Burns Open 1 (2017) 2–8

Contents lists available at ScienceDirect

Burns Open

journal homepage: www.burnsopen.com

Burns among older persons: A narrative review

Jonathan Bayuo [a,b,*], Anita Esi Botchway [c]

[a] Department of Nursing, Faculty of Health and Medical Sciences, Presbyterian University College, Ghana
[b] Burns Intensive Care Unit, Directorate of Surgery, Komfo Anokye Teaching Hospital, Kumasi, Ghana
[c] Directorate of Surgery, Komfo Anokye Teaching Hospital, Kumasi, Ghana

ARTICLE INFO

Article history:
Received 7 April 2017
Received in revised form 19 May 2017
Accepted 21 May 2017
Available online 29 May 2017

Keywords:
Older persons
Burns
Incidence
Aetiology

ABSTRACT

Background: The older adult population has been noted to be increasing at a steady rate and they have been described as persons at a high risk of being involved in burns. Thus, attention towards trauma among older adults is on the rise and there is a need to understand the characteristics of the injury among this population group.

Methods: A narrative review approach was utilised for the study. PubMed, ScienceDirect and Google Scholar were used as search engines to identify studies that focused on burns in older adults or discussed some aspects related to the phenomenon from January 2000 to January 2017.

Results: In all, thirty one (31) articles were retrieved. The terms "older adult" and "elderly" was noted to exist in literature with varying age limits. Older persons were noted to form a substantial number of persons affected by burns with flame burn identified as the major type of burns affecting older adults. However, scald burns were recognised to be higher among older females than males. Majority of these injuries were noted to occur within the domestic settings and associated with cooking. The presence of co-morbid factors was reported in most studies with hypertension and diabetes recorded as the commonest. The existence of dementia was noted to be associated with severe burns and double length of hospital stay. Outcomes of the injury included varying mortality rates, worsening of existing premorbid conditions, respiratory complications such as pneumonia and longer hospital stay. The use of a frailty scoring system was noted to offer better outcome prediction as compared to only the chronological age. One study noted that females experienced longer hospitalisation periods as compared to elderly males even though their burns were smaller.

Conclusion: Older persons are affected by burns and resources required to meet their needs may be higher due to their longer periods of hospitalisation. The domestic nature of their injuries provides a window of opportunity to design preventive strategies. Also, policies and strategies are needed to protect the well-being of older persons. Further studies are needed to clearly understand gender differences associated with burns as this can impact management strategies. Follow up strategies after discharge need to be considered to understand the outcomes overtime. Also, more prospective studies and randomised control trials are needed in understanding the effectiveness of various interventions used in the clinical management of older persons.

1. Introduction

Burn injury has been described as a common traumatic injury which causes significant mortality and morbidity [1]. The occurrence of burn injury is not specific to any population or age group as they can affect any person. Despite this, the older adult population has been indicated to be a high risk group of being involved in burns. The occurrence of burn injury among the older persons has been attributed to decreasing physical strength, impaired protective mechanism, poor vision, existence of multiple co-morbidities and decreased reaction time [2]. Some occurrence of burns among the older adult population has been attributed to abuse and neglect [2]. Though older persons are a high risk group, there is generally limited exploration of the characteristics such as incidence of burn injury among them as well as outcomes of the injury. However as the older adult population is expected to increase [3], there is an interest in understanding the epidemiology and outcomes among them as these may provide useful insights into the phenomenon. Thus, this narrative review seeks to explore

* Corresponding author at: Department of Nursing, Faculty of Health and Medical Sciences, Presbyterian University College, Ghana.
E-mail address: jbayuo88@gmail.com (J. Bayuo).

http://dx.doi.org/10.1016/j.burnso.2017.05.006
2468-9122/

the incidence, aetiology and outcomes of burns among older adults.

2. Materials and methods

This review aimed to include all studies from January 2000 to January 2017 reporting on aetiology, incidence and outcome of burns among older persons. Language restrictions were set to cover articles reported in English. PubMed, ScienceDirect and Google Scholar were used as the search engines. The PubMed search included automatic and manual search strategies with the following MeSH terms: "older adult burns", "burns", "burn epidemiology", "burn outcomes", "incidence", "burn causes" and "burns in elderly persons". This yielded a total of 10,111 results. Additional filters were added and this included age, full text or abstract availability in English and species (human). Furthermore in ScienceDirect and Google Scholar, more elaborate combinations such as "outcomes of burns among older adults", "incidence of burns among older adults", "cause of burns among the elderly" and "outcomes of burns among the elderly" were used. No initial definition for the term "older adult" and "elderly" was provided as each paper added to this review had its unique definition of the term. The studies included were retrospective studies, prospective studies, systematic reviews, literature reviews and trial studies. This resulted in 45 articles. After the search, duplicates, case reports and editorials were removed. Also, studies that did not report the epidemiology or outcomes of burns among older adults were excluded. Thus, only studies that focused solely on older persons or reported features focusing on incidence, aetiology or outcomes specific to older adults were included. Overall, thirty one (31) articles met the inclusion criteria and were included in the review. The initial search was undertaken by JB. Selection of articles was undertaken by JB and AEB independently and compared the outcomes together to reach a consensus (see Table 1).

