

Epidemiological Analysis of Burns in Hammams: Assessment of Prognosis and Economic Impact in Marrakech

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DOI: [10.36347/sasjs.2024.v10i06.014](https://doi.org/10.36347/sasjs.2024.v10i06.014)

| Received: 29.04.2024 | Accepted: 03.06.2024 | Published: 20.06.2024

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Abstract

Original Research Article

Burns from hammams, although less common than other types of burns, are a particular concern in regions where hammams or Moorish baths are widely frequented, such as in Marrakech, Morocco. The burn center at ARRAZI Hospital, part of the Mohamed VI University Hospital Center in Marrakech, admitted 22 patients with burns from hammams out of a total of 403 burn patients over the past four years, resulting in a prevalence of 5.45% among the total burn population during this period. The most affected population in our study is elderly men with a history of cardiovascular conditions or associated risk factors. The burns are often deep and extensive, with more than 20% of Total Body Surface Area (TBSA) affected in 27% of our sample. The most commonly affected areas are the gluteal region followed by the posterior trunk. The consequences of these burns are significant both in terms of prognosis and economic impact. Although the prevalence is low, the impact is substantial. Therefore, prevention is essential to avoid the health and economic complications that result from these incidents in hammams.

Keywords: Burns, Epidemiology, Prognosis, Economic Impact, Public Baths, Morocco, Marrakech, Retrospective Studies, Incidence, Health Care Costs, Burn Units.

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1. INTRODUCTION

Burns represent a significant medical challenge worldwide, both due to their prevalence and their impact on individual health and healthcare systems.



Figure 1: Illustration representing a traditional public bath

Burns from hammams, although less common than other types of burns, are a particular concern in regions where hammams or Moorish baths are widely frequented, such as in Marrakech, Morocco.

This study aims to conduct a comprehensive epidemiological analysis of burns from hammams in Marrakech since the beginning of the second decade of the 2000s, with a focus on assessing the prognosis of affected patients and the associated economic impacts. By thoroughly examining the epidemiological characteristics of these burns, as well as their impact on local health and economy, this study seeks to provide essential information to guide burn prevention and management policies in this region.

2. MATERIALS AND METHODS

A. Study Type

This is a retrospective and cross-sectional descriptive observational study.

B. Sampling and inclusion criteria:

Patients admitted for burns from hammams at the Department of Plastic Surgery and Burn Center of the Mohamed VI University Hospital Center in Marrakech, over a period of 4 years and 3 months, from 2020 to March 29, 2024.

C. Methods

Data collection:

- Data collection sheet developed using GOOGLE FORMS.
- Descriptive analysis of all the data imported from GOOGLE FORMS into MICROSOFT EXCEL.
- The various items on the data collection sheet were filled out from the service archive.

Ethics:

- Respect for anonymity.
- Absence of conflicts of interest.

3. RESULTS

Out of the 403 burn patients admitted during the study period, 22 patients were included in our study, representing 5.45% of the burn population over the past four years.

A. Distribution according to epidemiological data:

a) Age and gender :

Regarding age:

- Patients' ages ranged mainly from their thirties to their eighties, with a clear predominance of the elderly population.
- Only one admission was 6 years old in our sample.
- The average age was 66.68 years.

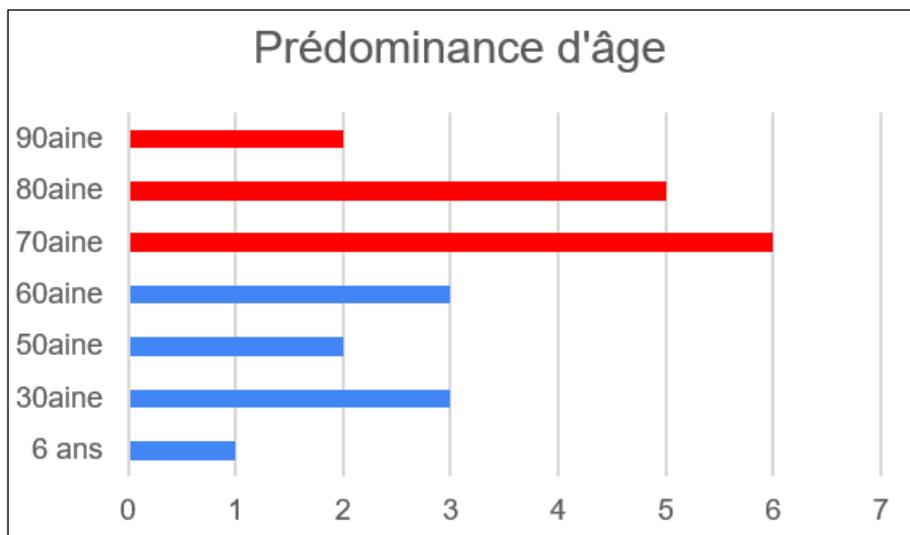


Figure 2: Age distribution graph of the studied population

Regarding gender:

- 68% of our sample were male.
- The sex ratio was 2.125.



