



# Risk factors of burn injury and prevention methods in the elderly

*Fatores de risco e métodos de prevenção de queimaduras em idosos*

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## ■ ABSTRACT

**Introduction:** As the population ages, the elderly become more susceptible to burn injuries. Studies that assess the epidemiological data and risk factors of burn injuries in the elderly are valuable tools to evaluate the strategies developed with the aim of preventing these injuries. **Objective:** We aimed to describe the risk factors of burn injury and prevention methods in the elderly. In addition, we aimed to determine the correlation between the risk factors and the epidemiological data on the incidence and mortality from studies published in the literature worldwide. **Methods:** In the literature review, we consulted 21 articles published between January 2000 and December 2012 in 4 continents from the following databases: Lilacs, Medline, PubMed, Cochrane, and ScienceDirect. **Results:** We selected 21 articles from 4 continents. The research period ranged from 2 to 28 years. The number of elderly patients ranged from 45 to 308. Their mean age ranged from 64.5 to 85 years. The predominant accident site was the place of residence (68% to 98%), with the kitchen being the most prevalent location (17% to 65%), followed by the bathroom (9% to 31%). The main causes were direct fire or flammable liquids (29% to 73%) and scalding (17% to 66%). Injury by inhalation was found in 12% to 41% of the elderly, with mortality ranging from 6% to 65%. **Conclusion:** We conclude that the place of residence is the most important and prevalent location of burn injuries in the elderly. Therefore, preventive measures against burn injuries in this type of environment should be intensified.

**Keywords:** Burn injury; Elderly; Risk factors; Primary prevention.

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## ■ RESUMO

**Introdução:** Com o envelhecimento populacional, os idosos estão sujeitos a aumento dos traumas por queimadura. Estudos que realizam mensuração de dados epidemiológicos e fatores de risco de queimadura em idosos são um recurso importante para avaliar resultados de tratamento e desenvolvimento de estratégias que visem à prevenção.

**Objetivo:** Descrever os fatores de risco e os métodos de prevenção de queimadura em idosos, correlacionando-os aos dados epidemiológicos de incidência e mortalidade em estudos publicados na literatura mundial.

**Método:** Na revisão da literatura realizada, foram consultados 21 artigos de 4 continentes nas bases de dados: Lilacs, Medline, PubMed, Cochrane e ScienceDirect, de janeiro de 2000 a dezembro de 2012.

**Resultados:** Foram selecionados 21 artigos de 4 continentes. O período variou de 2 anos a 28 anos. O total de pacientes idosos variou de 45 a 308. A idade média foi de 64,5 a 85 anos. O gênero foi descrito em 18 trabalhos, sendo 1132 homens e 1076 mulheres. O local predominante do acidente foi a residência (68 a 98%), com a cozinha sendo a localidade prevalente (17 a 65%), seguindo o banheiro em 9 a 31%. Os agentes principais foram o fogo direto ou líquidos inflamáveis (29 a 73%) e a escaldadura (17 a 66%). Lesão por inalação foi encontrada em 12 a 41% dos idosos e a mortalidade variou de 6 a 65%.

**Conclusão:** Conclui-se que a residência é o local de maior importância e prevalência da queimadura em idosos e devem ser intensificadas as medidas de prevenção deste acidente neste ambiente.

**Descritores:** Fatores de risco; Idosos; Prevenção primária; Queimaduras.

## INTRODUCTION

The world's elderly population is continuously increasing owing to the improvements in health and medical care. This increase leads to a higher number of elderly people that require medical care for injuries<sup>1</sup>. During the year 2012, the American Burn Association surveyed the data collected in the United States, Canada, and Sweden, and found that among the 183,000 patients who were assisted in the period between 2002 and 2011 in 91 hospitals specialized in the treatment of burn injuries, 12% corresponded to people older than 60 years<sup>2</sup>. The population of elderly burn victims brings high costs to the health system, with an approximate average expenditure of US\$ 1,000.00/day in the United States, referring to patients hospitalized in reference centers for burn treatment, with longer hospitalization periods and higher rates of complications and mortality<sup>1,3</sup>. These patients are at a higher risk of burn injury because of known risk factors such as slower reaction to injury, limited mobility, lower capacity to interpret risks due to the weakening of

reasoning ability, and premorbid factors that influence both incidence and prognosis, such as chronic diseases, alcoholism, medication use, senility, and psychiatric or neurological disorders<sup>1,3</sup>. In prevention studies, most of the risks factors have been shown to be preventable with education of the elderly population, family members, and caregivers. Thus, effective elderly burn prevention programs are required. These same studies also emphasized professional training since graduation and continuous training of experts in the fields of geriatrics and family physicians in order to effectively prevent burn cases in the elderly<sup>4</sup>.