3. Results

3.1. Discussion

3.1.1. Definition of the terms "older adult" and "elderly"

Older adults have been noted to be a category of persons also prone to burns of varying degrees. The process of ageing may be associated with several physiological changes which result in diminished functional reserves and decreased ability to adapt to burn trauma [26]. The growing number of older adults and their susceptibility to injuries makes them important consumers of burns and trauma care [4]. As the older adult population is expected to rise, there is a need to understand the incidence of burns as well as outcomes of these injuries as they can aid in designing preventive measures. However in the first instance, there is need to understand what the term "older adult" and "elderly" means.

The term "older adult" appears to be loosely defined in literature [6]. For instance in the paper by Duke et al. [22], older adults included in their study were aged 45 years and above. In other studies, it was defined as those aged 55 years and above [9,10,13]. Furthermore, the term "older adult" was defined as those aged 60 years and above [12,15]. However, in the study by Taylor et al. [17], the term "seniors" was used to refer to persons aged 60 years and over. Also in the studies by Yin et al. [31] and Davies et al. [29], the term "elderly" was defined as persons aged 60 years and over. In addition to the above, other papers presented in this review have defined the term "elderly" as those aged 65 years and over [2,4,5,21,23]. One study that was undertaken at the Victorian Adult Burn Service, Melbourne, however defined the term "elderly" as those aged 70 years and above [7]. These notwithstanding it appears the term "older adult" represents persons aged between 45 years and 55 years whilst persons aged 60 years and over characterises the term "elderly" or "seniors".

Peck [1] has argued that the term "elderly" is a commonly used synonym for "aged" though this is not listed in the Medical Subject Headings (MeSH) as a distinct term. Peck [1] further notes that on the basis of numeric approach, the term "elderly" defines a person aged between 65 to 79 years which is in line with some studies presented here [2,4,5,21,23]. The World Health Organisation [34] has noted that most developed countries have accepted the chronological age of 65 years as a definition of the term "elderly" or "older person". However it has been argued that this definition does not adapt well the situation in Africa and as such 50 years and above is accepted as the general definition of an older person [34]. Despite these challenges in accepting a uniform term, Peck [1] has argued that from a medical perspective, persons in this age group may have variable fitness level and as such there may be a need to consider the general condition and social situation of the patient rather than following a strict age limit [1]. In similar lines, Masud et al. [32] have proposed the use of an elderly person's biological age or global pre-morbid state rather than chronological age assess the elderly burnt patient. Thus in their study, the frailty scoring system devised through the Canadian Study of Health and Ageing was utilised which revealed differences between elderly burned patients who died and those who survived ($p = 0.0001$; Mann–Whitney U test = 78). This suggests that elderly burned patients with better pre-morbid capacity were more likely to survive. The study by Romanowski et al. [33] provides further support for this assertion as they noted that non surviving elderly burned patients had higher frailty scores as compared to those who survived. Also, those who were discharged home had lower frailty scores as compared to those who were discharged to skilled nursing facilities. These findings may indicate that in predicting outcomes of burns among burn older adults, there is a need to consider frailty scores rather than chronological age and in defining an older person, researchers may need to be cognizant of these scores in predicting outcomes rather than an all fit all chronological age [45]. The findings by Pham et al. [13] further corroborate this assertion as they observed the importance of comorbidities over chronological age in pneumonia development among older adults. These indicate the limited benefit of considering only the chronological age in predicting outcomes in burn older persons. These findings may specify the usefulness of the frailty scoring system which can be adapted and used as an adjunct in assessing outcomes of burns in the older adult population [32].

3.1.2. Incidence of burns among older persons

The studies presented in this paper affirm that older adults are also affected by burns and clinical management remains a challenge [35]. The studies included in this review reported various levels of burn injury prevalence among older persons. Chang et al. [4] observed that older persons aged 65 years and above formed 8.5 per cent (94) out of the 1110 patients admitted with burns. Using the same age limits, Rao et al. [5] noted in their study that sought to analyse aetiology and outcomes of burns among elderly that 63 participants were observed to older than 65 years. Pham et al. [10] also observed that from 1991 to 2005, older adults with burns formed 14 per cent (23, 180) of the total 180, 401 burned patients admitted. Pham et al. [13] further identified that from 1995 to 2007, older adults formed 8.6 per cent (23,794) of the total number admitted with burns. However, in both studies the definition for older adult was specified as those aged 55 years and above though both featured data from multiple centres (USA and Canada). In another multi-centre study (Australia and New Zealand, Moore et al. [15] noted that from 2005 to 2011, persons

Table 1
Summary of studies on older burned persons.

