Rīga Stradiņš University

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“RETURN-TO-WORK OUTCOMES OF BURN INJURIES AND OCCUPATIONALLY ACQUIRED BURNS”

RESEARCH PAPER

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Abstract

Background: Advances in burn treatment have significantly reduced mortality, resulting in a growing population of burn survivors living with potential functional and occupational impairments. Return to work has been used as a marker for meaningful recovery. This varies largely depending on the severity of the burn, often characterized by depth and total surface area, as well as individual socioeconomic and psychosocial backgrounds.

Aim: The aim of this research paper is to collectively review literature on return to work outcomes following burn injuries to compare rates and identify key predictors on successful reintegration. This review also aims to differentiate outcomes based on burn etiology focusing on differences in return to work in non-occupationally and occupationally acquired burns.

Hypothesis: With increasing burn severity and associated sequalae, the likelihood and success of returning to work will be reduced.

Objectives: The purpose of this research paper is to assess return to work rates across studies and key predictors.

Methodology: This paper was done by collecting primary studies conducted on return to work outcomes and impacting factors. Articles were sourced from databases including Primo, Pubmed, Elsevier and Clinical Key.

Keywords searched for included return to work outcomes, predictors of return to work, occupational burn injuries, long term functional impairments and rehabilitation interventions were used. Recent studies between 2010-2025 were included for this review. Research papers varied across countries, with the Netherlands, Finland, USA, Australia, Germany, UK, China, India and Sweden represented.

Conclusions: Majority of burn survivors do return to work, across all studies reviewed over 60% of participants generally returned to work. Outcomes vary significantly with varying key predictors found to predict poorer reintegration. Depth, TBSA, length of hospitalization, contractures, psychiatric outcomes and burn location were all found across studies to predict a failure to or a delay in return to work. Another key finding was that occupational burn injuries also displayed a decreased return to work outcome and were more often more severe. Beyond employment status, losses in work productivity, income changes and changes in occupational role were also significant. Clinical rehabilitation and psychological rehabilitation play a role in aiding reintegration and remain essential to sustaining occupational reintegration.

Keywords: Burn injury, Return to work, Occupational burns, Burn severity, Work productivity, Burn rehabilitation, Predictors of recovery.

Abstrakts

Konteksts: Apdegumu ārstēšanas sasniegumi ir ievērojami samazinājuši mirstību, kā rezultātā pieaug to apdegumu upuru skaits, kuriem ir potenciāli funkcionāli un profesionāli traucējumi. Atgriešanās darbā tiek izmantota kā jēgpilnas atveseļošanās rādītājs. Tas lielā mērā atšķiras atkarībā no apdeguma smaguma, ko bieži raksturo dziļums un kopējā virsmas platība, kā arī individuālā sociālekonomiskā un psihosociālā izcelsme.

Mērķis: Šī pētījuma mērķis ir pārskatīt literatūru par atgriešanās darbā rezultātiem pēc apdegumu traumām, lai salīdzinātu rādītājus un identificētu galvenos veiksmīgas reintegrācijas prognozētājus. Šī pārskata mērķis ir arī diferencēt rezultātus, pamatojoties uz apdegumu etioloģiju, koncentrējoties uz atšķirībām atgriešanās darbā gadījumos, kad apdegumi nav iegūti darbā un ir iegūti darbā.

Hipotēze: Pieaugot apdegumu smagumam un ar tiem saistītajām sekām, atgriešanās darbā iespējamība un panākumi samazināsies.

Uzdevumi: Šī pētījuma uzdevums ir novērtēt atgriešanās darbā rādītājus dažādos pētījumos un galvenos prognozējošos faktorus.

Metodoloģija: Šis pētījums tika veikts, apkopojot primāros pētījumus par atgriešanās darbā rezultātiem un ietekmējošajiem faktoriem. Raksti tika iegūti no datubāzēm, tostarp Primo, Pubmed, Elsevier un Clinical Key.

Meklēšanas atslēgvārdi ietvēra atgriešanās darbā rezultātus, atgriešanās darbā prognozētājus, darba apdegumu traumas, ilgtermiņa funkcionālos traucējumus un rehabilitācijas intervences. Šajā pārskatā tika iekļauti jaunākie pētījumi no 2010. līdz 2025. gadam. Pētījumu raksti dažādās valstīs atšķīrās, pārstāvēti Nīderlande, Somija, ASV, Austrālija, Vācija, Apvienotā Karaliste, Ķīna, Indija un Zviedrija.

Secinājumi: Lielākā daļa apdegumu upuru atgriežas darbā; visos pārskatītajos pētījumos vairāk nekā 60% dalībnieku kopumā atgriezās darbā. Rezultāti ievērojami atšķiras, un dažādi galvenie prognozētāji tika konstatēti, ka tie paredz sliktāku reintegrāciju. Dziļums, kopējā skartā ķermeņa platība, hospitalizācijas ilgums, kontraktūras, psihiatriskie rezultāti un apdegumu vieta visos pētījumos paredzēja nespēju atgriezties darbā vai tās aizkavēšanos. Vēl viens svarīgs atklājums bija tas, ka darba apdegumu traumas arī uzrādīja samazinātus atgriešanās darbā rezultātus un biežāk bija smagākas. Papildus nodarbinātības statusam nozīmīgi bija arī darba produktivitātes zudumi, ienākumu izmaiņas un izmaiņas profesionālajā lomā. Klīniskajai rehabilitācijai un psiholoģiskajai rehabilitācijai ir nozīme reintegrācijas veicināšanā un tās joprojām ir būtiskas profesionālās reintegrācijas uzturēšanai.

Atslēgvārdi: Apdegumu traumas, atgriešanās darbā, arodslimību apdegumi, apdegumu smagums, darba produktivitāte, apdegumu rehabilitācija, atveseļošanās prognozējamība.

Introduction

Burn injuries remain among the most devastating forms of trauma, not only due to risks of mortality but also long-term consequences for survivors. In recent decades, mortality has decreased due to clinical advances in treatment, resulting in a growing population of burn survivors living with the multifaceted sequelae of their injuries. As survival increases, the attention shifts towards the understanding of outcomes post-burn. One societally and individually crucial measure of this is the ability to return to employment. This represents not only a tool of measuring recovery from injury physically, but is also an important factor of independence, economic stability and social and societal reintegration.

