children most often transferred to paediatric ICUs.

The aim of this study was to describe the demographic and clinical burden of burns requiring hospitalization, as well as hospitalization charges, among children younger than five years old in Portugal, during the period 2011 and 2015.

2. Methods

We conducted a retrospective observational study, using a national hospitalization database from mainland public hospitals provided by the Portuguese Ministry of Health's Authority for Health Services. We included discharges from 2011 and 2015, of patients under 5 years old with primary or secondary diagnosis of burn, coded as 940.xx-949.xx using the International Classification of Diseases– 9th Revision– Clinical Modification (ICD-9-CM). Each hospitalization was considered as an isolated episode. We analysed age at admission, length of stay (LoS), sex, discharge date, discharge status, burn injury characteristics (burn depth, percentage of total body surface area burned (%TBSA), anatomical site, aetiology) using ICD-9-CM codes described in the Supplementary Table S1 in the online version at DOI: 10.1016/j.burns.2019.01.003, charges and region, classified using Nomenclature of Units for Territorial Statistics, level II (NUTS II).

Burn hospitalisation rates (i.e. hospitalisations per 100,000 inhabitants per year) were calculated by dividing the number of selected burn injury hospitalizations by the sum of the selected age-year-specific mainland Portuguese population (data extracted from the National Statistics Institute [24]).

Charges were calculated from expenditure tables for the Portuguese National Health Service hospital reimbursements, as defined by governmental decree in 2015 (in *Diário da República*) [25] and were performed using the diagnosis-related groups (DRG)-based budget allocation model by means of the 3MTM All-Patient Refined (APR) diagnosis-related groups (DRG) version 31. An analysis of the DRGs of the Major Diagnostic Category (MDC) 22 – Burns – by each DRG and severity of illness (SOI), included in Table 1, was also performed. The reimbursement is performed using the DRG-based model, which includes principal and secondary

Table 1 – Reimbursement price per hospitalisation, total number of hospitalisations and total reimbursement price per diagnosis-related group and Severity of Illness of the Major Diagnostic Category 22, in hospitalised children under 5-years old with burns in Portugal, from 2011 to 2015.

Diagnosis-related group number and designation	Severity of illness	Reimbursement price per hospitalization (Euros) [25]	Total number of hospitalisations (n, %)	Total reimbursement price (Euros)
841 — Extensive third degree burns with skin graft	1	27,003	3 (0.2)	81,008
	2	30,003	4 (0.3)	120,012
	3	34,926	1 (0.1)	34,926
	4	113,648	0	0
842 — Full thickness burns with skin graft	1	5947	77 (6.3)	457,897
	2	9313	3 (0.2)	27,940
	3	21,389	0	0
	4	58,733	0	0
843 — Extensive third degree or full thickness burns without skin graft	1	2245	67 (5.5)	150,400
	2	3292	4 (0.3)	13, 170
	3	4713	0	0
	4	18,240	0	0
844 — Partial thickness burns with or without skin graft	1	2297	972 (79.5)	2,233,014
	2	4131	10 (0.8)	41,313
	3	7782	0	0
	4	30,536	0	0
Total of Major Diagnosis Category 22	–	–	1141 (93.3)	3,159,680

diagnoses, medical or surgical procedures, age, gender, and discharge destination [26].

We converted the obtained charges (in Euros) to 2014 international dollars (I$), using the International Monetary Fund's conversion rate based on Purchasing Power Parity (PPP) for GDP rate for the year of 2014 and the Gross Domestic Product deflator index [27], by means of the "CCEMG-EPPI_Centre Cost Converter" v1.5 [28], in order to obtain a more adequate cost comparison with studies from other countries.

The statistics analysis, both descriptive and inferential, was performed using IBM SPSS Statistics, V23 (IBM Corp. USA) and R version 3.4.0.