Author(s)	Aim/Hypothesis	Method	Results	Conclusion
Chang, Edelman, Morris and Saffle [4]	To evaluate gender differences in the outcome and disposition of elderly burned patients	Retrospective during a five year period comparing demographic, etiologic and outcome differences between male and females aged 65 years and over	Out of the 1110 patients admitted 94 (8.5%) were elderly patients (aged 65 years and older). The majority of burns were flame burns (73.4%) followed by scalds (14.9%), contact injuries (6.4%) and electrical burns (1.1%). A greater proportion of older women sustained scald burns as compared to older males (32.3% and 6.3% respectively). Overall, the mortality rate was noted as 23 per cent	Elderly burned patients especially women utilise more resources than younger patients
Rao, Ali and Moiemen [5]	To analyse aetiology and factors affecting the outcomes of burns among older adults	Retrospective data analysed over a three year period taking into account aetiology, burn thickness, area burned and co-morbid factors	63 elderly patients (65 years and above) with flames noted as the major aetiological factor (49.2%) followed by scalds (30.2%). 12.7% (8 patients) also had inhalational injury. Hypertension was also identified as a major co-morbid factor (22 patients). 32 patients had one co-morbid condition. Overall mortality rate was observed as 34.9% (22 patients). Mean hospital stay was observed as 23.9 days for those who survived. Patients undergoing surgery had increased hospital stay and timing of surgery did not have any effect on hospital stay or survival. Pulmonary infection was recorded as the main cause of mortality (9 patients)	Positive correlation noted to exist between the number of co-morbid factors and mortality. Early surgery does not have any negative impact on patient survival
Davidge and Fish [6]	A literature review on specific issues for older adults with that need to be considered when treating older adults with burn injury	Literature review approach	Definition of older adult loosely interpreted in burn literature. Women are highly represented among older burned patients. Most burns are caused by flames (32.2%) followed by scalds (15.7%) and their injuries are characterised by prolonged hospitalisation (mean 12.8 + _17.9 days). In-hospital mortality of older burned patients in North America recorded as 18.5% over the past 10 years (even though this represents a reduction, it exceeds that of younger adults)	Managing older adults with burns represent a major therapeutic challenge
Mahar, Wasiak, Bailey and Cleland [7]	To provide basic probabilistic predictors of mortality in the elderly burns population	Retrospective data over a four year period	80 elderly patients (aged 70 years and above) comprising of 43 males and 37 females. Majority of burns were thermal in nature (95%: 15% had inhalational injury), followed by 1.25% been chemical and electrical burns each. Co-morbidities were present with the most common one been hypertension (45%). Overall mortality rate was recorded as 18.8%.%Total Burned Surface Area (TBSA),%Full Thickness Surface Area (FTSA), presence of inhalational injury and increasing age were identified as significant predictors of mortality	TBSA%, FTSA%, presence of inhalational injury and age significantly predict death among older adults with burn injury
Huang et al. [2]	To review issues relating to the management of older adults with burns	Literature review approach	Elderly patients over 65 years of age constitute between 13% and 20% of admissions to burn units, but have the highest death rate among the overall burn population. Management of elderly burn patients remains a difficult challenge. The risk of death from a major burn is associated with increased burn size, increased age, the presence of a full-thickness burn, the presence of inhalation injury, and female gender	Concerning the unique physiologic and metabolic changes in geriatric patients, it is imperative that a well-organized, protocol-driven approach to provide for proper medical care be considered
Chaudhary [8]	To find out the frequency of burns and mortality related to it among different age groups	Retrospective study from 1999 to 2008	Older persons (60 years and above) made up 3.2% (8) of the total patient population with flame burns affecting six patients and scalds affecting two patients. Out of the 8 patients, 6 died	Mortality was high among patients with flames and hot liquid burns
Lundgren et al. [9]	To examine the relative impacts of age and medical comorbidities on outcome following injury in a cohort of older adult	Retrospective study from 1999 to 2003	A total of 325 patients who were of 55 years and older were admitted to the burn center during the 5-year study period. The overall mortality rate was 18.5%. Mortality was independently associated with age, inhalation injury, and burn size. Longer length of stay was significantly associated with burn size, inhalation injury, and total number of in-hospital complications. Higher number of medical comorbidities was associated with increased mortality risk within 1 year following discharge	Age and TBSA% are the most significant factors impacting in-hospital mortality risk following burn injury
Pham et al. [10]	To characterise specific injury and outcome trends in older adult with burns	Retrospective study from 1991 to 2005	A total of 180,401 patient records were available from 1991 to 2005, of which 23,180 (14%) met age inclusion criteria. Length of stay per TBSA and median hospital charges increased with increasing age category, suggesting higher resource consumption with ageing. Mean number of operations per patient, however, decreased with age. Mortality rates and discharge to non-independent status increased with age. Flame burn was the most common injury aetiology in patients aged 55 and older and higher age category was associated with greater mortality	There are age-dependent differences in resource utilisation and mortality risk within the older burn population
Brusselaers et al. [11]	To describe the European hospitalised population with severe burn injury	Systematic review	The growth of the elderly population in the Western world is also reflected in the hospitalised population with severe burn injury, by an increasing mean age, or by an increased proportion of elderly (10% to 16% of the total population with severe burn injury). Furthermore in terms of gender distribution among the older adult population, a female predominance of up to 65% was found	There is greater information regarding hospitalised population with burn injury than is presumed