Therefore, development of burn prevention systems for the elderly is essential, focused mainly on the place of residence, provided that most burn injury cases in patients older than 60 years occur during their stay at home, unlike in young adults, in which most accidents, according to the literature, occur during work-related activities<sup>5</sup>.

The objective of this study was to describe the risk factors and burn prevention methods in the elderly. In addition, we aimed to determine the correlation

between the risk factors and the epidemiological data on the incidence and mortality from studies published in the literature worldwide.

## METHODS

This study consisted of a systematic review of specialized literature. We selected articles published in Portuguese and English languages between January 1, 2000, and December 31, 2012, in the following databases: Lilacs, Medline, PubMed, Cochrane, and ScienceDirect. The articles were indexed according to the Health Sciences Descriptors (DeCS) and MESH (burn, elderly, primary prevention, *queimados*, *idosos*, and *prevenção*). The search returned 189 articles in the PubMed/Medline database, 46 articles in the Cochrane database, 70 articles in the Lilacs database, and 240 articles in the ScienceDirect database. We included original articles that established a relationship between burn injury characteristics such as burn localization, type of burn, average burned body surface, country, time of the year, total number of patients with burn injuries and studied, age, sex, mortality, percentage of injuries caused by inhalation, and information on injury pre-morbidity conditions. We excluded studies performed in animals and any review study that did not address burn injuries in humans or burn injuries in the elderly, or had no data referring to the epidemiology of the case in the study. Of the articles found in the search, 21 met the inclusion and exclusion criteria and showed epidemiological data regarding the circumstances of the burn injury.

## RESULTS

The studies were grouped according to the search variables (inclusion criteria), as not all of them were included in the reviewed studies. The studies were representative of several world regions, representing 4 of the 5 world continents. Table 1 shows the representativity of the studies based on the study's location in each continent. The research period referring to each study ranged from 2 to 28 years.

The total number of elderly patients studied ranged from 45 to 308 per study, which represented 2.5% to 30% of the total number of burn injury patients from all ages in healthcare services. The mean age ranged from 64.5 and 85 years, with a standard deviation of 5.38. The sex was described in 18 studies, including 1132 men and 1076 women across all studies (Table 2).

In 10 of these studies, the elderly's location when the burn injury occurred was described (Table 3). Among these locations, the most predominant was the patient's place of residence, ranging from 68% to 98% of the time. In 6 of these studies, the authors specified

**Table 1.** Location where the studies on burn injuries in elderly people were performed, sorted according to continent.

Location	Number of articles
America	10
Europe	4
Asia	6
Australia	1
Africa	0

the location within the residence where the elderly became injured, the kitchen (17% to 65%) during food preparation being the most prevalent place, followed by the bathroom (9% to 31%), mostly associated with baths with hot water (Table 4).

In 18 of the reviewed studies published between 2000 and 2012, the most prevalent type of burn injury was analyzed. In 12 of these studies, direct flame or combustion of flammable liquids was the main cause of burn injuries (29.0% to 73.6%). Scalding with hot liquid was the second highest cause and the most frequent type of injury in 6 of the studies (17% to 66%; Table 5).

The number of elderly people who had pre-injury morbidities was high in the 5 studies that considered this information. Table 6 shows that in these studies, more than 50% of the elderly population with burn injuries had some chronic disease at the time of injury.

Injury caused by inhalation was described in 6 studies, with an incidence ranging from 12% to 41% in the affected elderly and mortality ranging from 6.8% to 65% of all elderly people (Table 7).

## DISCUSSION

Several studies have demonstrated an increase in the world's elderly population<sup>1,6</sup>. The elderly are more susceptible to injuries and are more likely to have a poor prognosis due to physiological changes that are typical of senility such as poor vision, slower reaction to injuries, movement limitations with more time spent on the bed, neurological problems leading to a lower capacity to evaluate risks, skin atrophy with slower scarring, and an immune system with lower efficacy and more susceptible to infections<sup>5,7-10</sup>.