3. Results

A total of 1217 hospitalisations with burns in children younger than 5 years old were registered between 2011 and 2015, with a mean of 243 burns per year. The male: female ratio was 1.37:1, with 57.8% (n=703) hospitalisations for male children. The total hospitalisation rate was of 54.56 hospitalisations/100,000 U5 inhabitants/year, 61.65 for males and 47.15 for females. Table 2 describes the demographic and clinical characteristics of these injuries by age and by time period.

Most of the hospitalisations (n=654; 53.7%) corresponded to 1-year old children, decreasing with ageing until 4-years old. Fig. 1 shows the age distribution per burn aetiology, including frequency throughout the studied period.

Hot liquid or object was the main cause for burns hospitalisations (n=1016; 89.4%), of which 20.1% (n=245) were caused by hot tap water. Fig. 2 shows the time trends of number of hospitalisations with hot liquid or object burns, by age. Fire/flames followed that cause with a total of 82 (7.2%) burn hospitalisations. Chemical and electrical burns represented 2.8% (n=23) and 1.3% (n=15), respectively.

In the majority of hospitalisations (n=978; 80.4%), children had a second degree (partial thickness) burn, while third degree (full thickness) burns represented a total of 162 hospitalisations (13.3%).

The most common sites injured were the trunk (39.6%), face and neck (33.9%), upper limb (33.4%) and hands/wrists (31.8%). Ankle and foot represented 0.43% of burn hospitalisations, with the rest of the lower limb only representing 0.9% and genitalia 1.6%.

The median LoS was 9 days (interquartile range: 4–16 days), increasing over time. There were three in-hospital deaths among the studied population (in-hospital mortality rate of 0.2%).

The mean charge of these hospitalisations was 3073.40 Euros (4918.38 I$). The average annual nationwide charge was 793,960.76 Euros (1,295,205.15 I$) in the studied period. Burn hospitalisations due to scald/hot liquid or object had a mean charge of 2931.28 (4781.86 I$), while fire/flames led to hospitalisations with a mean charge of 4875.71 Euros (7953.85 I$) and those due to electrical cause had a mean charge of 2768.70 Euros (4516.64 I$).

Among those with a fire/flames cause, hospitalisations of less than 5 days LoS were charged at average 2674.88 Euros (4363.59 I$) while those with 5 or more days LoS were charged at an average of 5853.85 Euros (9549.51 I$). Among those with a scald/hot liquid or contact with hot object as cause, hospitalisations of less than 5 days LoS were charged at an average of 2343.74 Euros (3823.39 I$) while those with 5 or more days LoS were charged at an average of 3130.14 Euros (5106.26 I$). Among those burned due to an electrical cause, hospitalisations of less than 5 days LoS were charged at an average of 2613.11 Euros (4262.82 I$) while those with 5 or more days LoS were charged at average of 3235.46 Euros (5278.08 I$).

Table 1 shows the reimbursement prices per hospitalization and total number of hospitalisations per DRG within the MDC 22 – Burns – (which represented 93.1% of all hospitalisations) and by cause.

Regarding geographical distribution (Fig. 3), the district with the highest hospitalization rate was Évora with 116.3 children hospitalised per 100.000 U5 inhabitants/year, followed by Bragança with 106.9/100.000 U5 inhabitants/year. hospitalisations due to burns were registered mostly in the Norte (n=531; 43.9%) and Centro (n=353; 29.2%). Fig. 3 shows that Oporto and Lisbon had an average of 54.5 hospitalisations per year, followed by Braga with 25.2 hospitalisations per year. The regions with lowest rates were registered in Beja and Portalegre, with 4.0 and 3.0, respectively.

The non-rural: rural ratio of hospitalisations with burns was 2.29:1, with 69.6% (n=772) in non-rural areas. However, when adjusted to the resident population, the hospitalization rate ratio for non-rural: rural was 0.42:1.

4. Discussion

This is the first nationwide Portuguese study focusing attention on burns in the paediatric age groups (children below 5 years old) from 2011 to 2015.

