Long-term outcome after burn

Pruritus, pain, personality and perceived health

EMELIE GAUFFIN
Abstract


This thesis investigated the role of burn-specific and individual-related factors for long-term outcome after burn with emphasis on pruritus, pain, personality and perceived health.

Consecutive adult patients, admitted to the Uppsala University Burn Center between 2000 and 2009, were included. Patients were assessed during hospitalization, at 3, 6, 12 and 24 months and finally at 2-7 and 10-17 years post-burn.

Pruritus was prevalent in half of the patients 2-7 years post-burn. Of the patients with pruritus, half had severe pruritus, which was independently related to full thickness burn and health-related quality of life (HRQoL) at 3 months post-burn. One third scratched to the point of bleeding. Such scratching was independently related to full thickness burns and the personality trait Impulsiveness, but did not necessarily imply more severe pruritus. Results suggest that many patients lack adequate treatment.

Pain was prevalent in one third of the patients 2-7 years post-burn. Severity levels generally decreased over time and was at follow-up mostly regarded as mild to moderate. Post-burn pain has a negative effect on HRQoL and at 3 months post-burn, HRQoL was independently related to the reporting of post-burn pain at 2-7 years.

Personality trait scores in burn patients deviated little from norm values. Personality traits remained largely stable the first year after burn injury, except for an increase in the trait Stress Susceptibility, which was scored lower during the acute care phase but normalized at 12 months post-burn.

In qualitative interviews 10-17 years post-burn, participants reported living a near normal life. The subscales of the burn-specific health scale brief were in general still applicable at this time point. Additional areas playing an important role for post-burn health and outcome were skin-related problems, morphine de-escalation, the importance of work, stress and avoidance, mentality and the healthcare system.

Certain subgroups of burn patients are more vulnerable and likely to develop post-burn sequelae and this is dependent on both burn severity and individual characteristics. In general, however, many former burn patients recover well in the long run.

Keywords: Burns, Pruritus, Pain, Personality, Quality of Life, Health Status, Wounds and injuries, Patient Reported Outcome Measures, Rehabilitation

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To my brother
This thesis is based on the following papers, which are referred to in the text by their Roman numerals.


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Abbreviations

BPI-SF  Brief Pain Inventory Short Form
BSHS-A  Burn Specific Health Scale-Abbreviated
BSHS-B  Burn Specific Health Scale-Brief
BSHS-R  Burn Specific Health Scale-Revised
DSM-IV  Diagnostic and Statistical Manual of Mental Disorders IV
EQ-5D  EuroQol-5 Dimensions
HRQoL  Health Related Quality of Life
IES-R  Impact of Event Scale-Revised
LOS   Length of Stay
PTSD  Post-Traumatic Stress Disorder
QoL   Quality of Life
QPA   The Questionnaire for Pruritus Assessment
TBSA  Total body surface area
TBSA-FT Total body surface area-full thickness
SCID-I  Structured Clinical Interview for DSM-IV Axis I Disorders
SSP   Swedish universities Scales of Personality
VAS   Visual analogue scale
Introduction

"And I had been a boy scout. And I had been a paramedic. I understood what happened and I knew that I had to get hold of cold water. That’s a bit weird but I had to act you know. But I was convinced that I was going to die because it hurt so much. It was…the pain, the pain was unbearable. I’ve never felt anything like that before.”

Former burn patient, 43 years

Although significant overall progress has been made in recent decades in the field of burn care, burns are still regarded as one of the most severe traumas that an individual can suffer. About 180 000 people die every year in burn injuries worldwide [5]. Burn survivors must face not only the physical and psychological consequences but also the stigma a visible burn may pose.

The risk of being burned as well as the outcome is still in part a socioeconomic question. In low- and middle-income areas, where the majority of burn injuries occur, burns constitute one of the leading causes of disability-adjusted life years [5]. Globally, low socioeconomic status is also associated with more severe burns and higher mortality rates [158; 161]. In addition, the elderly, children and people of ethnic or racial minorities are more susceptible to burn injuries [161], as well as persons under the influence of alcohol or drugs [10]. Furthermore, certain individual or behavioral characteristics and environmental circumstances may increase the risk of being burned.

All burn patients carry with them a personal history and unique attributes that may be beneficial in or complicate the post-burn phase. It is therefore important to consider not only markers of burn severity but also individual characteristics when investigating post-burn outcome. Owing to the development of modern burn care, we generally can manage more severe burns today, which also calls for long-term follow-up studies.

This thesis aims to explore the interplay between burn- and individual-related factors for the long-term outcome after burn. While data and results in this thesis are presented on the group level, it is important to keep in mind that the participants are individual persons, each with their unique experiences and stories.
The burn

A burn occurs because of a thermal impact on the skin or other tissue and can be expressed as a function of exposure time and tissue temperature. Discomfort or pain is dependent on the accumulated thermal impact, but is generally perceived at temperatures above 43° at which point cell damage occurs. The time-temperature relationship is influenced by several factors, including pre- and post-burn tissue temperature, blood flow and heat, but can be illustrated mathematically, which allows for calculations and estimations of burn damage under varying conditions [6; 118].

The skin

The skin, which is the lining that constitutes the border between our bodies and the surrounding environment, serves as a physical and immunological barrier with the role of protecting and maintaining homeostasis and receive external sensory stimuli [67; 82; 178].

The skin can be divided into three main layers. The epidermis is the outer skin layer, built mainly of keratinocytes that constitute a stratified epithelium. Between the keratinocytes resides melanocytes, which produce skin pigment, and immunologically active cells. The second layer is the dermis, which consists of elastic and connective tissue, with varying thickness depending on the anatomic location. This supportive framework hosts additional immunologically active cells and skin appendages, such as blood vessels, hair follicles and sweat and sebaceous glands. The third and innermost layer is the hypodermis, or subcutaneous tissue, that is largely composed of adipose tissue. The subcutaneous layer has multiple functions, including insulation and nutritional storage. Several types of mechanoreceptor, including free nerve endings, are located in the skin, both in the epidermal and dermal layers. These mechanoreceptors detect vibration, touch, pressure or other sensory phenomena (such as pruritus or pain) and convey these sensations by afferent nerve fibers [15; 82].

A burn may not only cause scarring and altered skin appearance but can also undermine skin function. Burns destroy the integrity of the skin, and in severe cases, threaten homeostasis. Deeper burn injuries may also cause irreversible damage to skin appendages and nerve fibers; such damage may lead to loss of skin elasticity, dryness, impaired thermoregulation including sweating [39; 40; 71] as well as sensations of pruritus and pain.

Assessment of burn extent and depth

Burns are described clinically by the skin surface area affected by the burn and burn depth. The total body surface area (TBSA) can be estimated using Wallace’s rule of nines that arbitrarily divides the body into sections of 9% and can then be used to calculate TBSA. For smaller or patchy burns, “rule of
palm” can be applied, where the burned patient’s palm surface area, excluding digits, corresponds to 0.5% of TBSA (if digits are included, about 0.8% of TBSA). Different charts, such as the one by Lund and Browder, are also available [206].

Burn depth has previously been classified into first, second or third degree burns [53]. Today, a four-level classification system is used [138]:

- epidermal
- superficial partial-thickness (superficial dermal)
- deep partial-thickness (deep dermal)
- full thickness

Full thickness burns, expressed as TBSA-full thickness (TBSA-FT), penetrates the thickness of the dermis and reaches underlying subcutaneous tissue. Assessing burn depth is important given that superficial injuries can heal spontaneously, whereas deeper burns often require surgery. Most commonly, burn depth is estimated clinically based on ocular inspection of wound appearance, investigation of capillary refill and sensibility tests [138]. Moreover, new techniques developed for more exact approximations of burn depth (e.g., laser doppler, thermal imaging or spectroscopic approaches) are being implemented [78].

Systemic response

Although the most obvious insult is damage to the skin, a severe burn also causes a massive internal stress response. The overall physical burden is dependent not only on the size and depth of the injury but also on the location of the injury, age of the patient and co-existing injuries or illnesses [92].

One of the most serious emergent threats is whether inhalation of smoke has occurred such that the airways are affected or obstructed. Such a threat may cause both local and systemic inflammatory and toxic reactions [51; 186]. Inhalation injury, along with burn chock, are important mortality predictors and the most common causes of early (<48 hours [h]) death after burn injury [27; 76].

A burn trauma leads to activation of the inflammatory cascade systems in the body, at first to release pro-inflammatory cytokines [115; 144; 237] and later to compensate through upregulation of the anti-inflammatory response system [144]. This acute response is essential for mobilizing the defense systems of the body but the initial hyper-inflammatory state may have a counter-productive effect including an increased risk of infection, sepsis and acute organ damage [112; 144], which are the most common late (>48 h) causes of mortality [23; 27; 43]. The tissue damage itself causes vascular insult with plasma leakage, leading to hypovolemia and hemodynamic changes as to why early but balanced fluid resuscitation is crucial [29; 73]. The acute stress
reaction after burn also induces a neuroendocrine response [108; 109] and a hypermetabolic state [165].

The inflammatory response may also lead to secondary neuronal assault, and prolonged exposure to physical or psychological stress can lead to maladaptive responses of the neuroendocrine systems. A pro-inflammatory state and exhaustion of the neuroendocrine systems can lead to cognitive deficits and has been linked to symptoms of depression and anxiety-related disorders such as post-traumatic stress disorder (PTSD) [87; 112; 128; 214]. This association was recently demonstrated in a burn patient sample where a correlation between pro-inflammatory cytokines and symptoms of depression and PTSD was found [80].

**Epidemiology and etiology**

Over the past decades, there has been notable progress in the field of burn care, with greater attention paid to burn preventive measures. This progress has resulted in a downward trend in incidence, severity, length of hospital stay and mortality rates in developed countries. Data from middle- or low-income areas, where most burn injuries occur, are sparse but indicate that people in these areas suffer a higher load of fatal burns [161; 190]. Certain subgroups (e.g., ethnic or racial minorities) are more vulnerable, as are the elderly and children [161]. Men are generally overrepresented, where the male:female ratio is approximately 2:1 [190]. In general, flames, scalds and contact burns are the most common thermal injuries in adult patients, whereas scalds predominate in pediatric populations [27]. The majority of burns occur suddenly and unintentionally, most often at home or at work [5; 161]. A small proportion of burns is however intentional; either self-inflicted (self-harm, suicidal actions) or through an assault by another person [162].