An interesting aspect of assessing outcomes includes what predictors can be pinpointed in determining successful return to work. Many survivors do reintegrate into work and trajectories for this can be varying. Some may smoothly transition into their pre-existing role, while others may need to change roles due to their injuries and others may face disability limiting them from re-employment. It is well known that burn injuries can be complex and severity can be expected to play a crucial part in this.

Occupationally acquired burns also pose unique challenges and tend to be vary etiologically in comparison to non-occupationally acquired burns. Comparison between the two can reveal differences in return-to-work outcomes and psychological impacts.

The aim of this review is therefore threefold. The first and main aim is to review current literature on return-to-work outcomes after burn injuries, both in rates and in long term outcomes. Second, to examine what current literature reveals as key predictors in outcomes. And third, to consider how burns differing in their location, occupationally versus non-occupationally acquired burns, affect outcomes. In doing so, current progress and gaps that remain in supporting burn survivors will be highlighted.

Methodology

Primary sources were used to complete this literature review. PRIMO, Pubmed, Clinical Key and Elsivier. were used to scope available research. Inclusion criteria for reviewed studies included:

studies written after 2010, studies written in English, studies investigating return to work rates or predictors following burn injuries and occupational burn injuries.

1. Background

Improvements on burn treatment have reduced mortality of burn injuries significantly, and in turn leading to more burn survivors left affected by the injuries functional consequences (Spronk et al., 2021). Significant morbidity is increased in patients following severe burn injuries, having a negative impact on their ability to work (Kush et al., 2024).

1.1 Burn injuries

Burns are acute traumatic injuries to the cutaneous tissue or other tissues exposed to the source of injury, most typically thought of to be caused by excessive heat. These injuries can also be caused by non-thermal causes; chemicals, electricity, radiation or friction, all of which have differing mechanisms of causing said injury.

1.1.1 Thermal burns

Thermal burns are the most common burns globally. Etiologically these arise from contact with open flames, hot liquids (scalds) or hot surfaces and are exceptionally common in both occupational and non-occupational settings.

Thermal burns are affected in three ‘zones’. Initially, when a thermal burn is received the area immediately affected by the source of injury is damaged and tissue coagulates, resulting in eschar tissue (necrotic tissue), an area which receives no blood flow. The area immediately around this is still viable, known as the zone of stasis, but perfusion is defective and at risk of injury. The third region around the second zone is known as the zone of hyperemia, where cutaneous tissue is relatively normal, but perfusion is increased and vasodilated. (Blyth & Murray, 2026)

1.1.2 Chemical burns

Pathophysiology of chemical burns depends on whether the chemical exposure was acidic ($pH<7$) or alkaline($pH>7$). Acidic exposure burns result in coagulative necrosis, a process where protein denaturation occurs resulting in an eschar. This acts as a barrier for further penetration of the chemical into deeper tissues (Vanhoy et al., 2023). In the case of alkaline chemical burns, cell membrane fatty acids undergo saponification and protein complexes are formed, resulting in liquefactive necrosis. Liquefactive necrosis allows for deeper penetration of the chemical, resulting

in a much deeper burn with an increased amount of systemic effects, including arrythmias and electrolyte disbalances (Vanhoy et al., 2023).

1.1.3 Electrical burns

Electrical burns represent a distinct category of burn injuries. In contrast to thermal and chemical burns, electrical burns often penetrate into deep tissue resulting in progressive necrosis due to microvascular damage, sometimes lacking the outward appearance of a burn (Gandhi et al., 2022). When high voltages pass through the skin, they cause extensive damage and due to the underlying progressive necrosis, patients presenting with severe electrical burns typically require at least two debridement surgeries. For instance in Gandhi et al.'s study 40% underwent amputations (Gandhi et al., 2022). These burns represent a large amount of those which require long hospital stays. Approaching this from an occupational perspective, these burns are highly relevant in work related burns, especially construction or utility industries where high-voltage equipment is used (Gandhi et al., 2022; Purola et al., 2022; Schneider et al., 2020). Electrical burns stand out as an occupational hazard.

1.2 Burn classification based on surface area (TBSA)

Surface area of burns is estimated before starting treatment. Total Body Surface Area (TBSA) is estimated using the 'rule of ninths. This estimation is crucial when considering fluid resuscitation requirements and additionally serves as a tool for predicting severity of outcomes(Moore et al., 2024). Once estimation is done, necessary fluid resuscitation is calculated using a formula which takes into consideration the patients weight (Moore et al., 2024). Estimation is as follows; entire head 9% (4.5% anteriorly and posteriorly, respectively), entire trunk 36% (18% anteriorly (further broken down into 9% for chest and abdomen), 18% posteriorly), upper extremities 18% (9% for each extremity, further broken down til 4,5% for anterior and posterior regions), lower extremities 36% (18% for each extremity, also broken down for 9% for anterior and posterior regions and finally, the groin 1%. Only 2^{nd}-4^{th} degree burns are used for this estimation (Moore et al., 2024; Singer & Dagum, 2008). TBSA becomes important when determining return to work outcomes, due to it's value in determining severity.

1.3 Classification based on depth

Traditionally, burns are classified based on their depth and thereby classified into 3 ‘degrees’. Superficial burns (1st degree burns) are confined to the outermost layers of the skin, the epidermal layer (Singer & Dagum, 2008). 1st degree burns are painful, dry and red. Burns like these require no (or very limited) treatment, as they heal within a week, without blistering, with fully healed epidermis.

Partial thickness burns (2nd degree burns) are grouped into superficial partial (2a) and deep partial (2b) groups (Pan, 2013). 2a group burns affect the epidermis and papillary dermis, and upper layers of the dermis typically form blisters within 24 hours from the injury. Burns are painful and red. Blanching on pressure is slower, when compared to 1st degree burns. These typically heal within 2 weeks, rarely causing scarring (Pan, 2013). 2b burns involve the deeper layers of the dermis (papillary and reticular), which includes hair follicles, glands and receptor cells. These burns are painful, but more so to applied pressure (Pan, 2013). Blanching on pressure is not present and blisters always form (Pan, 2013). Skin is discolored and mottled in appearance with patches of reddish/whitish discoloration. Healing takes 2-9 weeks, if healing isn’t complete within 3 weeks long term effects are possible and then typically require surgical intervention to ensure healing (Pan, 2013). Scars form as a result of damage, leading to increased risk for contractures (Pham et al., 2020), along with a multitude of other long term physical outcomes.