Othman and Kendrick [12]	To provide an overview on the epidemiology of burns in East Mediterranean region	Systematic review	Factors associated with mortality according to individual studies include older age (60 and over). Mortality for flame injuries is much higher than for scald injuries	Burns remain a major public health issue needing further research to assess effectiveness of intervention programmes
Pham et al. [13]	To characterise patient and injury factors associated with pneumonia development in older adults with burn	Retrospective study involving data from January 1995 to December 2007	From 1995 to 2007, a total of 23,794 patients aged ≥55 years in the NBR met inclusion criteria for analysis, and of these, 2052 (8.6%) patients developed pneumonia during hospitalisation. Patients with pneumonia had larger overall TBSA burned and were more frequently caused by flame/flash flame mechanism. Patients who developed pneumonia had a higher number of operations ($P < 0.001$), length of stay per TBSA (4.0 vs. 3.2, $P < 0.001$), including intensive care length of stay (21.7 vs. 4.9, $P < 0.001$), and days on mechanical ventilation (19.5 vs 3.1, $P < 0.001$)	Findings highlight the importance of comorbidities over chronological age in pneumonia development in older adults with burns
Hendrix et al. [14]	To evaluate the effect of neighbourhood level socio-economic indicators on burn injury risk determines whether race and neighbourhood influence burn injury outcomes in the elderly	Retrospective study	High proportions of rural households and poverty (1.26; $p < 0.0001$) were significantly associated with increased risk of burn injury. No significant differences in mortality were observed between Caucasian and Minority patients in individual. Minorities had significantly higher odds of increased length of hospital stay in individual	Identification of areas with a population most at risk for burn injury is essential for the development of effective prevention programs
Moore et al. [15]	To identify factors independently associated with mortality	Retrospective multi centre cohort study from 2005 to 2010	Between January 2005 and December 2011 1715 patients were admitted to intensive care unit with acute thermal burn. Out of this, 242 were older adults (aged 60 years and over) with a total mortality of 74 (30.6%)	Risk of death following major burns can be predicted from a combination of physiologic and burns specific parameters. Female sex is a highly significant risk factor
Taylor et al. [16]	To generate a burn resource disaster triage table based on current burn treatment outcomes	Retrospective study	Resource utilisation was divided into expectant (predicted mortality >90%), low (mortality 50–90%), medium (mortality 10–50%), high (mortality <10%, admission 14–21 days), very high (mortality <10%, admission <14 days), and outpatient. Expectant status for those >70 years began at 50% burn. Inhalation injury lowered the expectant category to a burn size of 40% in >70 year old	Inhalation injury significantly alters triage in a burn disaster. Use of these updated tables for triage in a disaster may improve our ability to allocate resources
Taylor et al. [17]	Age variably impacts mortality after burn and that age-specific models for children, adults, and seniors will more accurately predict mortality than an all-ages model	Retrospective study	Mortality models were constructed for all ages and age-specific models: children (<18 years), adults (18–60 years), and seniors (>60 years). Overall mortality was 4% but varied by age (17% seniors, <1% children). Age, TBSA, and inhalation injury were significant mortality predictors for all models ($p < 0.05$). In the senior model mortality increased with age. Seniors had greater increase in mortality per 1% increment in burn size and 1 year increase in age than other ages	A "One size fits all" models for predicting burn outcomes do not accurately reflect the outcomes for seniors and children. Age-specific models for children and seniors may be advisable
Jeschke et al. [18]	To determine burn sizes that are associated with increased mortality and morbidity after burn	Prospective multi centre cohort study	In children, the cut off burn size for mortality, sepsis, infection, and multiple organ failure was approximately 60% total body surface area burned. In adults, the cut off for these outcomes was lower, at approximately 40% total body surface area burned	In the modern burn care setting, adults with over 40% total body surface area burned and children with over 60% total body surface area burned are at high risk for morbidity and mortality, even in highly specialised centres
Taylor et al. [19]	To determine how the effects of burn outcome predictors and the outcomes of interest vary as a function of time throughout hospitalisation	Retrospective study	Maximum length of stay among patients who died was 270 days and 731 days among those discharged. Total body surface area, age, and inhalation injury had significant effects on the sub-distribution hazard for discharge. Burn size (coefficient −0.046) determined early outcomes, while age (coefficient −0.034) determined outcomes later in the hospitalization	The key factors influencing outcomes differed throughout hospitalisation
Duci et al. [20]	To determine the outcomes of older adults with burn injury	Retrospective study	Fifty-six burned patient older than 60 years were included during a 10-year period. Of the 56 elderly patients 29 were women and 27 were men. Fire was the most common factor involved in the majority of these cases (60.7%) and three patients had diabetes mellitus. The average hospital stay for the 56 admitted cases was 13.8 days, and the range was 1–59 days. One patient from 56 elderly patients died and was with TBSA above 40% and one patient with diabetes underwent amputation of the digits of the lower extremity	Considering the gradual increase in the elderly population, an increase in burns among them may be expected
Wearn et al. [21]	To analyse the recent outcomes of elderly burn injured patients	Retrospective review	228 patients aged 65 years and older included in the study. Flame was the major aetiological factor (40%) followed by scalds (26%). Major co-morbidity noted was hypertension (33%). Incidence of inhalational injury was recorded as 13% and observed	Burn outcomes among the elderly have improved over the last decade

(*continued on next page*)

Table 1 (*continued*)