In Sweden, approximately 1000 patients per year are admitted to hospital care due to burns, with approximately the same male:female ratio (2:1) as reported above for the global general population [3]. Between 1987 and 2010, 30,478 burn patients were admitted to Swedish hospitals. During this period, there was a 42% reduction in admissions and a 45% decrease in age-adjusted incidence. Overall mortality was 2.2% but decreased significantly over the years [198]. These figures are similar to those of other Scandinavian countries [204]. As in other high income countries, a large number of burns in Sweden are work-related [47] though most fatal injuries occur at home [81].

In addition to some subgroups being more susceptible, certain individual attributes and environmental circumstances may increase proneness to burns or other traumatic events. For instance, the use of cigarettes or alcohol has been related to fatal burns in a Swedish burn population [81]. In a recent Finnish study 19% of the burn patients had been both drinking and smoking at the time of the injury [153]. Home fire deaths in the USA have decreased in conjunction with a decline in cigarette smoking [84].
Certain personality traits have also been reported to increase the risk of experiencing traumatic events [25; 99; 119]. More specifically, burn patients high in impulsiveness [160] or with a psychiatric diagnosis are more likely to suffer from burns that could otherwise have been prevented [166].

Long-term outcome

With modern burn care, the healthcare system can manage larger and more severe burns, which is why there is a need to investigate long-term post-burn sequelae. Research indicates a higher mortality rate ratio after hospital discharge in burn patients compared with the general population [45]. Long-term post-burn mortality in Sweden has been associated with older age and full thickness burns, but not total TBSA, mechanical ventilation and sex of the burn patient [164]. However, most former burn patients live years or decades after the injury, with the potential sequelae of their burns. Naturally, there are large individual differences in how the burn impacts daily life and long-term adjustment seems to be dependent not only on burn severity but also on personal characteristics.

Pruritus

Pruritus, or itch, can be defined as “an unpleasant sensation which elicits the desire to scratch” [211]. There are several conditions in which pruritus often is a prominent symptom, such as in atopic dermatitis, psoriasis and uremic patients [159]. Pruritus frequently accompanies the general wound healing process [159; 212] and most burn patients report pruritus at discharge [28]. However, in burn wounds the mending process may be lengthy and for many burn patients, pruritus can continue for many years, even long after their wounds have healed.

How the sensation of pruritus is conveyed from the skin to the brain is still not completely understood [142]. The suggested mechanism is that the sensation of pruritus starts in the skin through activation of unmyelinated C-fibers, keratinocytes and immune cells with subsequent release of pruritogenic mediators. Afferent nerve impulses are then transmitted by C-fibers to the spinal cord, ascend to the thalamus and are from there directed further to different areas in the brain [104]. Pruritus in general can be categorized according to the probable primary cause: pruritogenic (if the eliciting cause is located in the skin), neuropathic (if peripheral nerves are affected), neurogenic (if the central nervous system is involved) and psychogenic (if it is associated with psychiatric conditions), or idiopathic (if the cause is unknown) [211]. Pruritus in the long-term course after a burn injury is proposed to be mainly of neuropathic or neurogenic genesis but cutaneous and possibly psychological
mechanisms may also be involved [143]. The exact mechanisms underlying persisting post-burn pruritus are however still unclear.

At discharge, most burn patients report burn-related pruritus and as many as 87% of burn patients at 3 months, 83% at 12 months and 73% at 24 months report pruritus [28; 215]. In a Swedish study [226] 60% of the participants reported pruritus after an average of 9.3 (range 1-18) years.

The presence and extent of post-burn pruritus have been related to larger burn size [28; 30; 215], greater burn depth, larger number of surgical procedures [215], skin grafting [28; 100] and younger age [100]. Associations between pruritus and mental health [129], early symptoms of post-traumatic stress [100; 215] and certain personality traits [226] have also been reported. Finally, pruritus is common (30 to 50%) in psychiatric populations [97; 121].

Anti-pruritogenic treatment aims to target the most probable pathophysiological changes, which, however, can be difficult to determine. Treatment options most often constitute emollients and oral antihistamines [175] but gabapentin and pregabalin have also been proven effective [83].

Though pruritus is one of the most common and distressing problems in burn patients, long-term studies on this issue are still few. The presence of pruritus is often only investigated by one or a few items that do not allow for a detailed description of this condition. Furthermore, individual characteristics are seldom surveyed.

Pain

Despite intensive analgesic treatment during the acute care, burn patients must endure and cope with background pain, breakthrough pain and procedural pain [197]. These in-hospital experiences of pain may be psychologically traumatic with memories lingering for years [205; 234]. During hospitalization, pain is managed using analgesics such as morphine or other opioids (intravenously or orally). After discharge, opioids continue as the most common treatment; however, gabapentin or similar drugs in treating neuropathic post-burn pain are possible options [68; 83].

Pain perception and pathways share commonalities with those of pruritus but are more clearly outlined. The sensation of pain starts with the release of neurotransmitters and pro-inflammatory mediators in the skin as a response to painful stimuli and tissue damage [140]. This process activates peripheral nociceptors from which Aδ-fibers and C-fibers then transduce the signals to the central nervous system, leading to the perception of pain [21; 189]. Continuous signals of pain may induce pathological feedback loops and result in central alterations and maintenance of pain [21; 140]. As with pruritus, pain is classified according to the most probable origin: nociceptive (if pain originates from the skin), neuropathic and neurogenic (if neurologic pathways are involved), psychogenic (if pain is associated with psychiatric conditions), or idiopathic (if the cause is unknown). The primary component in persistent post-
burn pain is suggested to be neuropathic or neurogenic; however the underlying pathology is most probably multifactorial [140].

Chronic pain has been defined as pain lasting more than 3 or 6 months, with the time limit differing slightly between studies, and is estimated to be prevalent in 10-60% of the general population [195]. As is the case with pruritus, post-burn pain can continue many years after the injury, with prevalence rates as high as 52% after an average of 12 years [38]. Furthermore, severe acute burn pain may lead to the development of psychological problems such as symptoms of PTSD [63], and the high comorbidity between pain and depression in different populations is well documented [20]. Both of these conditions have been suggested to influence the development and perception of pain [49; 139]. The presence of pain also has a negative impact on health-related quality of life (HRQoL) [194].

In previous long-term studies of post-burn pain, postal questionnaires are commonly used and attrition rates are often high. As with post-burn pruritus, the possible association with individual-related factors is rarely examined.

Personality
The American psychologist, Gordon Allport, was one of the first to introduce the concept of personality traits in 1937 [11]. He based his analysis on extraction of trait-like terms from dictionaries and further lexical analysis. Over the years, several models have been developed with the aim to describe human behavior and personality trait structure. The most commonly applied concept today is the five-factor model of personality including domains Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness [126]. Each domain is in turn constructed by specific facets or traits, which can be assessed by The Revised NEO Personality Inventory (NEO-PI) as developed by Costa and McCrae [125].

There are however multiple theoretical frameworks regarding personality trait structure and several assessment methods can be used. Our research group has previously used the Swedish universities Scales of Personality (SSP) [69]. The SSP was derived from the Karolinska Scales of Personality and these tools aim at assessing personality structure associated with a risk of developing psychopathology, instead of attempting to include all facets of personality.

Personality traits are assumed to be rather stable during adulthood but may change over the life course in a fashion that reflects the individual’s psychological maturation [31]. However, findings have varied as to the age at which personality trait stability reaches its peak [171; 176; 192; 230]. Stability of personality traits may also be influenced by psychologically stressful life events [79; 110], but the potential effect of physical trauma is rarely investigated in this context [102].

Fauerbach et al. [55] reported that burn patients score higher on Neuroticism and Extraversion at discharge compared with the general population.
These higher Neuroticism and Extraversion scores were also associated with symptoms of PTSD after the burn, probably mediated by the use of avoidant coping strategies [55; 105]. The same relationship has been observed for Neuroticism and symptoms of depression post-burn [13]. In a Swedish burn patient sample using the SSP the investigators found higher scores at average 11.4 (range 3-19) years after the burn on the Neuroticism domain and on Neuroticism-related traits: Somatic Trait Anxiety, Stress Susceptibility, Lack of Assertiveness and Impulsiveness [225].

In several populations certain personality traits have been linked to lower compliance to medical treatment or to rehabilitation [16; 17; 50; 72] and to perceived need for or use of care [75; 185; 223]. In burn patients, impulsiveness has been linked to the presence of pre-burn psychiatric disorders [152] and Neuroticism or Neuroticism-related traits may predispose for poorer general post-burn outcome [54; 89] and the reporting of physical sequelae such as pruritus [226].

Thus, personality traits may affect the post-burn course but little is known about the stability or change in personality after physical trauma. Previous studies on personality structure in burn patients are cross-sectional and do therefore not allow for evaluation of temporal stability.

Psychopathology in patients with burns

Psychiatric disorders are frequent in burn patients before the traumatic event. Prevalence rates of lifetime psychiatric diagnosis in burn patients have been reported to be 27 to 42% for mood/affective disorders, 10 to 37% for anxiety disorders, and 14 and 47% for substance use disorders. Any lifetime psychiatric disorder has been found in 57 to 66% of burn patients [48; 54; 156]. Prevalence rates of major depression, assessed using structured interviews, range from 4 to 10% after discharge and the first 12 months post-burn [207]. Symptoms of PTSD ranges between 3 and 35% the first month after injury and 7 and 25% after 2 years. The strongest predictors for the development of post-burn PTSD is whether patients perceived the trauma as a threat to life, acute intrusive symptoms and burn-related pain [63].

For comparison, lifetime prevalence rates in the general population of the USA have been reported to be 19% for affective disorders, 25% for anxiety disorders, 27% for substance use disorders and 48% for overall psychiatric disorders [86]. In a Norwegian epidemiologic study from 2001 major depression was found in 18%, alcohol abuse or dependence in 23% and at least one lifetime psychiatric disorder in 52% of the general population [98].