Full thickness burns (3rd degree burns) reach the subcutaneous tissue. Pain receptors are damaged, so these burns are painless, but perception of deep pressure remains in tact. Tissue necrosis is the resulting clinical appearance, with skin appearing black, white or grey and leathery(Singer & Dagum, 2008). Skin is dry and elasticity is lost. If the burn is circumferential, it may result in ischemia of limb affected (Singer & Dagum, 2008). These burns do not heal spontaneously and require surgical intervention via grafting and debridement.

An important consideration here, is that not all burns are uniformly related to 1 degree, some parts of the affected area may include areas where the tissue penetration is deeper, clinically this poses challenges in early diagnostics. Burn depths start at 2b typically require in hospital treatment, due to these having surgical intervention required.

1.4 Epidemiology of burn injuries

Globally, the epidemiology is interchanging between different countries. 180,000 deaths occur yearly due to burn injuries, the vast majority of these occurring in low and middle income countries (WHO, 2023). According to the World Health Organization 2/3 of global mortality due to burns occur in Africa and Southeast Asia, likely due to lack of proper safety education and equipment, poverty and overcrowding. Non-fatal burns are a leading cause of morbidity and disability-adjusted life-years (DALYs) and are for the most part, preventable (WHO, 2023). By contrast, in higher income countries, advances in burn treatment and education seem to reduce the mortality of burn injuries, in turn resulting in increasing morbidity due to burns (Spronk et al., 2021).

Global disease burden databases illustrate these differences in high-income/western countries. Lee et al. compared severities of burns across countries and regions, finding that in 2021 the highest prevalences of severe burns were observed in Guatemala and El Salvador and the lowest in the Netherlands and San Marino. They also found that minor burns affected females more than males, observing these differences changed with age, likely reflecting an occupational risk that males encounter with increasing age (Lee et al., 2025). Additionally, it is important to note that severe burn injuries tend to be more common in men, across literature.

2. Occupational burn injuries

2.1. Epidemiology

In their population group of burn injuries presenting to burn centers across Australia and New Zealand, Mcinnes et al. found that 17.3% of burn injuries were work-related (Mcinnes et al., 2018). In a Switzerland university hospital from 2000-2012, 31% of burns treated were work-related (Müller et al., 2016).

In studies reviewed which focused on burn injury and return to work, not all studies report etiology, but among those which did, more severe burns tend to be work related (Goei et al., 2016). Goei et al reported 35% of patients being injured at work. Spronk et al. reported 22% of patients in their study as receiving occupational burn injuries (Spronk et al., 2025). This study was out of Australia and this percentage is slightly higher than that of Mcinnes et al.

Occupational burn survivors tend to follow somewhat similar trends in epidemiological patterns as non-occupationally acquired burns. A difference compared to global epidemiology is that men are more likely than women to be burned across all studies (Purola et al., 2022; Schneider et al., 2011; Sharaf et al., 2019; Spronk et al., 2025). This may be explained by men being more likely to work in industrial and construction fields where occupational burns reveal to be more common. Schneider et al. report that older participants and married participants were more likely to be injured by burns in work places (Schneider et al., 2020).

2.1.1 Occupations at risk

There are fields of work at higher risk for different types of burns. Logically, it will be those which are most in contact with heat sources, chemicals and electricity sources. Mcinnes et al. report that burn injuries were most common in the service and food sectors, followed by industrial and construction sites (Mcinnes et al., 2018). Similarly, Purola et al. report that the most common sectors were kitchen/bakery workers, mechanics and excavation work (Purola et al., 2022). They also found that in more severe burns which required treatment at a burn center, industry and electricity workers were most affected.

While thermal burns acquired by heat and flame were abundantly common, etiological differences can be found in chemical and electric burns. In terms of chemical burns, those working with cement are at a higher risk of these burns. Cement burns are the most typical occupationally acquired

chemical burns (Sharaf et al., 2019). In Sharaf et al.'s study they found that 54.7% of burns in their population were chemical, wherein cement was the causative agent in 46.7%. Further, 25.2% of said chemical lower limb cement burns were work related (Sharaf et al., 2019). In electrical burns, Gandhi et al. found that of their population studied, 67% of electrical burns requiring in-hospital treatment were occupation related.

2.2 Etiology

Occupational burn etiology tends to follow the same pattern as typical burn injuries, meaning thermal burns are most common. However, severe chemical and electric burns are more commonly seen in occupational acquired injuries, than non-occupational injuries. Mcinnes et al. report that the most common cause of occupational burn was Flame (33%), followed by Scalds (30.3%) and Chemical burns (17%). Purola et al. also reported that heat (not separated into direct mechanism) was the leading burn mechanism in the occupational burns reported to workers compensation centers (also separated into 62% in men, 82% in women) (Purola et al., 2022). In addition to this, Purola et al. also found that 58% of work-related burn patients treated in Finland's National Burn Center (where the more severe burns are treated) were electrical injuries (Purola et al., 2022).

3. Return to work outcomes

3.1 Importance of returning to work after burn injuries

Following a burn injury, occupational reintegration, often quantified in time until return to work, these outcomes are a valid way to measure recovery. Empirical and theoretical analysis of employment status support the idea that work supports health and well-being of individuals (Öster & Ekselius, 2011). The WHO also notes that in addition to returning to social life and daily activities, returning to work is also an important part of rehabilitation (WHO, 2025). Return to work doesn't serve as a standalone measure for 'full' recovery, as recovery takes into consideration a wide range of factors, but as societally and on an individual level employment status is crucial, it must be taken into consideration when evaluating recovery outcomes of burn survivors.

3.2 Review of return-to-work outcome studies

Studies examining return to work use varying increments of months or years to evaluate return to work time. There does not seem to be an agreed upon time frame in which return to work is expected or an appropriate convention in determining recovery. Lack of uniformity on this front makes direct comparison of outcomes challenging. In addition to this, studies use a considerably wide range of burn severities to examine this, further complicating comparison.