Using data from public hospitals we found a total of 1217 hospitalisations with a hospitalization rate of 54.56 hospitalisations/100,000 U5 inhabitants/year, which can be considered a midterm value in a worldwide scale. Comparing with other European countries, the hospitalization rate in Portugal stays below to the 82.5 hospitalisations/100,000/year reported by Norway [29] but higher than the 38 hospitalisations/100,000/year reported in Netherlands for children U5 [30]. It is important to note that, globally, the incidence of burns is reported to be higher in developing countries than developed countries [31]. For example, Canada has a hospitalization rate of 30.9 hospitalisations/100,000 inhabitants/year in the age group with 1–4 years old [32], that contrasts with a higher hospitalization rate of 781.1 hospitalisations/100,000 inhabitants/year, determined in Bangladesh [33].

This study reveals that there has been a downward trend in the rate of hospitalization for paediatric burns since 2011. This time trend is consistent with that reported across Europe [4], with the exception of only Iceland and Czech Republic. Although the declining trend in Portugal is a positive sign, there is space to improve, especially in the setting of preventive measures.

Focusing on gender distribution, hospitalization rates were higher in males, with a male to female ratio of 1.37:1. The proportion of approximately 58% of boys in our study goes alongside with what is observed across Europe [34,35], where

Table 2 – Demographic, clinical and economic characteristics of pediatric (0-4years old) burn hospitalisations in Portugal, between 2011 and 2015. Only valid values per variable are presented.