In the United States, burn injuries are the fifth leading cause of death by accident and the second leading cause of death in home-related accidents<sup>11-13</sup>. Considering the increase in the world's elderly population and the risk of injury that the elderly are exposed to, an increase in the prevalence of burn injury in this age group is expected<sup>7</sup>. Given the limitations of elderly people, they are described as having a higher risk of mortality from burn injuries compared to young adults, with an estimated mortality risk 4 times higher

**Table 2.** Authors, study period, location, number of patients per study (absolute and relative frequency numbers), mean age, and sex, referring to the reviewed studies.

Reference	Country/period	Patients (absolute number and relative frequency %)	Mean age	Sex	
				Male	Female
Mabrouk et al. <sup>1</sup>	Egypt/1995-2001	97 (2.5%)	64.5	44	55
Chang et al. <sup>4</sup>	USA/1998-2002	94 (8.5%)	76	63	31
Pomahac et al. <sup>5</sup>	USA/1993-2004	45	85	22	23
Lumenta et al. <sup>6</sup>	France/1990-2003	265 (16%)	76.5	105	160
Lionelli et al. <sup>7</sup>	USA/1972-2000	194	79	113	88
Mahar et al. <sup>8</sup>	Australia/2002-2006	80	79.5	43	37
Macrino et al. <sup>9</sup>	USA/2003-2006	179	-	103	76
Li et al. <sup>10</sup>	China/1999-2006	280 (4.1%)	65.1	161	119
Ehrlich et al. <sup>12</sup>	USA/1997-2003	77	-	19	58
Silva et al. <sup>13</sup>	Brazil/2004-2008	79	72	44	35
Serra et al. <sup>14</sup>	Brazil/2001-2010	120	70.78	47	73
Kut et al. <sup>16</sup>	Turkey/1997-2005	98 (7.3%)	73.31	44	54
Wong et al. <sup>17</sup>	China/2000-2005	59	-	22	37
Alden et al. <sup>18</sup>	USA/2000-2004	68 (24%)	78	38	30
Albornoz et al. <sup>19</sup>	Chile/2006-2009	66 (30%)	-	37	29
Yin et al. <sup>20</sup>	China/1996-2004	201 (5.8%)	69.3	125	76
Ho et al. <sup>21</sup>	China/1993-1999	94 (8.8%)	73.8	44	50
Rao et al. <sup>22</sup>	UK/1999-2003	63	80.4	-	-
Wibbenmeyer et al. <sup>23</sup>	USA/1977-1996	308	71.5	-	-
Morita et al. <sup>24</sup>	Japan/2003-2009	35	78.1	-	-
Liu et al. <sup>25</sup>	China/2003-2009	103	69.5	58	45

**Table 3.** Location of the accidents where the burn injuries occurred in the elderly people, according to the reviewed studies, referring to the period between 2000 and 2012.

Reference	Residence (%)	Outside of the residence (%)
Mabrouk et al. <sup>1</sup>	81	19
Lumenta et al. <sup>6</sup>	78	22
Ehrlich et al. <sup>11</sup>	90	8 (unknown: 2)
Wong et al. <sup>17</sup>	75	25
Alden et al. <sup>18</sup>	97	3
Albornoz et al. <sup>19</sup>	80	20
Yin et al. <sup>20</sup>	73.6	26.4
Ho et al. <sup>21</sup>	90.4	9.6
Wibbenmeyer et al. <sup>23</sup>	> 83	Unspecified
Liu et al. <sup>25</sup>	68.9	31.1

than in the younger age groups<sup>8,11,14-16</sup>. Even with the improvement in the treatment of burn injuries and the decrease in mortality among young patients, the literature fails to show an improvement in the prognosis in the elderly, which remains associated with high mortality

**Table 4.** Location where the accidents where the burn injuries occurred in the elderly people, according to the reviewed studies, referring to the period between 2000 and 2012.