Studies identified as having a measured return to work in under one year, can be considered to be evaluating short term return to work outcomes. The shortest time-point across studies was examined was Harhaus et al.(2025) in Germany, they examined directly after discharge at the start of rehabilitation, representing 0 months post injury, followed by end of rehabilitation, 3 and 12 months post rehabilitation. 22% returned to work at the start of rehabilitation, 59% at 3 months after rehabilitation and 84% at end of rehabilitation. It is important to note here is that only severe burns qualified for rehabilitation in this study following German guidelines: partial-thickness >15% TBSA, full thickness >10% TBSA, burns affecting face, hands, feet and genitals or severe scarring along large joints qualify and lasting neurological or functional deficits following high-voltage electrical burns, psychological sequelae impacts and age over 65 are considered (Harhaus et al., 2025). This can result in significantly lower results. However, in studies following similar increments (albeit without specific data about rehabilitation or direct return to work) found similar results.

Goei et al's study performed on Burn Center patients in the Netherlands, their first time increment was at 3 months, where 70% had returned to work, increasing to 92% at both 12 months and 24 months. This remaining 8% represented 5 patients, of which 2 had extensive injuries, with TBSAs of 12% and 75.5% resulting in functional impairment which was assumed to be the leading reason for failed return to work. These 2 patients were burned in work-related accidents. The other 3 patients however had more minor injuries at 3%-5% TBSA and 2 showed PTSD signs. (Goei et al., 2016).

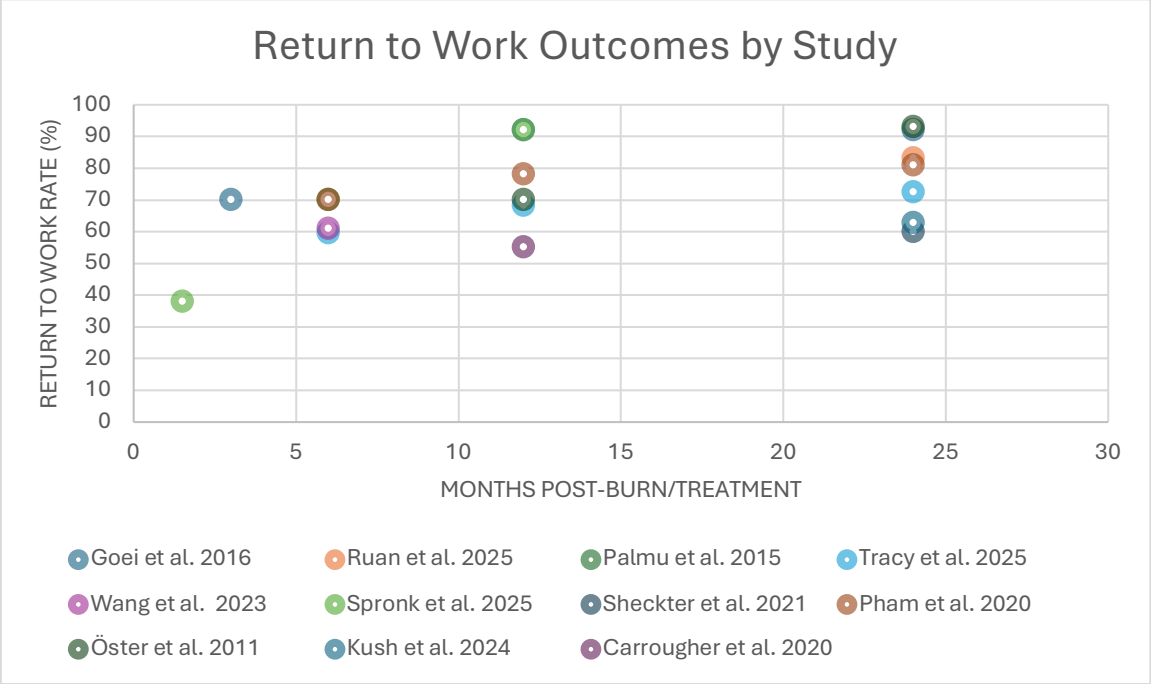
In a recent study in Australia, Spronk et al. (2025) also reported a very early timepoint, 1 month after injury, finding 37% had returned to work early. At 12 months, 67% of burn survivors had returned to work, increasing to 72% at 24 months. Findings at 24 months were reportedly lower than in other studies reporting similar increments(Spronk et al., 2025).

Another study with a shorter interval was performed by Tracy et al. in Australia, at 6 months 60% were employed, later at 12 months 68% were employed and at 24 months 72% were employed. They also reported that overall, 86% of participants were employed at some point in the 2 years the study was performed during. Another useful insight provided by their study was that the percentage of participants working in the same role as they were pre-injury decreased along with follow up, from 93% at 6 months to 64% at 24 months, indicating a potential difficulty in their pre-injury job (Tracy et al., 2025). Similarly to the priorly mentioned studies, Palmu et al. found that 70% of patients returned to work within 6 months.

Ruan et al. found that after 24 months after discharge 83.1% (147 patients) had returned to work (Ruan et al., 2025). In contrast to this, Shekter et al. reported a 60% return to work rate in 24 months (Sheckter et al., 2021), which is significantly lower. Ruan et al.'s study did contain approximately 50% minor burns, which in themselves can predict a better outcome.

Spronk et al. found that 69.5% of participants were employed 5-7 years after injury, their study also took into consideration changes in employment, and found that 18.9% of those employed at the time of their study reported changes in their working situation at least partly influenced by their burn injury (Spronk et al., 2021). This unique insight demonstrate the impact of injury outcomes on working situation, is beneficial for understanding the impact of burns on functional ability to work.

In summary, across all studies reviewed, two patterns emerge; return to work rates are consistently over 55% (excluding one study, where return to work at 0 months was detected), regardless of the type of burn, reported severity of burn or time increment examined, suggesting that burn survivors tend to exhibit resilience with reintegration into employment. And the second pattern, success rates of return to work are shaped by injury severity, psychosocial and socioeconomic factors.



Graph 1: Return to work outcomes across studies reviewed with stated 1,5 – 24-month outcome

4. Predictors of work outcomes

All studies collectively highlight a wide range of predictors in a 'failed' return to work. Rather than one factor being responsible for the failure to return to employment, recovery in this viewpoint is a complexity with an interplay of a range of factors. Like mentioned earlier, above 60%-90% will return to work after a burn injury, the next objective is to find key predictors as to why the remaining percentage of burn survivors do not.