	2011	2012	2013	2014	2015	0	1	2	3	4	Total
Total number of hospitalisations	259	258	249	228	223	184	654	188	105	86	1217
Hospitalisation rate [yearly average]	55.29	56.07	55.59	52.61	53.01	43.73	150.74	41.94	22.80	18.43	54.56
Female sex [(n, %)]	97 (37.5)	109 (42.2)	113 (45.4)	99 (43.4)	96 (43.0)	90 (48.9)	253 (38.7)	79 (42.0)	46 (43.8)	46 (53.5)	514 (42.2)
NUTS II											
Norte [(n, %)]	104 (40.3)	125 (48.4)	115 (46.6)	91 (40.6)	96 (43.2)	82 (45.1)	284 (43.7)	79 (42.0)	52 (50.0)	34 (40.0)	531 (43.9)
Centro [(n, %)]	71 (27.5)	72 (27.9)	74 (30.0)	72 (32.1)	64 (28.8)	61 (33.5)	193 (29.7)	48 (25.5)	29 (27.9)	22 (25.9)	353 (29.2)
Lisbon metropolitan area [(n, %)]	50 (19.4)	29 (11.2)	33 (13.4)	34 (15.2)	33 (14.9)	22 (12.1)	93 (14.3)	31 (16.5)	13 (12.5)	20 (23.5)	179 (14.8)
Alentejo [(n, %)]	20 (7.8)	21 (8.1)	20 (8.1)	19 (8.5)	19 (8.6)	7 (3.8)	56 (8.6)	20 (10.6)	9 (8.7)	7 (8.2)	99 (8.2)
Algarve [(n, %)]	13 (5.0)	11 (4.3)	5 (2.0)	8 (3.6)	10 (4.5)	10 (5.5)	24 (3.7)	10 (5.3)	1 (1.0)	2 (2.4)	47 (3.9)
Rurality of residence area											
Mainly urban [(n, %)]	203 (78.7)	196 (76.0)	181 (73.6)	169 (75.4)	162 (73.6)	141 (77.9)	510 (78.5)	121 (64.7)	77 (74.0)	62 (73.8)	911 (75.5)
Averagely urban [(n, %)]	33 (12.8)	35 (13.6)	33 (13.4)	26 (11.6)	31 (14.1)	22 (12.2)	77 (11.8)	32 (17.1)	16 (15.4)	11 (13.1)	158 (13.1)
Mainly rural [(n, %)]	22 (8.5)	27 (10.5)	32 (13.0)	29 (12.9)	27 (12.3)	18 (9.9)	63 (9.7)	34 (18.2)	11 (10.6)	11 (13.1)	137 (11.4)
Hospital with burn unit [(n, %)]	188 (72.6)	196 (76.0)	207 (83.1)	191 (83.8)	179 (80.3)	130 (70.7)	534 (81.7)	145 (77.1)	83 (79.0)	69 (80.2)	961 (79.0)
Hospitalisation days [median [IQR]]	8 [4,14]	8 [3,16]	10 [4,16]	10 [6,17]	8 [4,14]	7 [3,13.25]	9 [4,15]	9 [5,18]	10 [6,18]	8.50 [4,14]	9 [4,16]
Meets EBA criteria [(n, %)]	164 (66.1)	159 (63.1)	147 (61.3)	136 (61.8)	136 (63.6)	101 (59.4)	411 (64.5)	120 (65.9)	59 (57.8)	51 (61.4)	742 (63.2)
Full [(n, %)]	36 (13.9)	30 (11.6)	39 (15.7)	32 (14.0)	25 (11.2)	24 (13.0)	79 (12.1)	34 (18.1)	15 (14.3)	10 (11.6)	162 (13.3)
Only second degree [(n, %)]	208 (80.3)	216 (83.7)	191 (76.7)	178 (78.1)	185 (83.0)	140 (76.1)	544 (83.2)	139 (73.9)	85 (81.0)	70 (81.4)	978 (80.4)
TBSA											
<10% or unspecified [(n, %)]	170 (65.6)	199 (77.1)	193 (77.5)	179 (78.5)	164 (73.5)	147 (79.9)	491 (75.1)	131 (69.7)	74 (70.5)	62 (72.1)	905 (74.4)
10-19% [(n, %)]	50 (19.3)	38 (14.7)	34 (13.7)	34 (14.9)	39 (17.5)	17 (9.2)	109 (16.7)	36 (19.1)	23 (21.9)	10 (11.6)	195 (16.0)
20-29% [(n, %)]	12 (4.6)	11 (4.3)	8 (3.2)	2 (0.9)	9 (4.0)	8 (4.3)	20 (3.1)	7 (3.7)	4 (3.8)	3 (3.5)	42 (3.5)
30%+[(n, %)]	5 (1.9)	0 (0.0)	4 (1.6)	2 (0.9)	2 (0.9)	3 (1.6)	4 (0.6)	2 (1.1)	1 (1.0)	3 (3.5)	13 (1.1)
Affected body part											
Face [(n, %)]	20 (7.7)	24 (9.3)	24 (9.6)	24 (10.5)	16 (7.2)	10 (5.4)	74 (11.3)	10 (5.3)	4 (3.8)	10 (11.6)	108 (8.9)
Face head neck [(n, %)]	94 (36.3)	86 (33.3)	83 (33.3)	83 (36.4)	67 (30.0)	34 (18.5)	279 (42.7)	51 (27.1)	32 (30.5)	17 (19.8)	413 (33.9)
Wrists and hands [(n, %)]	80 (30.9)	92 (35.7)	78 (31.3)	75 (32.9)	62 (27.8)	62 (33.7)	230 (35.2)	57 (30.3)	19 (18.1)	19 (22.1)	387 (31.8)
Upper limb except wrist/hand [(n, %)]	88 (34.0)	88 (34.1)	78 (31.3)	72 (31.6)	81 (36.3)	53 (28.8)	241 (36.9)	52 (27.7)	33 (31.4)	28 (32.6)	407 (33.4)
Genitalia [(n, %)]	6 (2.3)	3 (1.2)	3 (1.2)	3 (1.3)	5 (2.2)	2 (1.1)	2 (0.3)	6 (3.2)	8 (7.6)	2 (2.3)	20 (1.6)
Major joints [(n, %)]	20 (7.7)	25 (9.7)	14 (5.6)	15 (6.6)	17 (7.6)	14 (7.6)	43 (6.6)	12 (6.4)	14 (13.3)	8 (9.3)	91 (7.5)
Trunk [(n, %)]	105 (40.5)	108 (41.9)	92 (36.9)	86 (37.7)	91 (40.8)	67 (36.4)	271 (41.4)	67 (35.6)	46 (43.8)	31 (36.0)	482 (39.6)
Lower limbs [(n, %)]	1 (0.4)	3 (1.2)	1 (0.4)	4 (1.8)	2 (0.9)	3 (1.6)	3 (0.5)	2 (1.1)	2 (1.9)	1 (1.2)	11 (0.9)
Ankle and foot [(n, %)]	0.22 (0.41)	0.25 (0.43)	0.26 (0.44)	0.19 (0.40)	0.35 (0.48)	0.38 (0.49)	0.15 (0.36)	0.34 (0.48)	0.39 (0.49)	0.40 (0.49)	0.25 (0.43)
Multiple specified sites [(n, %)]	10 (3.9)	9 (3.5)	15 (6.0)	19 (8.3)	2 (0.9)	7 (3.8)	27 (4.1)	11 (5.9)	8 (7.6)	2 (2.3)	55 (4.5)
Burn aetiology											
Chemical [(n, %)]	4 (1.7)	6 (2.5)	10 (4.3)	2 (0.9)	1 (0.5)	6 (3.8)	13 (2.1)	3 (1.7)	0 (0.0)	1 (1.3)	23 (2.0)
Electrical [(n, %)]	6 (2.5)	2 (0.8)	1 (0.4)	3 (1.4)	3 (1.5)	2 (1.3)	5 (0.8)	4 (2.3)	2 (2.0)	2 (2.5)	15 (1.3)
Fire or flames [(n, %)]	16 (6.6)	23 (9.4)	21 (9.0)	13 (6.1)	9 (4.4)	3 (1.9)	33 (5.3)	22 (12.6)	12 (12.0)	12 (15.2)	82 (7.2)
Hot liquid or object [(n, %)]	216 (89.3)	213 (87.3)	202 (86.3)	195 (91.5)	190 (93.6)	148 (93.1)	573 (91.8)	145 (83.3)	86 (86.0)	64 (81.0)	1016 (89.4)
Hot tap water [(n, %)]	48 (18.5)	41 (15.9)	39 (15.7)	46 (20.2)	71 (31.8)	38 (20.7)	118 (18.0)	39 (20.7)	29 (27.6)	21 (24.4)	245 (20.1)
Hospitalisation charge [mean in euros]	2678.27	2750.83	2701.87	2855.86	2961.28	3231.7	2569.32	2980.85	3290.44	2404.48	2783.61