Figure 3: Distribution by gender of the studied population

b) Geographical distribution :

The patients in our study were distributed as follows:

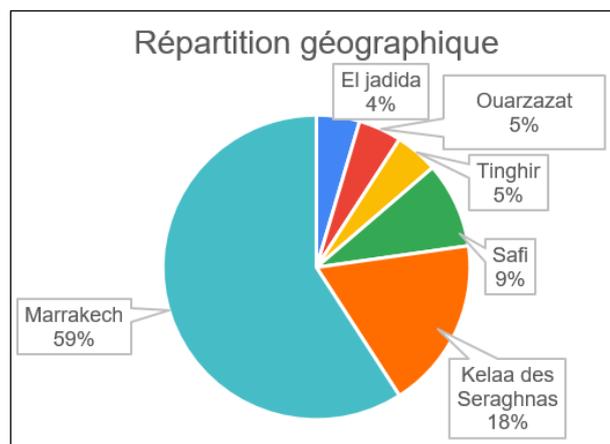


Figure 4: Graph depicting the regional prevalence of the studied population

B. Distribution according to medical history :

Among the 22 patients, a clear predominance of cardiovascular disease history and its risk factors was observed. Secondly, neuropsychiatric history was noted. The following graph illustrates this point:

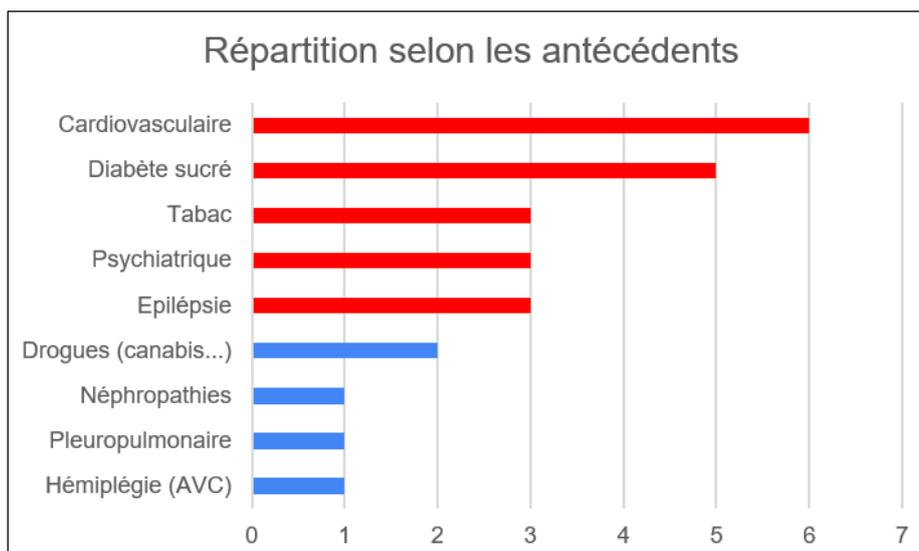


Figure 5: Predominance of cardiovascular history and its risk factors, in addition to neuropsychiatric conditions, in the studied population

C. Temporal distribution

Between 2020 and 2024, our sample demonstrated an upward trend in burns from traditional baths, with the peak occurring in 2023. A significant

increase was observed in December and January, indicating a winter resurgence due to low temperatures in the region and the need for more favorable bathing conditions.



Figure 6: Curve of the prevalence of burns from traditional baths in the studied population

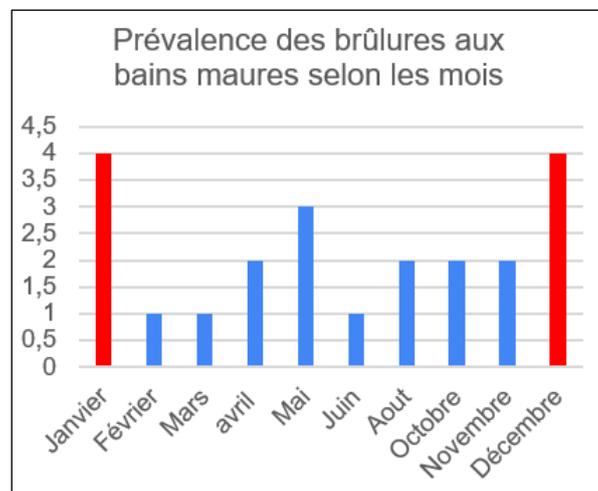


Figure 7: Graph highlighting the winter resurgence of burns from traditional baths in the studied population

D. In-hospital data

a) Admission delay

In our sample, only 7 of our patients presented within a timeframe of less than 24 hours. Moreover, significantly prolonged admission delays were evident, with some extending up to 17 days.