4.1 Injury severity and physical sequalae of injury

4.1.1 Burn severity

One of the most consistent predictors of failure or delayed return to work was severity of the burn. Generally a TBSA of >20% is considered to be a severe burn (Lee et al., 2025). Multiple studies indicate that larger TBSA was associated with delayed return to work (Goei et al., 2016; Ruan et al., 2025; Tracy et al., 2025; Vorstandlechner et al., 2021). Vorstandlechner et al. discuss >40% TBSA burn survivors having significantly lower return to work rates. Tracy et al and Tolentino-Bazan et al. observed similar patterns, both describing TBSA >20% as an independent risk factor for poor return to work outcomes (Tolentino-Bazán et al., 2021; Tracy et al., 2025). Kishawi et al. also describe increasing TBSA leading to increased hospital stay lengths and further issues in work life (Kishawi et al., 2020). In contrast to these, Spronk et al. found that while there were noted outcome differences in higher TBSA, this was not statistically significant, this may, however, reflect the sample's median TBSA 2,4%, which is comparatively less than others mentioned. For example, Tracy et al's. study which was also performed in Australia, had clearly outlined inclusion criteria for markers of severe injury and did find a larger TBSA to be a predictor of return to work failure (Tracy et al., 2025).

In addition to TBSA, burn depth is also used to predict burn severity. With increasingly larger burns, it is also typical for larger areas of said burn to be partial or full thickness (Blyth & Murray, 2026). Palmu et al. found that deeper burns, particularly those involving hands and face, carried worse return to work outcomes (Palmu et al., 2015). Similarly, Watzinger et al. noted that deep burns were significant factors in work-related impairment in hand burns (Watzinger et al., 2024). Tolentino et al. also found that 3rd degree burns were a predictor as well (Tolentino-Bazán et al., 2021). Lahdenperä et al. further expand on this, finding that patients who undergo skin grafting

due to 2nd and 3rd degree burns had lower HRQoL scores (Lahdenperä et al., 2025), suggesting that depth results in more consequences in quality of life and working impairment.

4.1.2 Burn Location

A limited number studies reported specifically on outcomes classed by affected body part, but in addition to TBSA burned areas have an impact on return-to-work rates (Kush et al., 2024). Tolentino-Bázan et al. found upper extremity burns (shoulder), thigh and knee to be significant (Tolentino-Bazán et al., 2021). Kush et al. outlined a similar result, with upper extremity, head and neck burns being significant to outcomes, while chest and abdominal burns seemed to lack an impact on outcomes (Kush et al., 2024).

4.1.3 In-hospital interventions

Length of hospital stay functions as a marker for complexity and severity of burn injuries. Multiple studies note that length of hospital stay is a risk for failure to return to work at follow-up (Goei et al., 2016; Öster & Sveen, 2014; Spronk et al., 2025 ; Tolentino-Bazán et al., 2021). In addition to this, Kishawi et al. also note that deeper burns result in longer hospital stays (Kishawi et al., 2020), tying together depth (severity) and length of treatment. Length of stay can also indirectly indicate how well a wound began the healing process. Ruan et al. found that delayed wound healing (>10 days) also negatively affected return to work rates (Ruan et al., 2025). Carrougher et al. suggest that for every 10 days spent in hospital receiving treatment, there is a 14% lower chance to return to work after 12 months (Carrougher et al., 2020). Burns requiring more clinical interventions warrant longer stays in hospital, which links together these outcomes.

Furthermore, management required also affects outcomes. As previously outlined more severe burns (based on TBSA and depth), need necessary treatments in hospital. It is known that 3rd and 4th degree burns do require surgical treatment (Blyth & Murray, 2026). Kush et al. found that of those who required major surgery, majority failed to return to work whereas in groups receiving conservative and minor surgical treatment, the majority did return to work (Kush et al., 2024).

4.1.4 Long term physical sequalae

When looking beyond the focus of severity of acute burn injury, chronic long-term physical consequences of burns carry significant impact. Pham et al. focused on post-burn contractures and how they affected return to work outcomes. They reported that at 24 months follow-up 81% without

post-burn contractures had returned to work, whereas 65% with contractures had (Pham et al., 2020). Amputations were also found to be a strong predictor of unemployment post burn, regardless of the amount of or level of amputations (Carrougher et al., 2020; Tolentino-Bazán et al., 2021), while other studies highlight functional impairments resulting from scarring and mobility or range of motion limitations as risk factors (Ruan et al., 2025; Sharaf et al., 2019).

Wang et al. highlight that not all patients with similar burn etiologies follow the same patterns of recovery, in patient-reported outcomes studied in China, pain and itching at site of injury following recovery were closely linked to return to work outcomes (Wang et al., 2023). Collectively, severe burns that caused physical limitations play a major role in employability and this is reported across virtually all studies. There is no contradiction in results discussing severity and its impact on return to work.

4.2 Electric burns

Electric burns have been associated with poorer outcomes, due to their pathophysiological differences compared to thermal burns. They disproportionately cause deeper structural damage, oftentimes leading to devastating nerval and muscular damage (Gandhi et al., 2022). Both Purola et al. and Gandhi et al. highlighted that these injuries are often underestimated and require longer stays in hospital as well as numerous surgeries, which as previously discussed, in themselves raise the risks for impairments in occupational and functional outcomes (Gandhi et al., 2022; Purola et al., 2022). In Gandhi et al.'s study 40 patients required amputations, of these 40, 32 had high voltage electrical burns requiring upper limb amputations at various levels and even further 8/40 had bilateral upper limb amputations. They used the HRQoL model to assess patients, and across all domains investigated, amputation survivors and high voltage injury survivors scored significantly lower, this included working ability impairment. As electrical injuries themselves put patients at risk for more severe outcomes, these findings suggest a unique disadvantage in electrical burn injury survivors and their ability to return to work.

4.3 Demographic variables

Non-modifiable factors, such as age and sex also arise as predictors. Across various cohorts, older age was associated with delayed or failed return to work (Ruan et al., 2025; Tang et al., 2016; Vorstandlechner et al., 2021; Wiechman et al., 2023). Ruan et al. also showed that female

participants were disproportionately representing participants with poorer return to work outcomes, regardless of the fact that women were accounting for a much smaller portion of the population sample, accounting for 50% of those unemployed at 2 years (Ruan et al., 2025).