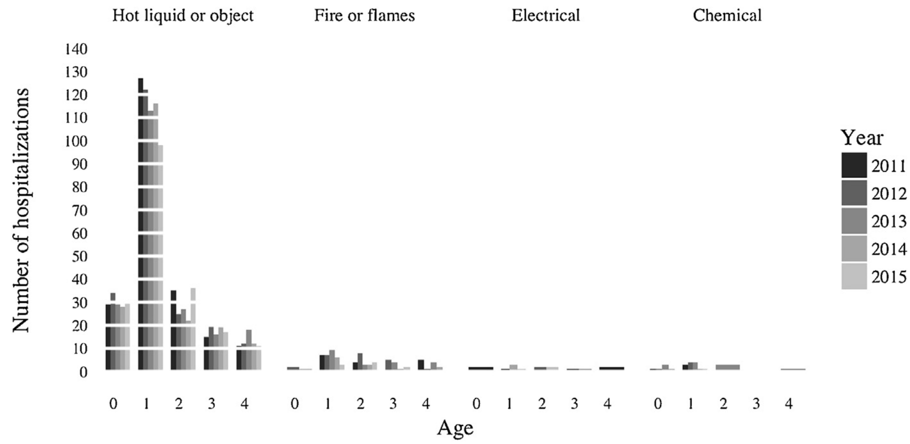

Fig. 1 – Number of hospitalisations with burns by age, by year and per burn aetiology, in children (0–4 years-old) in Portugal between 2011 and 2015.