Reference	Country	Location where the accident occurred	
		Kitchen	Bathroom
Mabrouk et al. <sup>1</sup>	Egypt	40	31
Lionelli et al. <sup>7</sup>	USA	17.1	10.7
Ehrlich et al. <sup>11</sup>	USA	65	13
Wong et al. <sup>17</sup>	China	54	10
Yin et al. <sup>20</sup>	China	50.2	9
Liu et al. <sup>25</sup>	China	35.9	9

rates and injury sequelae, mainly due to chronic diseases that complicate aspects of the treatment, such as fluid resuscitation in patients with heart disease or infections in those with diabetes and decreased immune response. Furthermore, the literature shows that the elderly have a lower probability of returning to their previous activities due to sequelae derived from burn injuries, especially when compared with young adults<sup>5,9,14,17-19</sup>.

**Table 5.** Type of accident that led to the burn injuries in the elderly people, according to the reviewed studies, referring to the period between 2000 and 2012.

Reference	Country	Scalding (%)	Flame (%)	Electricity (%)	Other (%)	Not described
Mabrouk et al. <sup>1</sup>	Egypt	60.82	31.96	7.22	-	-
Chang et al. <sup>4</sup>	USA	14.9	73.4	1.1	6.4	-
Lumenta et al. <sup>6</sup>	France	30.9	65.3	1.1	2.6	-
Lionelli et al. <sup>7</sup>	USA	16.9	73.6	-	8	1.5
Li et al. <sup>10</sup>	China	36.1	33.9	15.7	3.6	-
Ehrlich et al. <sup>11</sup>	USA	58	12	-	27	-
Silva et al. <sup>13</sup>	Brazil	17.6	69.6	-	-	-
Serra et al. <sup>14</sup>	Brazil	20	66.7	-	-	-
Kut et al. <sup>16</sup>	Turkey	57.1	26.5	-	-	-
Wong et al. <sup>17</sup>	China	64	29	-	5	-
Alden et al. <sup>18</sup>	USA	17	-	-	-	-
Albornoz et al. <sup>19</sup>	Chile	17	70	-	-	-
Yin et al. <sup>20</sup>	China	39.8	52.7	3.5	4	-
Ho et al. <sup>21</sup>	China	66	31	-	3	-
Rao et al. <sup>22</sup>	UK	30	49.2	-	20.6	-
Wibbenmeyer et al. <sup>23</sup>	USA	15	69	1	15	-
Morita et al. <sup>24</sup>	Japan	22.8	74.2	2.8	-	-
Liu et al. <sup>25</sup>	China	37.9	51.5	4.9	5.7	-

Burn injuries caused by direct flame or combustion of flammable liquids are included in the "Flame" column.

**Table 6.** Percentage of elderly people with comorbidities.

Reference	%
Mabrouk et al. <sup>1</sup>	53
Alden et al. <sup>18</sup>	66
Ho et al. <sup>21</sup>	59
Wibbenmeyer et al. <sup>23</sup>	65
Morita et al. <sup>24</sup>	68

This study aimed to collect epidemiological data and identify possible burn causes in the elderly in order to promote the development of methods to prevent these accidents. This type of accident is prevalent in several regions of the world, and the results in this study are representative of 10 countries in 4 of the 5 continents of the world. Our data show that the prevalence is not sex-based, as the studies show a similar prevalence for each sex.

The most frequent location where burn injuries occur in the elderly was their own residence, ranging from 68% to 98% of the time, whereas in young adults, burn injuries were associated with their work-related activities<sup>5</sup>. Burn injuries occur more frequently in the elderly who live alone or during the day, when their families are at work, and who perform their daily activities such as cooking or using hot water for the bath, without any family supervision<sup>1,20</sup>. In

our literature search for locations within the place of residence in which the elderly are more often involved in accidents and which activities they were involved during the accident, we found that the most of the accidents occurred in the kitchen, with a prevalence of up to 65%, followed by the bathroom, as demonstrated in this study. This shows how much the elderly require supervision when performing daily activities that are as simple as cooking or bathing, as a great part of these elderly people lose their sense of danger when performing those activities. The most prevalent type of accident was by direct flame, followed by scalding. Scalding is a common occurrence in the winter months and in countries with colder climates, especially during the preparation of the bath, in which tap water at high temperatures is used<sup>11,16</sup>. Most of the elderly have chronic diseases, with a comorbidity prevalence of 53% to 68%, which makes their healing and treatment more difficult. Thus, the mortality of these elderly people remains high, especially in those who are older, who have a larger portion of body surface burned, or whose injury was by inhalation, as these are the factors that have more influence on prognosis<sup>6,21-25</sup>. In this study, we found data indicating that 4% to 28% of the elderly were injured by inhalation, with mortality rates as high as 65% of the burn injury cases (6.8% to 65%), showing that the mortality rates are high and