Education levels also appear to be relevant in employment after burn injuries. Various studies reported on this (Tang et al., 2016; Vorstandlechner et al., 2021). Tolentino-Bazan et al. specifically pinpointed lower than elementary level education as being a predictive factor for failed return to work after treatment (Tolentino-Bazán et al., 2021). This possibly reflects lower education background leading to less opportunity in occupational re-training. Additionally, physically demanding occupations are typically those which require less education.

4.4 Socioeconomic and systemic factors

Finally, the influence of socioeconomic factors must be taken into consideration. These factors were evident in multiple studies, and it can be expected that national standards of health care and consequent pricing affect this. Agoubi et al. focused on return to work outcomes in distressed communities and found that in these socioeconomically distressed communities, the odds for unemployment after burn injuries were twice as high compared to less distressed communities, even after adjusting for severity of burns in the US (Agoubi et al., 2025). Tracy et al. similarly found that participants from lower socioeconomic backgrounds as well as those relying on public funding had worse return to work outcomes in Australia (Tracy et al., 2025). Tang et al. also added that in China, self-reported economic status as well as payer source were significant factors in ability to return to work, as well as functional independence (Tang et al., 2016). Another study in China also emphasized that social support, as perceived by participants, affects outcomes (Wang et al., 2023). In the US, insurance type also played a significant role in outcomes (Carrougher et al., 2020).

5. Long term work outcomes

Long term work outcomes seem to be an understudied aspect of burn injuries. Many studies maintain a focus on previously discussed return to work outcomes, not taking into consideration how effectively burn survivors are able to complete their work tasks at hand. In addition to directly burn related work restrictions, long term mental illnesses resulting from burns may also play a role in functioning later in life after traumatic injury.

5.1 Long term effects on work productivity

The most comprehensive long-term study found and reviewed as by Spronk et al. in the Netherlands. Discussed earlier in relation to return to work outcomes, they found that 69.5% were employed 5-7 years after injury and included that 18.9% of participants had employment changes due to injury. Unlike majority of studies reported in return-to-work rates, they also took into consideration productivity. This was measured by 'absenteeism' and presenteeism' and used these parameters to predict productivity loss. Productivity loss at work was 12.2% on average, for those classified as having severe burns this was higher (25.5%) than those with mild/intermediate burns (8.4%) (Spronk et al., 2021). To support this view, Öster et Ekselius also noted that 8 of 39 (22%) participants returned to work with modified tasks or roles due to the burns sequalae (Öster & Ekselius, 2011). This insight is particularly beneficial as they looked beyond successful return to work, to examine how the injury has affected participation in work. Another study with a valuable addition was done from Tracy et al's study, where they found that while of their participants who returned to work, the percentage working for the same employer as pre-burn decreased throughout follow up. At 6 months, 93.8% returned to the same employer. This decreased to 74.5% after 12 months and further to 67.4% at 24 months (Tracy et al., 2025). Also, in a study focusing solely on burns affecting the hands, Watzinger et al. noted that 13.8% of patients changed occupation due to burns(Watzinger et al., 2024).

Spronk et al. (2025), in Australia's study had similar variables taken into consideration. Work impairment was assessed in those participants which did return to work. Despite their cohort having a median of low TBSA burns (2.5%), They reported of those who had returned to work within 1 month post-burn, work impairment was in the majority (60%). This percentage decreased over time, at 1,5 months impairment levels decreased to 55.2% (which is a noticeable change in just 0,5 months, indicating that participants had adjusted or further recovered in this short period of time),

48.1% at 3 months, 40.6% at 6 months and 39.5% at 12 months. They also reported that ‘extreme’ work impairment was found in 20.8% of workers at 1 month post burn, decreasing over time to 9.8% by 12 months post burn(Spronk et al., 2025).

Shekter et al. approached productivity economically, as gains or losses in income, comparing pre- and postinjury income changes at 24 months after injury. In their study they found that less than half of participants returned to pre-injury productivity, only 46% being those who were employed pre-injury had regained their pre-injury income while 77% of all who returned to work (Sheckter et al., 2021). This further highlights the economic aspect of burn survivors, even those which do return to work aren’t always fortunate enough to continue working in the same capacity as prior.

5.2 Predictors for productivity loss

There is only one study reviewed (and found) which outlines predictors for productivity loss explicitly, studied by Spronk et al (2025). While predictors for failed return to work can indirectly indicate factors which could result in productivity loss, studies outlining these lack.

In their study work impairment outcomes outlined in 5.1, they found a variety of significant variables that were found in those who had impaired work ability. Factors found were similar to predictors overall in return to work, this trend is completely logical, as an delayed or failed return to work can be expected as indicator for work impairment in the future, although this is not specifically outlined in any study. Spronk et al found that older age, prolonged length of hospital stay, prolonged wound healing, readmission to hospital, more occupational therapy input 6-12 months after burn and more psychology sessions 3-6 months after burn were all significant factors. Lower levels of impairment were found to be contact burn injuries, burns from explosions or flash and more occupational therapy 1-3 months after burn(Spronk et al., 2025).

5.3 Psychiatric outcomes in relation to return to work and work productivity

Psychiatric outcomes in themselves are equally as important as the ability in itself to return to employment and they seem to have an interplay in ability to work productively. Younes et al. found that burned patients which required inpatient care were at a significant risk to develop post traumatic stress disorder (PTSD) compared to the general population (Younes et al., 2025). Similarly, Soo Lee et al. analyzed PTSD claims in burn survivors in Korea and found that psychiatric consequences, such as PTSD and depression were more common in burn victims(Soo Lee et al., 2018). The functional outcome of this was further highlighted by Goei et al. whose study showed that among 5 patients who failed to return to work, 2 had minor burns but exhibited symptoms of PTSD, suggesting that the disorder was linked to their inability to continue work (Goei et al., 2016).

Further evidence was noted by Öster & Ekselius where their cohort showed that after 4,5 years, psychiatric disorders (specifically personality disorders), substance abuse and anxiety were predictors of failure to return to work (Öster & Ekselius, 2011). Tang et al. also linked psychiatric distress to quality-of-life post burn in their study. They highlighted sleep disorders, anxiety and depression as key predictors in reduced work productivity. Weichman et al. also stressed the importance of community integration and social support (Wiechman et al., 2023).