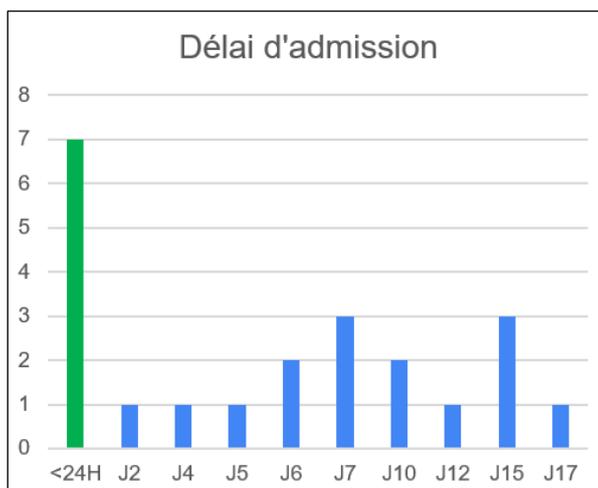


Figure 8: Graph illustrating the admission delays in the studied population

b) Mechanisms and contexts of burns from Moorish baths

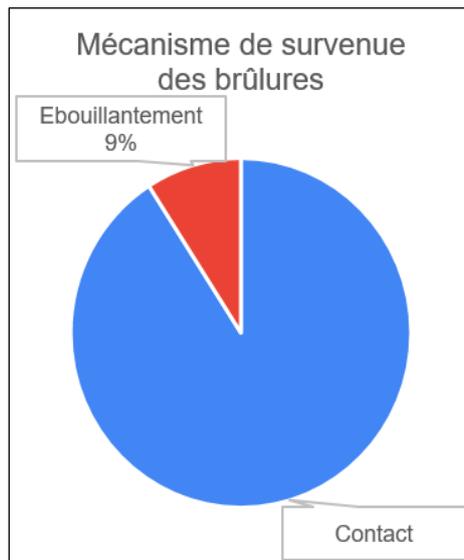


Figure 9: Mechanism of occurrence of burns in the studied population

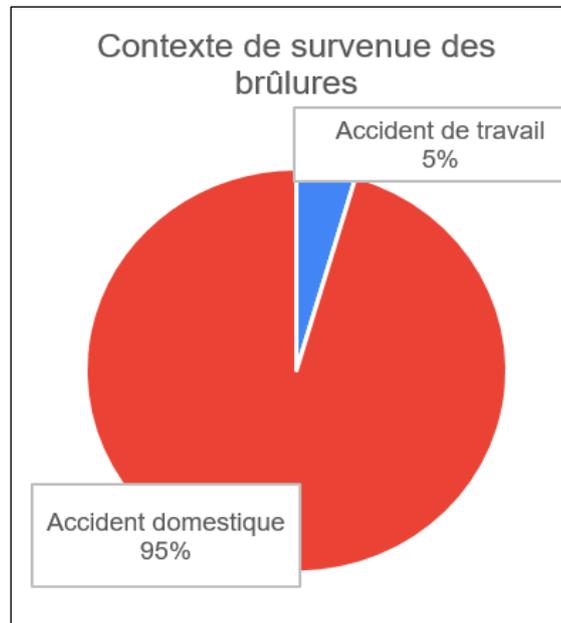


Figure 10: Context of occurrence of burns in the studied population

In our series, the contextual analysis revealed that most burns occurred due to contact with hot surfaces in the context of a domestic accident. This could be explained by episodes of cardiovascular events (such as syncope/lipothymia) or even by inadvertent lapses in safety measures regarding carbon monoxide poisoning. Consequently, patients experienced falls, due to loss of consciousness, onto these hot surfaces for a duration sufficient to cause the injuries.

c) Clinical characteristics

In the context of burns from Moorish baths, the clear majority of admissions presented with deep burns,

ranging from 3 to 30% of total body surface area burned, with an average of 14.72%. Although the prognosis was not unfavorable based on the UBS score, which never exceeded 100 in our sample, the predominance of elderly individuals with their medical history, the depth and percentage of total body surface area burned, in addition to the prevalence of burns to the buttocks and perineum, collectively made burns in this context a serious phenomenon.