**Table 7.** Mortality rates and injuries caused by inhalation.

Reference	Country/location	Mortality (%)	Inhalation (%)
Mabrouk et al. <sup>1</sup>	Egypt/1995-2001	31.9	-
Chang et al. <sup>4</sup>	USA/1998-2002	23.4	-
Pomahac et al. <sup>5</sup>	USA/1993-2004	29	-
Lumenta et al. <sup>6</sup>	France/1990-2003	30.6	17.7
Lionelli et al. <sup>7</sup>	USA/1972-2000	47	28
Mahar et al. <sup>8</sup>	Australia/2002-2006	18.8	18.7
Macrino et al. <sup>9</sup>	USA/2003-2006	-	41
Li et al. <sup>10</sup>	China/1999-2006	7.5	-
Ehrlich et al. <sup>11</sup>	USA/1997-2003	-	-
Silva et al. <sup>13</sup>	Brazil/2004-2008	41.8	-
Serra et al. <sup>14</sup>	Brazil/2001-2010	36.7	-
Kut et al. <sup>16</sup>	Turkey/1997-2005	6.1	-
Wong et al. <sup>17</sup>	China/2000-2005	6.8	-
Alden et al. <sup>18</sup>	USA/2000-2004	20	-
Albornoz et al. <sup>19</sup>	Chile/2006-2009	48	28
Yin et al. <sup>20</sup>	China/1996-2004	8	-
Ho et al. <sup>21</sup>	China/1993-1999	7.4	4.2
Rao et al. <sup>22</sup>	UK/1999-2003	-	12.7
Wibbenmeyer et al. <sup>23</sup>	USA/1977-1996	30.2	15.6
Morita et al. <sup>24</sup>	Japan/2003-2009	65.7	-
Liu et al. <sup>25</sup>	China/2003-2009	11.7	-

described as being up to 400% higher in the ones with injuries by inhalation<sup>7</sup>.

Most of the accidents involving the elderly are preventable<sup>9</sup>. In a study that conducted interviews with elderly people after incurring burn injuries, up to 85% of the interviewees reported that the accident could have been prevented<sup>26</sup>. As demonstrated, most of the accidents occurred inside the place of residence, especially when the elderly were alone and performing their daily tasks. The supervision of patients with comorbidities, movement restrictions, or any kind of debility is important to avoid accidents associated with high mortality rates and functional impairment of those who survive. Government programs that aim to promote the supervision of elderly patients, training of healthcare teams, family members, and caregivers for elderly orientation are important to decrease the incidence of accidents that occur in this group age, as well as the use of multimedia as a means to promote the preventive methods to a wider scope<sup>2</sup>. Preventive strategies should be focused on the residences, especially in places such as the kitchen and the bathroom, because of the high prevalence of accidents in these locations. Visits to the residencies in order to provide orientation, detection of risks, with respective changes and adaptations of the surroundings, are

important to promote the prevention of accidents and to reduce damages when these occur. Among the methods described that reduce the damage caused by these accidents are as follows: improvement of first aid, fast service response, shortening the interval from onset of injury to admission to hospitals, and multidisciplinary care that aim at early functional recovery. Thus, understanding the epidemiology of each region, individually, is important in order to propose and improve burn prevention systems based on their prevalence, as well as to provide orientation to healthcare teams regarding the need to focus on possible region-associated risks.

## CONCLUSION

Owing to the increase in the worldwide elderly population, the prevalence of burn injury accidents in this population has increased. The need for preventive measures against this type of accident has become even more relevant according to the mortality from this type of injury in the elderly population, as even with the improvement in the treatments, the mortality rates remain high, with high costs to the health system.

Implementing prevention systems based on regional statistics regarding the detection of the risks

of burn injuries to which the elderly are susceptible is the best method to avoid tragic accidents with major repercussions, thus requiring the involvement of governmental departments in order to improve these prevention methods.

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