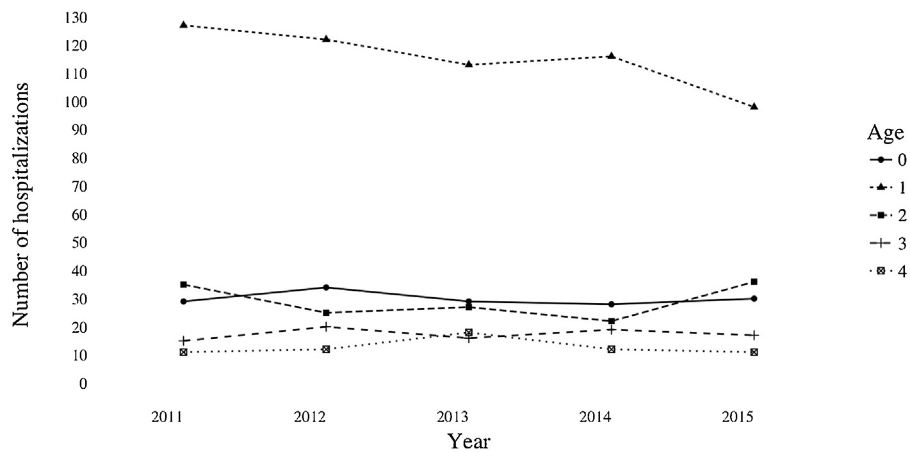

Fig. 2 – Number of hospitalisations with burns due to hot liquids or objects throughout the studied period (2011–2015) by age, in children (0–4 years-old) in Portugal.

boys account for 60%–65% of all paediatric burns [4], and worldwide, with a male to female paediatric ratio of 1.56:1 [31]. The male predominance in hospital admissions is also a fact in the younger age groups and this might possibly relate to more freedom granted by parents and or higher impulsiveness of this gender [11]. Concerning the aetiology of the burns, in the paediatric population, there is a clear dominancy of scalds [10,32,36].

An 11-year study of paediatric ICU burns admissions in Finland [34] identified that scalds were the only cause for the burn hospitalisations in the 0–2 year age group. An epidemiological survey from France reported a 64.1% percentage of scalds burns in patients aged 0–15 years [35]. Likewise, other European countries have identified consistent burn injury causes, with scalds being responsible for up to 60% to 75% of all paediatric hospitalised patients with burns [32].

Our study was not an exception to this rule. Responsible for 89.4% of the burns, hot objects/liquids and scalds have a significant impact on the child, family and health services and can lead to high levels of treatment [32,39,40,41]. However, it is important to highlight that this pattern has exceptions, for example Bangladesh and other low-middle income countries, where fire/flame is a leading cause of burns, most likely due to environmental, technological and cultural issues [33]. Obviously, characterising the burn aetiology is essential for the design of preventive measures or for further research, as discussed infra.

Burn injuries are associated with physical and psychological consequences to children and their families, as well as to the need of long-term treatment [13,37]. For the children, pain and the traumatic experience, and taking into account they are immature, the long-term consequences may become irreversible. Children who were victims of burns injuries also account higher rates of hospital admissions for unrelated conditions [12]. Given the relative lack of independence of the children in the studied age range, and that most burns occur at home, it would be expected that the burns suffered by this group would be avoidable [41].

Our median length of hospitalization (9 days - IQR: 4–16 days) points to a LoS corroborated by results in other studies that had average LoS of less than or equal to 10 days [5,23,32]. Establishing goals for hospital stay is important, but this should not lead to early discharge from paediatric patients as it could result in preventable morbidity.

~Burns of TBSA less than 10% are more frequent but may still be underestimated in this study because a large proportion of children with similar minor burns may have received