Our research group has prospectively investigated psychiatric diagnoses in burn patients using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I), see Table 1 [48; 147]. The SCID-I, has been established as the gold standard for this purpose. In another Scandinavian study Palmu et al. [155] assessed psychiatric disorders post-burn using a similar version of the
SCID. At 6 months post-burn, the prevalence of depression and PTSD was 2.2% for both disorders. The overall prevalence of mental disorders followed the same temporal trend as in both Swedish studies, showing a decrease from acute care to follow-up at 6 months.

Table 1. Prevalence of psychiatric disorders evaluated using the SCID-I in two Swedish burn populations at various time points.

<table>
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<tr>
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<th>Lifetime, %</th>
<th>12 months, %</th>
<th>2-7 years, %</th>
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<td></td>
<td>Öster and Sveen</td>
<td>Dyster-Aas et al.</td>
<td>Öster and Sveen</td>
</tr>
<tr>
<td>n = 107</td>
<td>n = 73</td>
<td>n = 94</td>
<td>n = 64</td>
</tr>
<tr>
<td>Any psychiatric</td>
<td>57</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>Any affective</td>
<td>37</td>
<td>42</td>
<td>6</td>
</tr>
<tr>
<td>Major depression</td>
<td>36</td>
<td>41</td>
<td>13</td>
</tr>
<tr>
<td>Any anxiety</td>
<td>27</td>
<td>37</td>
<td>21</td>
</tr>
<tr>
<td>PTSD</td>
<td>7</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Any substance use</td>
<td>29</td>
<td>32</td>
<td>4</td>
</tr>
</tbody>
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For more details, see [48] and [147].

In the two studies by our research group [48; 147], the presence of mental disorder at follow-up was related to a history of psychiatric morbidity. Individuals with a pre-injury psychiatric morbidity or symptoms also tend to require longer hospitalization [208; 229] and are more likely not to return to a previous occupation [46; 154].

Post-burn health

According to the World Health Organization, health is defined as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" [1]. Quality of Life (QoL) is a subjective measure of an individual’s general wellbeing [4], while the term HRQoL refers to the impact an condition, injury or illness has on the individual’s QoL as well as how this impact is perceived by the individual [61]. These terms are not always easily distinguishable and in burn research different concepts have been used: QoL, HRQoL and/or perceived health.

The different health concepts can be assessed using patient-reported outcome measures [22], often in the form of self-administered standardized questionnaires. These questionnaires can be generic or specific. Generic tools include a wider range of health aspects and are therefore generalizable across different populations. Specific instruments capture issues related to a certain condition, disease, patient group or function domain. For optimal coverage of the different aspects of health in an individual, the combined use of generic
and specific instruments has been recommended [36], including in burn research [130].

In burn research the EuroQoL-5 Dimensions (EQ-5D) and the 36 item Short Form Health Survey are the most commonly used generic instruments, while the Burn Specific Health Scale-Brief (BSHS-B) is the most widely administered burn-specific questionnaire. Patients are most often assessed during hospital admission and intermittently thereafter up to 24 months after injury [193]. There is generally a gradual improvement in HRQoL during and beyond this time point, and in some cases, HRQoL levels approximate those of the general population [150; 151; 217; 224]. Persisting low perceived health quality has been related to age [12; 14], burn depth [14; 137], rehabilitation issues [14; 150] and pain [137; 150].

Recent studies indicate however that even the combined use of generic and specific HRQoL questionnaires is not sufficient for coverage of additional aspects of health and functioning, such as environmental or personal factors [130; 131; 218]. Qualitative studies investigating post-burn health imply that other factors than those included in health status measurements are perceived as important in the post-burn course and for post-burn health [7; 8; 95; 134; 136]. Furthermore, post-burn health is rarely investigated several years after the injury and it is not known how the items of the BSHS-B correspond to the patients’ perceived health in the long-term perspective.
Background and aims of the thesis

Context

This thesis is part of a large multidisciplinary research program with the general aim of investigating factors of importance for the overall outcome after burn. The main hypothesis of the project is that not only burn-specific factors (e.g., extent, depth, location of burn injury and other severity markers) affect the post-burn course. Rather, there is a complex interplay between burn severity markers and individual and environmental factors that together determine the outcome (Figure 1).

The results from the project’s earlier studies have resulted in increased knowledge on post-burn adaptation. The papers included in this thesis are in part based on these results. Sveen et al. [200; 202] investigated PTSD in former burn patients, including validation of the IES-R that was used in paper I and II of this thesis. Öster et al. [148; 150] studied HRQoL and validated the EQ-5D questionnaire in the same burn population used in paper I and II. The factor structure of the SSP used in paper III was reported by Willebrand et al. [225] who, in another study, found an association with post-burn pruritus and anxiety-related personality traits [226]. Kildal et al. [88] developed and validated the BSHS-B which paper IV is in part based on. The research group has

Figure 1. Proposed interactions between burn- and individual-related factors, affecting outcome and adaptation after burn.
also explored cognitive processes [199; 227], return to work [46; 47; 145; 146], psychiatric disorders [48], nightmares [113; 114], patient satisfaction and use of health care [221; 223], experiences of family members [18; 19] and neuroendocrine response [108; 109] in former burn patients.

**General and specific aims**

The general aim of this thesis was to investigate physical and psychological long-term consequences after burns, mainly focusing on pruritus, pain, personality and perceived health. Attention was also given to the interplay between burn-specific and individual-related factors and how these affect the outcome.

The specific aims were to:

I  
   i) explore the prevalence and characteristics of post-burn pruritus 2-7 years after burn, ii) examine the potential role of burn- and individual-related factors on post-burn pruritus.

II  
   i) investigate pain severity over time as well as the prevalence and characteristics of post-burn pain 2-7 years after burn, ii) explore the potential role of burn- and individual-related factors on post-burn pain.

III  
   i) prospectively evaluate the stability in personality scores in burn patients from acute care to 12 months post-burn, ii) compare personality scores in burn patients with norm population scores.

IV  
   i) explore former burn patients’ perception of burn-specific health 10-17 years post-burn, ii) investigate how these experiences correspond to the subscales in the BSHS-B.
Methodology

Design, participants and procedures
Consecutive burn patients, admitted to Uppsala University Hospital Burn Center between 2000 and 2009, were asked to participate in an ongoing prospective study focusing on the long-term impact of burn injuries. Patients were eligible if they fulfilled the following criteria:

- ≥18 years of age
- Swedish-speaking
- without documented cognitive impairment or dementia
- ≥ 5% TBSA or a LOS at the Burn Center >1 day

In addition, patients were screened using a cognitive measurement scale (Mini Mental State Examination, MMSE) to discover possible previously unknown cognitive deficits and were in those cases excluded. Assessments (see below and Table 2) were made during hospitalization and at 3, 6, 12 and 24 months post-burn. In addition, patients were asked to participate in a long-term follow-up study 2-7 years after the burn, which had a social and vocational focus but where pruritus and pain also were assessed. A further qualitative interview study focusing on perceived health was conducted 10-17 years after the injury.

Paper I and II
Paper I and II are based on a consecutive sample of 279 patients that were admitted to the Uppsala University Hospital Burn Center between March 2000 and March 2007. Of these 279 patients, 112 met the inclusion criteria. Six patients were lost because of administrative reasons and 17 declined participation, leaving 89 patients that were included during the acute care. These 89 patients were interviewed during the hospital stay regarding psychiatric disorders. Self-report questionnaires assessing personality, symptoms of PTSD and HRQoL were administered by a member of the research team during the acute care and were then sent by post at several time points post-burn. The same 89 patients were also asked to participate in follow-up interviews 2-7 years after the burn. At this time, an additional nine patients declined participation, five were not possible to locate, four had died, two had emigrated, one was no longer willing to participate during the data collection process and one was
excluded because of severe mental illness, leaving a final sample of 67 patients (60%). The follow-up interviews were conducted by one of the authors (CÖ) between April 2007 and August 2008 and during these interviews, current psychiatric disorders as well as pruritus and pain were assessed.

Paper III
This paper is based on a consecutive sample of 357 burn patients admitted to the Uppsala University Hospital Burn Center between 2000 and 2009. Of these, 144 patients were eligible for inclusion, whereof 22 declined participation and 19 were lost for administrative reasons, leaving 103 patients eligible during the acute care. These 103 patients were assessed regarding personality and lifetime psychiatric diagnoses. At 12 months post-burn when personality again was assessed, 19 patients were lost to follow-up, resulting in 84 patients (58%) constituting the study population in paper III.

Paper IV
The sample in paper IV was based on a subgroup of the 67 patients who participated in paper I and II. We aimed at a purposive sample of patients with severe burn injuries (defined as a TBSA of ≥20%) resulting in 30 eligible patients. However, essential contact information was missing in four patients. A letter with information about the study was sent to the remaining 26 patients. These 26 patients were contacted by phone but six could not be reached. Thus, the final sample included 20 former burn patients which were given additional information and then asked to participate in the follow-up interview study. All 20 of these former burn patients gave their consent to take part in the investigation, which was conducted 10-17 years after the burn. Phone interviews focusing on perceived post-burn health were thereafter conducted between October and December 2017, by one of the authors (EG).

Instruments and investigations
Burn and individual-related information
Sociodemographic information was retrieved, including age, sex, marital status, educational level and working status. Data from patient medical records on injury characteristics (e.g., TBSA, TBSA-FT, LOS, location of the burn and whether the injury was visible or not) were also obtained. See Table 3.
Table 2. *Instruments/methods used for measures at different time points in paper I-IV.*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Instrument/method</th>
<th>Paper</th>
<th>Acute care</th>
<th>3 and 6 months</th>
<th>12 months</th>
<th>24 months</th>
<th>2-7 years</th>
<th>10-17 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pruritus</td>
<td>QPA</td>
<td>I</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>BPI-SF</td>
<td>II</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality</td>
<td>SSP</td>
<td>I and III</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychiatric disorders</td>
<td>SCID-I</td>
<td>I-III</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Symptoms of PTSD</td>
<td>IES-R</td>
<td>I and II</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>HRQoL</td>
<td>EQ-5D</td>
<td>I and II</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Perceived health</td>
<td>Qualitative</td>
<td>IV</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QPA = the Questionnaire for Pruritus Assessment, BPI-SF = Brief Pain Inventory Short Form, SSP = Swedish universities Scales of Personality, SCID-I = Structured Clinical Interview for DSM-IV Axis I Disorders, IES-R = Impact of Event Scale-Revised, EQ-5D = EuroQol-5 Dimensions.