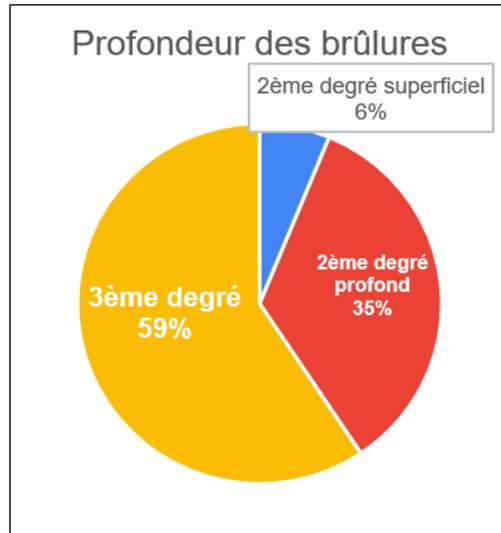


Figure 11: Distribution of burn depths in the studied population

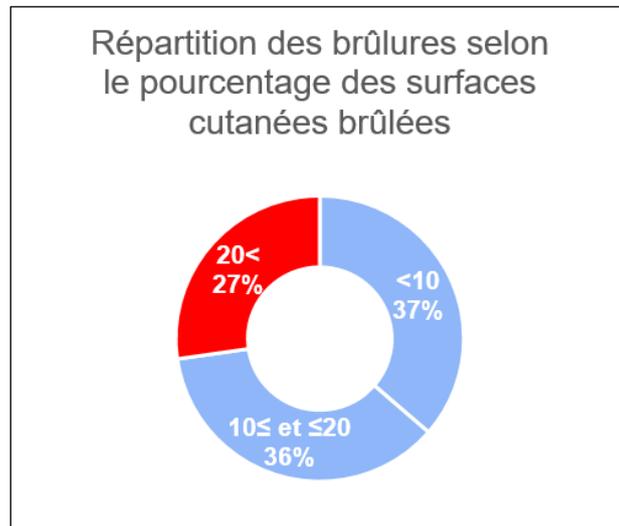


Figure 12: Distribution according to the percentages of burned total body surface area in the studied population (Mean = 14.72%)

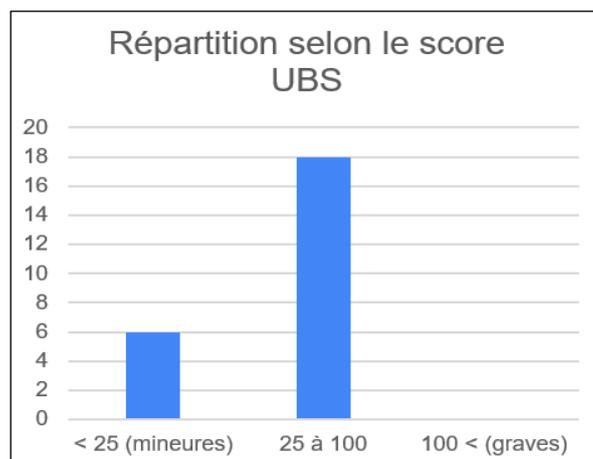


Figure 13: Distribution according to the UBS prognostic score of burns in the studied population

It was also noted a typical distribution of burns from steam baths in our sample. This was evidenced by

the predominance of burns in the buttock regions, the posterior trunk, and the limbs on the same side as the fall.

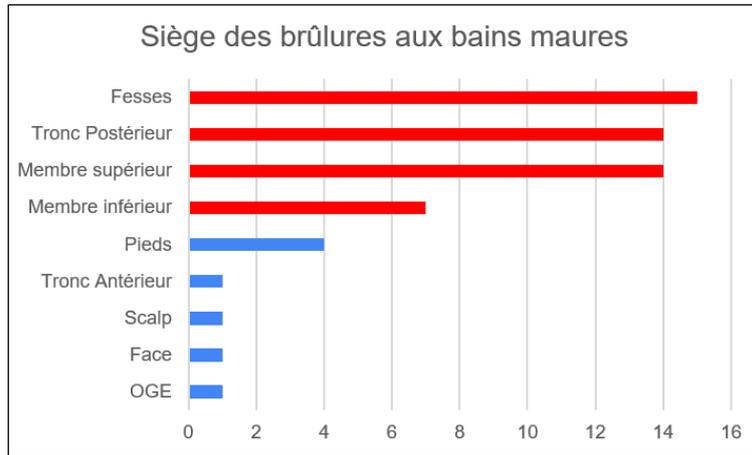


Figure 14: Topographical predominance of burns in the studied population

d) Associated injuries

Regarding associated injuries, systematically sought during the empirical examination of burn patients, only 2 cases of cranial trauma were reported.

child included in our study, for whom the Carvajal formula was used. The average fluid requirement was 3563.98ml per day, with a peak for those requiring over 4000ml per 24 hours.

e) Management and healthcare services

For the entire sample, fluid requirements were calculated using the Evans formula, except for the single

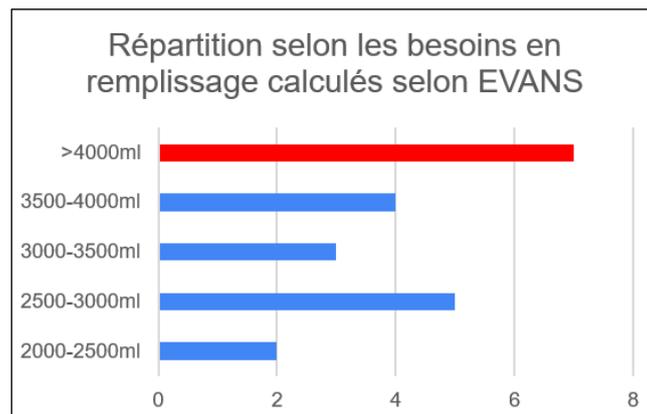


Figure 15: Distribution of fluid requirements in the studied population

As for caloric needs, calculations were based on the Curreri formula. The average caloric requirement

was 2184.54 Kcal per day, with a predominance for those requiring over 2000 Kcal per day.