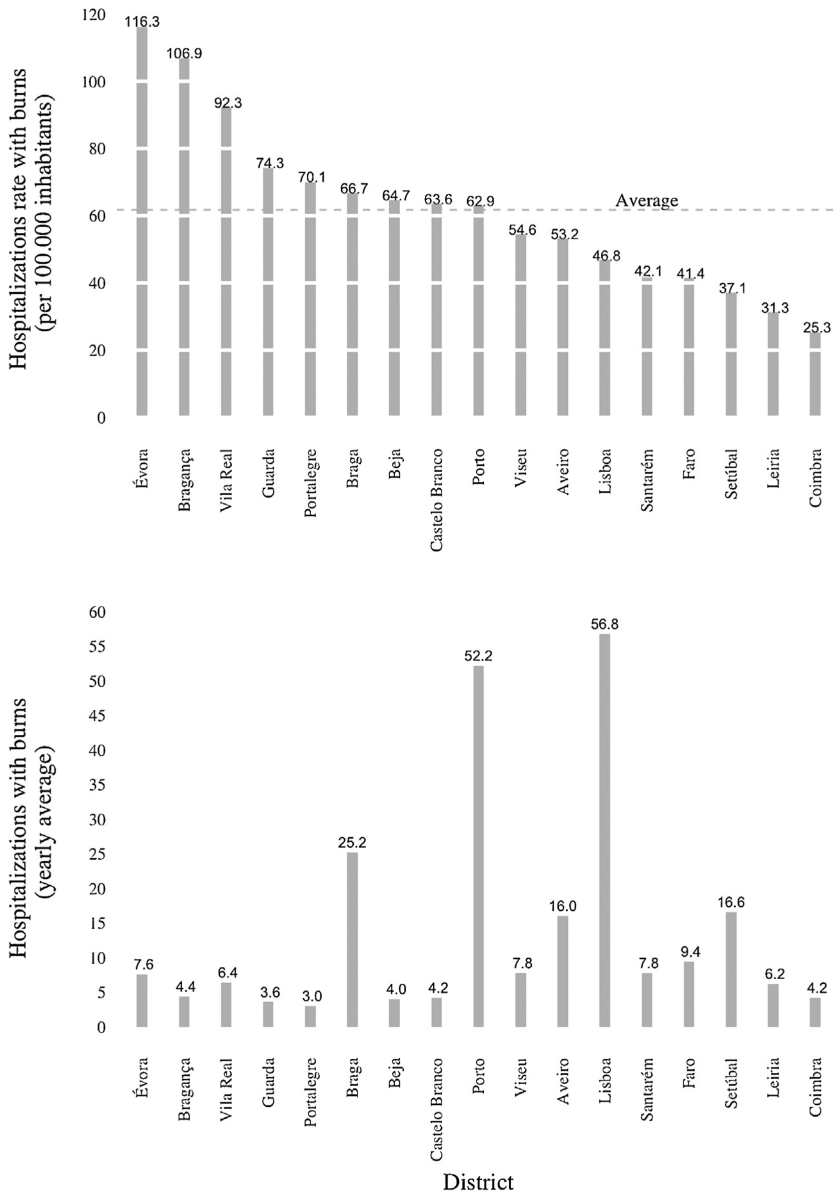

Fig. 3 – Hospitalization rate of children (0-4 years-old) with burns (per 100,000 under-five inhabitants) and average number of burn children hospitalised (below), per district.

treatment in an emergency room or other clinics, not culminating in hospitalization. Other studies corroborate this situation, showing that more than half of the patients presented, in addition to the clinical characteristics, TBSA equal to or greater than 10%. It has also been previously stated that children admitted to metropolitan hospitals were more prone to burns with 10% or less of TBSA and partial and total thickness burns than children hospitalised in rural hospitals and in remote areas [13,36,39,40,42].

We verified the existence of a difference in burns admission incidence between rural and urban causes, as already expressed by Hyland et al. [38]. In our study, urban areas had the highest number of hospitalisations, with a proportion of 69.6%. This observation is thought to be demographic related, because when the hospitalization rates were adjusted to the resident population, a non-rural to rural ratio of 0.42:1 was found. It would be interesting to study if the accessibility to the public hospitals was also a contributing factor to the overestimating of the urban hospital admissions. We can therefore consider that our result reflects in the question of the relation of the urban: rural proportion in agreement with the demographic data in Portugal. In 2011, 72% of the Portuguese population lived in predominantly urban areas, although they represented only 18% of the national territory, according to the Territorial Portrait of Portugal, released by the National Statistical Institute (INE) [43]. However, it is important to highlight the impact of the rural scenario in the hospitalization rates of burn injuries in children. This fact was also noticed by a study in Australia [36], where the lack of availability of outpatient medical support in addition to a higher incidence of burns in rural areas were proposed as possible explanations.