Table 3. *Sociodemographic and burn-related characteristics of the participants in paper I-IV.*

<table>
<thead>
<tr>
<th>Paper</th>
<th>Eligible n</th>
<th>Included n</th>
<th>Response rate %</th>
<th>Time since injury years</th>
<th>M/F</th>
<th>Age at injury years</th>
<th>TBSA %</th>
<th>TBSA-FT %</th>
<th>LOS days</th>
</tr>
</thead>
<tbody>
<tr>
<td>I and II</td>
<td>112</td>
<td>67</td>
<td>60</td>
<td>4.5 (1.9)</td>
<td>52/15</td>
<td>42.6 (14.8)</td>
<td>25.4 (20.4)</td>
<td>10.8 (14.8)</td>
<td>27.0 (33.9)</td>
</tr>
<tr>
<td>III</td>
<td>144</td>
<td>84</td>
<td>58</td>
<td>1.0 (na)</td>
<td>64/20</td>
<td>44.8 (15.6)</td>
<td>24.6 (19.9)</td>
<td>15.2 (15.5)</td>
<td>27.0 (35.6)</td>
</tr>
<tr>
<td>IV</td>
<td>30</td>
<td>20</td>
<td>na</td>
<td>14.1 (1.9)</td>
<td>14/6</td>
<td>38.4 (12.9)</td>
<td>47.9 (16.4)</td>
<td>23.1 (19.7)</td>
<td>51.4 (61.4)</td>
</tr>
</tbody>
</table>

Continuous variables presented as mean (SD). na = not applicable. M/F = male/females. TBSA = total body surface area. TBSA-FT = total body surface area full-thickness. LOS = length of stay.
Post-burn pruritus

The Questionnaire for Pruritus Assessment (here abbreviated as QPA) [233] is a detailed self-administered pruritus questionnaire based on the short form of the McGill pain questionnaire [132]. It was first adapted and used by Yosipovitch et al. [232] in 2002 to assess pruritus in patients with atopic dermatitis. The QPA contains questions about character, intensity, frequency, time pattern of the pruritus as well as a 20-cm pruritus visual analogue scale (VAS). The questionnaire has previously been validated in a French-Canadian burn population [157]. Pruritus was assessed during the interviews 2-7 years post-burn and patients were informed that the reported pruritus should be exclusively burn-related.

The English version of the QPA was translated into Swedish according to the following steps: 1) forward translation into Swedish, 2) back translation into the original language (English), 3) consensus and resolution between the versions, 4) revision by experts in dermatology and burn care, 5) synthesis of revision annotations to a Swedish version of the QPA and 6) testing of the questionnaire in interviews with burn patients. There were some minor modifications made in the Swedish version to meet the need for more information about medical background, such as airway allergic diseases and atopic dermatitis during childhood.

Post-burn pain

The Brief Pain Inventory Short Form (BPI-SF) [34] is a validated and widely used, self-administered questionnaire that was originally developed to assess cancer pain [34]. It has since been validated in studies of non-malignant pain [85; 203] and used for evaluation of post-burn pain [26]. The BPI-SF measures the severity of pain and the impact of pain on daily activities. Four linear scales, ranging from 0 (no pain) to 10 (worst pain imaginable) assess pain at its worst, least and average during the previous week as well as current pain level. Seven linear scales, ranging from 0 (no interference) to 10 (total interference), evaluate the effect of pain on general activities, mood, walking ability, work, relations, sleep and enjoyment of life. A weighted Pain Severity and Pain Interference Index, ranging from 0-10, can be obtained. Pain was measured using the BPI-SF during the interviews 2-7 years after the burn with the instructions that the reported pain should be burn-specific. For approximation of pain severity over time, the pain/discomfort dimension of the EQ-5D (described below) was used.

Personality

The Swedish universities Scales of Personality (SSP) is a questionnaire constructed to capture personality traits that are associated with risk of developing
psychopathology, rather than describing an individual’s entire personality structure. It is a 91-item self-administered inventory, with each item rated on a scale from 1 (“does not apply at all”) to 4 (“applies completely”). The questions are equally distributed across 13 scales or personality traits: somatic trait anxiety, psychic trait anxiety, stress susceptibility, lack of assertiveness, detachment, embitterment, mistrust, trait irritability, impulsiveness, adventure seeking, social desirability, verbal trait aggression and physical trait aggression. The psychometric properties of the SSP have been evaluated in an age- and sex-stratified normative sample [69] and has recently been used in Swedish burn populations [223; 225]. In one of these Swedish studies a factor analysis revealed three factors (referred to below as domains): Neuroticism, Sensation Seeking and Aggressiveness [225] (Table 4). The SSP was administered during the acute care and at 12 months post-burn.

### Table 4. Description of SSP domains and subscales.

<table>
<thead>
<tr>
<th>SSP domains¹ and subscales</th>
<th>Description of individuals with high scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neuroticism</strong></td>
<td>Anxious, susceptible to stress, un-assertive, detached, mistrusting, and irritable</td>
</tr>
<tr>
<td><em>Somatic Trait Anxiety</em></td>
<td>Autonomic disturbances, restless, tense</td>
</tr>
<tr>
<td><em>Psychic Trait Anxiety</em></td>
<td>Worrying, anticipating, lacking self-confidence</td>
</tr>
<tr>
<td><em>Stress Susceptibility</em></td>
<td>Easily fatigued, uneasy when urged to speed up</td>
</tr>
<tr>
<td><em>Lack of Assertiveness</em></td>
<td>Lacking assertiveness in social situations</td>
</tr>
<tr>
<td><em>Detachment</em></td>
<td>Avoiding engagement in others, withdrawn</td>
</tr>
<tr>
<td><em>Embitterment</em></td>
<td>Unsatisfied, blaming and envying others</td>
</tr>
<tr>
<td><em>Mistrust</em></td>
<td>Irritable, lacking patience</td>
</tr>
<tr>
<td><em>Trait Irritability</em></td>
<td>Suspicious, distrusting people's motives</td>
</tr>
<tr>
<td><strong>Sensation Seeking</strong></td>
<td>Impulsive, adventure seeking</td>
</tr>
<tr>
<td><em>Impulsiveness</em></td>
<td>Acting on the spur of the moment, non-planning</td>
</tr>
<tr>
<td><em>Adventure Seeking</em></td>
<td>Avoiding routine, need for change and action</td>
</tr>
<tr>
<td><strong>Aggressiveness</strong></td>
<td>Verbal and physical aggression, not socially conforming</td>
</tr>
<tr>
<td><em>Social Desirability</em></td>
<td>Socially conforming, friendly, helpful</td>
</tr>
<tr>
<td><em>Verbal Trait Aggression</em></td>
<td>Getting into arguments, berating people when annoyed</td>
</tr>
<tr>
<td><em>Physical Trait Aggression</em></td>
<td>Getting into fights, starts fights, hits back</td>
</tr>
</tbody>
</table>

¹Domains according to [225].

### Symptoms of PTSD

The Impact of Event Scale-Revised (IES-R) [219] is a 22-item self-report that measures symptoms in the three clusters of PTSD: intrusion, avoidance and
hyperarousal. The symptoms are rated 0, 1, 3 or 5, where 0 indicates no symptoms and 5 indicates a high frequency of symptoms. The scores can be used separately for each cluster, or together as a total score which ranges from 0 to 110. The IES-R was used and validated by Sveen et al. [201; 202] in a Swedish burn patient population 1 year after the burn injury, showing good properties as a screening tool for symptoms of PTSD in this setting [201]. The IES-R was administered during acute care and at 3, 6, 12 and 24 months post-burn.

Psychiatric disorders
The SCID-I [60] is one of the most widely used psychiatric diagnostic tools (often considered “gold standard” for this purpose). Because of its semi-structured design, the interviews are designed to be conducted by a trained clinician or mental health care professional. Lifetime psychiatric disorders were considered if the patient met criteria for a DSM-IV diagnosis at any time before and up to the time of the burn. At the 2–7-year follow-up interviews, the presence of any current psychiatric disorder was assessed.

Health-related Quality of Life
The EQ-5D [2] is one of the most commonly used generic instrument for the assessment of HRQoL. The questionnaire consists of two sections: a five-dimensional descriptive system and a VAS. The five dimensions of the EQ-5D include mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has three levels: 1 (no problems), 2 (some problems) and 3 (extreme problems). A weighted index that ranges from $-0.594$ (death or worse than death) to 1 (full health) can thereafter be obtained [44]. The EQ-VAS assesses the patient’s self-rated health, ranging from 0 (labelled “worst imaginable health state”) and 100 (labelled “best imaginable health state”). The EQ-5D has previously been validated in adult Swedish burn patients [148]. The EQ-5D was administered during acute care, at 3, 6, 12 and 24 months post-burn and at the 2-7-year follow-up.

Burn-specific health and perceived health
*The Burn Specific Health Scale-Brief*
The BSHS-B is a burn-specific assessment tool and is the most commonly used questionnaire to assess burn specific health [193]. The original BSHS was a 114-item questionnaire. To increase feasibility, it was abbreviated to an 80-item version (BSHS-A) and later to a simplified 31-item revised version (BSHS-R). Finally, a 40-item brief version (BSHS-B) was constructed and have shown good validity and psychometric properties [88]. The patients are asked to rate each item from 0 to 4, with 0 indicating an “extreme” problem.
and 4 denoting that the item was “not at all” a problem. The BSHS-B can be divided into nine subscales: simple abilities, hand function, heat sensitivity, treatment regimens, body image, affect, interpersonal relationships, sexuality and work. The BSHS-B was administered at several time points post-burn but these measurements are not used in the papers included in this thesis. Instead, the qualitative interviews described below was in part based on the subscales of the BSHS-B in order to achieve the second aim of paper IV (to explore how former burn patients’ experiences of burn-specific health 10-17 years after burn corresponded to the subscales in BSHS-B).