In a study by Gowojy et al. a remarkably long follow up time of 10-28 years in their study, averaging 14,2 years. While they didn't directly measure return to work rates, they found that the ability to return to work positively impacted mental health assessments (Gojowy et al., 2019), confirming the reciprocal relationship between the two. Concluding that the two do go hand in hand, and a focus on psychological support is a key factor in employment after burns.

6. Interventions and support systems

Interventions and support systems in place help patients achieve employment. Different countries use a varying standard of interventions, which may include physical therapy, occupational therapy or psychiatric support, and within countries access to these can be limited. Employment, however, should not be the only goal when analyzing from a 'return-to-work' lens, but rather job satisfaction, productivity and income. As highlighted in chapter 5, burn survivors may still be lacking in these fronts (Goei et al., 2016; Öster & Ekselius, 2011; Soo Lee et al., 2018; Younes et al., 2025). Studies outlining benefits of interventions in relation to occupational status are rather limited.

6.1 Clinical and rehabilitation interventions

Structured rehabilitation is essential in the context of functional recovery, not only because it works to address physical limitations caused by the burns, but because it serves as an important bridge to successful long-term outcomes in occupation and quality of life. Harhaus et al. performed an extensive multicenter trial, with the specific aim to compare two inpatient burn rehabilitation programs based on the ICF framework (WHO). They found that both programs led to significant improvement physically, in grip strength, range of motion and standardized burn scar assessment, all of which are key determinants on physical functioning. However, despite clear findings in physical gains, their study found that throughout follow up mental health scores didn't show as positive of an outlook. Mental health scores were initially lower at the start of rehabilitation with about half (49.5%) of patients showing higher than normal levels of distress. At the end of rehabilitation this result improved (26.7%). At their follow up at 12 months after rehabilitation, distress levels rose again (44.8%), to a level near what was found at the start of rehabilitation, indicating that rehabilitation insufficiently incorporates psychological and/or social interventions. As noted earlier, the prevalence of PTSD criteria meeting patients rose and fell following a similar pattern. They concluded that rehabilitation planning lacked in the psychological aspects, and emphasized the importance of integration of social services and support into rehabilitation, to aid return to work after rehabilitation (Harhaus et al., 2025). This also requires the cooperation of employers.

The effects of occupational therapy on work impairment were also outlined by Spronk et al. They reported that receiving higher volumes of occupational therapy 1-3 months post burn was associated with less impairment in work, whereas more occupational therapy 6-12 months post

burn was associated with more impairment in work (Spronk et al., 2025). However, their study does not provide data on whether or not those receiving occupational therapy 6-12 months after burn injury lacked early intervention to mitigate the effects of the burn injuries as a consequence or rather, if this was a reflection on the severity of the burn requiring a longer duration of occupational therapy. Regardless of this uncertainty, the findings still highlight the need for rehabilitation tailored to the needs of the individual while taking into consideration the severity of the injury and its potential sequelae. This dual interpretation reinforces the importance of continuum of care, incorporating the physical, psychological and occupational needs to optimize return to work outcomes.

7. Comparative outcomes: Occupational acquired burns vs. non-occupational burns

Not many studies provide a clear comparison between occupational and non-occupational burn outcomes. However, multiple studies do cite occupational burns as affecting return to work outcomes negatively when compared to non-occupational burns, as well as occupational burns accounting for more severe outcomes.

In a US cross-sectional survey study, differences in long-term social reintegration for burn survivors with and without work-related injuries were compared. The survivors included were all aged >18 and had >5% TBSA burns or burns in critical areas (hands, feet, face or genitals). Of survivors who were injured at work, scores on Work and Employment scales were significantly lower than those who were burned in non-work-related events. These workers were more likely to report that they felt fear about returning to work and felt a limitation in their ability to perform tasks at work. (Schneider et al., 2020)

Similarly to the previously mentioned study, in 2011 Schneider et al. found that of those treated in a regional burn center who were burned at work, after 1 year 44% remained unemployed compared to 22% burned in non-occupational settings. Here, it was also noted that psychiatric problems were a barrier to return to work in more participants burned at work compared to those not burned at work. (Schneider et al., 2011)

In a recent study by Spronk et al. they also found that occupational burn survivors were less likely to return to work. At one month after injury, work-related burn injured patients had a return to work rate of 33.6% compared to 41.3% in non-work-related injuries. An even more substantial difference was noted at 12 months post-burn with 82.3% in work-related burns and 93.1% in non-work-related burns. Their study also reported on work impairment, but this was not found to be affected by the etiology of the burn being work related (Spronk et al., 2025).

The only study that did not find a significant difference was done by Öster and Ekselius(Öster & Ekselius, 2011), although return to work rates were varying.

8. Discussion

This literature review reviewed trends in return-to-work trajectories after burn injuries. Collectively studies showed that majority of burn survivors do eventually return to work. In all studies which incorporated follow up after injury outlined gradual improvement in employment status throughout follow-up, seen in increasing percentages of participants returning to employment. Another key focus of this review was looking into the predictors which could possibly anticipate the lack of return to work and as could be expected, these were multifactorial. Majority of studies feature the severity of the burn itself, using predictors such as TBSA, depth and length of hospital stay, as factors. Fewer authors reported on less investigated variables. Yet, many studies lack a reflection on psychiatric sequalae, which serves to underline the complexity of recovery beyond merely physical recovery. The final aim of this review was to compare outcomes in burns specifically acquired in occupational settings and this was demonstrated across studies showing occupationally acquired burns were oftentimes more severe and resulted in poorer return to work outcomes.

It is worth noting that psychiatric sequalae serve not only as predictors for outcomes for poorer return to work rates but may be interpreted as outcomes in themselves, potentially arising from the inability to return to work itself. This suggests a reciprocal relationship between the two, where mental health influences the ability to return to work, while difficulties achieving return to work may exacerbate psychological distress. Such outcomes were described in multiple studies, highlighting the necessity of integrating psychological assessment and support into rehabilitation in long-term outlooks.