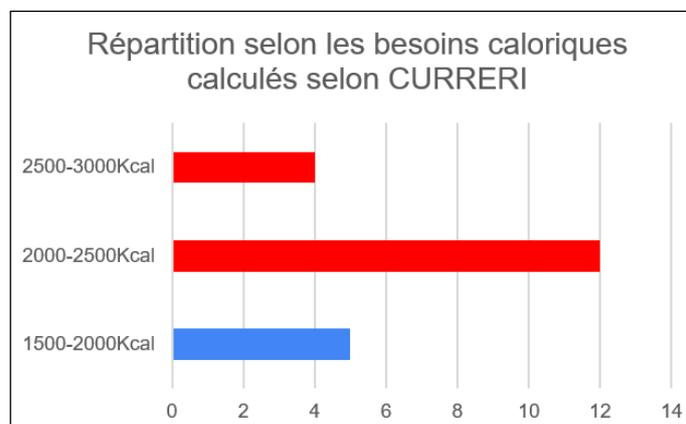


Figure 16: Distribution of caloric needs in the studied population (Mean = 2184.54)

The hospital stay ranged from one day to 45 days, with an average of 23.95 days. However, it is

noteworthy to mention that for most of our patients, the duration often exceeded one month.

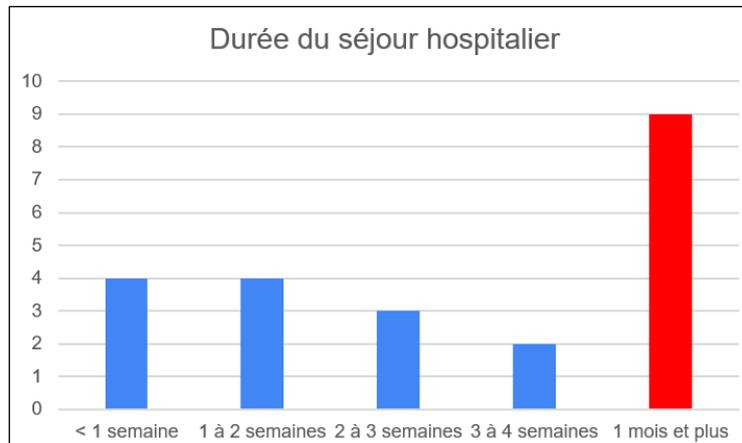


Figure 17: Graph highlighting the lengths of stay in the studied population

In the management of these patients, various measures and resources had to be employed. Key measures included excision and skin grafting procedures,

as well as repeated transfusions of albumin and packed red blood cells. Only one patient in our sample underwent coverage by a latissimus dorsi flap.

Table I: Delivered healthcare services and the number of beneficiaries

Healthcare service provision	N° of Patients
Necrosectomy	13
Skin graft	10
Flap	1
Albumin transfusions	14
Packed Red Blood Cell Transfusions	10

f) Complications

During their hospitalization, all patients in our sample presented with infections originating from cutaneous sources. The infection was either community-acquired when admission was delayed or when there was a history of traditional treatment application or

inadequate care, or it could be nosocomial due to prolonged hospital stays.

Six patients in our sample experienced instabilities resulting in their demise. This yields a mortality rate of 27.27% for burns from Moorish baths.

Table II: Intra-hospital complications observed and the number of affected patients.

Complications	N° of Patients
Hemodynamic or respiratory instability	6
Infections	22

g) gAt discharge

Among the 16 survivors, only 2 of our patients were discharged from the burn center with TBSA burned of 6% and 10%, respectively, while all others had fully epithelialized either through directed healing or after skin grafting. The aforementioned 2 patients were followed up as outpatients and scheduled for potential skin grafting procedures in the operating room.

E. Economic data

The management of burns from Moorish baths has proven to be particularly costly. The average bill amounts to 20347.12 dirhams, with a total sum of the combined invoices for the entire sample reaching 325554 dirhams. This cost is notably high considering that the entry price to the steam bath is 10 dirhams for general access and up to 300 dirhams for more luxurious services.