Qualitative interviews
In paper IV phone interviews using a semi-structured approach were conducted. Open-ended questions were used to elicit a rich description from the respondents. The first question was “How does the burn injury that afflicted you some years ago affect you today?”. Additional inquiries followed covering the nine subscales of the BSHS-B (simple abilities, hand function, heat sensitivity, treatment regimens, body image, affect, interpersonal relationships, sexuality and work). In addition, respondents were asked whether some things had gone particularly well and whether some things had been especially troublesome. The interviews, lasting between 16 and 77 minutes (mean 40 minutes), were performed and transcribed verbatim by one of the authors (EG). The total transcripts from the interviews comprised 195 pages.

Ethics
The investigations were performed according to the Declaration of Helsinki and approved by the Uppsala University Ethics Committee.

Data analysis
Statistical analysis
In paper I and II, categorical variables were evaluated using Chi-square tests, or Fisher’s exact test when applicable. Students t-test were used to evaluate continuous variables. A logarithmic transformation was applied for skewed variables. Dichotomous variables were presented as yes/no and continuous variables as M±SD. Logistic regressions were used to identify possible variables associated with post-burn pruritus and pain. Burn- and individual-related variables were first evaluated univariately. Only independent covariates with \( p < 0.10 \) were included in subsequent regressions to avoid overfitting of the models. Because certain variables were highly correlated, only one variable in each group was included in the logistic regression models. A forward regression strategy was chosen with \( p < 0.05 \) as the limit for entry and \( p < 0.10 \) for
removal. Nagelkerke’s $R^2$ was used as an approximation for the ordinary least squares (OLS) $R^2$.

To investigate the correlation between the BPI-SF Pain Severity Index and the Pain Interference Index in paper II, Spearman’s correlation coefficient (rho) was calculated. The same analysis was done when calculating the correlation coefficient between the Pain Severity Index and the EQ-5D pain/discomfort dimension.

In paper III transformations of the SSP scores into T scores ((M = 50, SD = 10) for each trait were made. Scores for each domain was calculated by summing the scores from all scales included in that domain and then dividing the sum by the number of included scales. Student’s one-sample t test was performed for comparison of burn and norm population scores during the acute care and at 12 months post-burn. Paired Student’s t-test was computed to evaluate stability or change in personality scores between the acute care and 12 months post-burn. Logistic regressions were run to investigate possible associations between burn- and individual-related variables and change in personality scores.

SPSS version 21 was used in paper I, version 21 and 23 in paper II and version 25 in paper III.

Qualitative analysis

For the qualitative interviews, a thematic approach according to Braun and Clarke [33] was employed that included the following steps. Interviews were transcribed verbatim by the first author and interviewer (EG) for familiarization with the data. To enhance the understanding of the interview data both authors (EG and CÖ) actively listened to the interviews again when needed and read the transcripts several times. Keeping in mind the aims of the study, sections with meaningful content (meaning units) were then manually coded, generating initial codes (Table 5). A deductive approach using an analysis matrix was applied when searching for themes. Codes were processed and discussed between the two authors and were either sorted into the matrix with predefined themes corresponding to the subscales of the BSHS-B or into additional themes. When reviewing themes, coherence within each theme was ensured and subthemes were created based on dissimilarities within the themes. Defining and naming the additional themes were done after a joint discussion of the two authors and with the ambition of capturing the essence of the content of each theme. The themes and subthemes that were held to correspond to the subscales of the BSHS-B were labelled using these names. The consolidated criteria for reporting qualitative studies (COREQ) [209], which was applied in the present study, is a comprehensive checklist that is considered helpful in qualitative research when designing and conducting a study as well as when producing the report. Representative excerpts were chosen and used to clarify links between data and to facilitate interpretation of
results and drawing of conclusions. These excerpts were translated into English using a professional translation service and reviewed by both authors independently for correctness and to enable journal publication.

Table 5. Examples of meaning units, initial codes and final themes for predefined and additional themes

<table>
<thead>
<tr>
<th>Meaning unit</th>
<th>Initial code</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>I mostly lie in the shade, you know. [...] So, I think I’ve learned to sunbathe in a different way than before.</td>
<td>Not possible to sunbathe</td>
<td>Heat sensitivity¹</td>
</tr>
<tr>
<td>Then, then I kind of get, well, almost like overheated.</td>
<td>Overheated</td>
<td>Heat sensitivity¹</td>
</tr>
<tr>
<td>I don’t sweat where I have transplants so... it’s like I sweat, well... very heavily on my back and chest...</td>
<td>Issues with sweating</td>
<td></td>
</tr>
<tr>
<td>Yeah... I guess I was lucky... or however you’re supposed to look at it. Because I decided pretty early on that, like, I wouldn’t allow it [the burn] to affect me so much.</td>
<td>Being fortunate Does’t allow the burn to affect life</td>
<td>Mentality²</td>
</tr>
<tr>
<td>Well, for me, it’s been like that my entire life. I’ve always looked ahead.</td>
<td></td>
<td>Looking ahead</td>
</tr>
<tr>
<td>I think it depends on your mind-set in that... in the end, you decide for yourself how much it will affect you.</td>
<td>Mind-set Decide for yourself</td>
<td></td>
</tr>
</tbody>
</table>

¹ Predefined theme according to the BSHS-B.
² Additional theme.
Results

Prevalence and prediction of prolonged pruritus after severe burns (paper I)

Fifty-one patients (76%) reported burn pruritus any time after the burn. Thirty-three individuals (49%) reported ongoing burn-specific pruritus the past 2 months before the follow-up interviews at 2-7 years after the injury, whereof 32 (48%) completed the entire QPA. The 18 patients (27%) who did no longer experience pruritus at follow-up reported that pruritus had lasted for an average of 15 (13) months post-burn. See Figure 2 and 3.

Pruritus was mostly perceived as bothersome or annoying and tickling/crawling or stinging/burning. Twelve patients reported that the pruritus affected their mood and cognition, causing more agitation, concentration difficulties, depressive symptoms, anxiety or frustration. Twenty-three patients had current treatment for their pruritus. Eighteen patients used emollients/moisturizers, one had topical steroid and five had oral antihistamines as treatment regimens. None had gabapentin or similar drugs.

Figure 2. Presence of post-burn pruritus in the 67 patients.
Figure 3. Frequencies of pruritus in the 33 participants reporting ongoing pruritus.
Sixteen patients (50%) met the criterion for severe pruritus. This was based on the total sum of the four-level response question “To what extent do the following descriptions correspond to your pruritus?” (Table 6). The descriptions included ‘bothersome’, ‘annoying’, ‘unbearable’ and ‘painful’, with each item rated 1 (not at all), 2 (to a low degree), 3 (to a moderate degree) and 4 (to a high degree). Individuals with a total score of $\geq 9$ out of 16 was considered to have severe pruritus.

<table>
<thead>
<tr>
<th>To what extent do the following descriptions correspond to your pruritus?</th>
<th>Not at all</th>
<th>Low degree</th>
<th>Moderate degree</th>
<th>High degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bothersome</td>
<td>4</td>
<td>11</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Annoying</td>
<td>1</td>
<td>8</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Unbearable</td>
<td>17</td>
<td>10</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Painful</td>
<td>19</td>
<td>8</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Individuals with severe pruritus had larger TBSA, deeper burns as expressed by TBSA-FT and longer hospital stay, as expressed by LOS, and a higher rate of lower limb injuries and below knee injuries. These patients also scored lower on personality traits Psychic Trait Anxiety and Social Desirability, and higher on Physical Trait Aggression compared with those without severe pruritus. Patients with severe pruritus also reported lower HRQoL, as measured by EQ-5D index and EQ-5D VAS, at 3 and 12 months post-burn. In the subsequent regression analysis, only TBSA-FT (OR=3.8; CI=1.2-12.5) and EQ-5D index at 3 months (OR=0.043; CI=0.002-0.92) remained in the final model ($R^2 = 0.55$).

Eleven (34%) scratched themselves to the point of bleeding which, when univariately evaluated, was related to greater TBSA-FT, LOS and visible injuries. Patients who scratched themselves to the point of bleeding also displayed higher scores on personality traits Impulsiveness and Trait Irritability, as well as more symptoms of PTSD, as assessed by the IES-R, at 12 months post-burn, compared with patients who did not scratch to bleed. In the best-fit logistic regression model, scratch to the point of bleeding was related to TBSA-FT (OR=3.5; CI=0.93-13.1) and Impulsiveness (OR=1.13; CI=0.99-1.29) ($R^2=0.32$).

Scores on the QPA VAS did not differ between those individuals who scratched themselves to the point of bleeding and those who did not ($p=0.5$).

\(^1\)p<0.1 but >0.05. Reported here since variables with \(p<0.1\) were included in subsequent logistic regressions.
Health-related quality of life (EQ-5D) early after injury predicts long-term pain after burn (paper II)

Of the 67 patients, 20 (30%) reported post-burn pain on the BPI-SF 2-7 years after the injury. Based on this information, patients were divided into two groups in accordance with reports of ‘current pain’ (n=20) or ‘no current pain’ (n=47) on the BPI-SF. Pain severity at its worst was 5.3 (2.4), at average 3.7 (1.9) and overall Pain Severity Index was 3.4 (2.0). Pain interfered most often with general activity, work, enjoyment of life and mood, with an overall Pain Interference Index of 3.2 (2.4).

Pain severity approximated with the EQ-5D pain/discomfort dimension generally decreased over time; however, at 12 months post-burn a slight increase in pain severity levels were seen for the ‘current pain’ group. Except for during the acute care, the ‘current pain’ group reported higher pain/discomfort levels at each time point, compared to the ‘no pain group’ (Figure 4).