A crucial limitation when comparing return-to-work outcomes across the studies reviewed is the substantial heterogenicity between design and measurement of outcomes. Definitions for return to work seem to vary, with some studies focusing solely on employment of any kind, while others focus on namely returning to prior occupation. Some studies, for example those by Spronk et al., do however take both variables into consideration. Tracy et al. also successfully outlined an overall higher employment rate while also finding only 64% had returned to their previous role, this taken into consideration with Sheckter et al.'s study focusing on economical losses after injury show that there is a large amount of survivors unable to return to the role they previously were successful in. This in itself can be seen as a psychologically distressing situation, especially if physical labor / use of extremities injured were important parts of their career's prior. This was demonstrated in

Tolentino-Bázar et al.'s study where upper extremity burns functioned as a negative predictor in return-to-work outcomes.

An additional methodological challenge lies in the intervals used to determine return to work rates, or rather a lack of standardized follow up. Many studies do use multiple follow up points to outline this, and these valuable add to the interpretation of at which point reemployment plateaus. Studies did find gradual improvement, but the inconsistency in increments makes comparison less reliable, risking overstating potential differences when true differences may lie in the timing itself, rather than realistic variation in recovery. Studies varied in whether follow ups began at months post injury or post treatment. Especially in those receiving longer courses of treatment with longer hospital stays it can be anticipated that these patients have lower return to work at an earlier follow up at 3 months, if follow up is 3 months post burn, rather than treatment. Additionally, few studies used longer follow ups than 24 months. A suggestion for further study could be to continue with a model of 6, 12 and 24 month follow up, as multiple studies did, but also include a later timepoint at, for example, 5 years post injury.

Further building on this point, inclusion criteria for participants is varying among studies. Some cohorts demonstrated relatively varying return to work rates, even within the same country. For example, Goei et al, outlining 92% at 12 months (Goei et al., 2016), while others outlined much lower return to work rates such as Spronk et al. who found 69.5% returned to work within 5-7 years (Spronk et al., 2021), a notably longer interval. In Goei et al's study, which included all patients of working age treated at a burn center whereas Spronk et al's study had inclusion criteria centered on severity of burns treated. Direct comparisons of studies with differing inclusion criteria can be limit the value of comparison, as outcomes can be skewed positively or negatively depending on severity of burns included.

This dissimilarity also extends to how predictors for outcomes are examined. Severity markers such as TBSA, depth and length of hospital stay are very commonly used while other more specific burn outcomes such as pain, sleep disturbances or pre-existing community-level disadvantages are less reported and studied. Wang et al. highlighted symptoms reported by patients and how they translated into impacts on occupational outcomes, while Agoubi et al. demonstrated that community distress nearly doubled risks of unemployment. Variables such as these, when more routinely included, would allow for a more holistic view of what barriers are at interplay with reintegration.

Differences between healthcare and rehabilitation opportunities can be identified between countries, along with their respective healthcare and rehabilitation opportunities across countries, their respective health care systems and employment opportunities. For example, in the US, insurance policy seems to play a role in outcomes (Carrougher et al., 2020). In the studies done in the US, employment outcomes at 24 months post burn were 60-70% (Pham et al., 2020; Sheckter et al., 2021), which demonstrate lower return rates compared to other studies with the same interval.

The third focus of this thesis was in determining occupational burn differences compared to non-occupational burns. Across multiple studies, occupational burns were disproportionately severe, with electric and chemical burns being more common on these fronts than in non-occupational settings (Gandhi et al., 2022; Purola et al., 2022; Sharaf et al., 2019). Occupational burns also significantly contributed to reduced return to work outcomes (Schneider et al., 2011; Schneider et al., 2020; Spronk et al., 2025). This finding can be attributed to severity being higher and as this likely does play a role, but in questionnaires in Schneider et al.'s 2020 study, participants burned at work did express feelings of fear about their workplace where said injury happened, suggesting psychological factors tie into this as well. Taken together, these outcomes suggest that not only do burns represent more severe outcomes and in turn clinical burden but also may pose a greater socioeconomic challenge, reflecting the need for work-place education and safety as well as rehabilitation strategies clinically.

Overall, findings such as these, show optimism that the majority of burn survivors do return to employment. Research in this field may aid in determining which patient groups required more support in reintegration, highlighting the need for continued development of rehabilitation guidelines.

9. Conclusion

This review demonstrates that while the majority of burned patients do return to employment, the process of reintegration into workplaces in complex and shaped by an interconnected array of factors. Return-to-work rates are promising, with above 55% at all time frames past 3 months across all studies reviewed and a gradual increase thereafter, but variation in methodology and health care systems make direct comparison challenging. The most widely demonstrated predictors of reduced return to work outcomes are those relating to physical severity of the burn, particularly TBSA, burn depth and longer hospital stays emerged as strong predictors for delayed or failed outcomes. In addition, psychological sequelae emerge as equally influential, yet less studied. Finally, several studies reviewed also highlight that returning to work does not necessarily translate to full recovery, with long term productivity losses demonstrated in the form of reduced income, changes in employment due to injury and physical persistent symptoms.

From on occupational perspective, work-related burns present their own set of challenges. These burns were found across studies to be more severe, in both their etiological nature and physical injury markers. Occupationally acquired burn injuries also bear with them socioeconomic consequences, highlighted by reduced return to work rates compared to non-occupationally acquired burns.

These findings combined further highlight the need for standardized rehabilitation, workplace adaption and support for those injured by burns. Addressing challenges faced by burn survivors requires interdisciplinary collaboration with an increased focus on psychological support. Burn survival is no longer to be measured by success of treatment or solely by ability to return to work; true recovery must also be defined by the subjective ability of survivors to reintegrate and reclaim their places in the workforce, and more importantly society.

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Annex No. 2 _____
to the Decree No. _____
Form E-21

APPROVED
by the Rīga Stradiņš University Rector's
Decree No. ___/___/___ of __. __.____

DECLARATION
(in Riga)

_____

I hereby declare that:

_____Final Paper_____
(type of paper, e. g.: Bachelor's, Master's Thesis, Qualification Paper, Final Paper)

_____Return-to-work Outcomes of Burn Injuries and_____
_____Occupationally Acquired Burns_____
_____
(title of the paper)

(hereinafter referred to as Paper) has been developed lawfully and in good faith, to wit:

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