Author(s)	Aim/Hypothesis	Method	Results	Conclusion
			mortality rated noted as 14.9%	
Duke et al. [22]	To assess if burn injury in older adults is associated with changes in long-term all-cause mortality and to estimate the increased risk of death attributable to burn injury	Population based matched longitudinal study	A total of 6014 older adults (defined as aged 45 years or older) from 1980 to 2012. For those hospitalised with burns, 180 (3%) died in the hospital and 2498 (42%) died after discharge	Burn injury is associated with increased long-term mortality
Stylianou et al. [23]	To describe, distribution and time trends in burn injury in England and Wales	Retrospective descriptive observational study	Flame burns was the major form of injury among the elderly population (aged 65 years and above)	Mortality from burns in England and Wales is decreasing in line with western world trends
Jeschke et al. [24]	To gain insights into why elderly burned patients have poorer outcomes as compared to other adult patients	Prospective translational trial study	Elderly burned patients have increased mortality, more premorbid conditions, increased incidence of multi organ failure and longer hospital stay but a lower incidence of infection or sepsis. These clinical outcomes were associated with delayed hypermetabolic response, increased hyperglycaemic and hyperlipidemic responses, inversed inflammatory response, compromise of the immune system and delay in wound healing	The responses of the elderly to burns are complex and not linear and this requires a multi-modal approach to improve outcomes
Rybarczyk et al. [25]	To define the epidemiology of burns in WHO African Regions	Systematic review	Older females are at a greater risk of burn injury. WHO African regions bear a large burden of the injury	Consistent epidemiologic trends can inform education and preventive strategies
Sharif et al. [26]	To review the aetiology, treatment and outcome of burns sustained by persons aged 90 years and above	Retrospective study from 1998 to 2013	Twenty-two elderly patients were admitted with a 2:1 female to male ratio and mean TBSA of 9 per cent. Six died during admission and those who survived averaged eight days in patient stay per % TBSA	Clinical management of the elderly requires significant levels of resources and they may fare worse than younger elderly persons
Morita et al. [27]	To assess the characteristic of elderly Japanese patients with severe burns	Retrospective study	35 elderly patients admitted (aged 65 years and over). Burns were most widely caused by flames followed by scalds and ten patients attempted suicide	Severe burns are fatal to elderly persons
Ehrlich et al. [28]	To describe the risk factors, aetiology and referral patterns of elderly patients treated with minor burns in an urban Emergency Department	Retrospective chart review over a six year period	77 elderly patients were included (aged 65 years and over) with significant co-morbid medical illness. 68 per cent were cooking related incidents	Cooking related activities accounted for majority of minor burns in the elderly
Davies et al. [29]	to identify early predictors of mortality in elderly burned patients	Prospective database reviewed	Of the total 1343 patients, persons aged 60 years and over formed 203 (15%). Age, TBSA, base deficit, pO2, respiratory rate, Glasgow Coma Scale (GCS) and Revised Trauma Score (RTS) all correlated with mortality ($p \leq 0.05$)	Predicting outcomes in elderly burned patients is difficult. A model using age, TBSA and RTS may help to identify patients with decreased chances of survival
Harvey et al. [30]	To assess the impact of dementia on risk of burns	Retrospective study from 2003 to 2012	Of the 1535 older persons admitted (aged 65 years and over), 169 (11%) had a record of dementia. Persons with dementia were more likely to be admitted with burns to the trunk and have greater than 20% TBSA. Mean length of stay was more than double for persons with dementia	Burns in persons with dementia are significant injuries
Yin et al. [31]	To analyse the epidemiologic characteristic of severe burns among the elderly in Shanghai	Retrospective review from 1996 to 2004	A total of 201 patients (aged 60 years and above) were reviewed. Majority were men (62.2%) with flame burns as the common aetiology (52.7%). The most common pre-injury condition was cardiovascular in nature and multiple organ failure was noted to be the most common complication	Domestic and work place burns with devastating consequences are common among the elderly in Shanghai
Masud et al. [32]	To compare global pre-morbid state, using the frailty scoring system and age, to evaluate the outcome of burns among the elderly	Retrospective study from 2005 to 2009.	42 patients fit the criteria: aged 65 years and above and burns $\geq$10% TBSA. 18 (42.9%) patients aged 65 to 95 years survived their stay with 83.3% surviving at one year. 24 (57.2%) persons aged 66 to 95 years died. Persons with better pre-morbid capacity as evaluated by the frailty scoring system were likely to survive the burn injury	Frailty scoring system may be a useful adjunct in predicting burns outcomes in the elderly population
Romanowski et al. [33]	To determine if higher frailty scores were associated with higher risk of mortality for elderly burn patients	Retrospective study	Frailty scores were assessed from admission data and calculated using the Canadian Study of Health and Aging clinical frailty scale. Non survivors had significantly higher Frailty Scores compared to survivors (5.2 ± 1.2 vs 4.4 ± 1.2). Frailty Scores were also significantly higher in patients discharged to skilled nursing facilities (SNF) (5.34 ± 0.9) compared to those who were discharged home (4.1 ± 1.2) or to physical rehabilitation facilities	Frailty scores on admission allow for a more complete assessment of elderly patients and can be used to establish benchmark models for burn injury outcomes

aged 60 years and over were 242 out of 1715 patients (14.1%) admitted with burns. In a developing country of Taiwan, Huang et al. [2] indicated that older adults formed 13 to 20 per cent of persons admitted to the burn unit. Also from a study undertaken in Shanghai, Yin et al. [31] observed that from 1996 to 2004, a total of 201 burns were recorded among persons aged 60 years and above. Though the incidence of burn injury has been noted to be decreasing in the Western Countries, the rate of reduction has been indicated to be slower than other illnesses [11,12]. However, the burden of burn incidence remains high in African WHO regions and requires public health interventions [25].