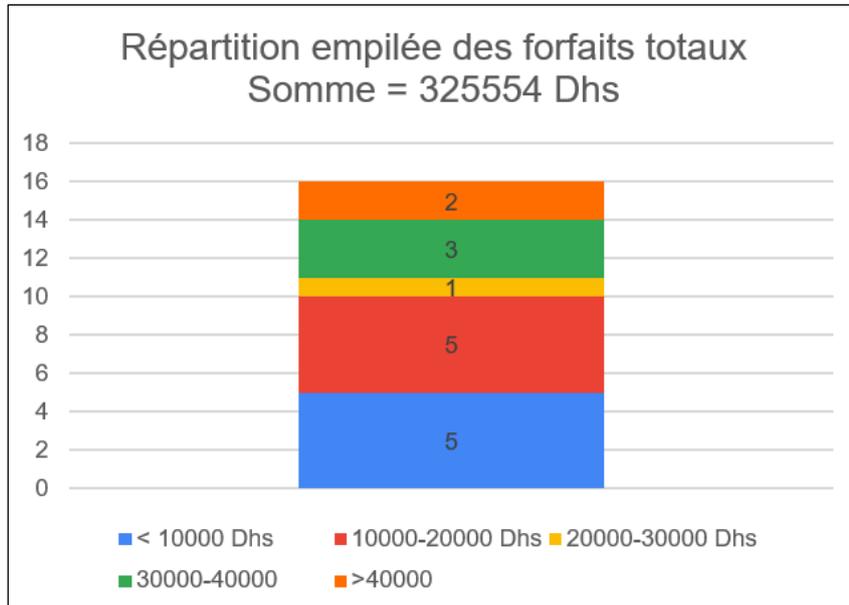


Figure 18: Stacked bar chart highlighting the cost of different healthcare services in the studied population

4. DISCUSSION

A. Overview

The Moroccan hammam, or Moorish bath, is much more than a mere bathing place; it is a living symbol of Morocco's rich history and profound culture. Its origins date back to ancient times, drawing inspiration from the public bathing traditions of the Roman era and Islamic hygiene practices.

From a socio-cultural standpoint, the Moroccan hammam plays a crucial role as a communal gathering space, fostering social exchanges and strengthening interpersonal bonds.

Architecturally and technically, the Moroccan hammam is characterized by its ingenious construction and specific layout. The hot circuits, originating from the furnace, constitute the vital element of this structure.

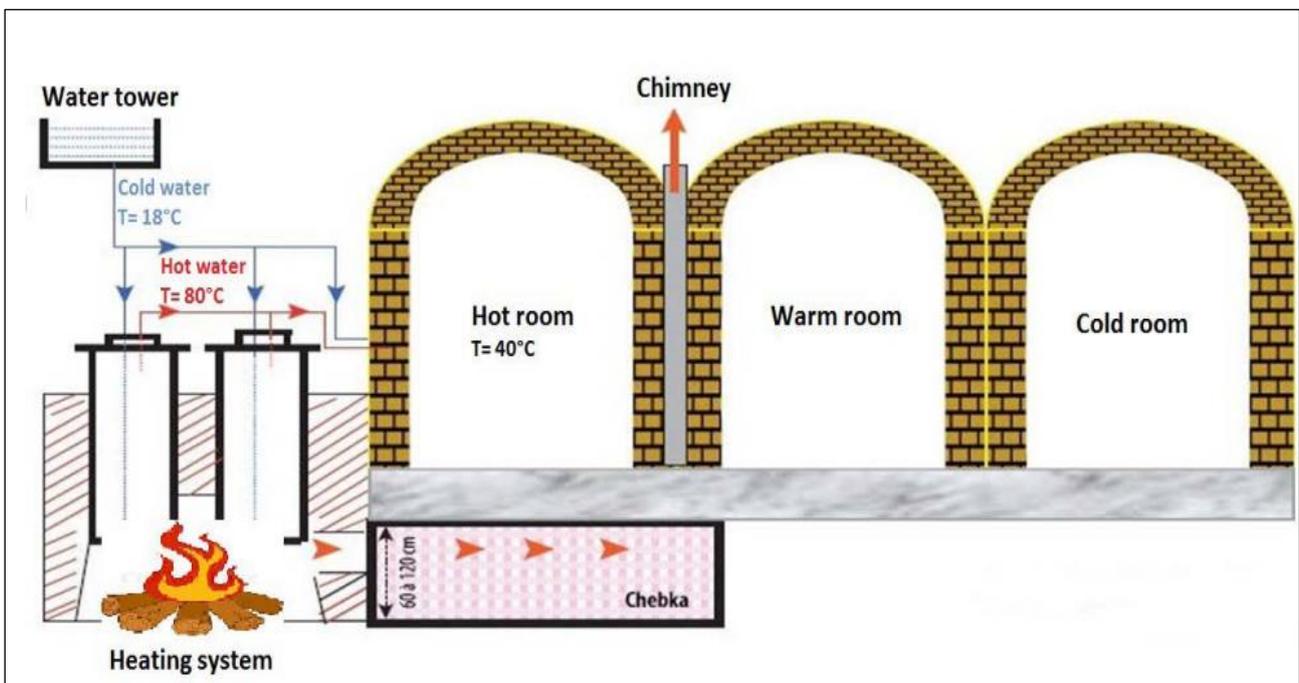


Figure 19: Diagram of a traditional hammam [1]