![Figure 4. Pain severity levels over time as measured by the EQ-5D pain/discomfort dimension from acute care to 2-7 years after burn for the ‘current pain’ (n=20) and ‘no current pain’ (n=47) groups. *p<0.05.](image)

HRQoL, as assessed by the EQ-5D index, was found to increase for both groups, indicating improvement over time. However, the ‘current pain’ group reported lower EQ-5D index levels compared with the no current pain group at 3, 12 and 24 months and 2-7 years post-burn (Figure 5).
All burn severity variables, i.e TBSA, TBSA-FT and LOS was associated with pain at 2-7 years post-burn, however only the effect of LOS was sufficiently strong to be discernible in subsequent logistic regression analysis. Logistic regression models for detection of variables related to pain at follow-up at different time points, LOS was independently related to post-burn pain (both OR=2.54; CI=1.28-5.05; $R^2=0.18$) at care and at 6 months post-burn.

At 3 months HRQoL, expressed as the EQ-5D index, was independently related to the reporting of pain at 2-7 years (OR=0.016; CI=0.001-0.17; $R^2=0.36$). At 12 months post-burn symptoms of PTSD as measured by the IES-R (OR=1.032; CI=1.005-1.060), and LOS (OR=2.88; CI=1.34-6.23), were associated with post-burn pain ($R^2=0.32$). At 24 months, the EQ-5D index (OR=0.010; CI=0.001-0.231) together with LOS (OR=3.92; CI=1.30-11.8) were related to pain ($R^2=0.49$).

Logistic regressions including the EQ-5D index were also performed with a re-calculated EQ-5D index without the pain/discomfort dimension included to exclude a possible carryover effect by this dimension. The results from these calculations were similar to those presented above (data not shown).

There was no association between lifetime or current psychiatric disorders as assessed by SCID-I and post-burn pain.
Stability in personality after physical trauma (paper III)

When comparing personality scores in burn patients during the acute care with those of the norm population, the only difference observed was lower scores on trait Stress Susceptibility in the burn population. No differences on the domain level were detected. At 12 months post-burn, scores on traits Somatic Trait Anxiety, Embitterment, Impulsiveness and Social Desirability were higher in burn patients compared with the norm population. No differences were observed on the domain level (Table 7).

Personality on the domain level remained stable between acute care and 12 months post-burn. On the trait level there was an increase in Stress Susceptibility scores between the two time points (Table 7). No associations between this increase in Stress Susceptibility and any of the burn related variables (TBSA, TBSA-FT, LOS, hand injury, visible injury, facial injury) or individual-related variables (age, sex marital status, psychiatric disorders) were seen in logistic regression analysis (data not shown).

Table 7. Domain and trait scores at acute care and at 12 months post-burn in burn patients compared to norm population scores.

<table>
<thead>
<tr>
<th></th>
<th>Acute care</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuroticism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somatic Trait Anxiety</td>
<td>50.7 (12.2)</td>
<td>52.9 (11.0)³</td>
</tr>
<tr>
<td>Psychic Trait Anxiety</td>
<td>48.7 (13.2)</td>
<td>49.7 (11.5)</td>
</tr>
<tr>
<td>Stress Susceptibility</td>
<td>46.7 (12.3)²</td>
<td>52.1 (11.0)</td>
</tr>
<tr>
<td>Lack of Assertiveness</td>
<td>49.6 (10.8)</td>
<td>50.2 (10.7)</td>
</tr>
<tr>
<td>Detachment</td>
<td>48.6 (10.6)</td>
<td>48.2 (9.7)</td>
</tr>
<tr>
<td>Embitterment</td>
<td>51.7 (13.7)</td>
<td>53.4 (11.5)³</td>
</tr>
<tr>
<td>Mistrust</td>
<td>50.3 (14.4)</td>
<td>51.1 (11.7)</td>
</tr>
<tr>
<td>Trait Irritability</td>
<td>47.5 (11.5)</td>
<td>48.5 (9.7)</td>
</tr>
<tr>
<td>Sensation Seeking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impulsiveness</td>
<td>51.5 (10.7)</td>
<td>52.8 (10.1)³</td>
</tr>
<tr>
<td>Adventure Seeking</td>
<td>48.8 (9.7)</td>
<td>50.5 (9.6)</td>
</tr>
<tr>
<td>Aggressiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Desirability</td>
<td>52.3 (13.0)</td>
<td>52.4 (9.0)³</td>
</tr>
<tr>
<td>Verbal Trait Aggression</td>
<td>50.0 (10.7)</td>
<td>49.9 (10.4)</td>
</tr>
<tr>
<td>Physical Trait Aggression</td>
<td>49.6 (10.6)</td>
<td>51.3 (10.5)</td>
</tr>
</tbody>
</table>

Results presented as mean (SD).
¹ n=83 owing to missing data.
² Lower compared to norm population T-scores (M=50, SD=10), p<0.05.
³ Higher compared to norm population T-scores (M=50, SD=10), p<0.05.
⁴ Increase between acute care and 12 months post-burn, p<0.001.
Patient perception of long-term burn-specific health and congruence with the Burn Specific Health Scale-Brief (paper IV)

The results of paper IV revealed both overlapping and gaps between the subscales of the BSHS-B and patients’ perception of post-burn health at 10-17 years post-burn.

*Themes corresponding to the BSHS-B subscales*

Problems in the area of simple abilities varied from no difficulties to significant impairment. Difficulties with hand function included decreased strength and sensory ability, loss of fine motor skills and stiffness in fingers.

Problems with heat sensitivity in different situations were expressed. The skin was highly sensitive and easily burned when exposed to sunshine. Decreased sweating in burned or transplanted areas sometimes led to a sensation of being “overheated”. The use of specific treatment regimens was rarely reported; emollients were used for dry skin or decreasing itch, as was antihistamines. Coping with how an altered appearance after burn was perceived by others as well as having to reevaluate the body image was something the respondents perceived as burdensome. Some expressed that it got easier with time and others stated that they never had paid much attention to how they looked.

Changes in mood or affect included being more thankful and appreciating life to a greater extent but also increased irritability, being more cynical and being more emotionally sensitive to sorrowful events. Interpersonal relationships had for some grew stronger with supportive relatives and friends, while others withdrew from social relations and situations. Problems regarding sexuality rarely were explicitly expressed but the burn caused insecurity when associating with new people and that this was an obstacle for meeting a new partner.

Successful vocational rehabilitation was achieved by adaptation of work assignments which allowed respondents to return to their previous occupation. Some had changed occupation or had a retirement pension due to consequences of the burn or because of age.

*Additional themes*

In addition to issues with heat sensitivity as described above, other skin-related problems, such as cold sensitivity, pruritus/paraesthesia/pain, wounds and tension were reported. Cold itself made the skin more fragile, causing wounds, and could trigger pruritus. Pruritus, paraesthesia and pain were reported as occasionally present, for some individuals, pruritus was more pronounced and demanded treatment.
Another problematic area was de-escalation of morphine. Whereas some respondents had no problems, others reported complete lack of support and follow up as well as developing an addiction.

The respondents highlighted the importance of being able to return to their previous occupation after the burn and that colleagues and supervisors played an important supporting role in this process.

Despite that several years had passed since the burn, there were statements of a lingering uneasiness when sensing smoke, handling fire or watching intense and uncontrolled fires in movies. These feelings of anxiety led to stress in and avoidance of these situations.

The respondents emphasized that their own mentality including fortitude, optimism and the ability to look ahead were crucial factors for a successful outcome.

The healthcare system was described as both facilitating when care and rehabilitation were provided by an experienced and caring staff, but as exasperating when psychological support was not provided or when the respondents perceived that the transfer from specialty care to a general ward took place too abruptly.
Discussion

Methodological considerations

Design

Patients in paper I-III were assessed prospectively regarding individual-related variables (e.g., HRQoL, symptoms of PTSD, personality and psychiatric disorders), which allowed for early identification of independent variables of importance for the outcome. A limitation of paper I and II is that post-burn pruritus and pain were only evaluated cross-sectionally at 2-7 years after the burn. Another limitation is that in paper II pain levels over time were assessed using the three-level EQ-5D dimension, providing only a crude estimation of pain severity, as discussed below.

The aim of paper IV was to explore the participants perception of their current health. They were also asked about whether some things had gone either particularly well or not well. The long interval since the injury (10-17 years) raises the question of recall bias. Previous research indicates that memory specificity does not differ between recovered burn patients and controls without burns matched for age and education. However, burn patients display longer latencies than controls, as well as an attentional bias towards the injury [227]. The risk that participants both under- and over-report symptoms or issues must therefore be kept in mind when interpreting the results.

Sample

The Uppsala Burn Center is one of two national burn centers and covers primarily the northern part of Sweden. These centers correspond to a catchment area that included three million inhabitants at the time of the inclusion in the present studies. Patients were included consecutively to reduce the risk of sample bias. Given the rather high response rates obtained in papers of this thesis, the current samples may be viewed as representative of Sweden and other countries with similar social and health care standards. The male:female ratio and burn sizes are also comparable with other studies in burn research. Thus, the results may be regarded as generalizable to populations in countries of similar socioeconomic standards with burns that require hospital admission. To ensure that participants would understand and be able to fully participate in assessments, patients with documented dementia or cognitive impairment
were excluded and all eligible patients were assessed with a cognitive measurement scale (Mini Mental State Examination, MMSE) before inclusion. In paper IV, a purposive sampling approach was used that aimed to include patients with severe burns to increase the chance of retrieving comprehensive descriptions from the respondents on possible remaining burn-related sequelae.

Long-term follow-up studies often have to contend with high attrition rates. Research indicates that younger patients, patients with minor burns, substance use and with other socioeconomic risk factors [58; 74] are more likely to be lost to follow-up. Sociodemographic variables and burn severity markers were registered for all patients in this cohort, which allowed for detailed descriptions of non-responders. There were no differences between responders and non-responders in paper I and II and only minor differences in paper III and IV. Moreover, considering the long follow-up period in studies I and II, attrition rates were relatively low [26; 38; 74]. It is notable that all patients in paper IV that we were able to contact were willing to participate in the study. Respondents spontaneously stated that the good care they received during hospitalization was the reason for their desire to take part in the study.