The most common form of burn injury was noted as flame burn which was followed by scalds [2,4,6,7,21]. By interrogating the mechanism of injury further, Wearn et al. [21] noted that cooking related burns were most common followed by prolonged contact with the source of heat. This was affirmed in the study by Ehrlich et al. [28] as they observed cooking related activities to be the most common cause of minor burns among older persons. Huang et al. [2], Davidge & Fish [6] and Yin et al. [31] also reported that the majority of elderly burns occur at home, most commonly in the kitchen followed by the bathroom and living room. The systematic reviews by Rybarczyk et al. [25] and Brusselaers et al. [11] also noted the home to be the occurrence of most burns. These findings may point to the fact that domestic settings of the elderly may pose a major risk factor to their involvement in burns. This may be related to the fact that ageing has been associated with issues such as visual impairments, limited mobility and reduced reaction time which may predispose older adults to burns. In addition, Mou et al. [36] have argued that some western lifestyles such as older persons living alone may exacerbate loneliness and put the older adult at risk of burn injury. Moreover, Hendrix et al. [14] observed that high proportions of rural households and poverty were associated with increased risk of burn injury in North Carolina and this may offer suggestions for developing preventive strategies. As majority of older persons will continue to live in their homes, there is a need to re-assess risk factors in the homes of the elderly so as to minimise the occurrence of burns. Social support schemes and policies may need to be enhanced to further support older persons in their homes as well as alleviate poverty levels. This is particularly essential in an era in which ageing in place is being promoted and encouraged. However this might appear challenging for developing countries as even though these countries are undergoing demographic ageing, minimal actions have been taken towards supporting older persons [41]. Similarly, Lloyd-Sherlock [42] has observed that social policies in developing countries have focussed more on other categories of individuals such as children and mothers and as such it will be a great challenge to factor older persons into these policies. Specifically in Africa, Gachuhi and Kiemo [43] have argued that ageing is taking place alongside poverty, HIV/AIDS pandemic, rapid transformation of the extended family system, social and economic hardship and these emphasize the need for policies and strategies to protect their well-being especially as the incidence of burns remains high in African WHO regions [25]. The need for these policies and preventive strategies is further heightened by the availability of limited resources in caring for burned patients [8].

Some studies presented in this review have indicated gender differences regarding the incidence of burns. For instance, Rybarczyk et al. [25] indicated that older females are at a greater risk of burns. More specifically, Chang et al. [4] reported a higher incidence of scald burns among older women (32.3%) and also noted that the incidence of flame burns among both genders was similar. In a way this may be attributed to the domestic nature of women as compared to men. However, further research is guaranteed in this direction.

Jeschke et al. [24] in their translational trial noted that the occurrence of burn injury among older persons is associated with a delayed hypermetabolic response, inverse inflammatory response, compromised immune system and increased hyperglycaemic and hyperlipidemic responses. Thus, they argue for the need for a multi-modal approach in the clinical management of the older person. Though Huang et al. [2] have noted the difficulty in managing the older burned patient, they affirm the need for a well organised protocol driven approach to achieve optimum medical care for older adults. However, this may indicate the need for more prospective studies and randomised control trials in relation to what works best for older persons with various burns. This is necessary as most studies presented here make use of retrospective approaches even though some are multi-centre studies.

3.1.3. Co-morbid factors and outcomes of care

In some studies presented in this review, the presence of a co-morbid condition was reported. The major co-morbid conditions were noted to be hypertension and diabetes [5,9,20]. Thus, the occurrence of burns may have worsened these pre-existing conditions and reduced independence [37]. These pre-existing conditions compounded by the nature of the burn trauma may have caused longer periods of stay in the hospital as noted by some studies. For instance, Taylor et al. [19] noted that maximum length of stay among patients who died was 270 days and 731 days among those discharged. Longer length of stay at hospitals may indicate greater resource utilisation as observed by Taylor et al. [17]. In one study it was observed that older persons who had dementia were more likely to sustain burns greater than 20% TBSA as well as double mean length stay of persons without dementia [30]. In similar lines, Alden et al. [44] have also asserted burns in older persons with dementia can be severe. This appears rather worrying as the World Health Organization has predicted that by the year 2020, there will be nearly 30 million persons with dementia in both developed and developing countries and this is expected to continue to rise exponentially over the years. This strengthens the need for policies to be developed that support older persons as well as on going preventive strategies to protect older persons from burns.