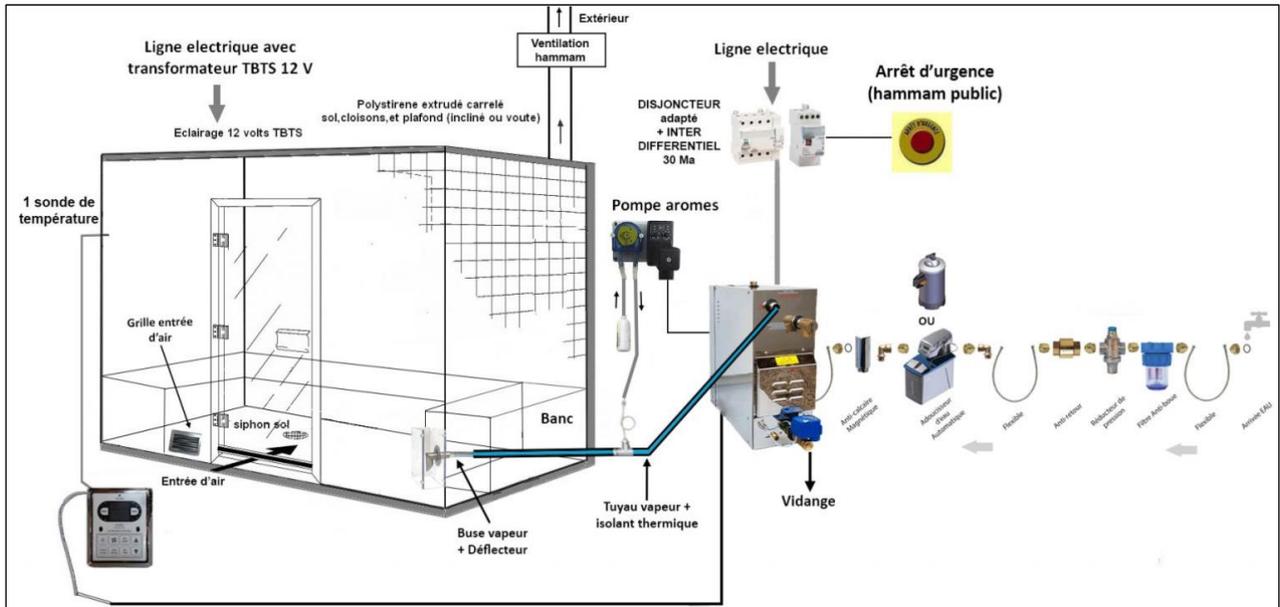


Figure 20: Diagram of a hammam with a generator

These circuits, consisting of channels circulating heated water, are designed to evenly distribute heat throughout the entire hammam.



Figure 21: Embedded copper circuits

The architecture also incorporates elements such as half-dome vaults, colorful ceramic tiles, and running water fountains, which contribute to the distinctive aesthetics and atmosphere of the Moroccan hammam.

It is noteworthy that in rural areas, the architecture is less sophisticated, and as a result, its traditional and amateur nature makes it less safe in terms of minimum safety conditions. This is explained by the absence of insulation between the wood combustion area and the ventilation area of the bathing chamber. As these two structures can be interconnected, they expose to a major risk of carbon monoxide poisoning.

B. Demographic and burn characteristics of Moorish bath burns

In our study, we found that Moorish bath burns accounted for only 5.45% of all burn patients. This figure is five times lower compared to the literature.

Table III: Comparison of the proportions of Moorish bath burns in the literature

Studies	Percentage
Fukunishi <i>et al.</i> , [2]	26,9%
Papp <i>et al.</i> , [3]	25,75%
Our study	5,45%

In terms of age and gender, a clear predominance of elderly men was noted in our study. While male predominance persisted in the literature, the

age predominance varied significantly from one study to another. In contrast to our study, a younger population was predominant in a Japanese study by Fukunishi *et al.*, [2], with an average age of 26.6 years.

Table IV: Comparison of sex ratios in the literature

Studies	Sex-ratio
Kaiser <i>et al.</i> , [4]	1,51
Fukunishi <i>et al.</i> , [2]	2,8
Valtonen <i>et al.</i> , [5]	2,54
Papp <i>et al.</i> , [3]	2,44
Our study	2,12

Table V: Comparison of ages in the literature.

Studies	Mean ages (in years)
Kaiser <i>et al.</i> , [4]	53,9
Fukunishi <i>et al.</i> , [2]	26,6
Papp <i>et al.</i> , [3]	43
Our study	66,68

The winter resurgence of this type of burns has been demonstrated in our study and also in that of Kaiser *et al.*, [4], with 67.9% of sauna-related injuries occurring in the autumn-winter period. Mortality was calculated in our study at 27.27%, a figure not far from that described by Fukunishi *et al.*, [2] at 18.5%, but not corroborated by Papp *et al.*, [3], whose figure does not exceed 2%.

Table VI: Comparison of mortality rates in the literature

Studies	Mortality rates
Fukunishi <i>et al.</i> , [2]	18,5%
Papp <i>et al.</i> , [3]	1,9%
Our study	27,27%

C. Financial impact

An investigation conducted at our center by Aitbenlaassel *et al.*, [6] provided insight into the economic burden of burns during the acute phase (Table VII).