In relation to mortality, we found three in-hospital deaths, which corresponds to 0.2% of in-hospital mortality rate. Higher number of fatalities might have been found if we considered non-hospital deaths, such as in the studies of Spinks et al. in Canada or den Hertog in the Netherlands [30,32]. It was expected a lower rate as paediatric patients with burns have higher survival rate and the risk of mortality increases with age [4]. However, we have a higher rate than that described in Australia of 0.06% [36].

Regarding hospital charges, we found a mean hospitalization charge of 4918.38 I$, which is higher than in most of the other studies. Cooper et al., in the UK, described a mean hospitalization cost of 3840.01 I$ for children U5 burns admitted 2 or more days and 1499.90 I$ for those admitted less than 2 days [44]. Also, it was pointed out that hospitalization is the main source of cost in children U5 burns [44]. Kai-Yang et al. in Shanghai, described a mean hospitalization cost with scald burns in children under four years old of 3134.85 I$ and similar to those between 4 and 14 years old [45]. Carey et al. described a mean hospitalization cost of 3523.06 I$ for paediatric burns (0–18 years old) in Boston [46]. Also in the USA, Myers and Lehna described a mean hospitalization cost between 23,366.40 and 34,039.37 I$ [47], while for Elmasry et al. was of 23,450.46 I$ [49]. As in our study, Shields et al. described higher costs for fire-related burns when comparing to hot liquid or hot substance [48]. In Sweden, Elmasry et al. described that the cost by inpatient episode was of 35,343 I$ and proposed a flexible out scheme, i.e. managed in outpatient setting but admitted for at least one overnight during the whole care period, which has reduced length of stay and costs [49]. Only Klein et al., described a mean hospitalization cost higher than that in our study, average of 10,664.55 I$, in paediatric patients younger than 16 years old in an American burn centre [50].

Several cost-effective public health interventions to prevent burns in children have already been proposed, such as legislation to lower thermostat settings on domestic water heaters and annual educational notices to utility customers [51] or installing thermostatic mixer valves as standard in social housing in new buildings and major refurbishments accompanied by educational information [52]. Taking into account that most of burn injuries could be preventable, prevention programmes may assume an important role, indirectly avoiding the consumption of health care resources (e.g. hospitalisations). These programmes could be addressed at different levels either geographically or in different settings (e.g. at primary health care).

This study had some limitations such as the nature of the data, based on ICD-9-CM coding and dependent on its accuracy and diagnosis. In addition, there was missing data in some variables. Further, we did not include data from primary, outpatient or emergency care, or even from private hospitals. Only deaths occurring during hospital stay were included, i.e. deaths before or after hospitalization could not be included. There were also limitations on the analysis of hospitalization charges, as the costs were estimated based on hospital reimbursements using the diagnosis-related groups (DRG)-based budget allocation model, which is possibly not the preferable methodology. Also, other hospitalisations due to complications without a specific diagnosis of burns were not included, which might underestimate the burden of hospitalization charges due to burns. As we focused in the hospitalisations with burns, we are not estimating all the occurred burns in Portugal and it might be quite erratic to generalise to Portuguese burns incidence.

5. Conclusion

In this five-year nation-wide retrospective study in Portugal, we described all the hospitalisations with burns in children under five-years old. Almost 90% of all burns were due to hot liquid or object and most of the studied patients were younger than 2 years old. Also, urban areas had a higher risk for burns in this population; Évora and Bragança still have quite high hospitalization rates. In fact, there is a need for prevention programmes and associated research on their cost-effectiveness, as well as consideration of establishing a paediatric burn centre to provide specialised services. Further research on paediatric burns prevention and management, including public health, health services and health policy research should be performed in Portugal.

Competing interests

The authors declare that they have no competing interests.

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