Also, other outcomes were noted among older adults with burns. All studies reported varying degrees of mortality among older adults with burns. Some studies noted that the mortality rates were higher among the oldest old categories [17,18]. Also, some studies observed higher mortality rates among older persons who sustained flame burns as compared to those who sustained scald burns [8,12]. In addition, all studies indicated that increasing age is associated with higher mortality rates in burns care. All studies except one focused only on mortality among admitted older burned patients. Duke et al. [22] observed that a greater number of older adults died after discharge (42%). Lundgren et al. [9] also indicated that higher number of premorbid conditions increased the overall mortality risk within one year following discharge. This may specify the need to have a follow up mechanism on older burned patients to assess overall outcomes of the burn injury.

Furthermore, the development of various morbidities was noted. For instance, Brusselaers et al. [11] observed that respiratory complications such as pneumonia and acute respiratory distress syndrome affected 45% elderly patients and this accounted for their deaths. The developments of infections, multi organ failure and septic episodes have also been reported [24,31]. Some studies also reported gender differences regarding the outcomes of the burns. For instance, Chang et al. [4] observed that older women tended to stay longer in the hospital as compared to men. Despite the similar incidence of inhalational injury among both genders, the authors noted that mortality rates were higher among females

as compared to males even though women who died had smaller total burned surface area as compared to their male older adults (25.4% vs. 44.5%). In similar lines, previous studies have also reported greater mortality rates among female older burned patients [38,39]. Though Thornton [40] have reported that post-menopausal women tend to lose greater amounts of collagen which may contribute to slower healing rates, there is still a need for further research in assessing determinants of mortality among older females with burn injury.

4. Conclusion

In conclusion, there is a need to appreciate that older persons are also affected by various burns and outcomes may vary. Considering the changes associated with ageing, there is a need for assess the applicability of various burn management strategies among older adults so as to identify how best to improve successful outcomes. This study is limited in that all studies reported in languages other than English were excluded. Also, there is a need to enact policies and develop strategies that can enable elderly persons' age in place successfully. In predicting outcomes of burns among older persons, there may be a need to be cognizant of the older burned person's frailty score and not only their chronological age. There is a need to step up public health campaigns to protect the well-being of older persons in our societies.

Conflict of interest

None declared.

Funding

None.