Table VII: Cost of burns by country in the literature in US dollars [6]

Studies	Average cost in US dollars
Etats-unis	301 516
Suisse	167 353
Australie	73 532
Brésil	39 594
Maroc	16 975
Turquie	15 250

The average cost in our study for the treatment of burns at the Moorish bath was 20,347.12 dirhams per patient, for a total of 325,554 dirhams or \$32,101.17 over the last 4 years. A figure quite close to the study that was carried out.

D. Prevention

Preventing burns at Moorish baths requires a proactive and strategic approach, integrating measures at

different levels to ensure the safety and well-being of visitors. These measures can be categorized into primordial, primary and secondary prevention, each playing a vital role in reducing the risk of burns and promoting a safe and enjoyable bathing experience.

Primordial prevention aims to eliminate or reduce risks at source, by implementing structural and organizational measures to ensure the safety of hammam users. Among the essential measures are:

- Safe architectural design: Ensure that the design of steam rooms incorporates appropriate safety standards, such as heat-resistant materials, non-slip surfaces and adequate ventilation.
- Staff training: Provide in-depth training to staff on safety measures, including handling heating equipment, first aid for burns, and monitoring visitors for signs of distress.
- Signage and awareness: Install clear and informative signage to warn visitors of potential hazards, such as hot surfaces and high temperatures, and provide advice on safety and appropriate behaviors.
- Limitation of flow: Certain populations are more vulnerable than others. Our study demonstrated that burns in Moorish baths are the prerogative of elderly subjects and those with associated defects. It would therefore be common sense to limit access to traditional baths to younger and less dependent subjects.

Primary prevention aims to reduce risks before they occur, focusing on awareness, education and personal protection measures. Primary prevention measures include:

- Temperature Regulation: Ensure that water and air temperatures in the steam room are maintained at safe levels. Installing thermostats and temperature limiters can help ensure a safe bathing environment.
- User education: Make visitors aware of the risk of burns and provide information on safe behaviors, such as checking water temperature before submerging and limiting time spent in high temperature areas.
- Protective equipment: Provide visitors with personal protective equipment, such as non-slip bath mats and heat-resistant gloves, to reduce the risk of burns when using the hammam facilities.

Secondary prevention aims to reduce the consequences of burns by intervening quickly and effectively in the event of an incident. Secondary prevention measures include:

- First aid: Ensure the availability of first aid equipment, such as burn care kits, and train staff to provide immediate assistance in the event of burns, including cooling the affected area and applying dressings appropriate.

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5. CONCLUSION

The burn center at the ARRAZI hospital at the Mohamed VI University Hospital in Marrakech admitted 22 burn patients to the Moorish baths out of a total of 403 burn patients over the last 4 years. That is to say a prevalence of 5.45% in the entire burn population over this same period.

The population most concerned in our study is that of elderly men with a history of cardiovascular disease or their risk factors.

The burns are often deep with fairly large surfaces, with more than 20% SCB in 27% of our sample.

The site most often affected is that of the gluteal region followed by the posterior trunk. Allowing us to imagine a fall of the patient from his height, and contact with the hot surface for a sufficient duration on these sloping areas.

The cost of these burns is quite heavy both in terms of vital prognosis and in economic terms. The mortality rate is estimated at 27.27% in our study. And the total cost of this pathological phenomenon is 325,554 dirhams. Too severe a ransom when the initial

investment is 10 to 300 dirhams with the intention of leisure and comfort.

Although the prevalence is low, the impact is too great. Prevention is therefore essential in order to avoid all health and budgetary complications arising as a result of these incidents in the Moorish baths.

REFERENCES

1. Chakri, N., El Amrani, B., Berrada, F., & Jounaid, H. (2019). Environmental diagnosis of traditional hammams of Dar Bouazza's Commune, Morocco. *Desalination Water Treat*, 170, 405–414.
2. Fukunishi, K., Maruyama, J., Takahashi, H., Kitagishi, H., Uejima, T., Maruyama, K., & Sakata, I. (1999). Characteristics of bath-related burns in Japan. *Burns*, 25(3), 272-276.
3. Papp, A. (2002). Sauna-related burns: a review of 154 cases treated in Kuopio University Hospital Burn Center 1994–2000. *Burns*, 28(1), 57-59.
4. Kaiser, P., Seeher, U., Krasniqi, A., Keiler, A., Crazzolara, R., & Meryk, A. (2023). Injuries related to sauna bathing. *Injury*, 54(7), 110825.
5. Valtonen, J., Lindford, A., Vuola, J., & Koljonen, V. (2023). Sauna contact burns in adults in the Helsinki Burn Centre during 2006–2018. *Burns*, 49(7), 1733-1738.
6. Aitbenlaassel, O., Zine-Eddine, I., Elatiqi, O., Laamrani, D., & Benchamkha, Y. (2021). The Cost Of Acute Burn Patients Treated In A Moroccan Intensive Burn Care Unit. *Annals of Burns and Fire Disasters*, 34(4), 360-364.