Fortunately, the incidence of burn injuries in Sweden is low. This low incidence leads, however, to one of the general limitations of this thesis, namely the relatively small sample sizes in paper I-III. A small sample size decreases statistical power, increases the risk of type II errors and limits the number of variables that can be included in multivariate regression models. Because of these limitations, the term ‘prediction’, which is used in paper I and II, may be precarious and must be interpreted with caution. Paper IV included 20 participants for qualitative interviews and thematic analysis, which is well within the recommended sample size [24].

Method

Self-administered questionnaires

The use of self-administered questionnaires allows for convenient data collection under the assumption that the respondents answer truthfully and understand the questions. However, there is always a risk of misinterpretation due to ambiguous or double-barrelled questions (questions that ask respondents two questions at the same time but only allow one response) [32]. During hospital admission, questionnaires were administered by a member of the research team and the respondents were given the opportunity to ask questions with respect to the self-reports or separate items in the questionnaires. The questionnaires on pruritus and pain were administered at the interviews 2-7 years post-burn. To decrease the risk of misconstruing the intention of the pruritus and pain questionnaires, the interviewer ensured that the questions pertained to only burn-specific pruritus and pain.
There are several types of potential response bias that must be addressed. Acquiescence bias refers to the tendency to agree with the questionnaire items. This problem has been addressed in personality research as it has been suggested to impact personality factor structure [170]. To avoid acquiescence bias the use of validity scales (e.g., assessing social desirability) has been recommended, but with inconclusive results [124; 163; 180]. The issue of providing socially desirable answers has previously attracted attention in pain research where it has been indicated to influence the reporting of pain [42] and symptoms of psychological distress [42; 103; 111] in pain patients. Health scale measurements often include VAS or Likert scales in which the risk of end-aversion (the disinclination of using the extreme ends of a continuous scale) and positive skew (using the positive end of the scale rather than the negative) must be considered [196].

The term validity refers to whether an instrument measures what it claims to be measuring, the extent to which the instrument includes the entire scope of what it claims to be measuring and whether it correlates with other similar instruments, preferably to a “gold standard” if available. Reliability implies the temporal reproducibility or consistency of scores, i.e. whether the same instrument provides the same result or information each time it is used [35]. The questionnaires used in this thesis have been previously validated across different populations. The SSP has been psychometrically evaluated in a Swedish burn sample [225] where the domains used in paper III were defined; however, no new factor analysis for the current study was performed because the sample was too small for a meaningful factor analysis. The IES-R is a valid instrument for estimating symptoms of PTSD and has previously been validated in a Swedish burn population [201; 202]. In both research and clinical settings self-administered questionnaires, such as the IES-R, are used for rating of psychiatric symptoms. It is however important to keep in mind that these rating scales provides merely an indication of symptom severity and does not equal an actual diagnosis. For diagnostic screening of psychiatric disorders, the gold standard SCID-I interview was performed by trained clinicians and researchers in the research team. Several validated questionnaires are available when assessing HRQoL. The EQ-5D, also validated in a burn population [148], is one of the most commonly used generic instruments and used in this thesis; however, there is no conclusive recommendation regarding choice of HRQoL-questionnaire [62].

When evaluating pruritus, there are several questionnaires available, of which many are based on the McGill Pain Questionnaire such as the QPA that was used in the present thesis. However, there is no gold standard tool to assess itch [143; 159]. The QPA was chosen since it previously has been validated in burn patients [157] and provides a detailed description of pruritus. As with pruritus, there is no gold standard tool in pain assessment. In clinical settings one of the most employed instruments to assess pain severity are numerical rating scales, which are often rated on an 11-point scale from 0 (“no
pain”) to 10 (“worst imaginable pain”) [57]. Pain levels over time in paper II were approximated using the pain/discomfort dimension of the EQ-5D. This was done because the BPI-SF was only administered at 2-7 years post-burn. The EQ-5D pain/discomfort dimension assesses pain severity on three levels; no problems, some problems and extreme problems. The drawbacks are that this three-level scale provides only a crude assessment of pain severity and the dimension is constructed to assess non-specific pain and discomfort, i.e. a broader spectrum of symptoms. To survey disease-specific pain intensity and the influence of pain on daily activities the BPI-SF is a suitable instrument. However, the instrument does not allow for differentiation between the different categories of pain (nociceptive, neurogenic/neuropathic, psychogenic or idiopathic). The BPI-SF has been validated in cancer, non-cancer and chronic pain [85; 91; 106; 203] but not in a burn patient sample, though it has previously been used in this setting [26].

Qualitative method
In qualitative methodology terms regarding the overall quality of the study can be gathered under the major concept trustworthiness. The following including aspects can be outlined [66; 107]:

Credibility refers to the rigor of the study, implying that the study is carried out and results are reported in a way that demonstrates the probability of the findings. A trained interviewer (EG) with experience from burn care, but with no previous knowledge of the respondents in the study, conducted semi-structured in-depth interviews with former burn patients. Meaning units and codes were continually evaluated and compared with the raw data by both authors.

Dependability regards the stability during the data collection process and was achieved by continuous documentation during the study processes and by repeatedly reviewing the data. Both authors were closely involved in the analyzing process and the reviewing of meaning units, initial codes and themes.

Transferability implies how well results can be transferred, or generalized, to other settings. Clear descriptions of the respondents, context and study design were outlined and representative quotes were selected to enhance the readers’ understanding of the results.

Confirmability concerns how well the results are derived from the data and whether correct interpretation has been made. To increase confirmability, all results were continually checked against the aims of the study as well as the raw data.

There is always a risk of interpretative errors by the authors. Such errors can occur because of the researcher’s pre-understandings and knowledge. To minimize the risk of such interpretative errors, the interviewer (EG) had not been involved in the care of the respondents nor met them before. Moreover, thematic analysis is a method that aims at describing respondents’ narratives as such, with minimal room for interpretation. It is also a suitable method when working with pre-defined themes, which were used in paper IV.
Ethical considerations

A burn causes considerable physical and psychological stress additional to numerous, painful wound dressings, surgeries and other procedures during hospitalization. Such a circumstance must be kept in mind when assessing patients during the acute care. Investigations during admission were therefore made after careful evaluation of each patient’s physical and psychological condition. Assessments were avoided on days of wound dressings or other physically or psychologically demanding procedures. Being reminded of a traumatic event during the recovery process might be stressful and anxiety provoking. However, previous research indicates that talking about the trauma may be perceived as beneficial [228]. At the follow-up 10-17 years after the burn injury, no patient expressed distress during the interview; rather, they were positive about taking part in the study. During the whole study process, patients who expressed the need for or displayed symptoms that might require further physical or psychological care were assisted with referrals to such care.

General discussion

Pruritus and pain

The results confirmed and extended the findings from previous research by showing that post-burn pruritus and pain still were prevalent problems 2-7 years after injury as well as providing a detailed description of pruritus and pain and outlining the possible effects of individual related factors. The presence of post-burn pruritus could affect mood and cognition. Pain severity at 2-7 years post-burn was generally regarded as mild to moderate as previously suggested [127; 220; 236] and could interfere with everyday life activities. In the interviews at 10-17 years post-burn some respondents described the presence of intermittent itching or tingling, whereas others reported more severe symptoms in this area as well as problems with heat, cold, wounds and tension.

The reporting of pruritus and pain was related to the extent and depth of the burn which is in line with previous findings [167; 215]. The dynamic wound healing and scar remodeling processes can last for more than a year [59] promoted by an interplay between pro-inflammatory mediators, cutaneous innervation and skin cells [59; 64]. Pruritus and pain are in particular increased in hypertrophic scarring [120], possibly caused by elevated levels of pro-inflammatory mediators such as substance P and calcitonin gene-related peptide [101; 184]. A subgroup of patients scratched themselves to the point that they bled, a behavior that may maintain the pro-inflammatory state and prevent complete wound healing. Deeper burns affect or destroy the skin appendages such as sebaceous glands which can cause dry and fragile skin and thus cause disruption of the skin barrier [187]. In the interviews at 10-17 years post-burn,
respondents reported that they often experienced dry and fragile skin, which caused both pruritus and small wounds.

The findings indicate that pruritus is not exclusively related to burn severity; patients with severe pruritus or those who scratch to the point of bleeding may constitute different subgroups with varying accompanying personal characteristics. Pathological skin picking has previously been suggested as an emotional-based impulsivity and a response to negative emotions [168; 169; 191], anxiety [179] and stress [90]. Similar links between pruritus and personality have been reported in the literature. Applying the SSP, our research team [226] previously found an association between pruritus and anxiety-related personality traits at 11.4 (range 3-19) years after burn. More specifically, reporting of occasional pruritus was related to Lack of Assertiveness and persistent pruritus was associated with Physical Trait Anxiety. A Swedish study of patients with psoriasis [173], also using the SSP to evaluate personality structure, showed that individuals with severe pruritus scored higher than those with mild pruritus on the personality traits Somatic Trait Anxiety, Embitterment, Mistrust and Physical Trait Aggression. In this thesis, scratching that caused bleeding was related to pruritus but did not necessarily imply more intense or severe pruritus. Conversely, patients may suffer from severe pruritus without presenting scratch marks. This further indicates that pruritus is a highly subjective sensation and that individual characteristics may significantly influence the person’s interpretation of and reaction to pruritus.

Many patients described their pruritus as a tickling/crawling or stinging/burning sensation, which is how most burn patients characterize their pruritus in general [159]. These are attributes often associated with neurogenic or neuropathic origin, which, together with pruritogenic origin, are the most commonly suggested causes of persisting post-burn pruritus [143]. Considering this, it is noteworthy that no patient was treated with gabapentin or similar drugs, which are possible treatment options also in post-burn pain [83].