References

[1] Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. Burns 2011;37(7):1087–100.
[2] Huang SB, Chang WH, Huang CH, Tsai CH. Management of elderly burn patients. Int J Gerontol 2008;2(3):91–7.
[3] United Nations. Department of Economic. (2010) 'World population ageing 2009: Vol. 295. United Nations Publications.
[4] Chang EJ, Edelman LS, Morris SE, Saffle JR. Gender influences on burn outcomes in the elderly. Burns 2005;31(1):31–5.
[5] Rao K, Ali SN, Moiemen NS. Aetiology and outcome of burns in the elderly. Burns 2006;32(7):802–5.
[6] Davidge K, Fish J. Older adults and burns. Geriatr Aging 2008;11(5):270–5.
[7] Mahar P, Wasiak J, Bailey M, Cleland H. Clinical factors affecting mortality in elderly burn patients admitted to a burns service. Burns 2008;34(5):629–36.
[8] Chaudhry IA. Burns: frequency and mortality related to various age groups. J Surg Pak 2009;14(2):67–71.
[9] Lundgren RS, Kramer CB, Rivara FP, Wang J, Heimbach DM, Gibran NS, et al. Influence of comorbidities and age on outcome following burn injury in older adults. J Burn Care Res 2009;30(2):307.
[10] Pham TN, Kramer CB, Wang J, Rivara FP, Heimbach DM, Gibran NS, et al. Epidemiology and outcomes of older adults with burn injury: an analysis of the National Burn Repository. J Burn Care Res 2009;30(1):30.
[11] Brusselaers N, Monstrey S, Vogelaers D, Hoste E, Blot S. Severe burn injury in Europe: a systematic review of the incidence, etiology, morbidity, and mortality. Crit Care 2010;14(5):R188.
[12] Othman N, Kendrick D. Epidemiology of burn injuries in the East Mediterranean Region: a systematic review. BMC Public Health 2010;10(1):83.
[13] Pham TN, Kramer CB, Klein MB. Risk factors for the development of pneumonia in older adults with burn injury. J Burn Care Res 2010;31(1):105.
[14] Hendrix L, Charles A, Buchholz V, Jones S, Cairns B. Influence of race and neighborhood on the risk for and outcomes of burns in the elderly in North Carolina. Burns 2011;37(5):762–9.
[15] Moore EC, Pilcher DV, Bailey MJ, Stephens H, Cleland H. The Burns Evaluation and Mortality Study (BEAMS): predicting deaths in Australian and New Zealand burn patients admitted to intensive care units with burns. J Trauma Acute Care Surg 2013;75(2).
[16] Taylor S, Jeng J, Saffle JR, Sen S, Greenhalgh DG, Palmieri TL. Redefining the outcomes to resources ratio for burn patient triage in a mass casualty. J Burn Care Res 2014;35(1):41.
[17] Taylor SL, Lawless M, Curri T, Sen S, Greenhalgh DG, Palmieri TL. Predicting mortality from burns: the need for age-group specific models. Burns 2014;40(6):1106–15.
[18] Jeschke MG, Pinto R, Kraft R, Nathens AB, Finnerty CC, Gamelli RL, et al. Morbidity and survival probability in burn patients in modern burn care. Crit Care Med 2015;43(4):808.
[19] Taylor SL, Sen S, Greenhalgh DG, Lawless M, Curri T, Palmieri TL. A competing risk analysis for hospital length of stay in patients with burns. JAMA Surg 2015;150(5):450–6.
[20] Duci SB, Arifi HM, Ahmeti HR, Zatriqi VK, Buja ZA, Hoxha ET, et al. Outcomes of older adults with burn injury: university Clinical Center of Kosovo. World J Plast Surg 2015;4(2):153.
[21] Wearn C, Hardwicke J, Kitsios A, Siddons V, Nightingale P, Moiemen N. Outcomes of burns in the elderly: revised estimates from the Birmingham Burn Centre. Burns 2015;41(6):1161–8.
[22] Duke JM, Boyd JH, Rea S, Randall SM, Wood FM. Long-term mortality among older adults with burn injury: a population-based study in Australia. Bull World Health Organ 2015;93(6):400–6.
[23] Stylianou N, Buchan I, Dunn KW. A review of the international Burn Injury Database (iBID) for England and Wales: descriptive analysis of burn injuries 2003–2011. BMJ Open 2015;5(2):e006184.
[24] Jeschke MG, Patsouris D, Stanojcic M, Abdullahi A, Rehou S, Pinto R, et al. Pathophysiologic response to burns in the elderly. EBioMedicine 2015;2(10):1536–48.
[25] Rybarczyk MM, Schafer JM, Elm CM, Sarvepalli S, Vaswani PA, Balhara KS, et al. A systematic review of burn injuries in low-and middle-income countries: Epidemiology in the WHO-defined African Region. Afr J Emerg Med 2017.
[26] Shariff Z, Rodrigues JN, Anwar U, Austin O, Phipps A. Burns in patients over 90: A fifteen-year series from a regional burns centre. Burns 2015;41(2):297–300.
[27] Morita S, Higami S, Yamagiwa T, Iizuka S, Nakagawa Y, Yamamoto I, Inokuchi S. Characteristics of elderly Japanese patients with severe burns. Burns 2010;36(7):1116–21.
[28] Ehrlich AR, Kathpalia S, Boyarsky Y, Schechter A, Bijur P. Elderly patients discharged home from the emergency department with minor burns. Burns 2005;31(6):717–20.
[29] Davis JS, Prescott AT, Varas RP, Quintana OD, Rosales O, Pizano LR, et al. A new algorithm to allow early prediction of mortality in elderly burn patients. Burns 2012;38(8):1114–8.
[30] Harvey L, Mitchell R, Brodaty H, Draper B, Close J. Dementia: A risk factor for burns in the elderly. Burns 2016;42(2):282–90.
[31] Yin Z, Qin Z, Xin W, Gomez M, Zhenjiang L. The characteristics of elderly burns in Shanghai. Burns 2010;36(3):430–5.
[32] Masud D, Norton S, Smailes S, Shelley O, Philp B, Dziewulski P. The use of a frailty scoring system for burns in the elderly. Burns 2013;39(1):30–6.
[33] Romanowski KS, Barsun A, Pamlieri TL, Greenhalgh DG, Sen S. Frailty score on admission predicts outcomes in elderly burn injury. J Burn Care Res 2015;36(1):1–6.
[34] http://www.who.int/healthinfo/survey/ageingdefnolder/en/
[35] Keck M, Lumenta DB, Andel H, Kamolz LP, Frey M. Burn treatment in the elderly. Burns 2009;35:1071–9.
[36] Mou J, Griffiths SM, Fong H, Dawes MG. Health of China's rural–urban migrants and their families: a review of literature from 2000 to 2012. Br Med Bull 2013;106(1):19–43.
[37] Campbell JW, Degolia PA, Fallon WF, Rader EL. In harm's way: moving the older trauma patient toward a better outcome. Geriatrics 2009;64(1):8–13.
[38] O'Keefe GE, Hunt JL, Purdue GF. An evaluation of risk factors for mortality after burn trauma and the identification of gender-dependent differences in outcomes. J Am Coll Surg 2001;192:153–60.
[39] McGwin G, Cross JM, Ford JW, et al. Long term trends in mortality according to age among adult burn patients. J Burns Care Rehabil 2003;24:21–5.
[40] Thornton MJ. The biological actions of estrogens on the skin. Exp Dermtol 2002;18:311–5.
[41] Aboderin I, Ferreira M. Linking ageing to development agendas in sub-Saharan Africa: Challenges and approaches. J Popul Ageing 2008;1(1):51–73.
[42] Lloyd-Sherlock P. Social policy and population ageing: challenges for north and south. Int J Epidemiol 2002;31(4):754–7.
[43] Gachuhi JM, Kiemo K. Research capacity on ageing in Africa: Limitations and ways forward. Generations Rev 2005;15(2):36–8.
[44] Alden NE, Rabbitts A, Yurt RW. Burn injury in patients with dementia: an impetus for prevention. J Burn Care Res 2005;26(3):267–71.
[45] Basic D, Shanley C. Frailty in an older inpatient population: using the clinical frailty scale to predict patient outcomes. J Aging Health 2015;27(4):670–85.