As with pruritus, pain was related to individual characteristics. Pain severity levels decreased over time for both the group of patients with current pain and the group with no current pain at the 2-7 year follow-up. This finding is in line with previous results that also display a temporal improvement of pain severity [49; 181]. For patients with current pain at 2-7 post-burn however, a sudden increase in pain levels was seen at 12 months post-burn, and pain at follow-up was related to symptoms of PTSD at this time point. Pain has previously been related to symptoms of PTSD in burn patients [63] and chronic pain and PTSD often co-exist in clinical cohorts [188]. Moreover, PTSD may influence pain thresholds and perception [41; 133]. In this regard, recent studies have aimed to examine the theory of a mutual maintenance between pain and symptoms of PTSD, as reviewed in [172]. Symptoms of hyperarousal and intrusion seem to play an important mediating role between pain and symptoms of PTSD. The effect of catastrophizing, i.e repetitive, fearful and negative thinking regarding an event or a symptom such as pain, was more
inconclusive [172]. However, some studies advocate that pain co-existing with symptoms of PTSD as well as altered pain perception and thresholds in patients with PTSD may be mediated by catastrophizing [65; 213]. Van Loey et al. [216] recently investigated pain, pain catastrophizing and symptoms of PTSD in a burn patient sample during the acute care and after 6 and 12 months. Their findings showed a link between pain catastrophizing and acute and chronic PTSD symptoms, and pain at 12 months post-burn.

Burns cause excruciating pain and it is essential to optimize pain control which during the acute phase is achieved by the use of morphine or other opioids. Such medications are also prescribed after discharge as they are affective analgesics. Morphine de-escalation was reported at the 10-17 year follow-up as an issue in the post-burn period. Respondents exclusively used the words ‘morphine’ and/or mentioned morphine-based drugs, which is why this theme was named morphine de-escalation; however, when naming this theme, the word “opioid” might have been more inclusive. Opioid addiction today is an escalating and serious problem and, to a great extent, a product of the liberal prescription of this drug for pain relief [9; 37; 70]. In burn care opioid prescription follows the same trend and has increased rapidly in the past few years [210]. Thus, there is a balancing act between adequate pain management and careful follow up to avoid dependence and addiction.

The suggested multifactorial genesis, both in post-burn pruritus and pain, requires however a thorough individual evaluation to provide best possible treatment. Certain subgroups of patients, especially if psychological processes or individual characteristics are suspected to be involved, might benefit from supplementary approaches such as cognitive behavioral therapy [123; 182].

The functions of our skin are not exclusively physiological but also social and communicative [141]. Facial information and appearances are interpreted automatically and outline the base for our first impressions of others [235]. Altered or deviant skin or facial appearances may constitute a stigma that can have detrimental effect in a person’s wellbeing [116]. Many burn patients struggle with accepting their altered appearance, dealing with inquiries from the environment and experience alienation caused by burn scarring [77; 117; 136; 174] also several years after the injury [149; 231], as reflected in the interviews 10-17 years post-burn.

Personality traits

Burn patients scored lower than norm population during hospitalization on the trait Stress Susceptibility, a result that may seem somewhat contradictory. One possible explanation for this finding could be the sedative effect of treatment regimens during acute burn care. Moreover, in a recent meta-analysis Roberts et al. [177] investigated the impact of different interventions on personality. The authors concluded that therapeutic interventions, including supportive approaches, could influence personality traits to change in a beneficial direction.
Most burn patients perceive the multidisciplinary acute burn care approach as helpful and satisfactory and patients who experience a close and good contact with the nursing staff report lower stress scores during hospitalization [221; 222]. In the qualitative interviews, and as previously reported [135], respondents report that lack of competence in health care professionals is exasperating while good quality care and psychological support facilitate the rehabilitation phase. Thus, the multidisciplinary burn care might have a stabilizing and beneficial effect on personality trait ratings.

Stress Susceptibility scores were normalized at 12 months post-burn. However, it should be noted that these Stress Susceptibility scores still increased at the group level during this period. This may indicate a persisting effect of the stress load of physical trauma on this facet of an individual’s personality. One year after injury, transition to general care or the home environment has occurred and the supportive infrastructure that is present during the acute care is attenuated. Stress and difficulties that may accompany this transitional period also became evident in the interviews with former patients. In the study by Willebrand et al. [225] burn patients scored higher on Stress Susceptibility compared with norm population scores 11.4 (range 3-19) years post-injury, as well as on Somatic Trait Anxiety, Lack of Assertiveness and Impulsiveness.

Further interpretation and discussion are however precarious because of the paucity of previous research and cross-sectional design of available findings as well as because of the rather small sample in paper III and the minor (<1 SD) differences between burn patient scores and the norm population scores and the small (<1 SD) increase in Stress Susceptibility.

Post-burn health

Health, QoL or even HRQoL are broad concepts why even the combined use of generic and specific instruments can be insufficient in capturing the entire concept [130; 131; 218]. Over the past years, qualitative research has attracted attention, also in the field of burn care [96]. Qualitative methodology allows the researcher extend beyond the scope of numbers and figures and instead achieve a more extensive and in-depth understanding of a concept. However, temporal evaluation of post-burn health is most often conducted, and conveniently achieved, by using questionnaires such as the generic EQ-5D or the specific BSHS-B [193].

In this thesis, HRQoL expressed as EQ-5D index at 3 months after injury was independently related to pain after 2-7 years. This is probably because HRQoL at that time point is a more comprehensive measure of the total physical and psychological stress load after burn. HRQoL was generally scored lower in patients with pruritus and pain which is in line with previous research indicating persisting lower HRQoL after burn in patients reporting physical and psychological impairments, such as pain [150].
A recent systematic review by Spronk et al. [193] concluded that when investigating generic HRQoL, the lowest scores in the short-term are seen for the EQ-5D index and the EQ-5D pain/discomfort dimension. While the EQ-5D index gradually improves, however not sufficient to reach norm scores, the pain/discomfort domain continues to receive poor scores. The EQ-5D VAS is generally scored low early after burn but values tend to approach norm scores with time. The temporal trends of the BSHS-B subscales vary slightly. Heat sensitivity and body image improve with time but are continuously scored relatively low. Subscales simple abilities and hand function display the most distinct temporal improvements, followed by subscales affect and treatment regimens. The temporal trends of the subscale/domain work are more divergent between previous studies [193]. The impression of the interview data at 10-17 years post-burn was that though the subscales of BSHS-B generally were applicable, some of the subscales improve and slightly lose their significance over time, as in line with the previously mentioned findings.

Despite severe burns, participants in the interviews reported to lead a relatively normal life 10-17 years after the injury. When interpreting assessments of HRQoL over time, the theory of response shift has been proposed. Response shift refers to changes in the self-evaluation of a concept, such as HRQoL, caused by changes in an individual’s values, internal standards or conceptualization [122; 183]. This might further aid in the understanding of why some individuals with disabilities still perceive their health status as good, although external viewers may see it as a severe impairment. Thus, these improvements in HRQoL over time may not only reflect a temporal decrease of physical and psychological issues, but an intrinsic capability to adapt to the new conditions. Former burn patients often emphasize the role of optimism, positive coping, acceptance, gratitude and goal setting [8; 93; 95; 134] in post-burn adaptation. This positive and constructive way of thinking was also reflected in the interviews after 10-17 years post-burn in which respondents emphasized their own mentality as a crucial aspect for a successful post-burn outcome.

You have to get out there again, you know. No one will change your life for you, you have to do it yourself.

*Former burn patient, 37 years*

I…I. guess I was lucky…or however you’re supposed to look at it. Because I guess I decided early on that it wasn’t going to affect me you know. So…it’s worked…it’s worked out quite well (laughs).

*Former burn patient, 61 years*
Clinical implications and future directions

The present results indicate that more attention needs to be given to pruritus and pain in the post-burn course. Thorough and continuous analysis of the quality and character of pruritus and pain needs to be implemented in routine clinical care, with assessments early in the course to best provide specific preventive measures and identifying individuals at risk for developing these issues.

Pruritus and pain are subjective experiences and thus individual attributes, such as personality or co-existing psychiatric symptoms or disorders, may influence a person’s perception and reaction to pruritus or pain. Accordingly, individual attributes must be considered when assessing these conditions and for optimizing the treatment to the patient’s needs. Furthermore, few patients receive treatment with amitriptyline, gabapentin or similar drugs, even those these drugs have been reported effective in previous literature [83].

Prescription of opioids needs to be continually evaluated, both in a clinical and a research setting and followed-up carefully considering the risk of dependence. Thorough transference of information between burn specialty care and general wards or other care-givers, as well as between care-giver and patient may decrease the risk of prolonged opioid treatment and addiction. Such two-way communication including a care plan for each patient could also aid in making the transferral process less stressful.

Personality traits may affect treatment and rehabilitation adherence [16; 17; 50; 72] as well as influence outcome after trauma as previously demonstrated in patients with burns [55; 56; 89]. Additional prospective studies with larger samples of burn patients are needed to further elucidate the effect of physical trauma on personality traits and trait stability.

When assessing post-burn health, many of the subscales of the BSHS-B are still applicable in the long-term course. Investigating supplementary areas reflecting individual characteristics as well as the sociocultural and attitudinal environment may however be useful for an optimized and person-centered care. Good health care quality with an attentive and competent professional staff and adequate physical and psychological support can promote post-burn adaptation.
Conclusions

The burn patients in this thesis constitute a unique sample that were thoroughly and prospectively assessed from the acute care up to 17 years post-burn which adds an original dimension to this thesis. The findings support the general hypothesis that the interplay between burn-specific and individual-related factors determines the long-term outcome after burn. The main conclusions are as follows:

- Post-burn pruritus and pain are prevalent several years after the burn and impact everyday life and HRQoL.

- Scratching to the point of bleeding was linked to burn depth and personality but does not necessarily indicate more severe pruritus. Results suggest that many patients lack adequate treatment.

- HRQoL assessed early after burn was independently related to post-burn pain and may aid in identification of patients who are at greater risk of developing post-burn sequelae such as pain.

- The within-group increase in trait Stress Susceptibility scores from acute care to 12 months post-burn might reflect a persisting effect of the stress load after a physical trauma on a person’s susceptibility to stress.

- The existing themes of BSHS-B are still generally applicable long after burn; however, investigating factors that reflects the individual’s environment and intrinsic capacity may be of importance for a more holistic picture.

- Despite severe burns, respondents reported that they lived a relatively normal life at 10-17 years post-burn. They emphasized the possibility of returning to work and the support from the healthcare system, but also their intrinsic capacity and mentality, as key for successful adaptation; as to why we must not forget the individual’s own contribution on the road to recovery.
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