ORAL HEALTH STATUS, ORAL HEALTH RELATED QUALITY OF LIFE AND ASSOCIATED FACTORS IN PATIENTS WITH FACIAL BURNS AT THE BURN CARE CENTRE, INSTITUTE OF MEDICAL SCIENCES, PAKISTAN

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ORAL HEALTH STATUS, ORAL HEALTH RELATED QUALITY OF LIFE AND ASSOCIATED FACTORS IN PATIENTS WITH FACIAL BURNS AT THE BURN CARE CENTRE, INSTITUTE OF MEDICAL SCIENCES, PAKISTAN

by

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LIST OF ABBREVIATIONS

ADA	American Dental Association
ANOVA	One-way analysis of variance
ASTI	Acid Survivors Trust International
AMOS	Analysis of moment structures
ADD	ADD score
BBC	British Broadcasting Corporation
BCC	Burn Care Centre
BIAQ	Body Image Avoidance questionnaire
BRS	Brief Resilience Scale
CNN	Cable News Network
CPI	Community Periodontal Index
CFA	Confirmatory factor analysis
CALIS	Covariance analysis and linear structural equations
CFI	Comparative fit index
DIP	Dental Impact Profile
DIDL	Dental impact on daily living
DMFT	Decayed, missing, and filled teeth
EQS	Equations software
HICIC	Health and Social Case Information Centre
HADS	Hospital Anxiety and Depression scale
HIV	Human Immunodeficiency Virus

IFI	Incremental fit index
LISREL	Linear Structural Relationships
MRI	Magnetic Resonance Imaging
MM	Multilevel modelling
MSPSS	Multidimensional Scale of Perceived Social Support
MI	Modification indices
ML	Maximum likelihood
MPhil	Master of Philosophy
OPD	Outpatient department
OHIP	Oral Health Impact Profile
OHI-S	Oral Hygiene Index Simplified
OHS	Oral health status
OHRQoL	Oral health-related quality of life
PCA	Principal Component Analysis
PIMS	Pakistan Institute of Medical Sciences
PKR	Pakistani Rupee
PhD	Doctor of Philosophy
QoL	Quality of life
RSES	Rosenberg Self-Esteem Scale
RMSEA	Root Mean Square Error of Approximation
RNI	Relative non-centrality index
ROMONA	Reticular action model or near approximation
SEM	Structural Equation Modelling
SWAP	Satisfaction with Appearance Scale

SWAP-U	Satisfaction with Appearance Scale Urdu version
SF-36	Short Form Health Survey
SPSS	Statistical Package for the Social Science
SD	Standard deviation
SC	Simple count
SEPATH	Structural Equation Modelling and Path Analysis
TBSA	Total body surface area
TMD	Temporomandibular disorder
TLI	Tucker Lewis index
UK	United Kingdom
USA	United States of America
UV	Ultra violet
WHO	World Health Organization

LIST OF SYMBOLS

%	Percentage
~	Around
<	Less than
>	Greater than
±	Plus, minus
-	Minus
≤	Less than or equals to
≥	Greater than or equal to
α	Level of significance
β	Beta
N	Sample size
=	Equality
( )	Expression inside
&	And
*	Asterisk
$	US Dollar
#	Number sign
?	Question Mark

STATUS KESIHATAN ORAL, KUALITI HIDUP BERKAITAN KESIHATAN ORAL DAN FAKTOR-FAKTOR YANG BERKAITAN DALAM PESAKIT TERBAKAR MUKA DI BURN CARE CENTER, INSTITUTE OF MEDICAL SCIENCES, PAKISTAN

ABSTRAK

Terdapat pemahaman terhad mengenai status kesihatan mulut mangsa kebakaran muka. Oleh itu, kajian ini bertujuan untuk menentukan status kesihatan mulut, kualiti hidup berkaitan kesihatan mulut (KHBKM) dan factor-faktor risiko yang berkaitan di dalam satu sampel pesakit terbakar muka. Kajian keratan rentas ini telah merekrut pesakit terbakar muka secara rawak dan bersistematik di Islamabad, Pakistan. Pemeriksaan ekstra dan intra-oral telah dijalankan untuk mengukur keterukan kecacatan, status karies, periodontium dan higin mulut. Ciri-ciri sosio-demografi, status kesihatan mulut swa-penilaian, tabiat kesihatan mulut, KHBKM dan petunjuk psikososial telah dinilai dengan menggunakan instrumen diswa-isi dalam bahasa Urdu. Ciri-ciri kecederaan terbakar diperolehi dari rekod perubatan. Data telah dianalisa menggunakan analisis descriptif dan regresi linear, dan pemodelan persamaan struktur. Sejumlah 271 pesakit terbakar muka menyertai kajian ini. Majoriti adalah wanita (68.6%) dan berumur <35 tahun (78.9%). Sekitar 48% mengalami luka terbakar tahap ketiga, 46.1% mengalami >20% kawasan permukaan badan terbakar dan 82.7% mengalami kecederaan >2 tahun. Semua peserta mempunyai sekurang-kurangnya satu gigi berkaries dan min DMFT adalah 10.96 (sd = 2.41). Sekitar 60% mengalami periodontitis dan 66%, kebersihan mulut yang buruk. Majoriti peserta berpendapat bahawa status kesihatan gigi (79%) dan periodontal (80%) mereka adalah buruk. Sekitar 78% menggosok gigi sekali sehari dan 89% tidak

kerap mengunjungi doktor gigi. DMFT, CPI dan OHI-S dikaitkan dengan ciri-ciri luka bakar dan tabiat kesihatan mulut ($p < 0.05$). Psikologi, kos rawatan dan jarak ke pusat kesihatan adalah yang paling disebut sebagai halangan kepada penggunaan perkhidmatan penjagaan kesihatan. Analisis regresi berganda menunjukkan bahawa lebih teruk luka bakar, semakin lama masa berlalu sejak terbakar, usia dan masalah psikologi dikaitkan dengan status kesihatan mulut yang lebih buruk dan; lebih kerap memberus gigi dan lawatan pergigian, dengan status yang lebih baik ($p < 0.01$). Sekitar 94% peserta mempunyai sekurang-kurangnya satu item OHIP-14 yang terimpak. Secara psikososial, majoriti peserta mempunyai harga diri yang rendah (74.5%) dan tahap sokongan sosial yang sederhana hingga tinggi (95%) dan menunjukkan tahap kerisauan dan kemurungan yang tinggi. Kecacatan wajah yang lebih teruk, harga diri yang lebih rendah, rasa tidak puas hati terhadap penampilan, sokongan sosial yang lebih buruk dan kerisauan yang lebih tinggi dikaitkan dengan status kesihatan mulut dan KHBKM yang buruk ($p < 0.05$), tetapi bukan untuk ketahanan dan kemurungan. Analisis SEM menunjukkan model laluan yang menghubungkan kecederaan terbakar muka dengan status kesihatan mulut, KHBKM dan kualiti hidup umum. Luka terbakar juga berkait dengan fungsi psikososial, yang seterusnya dengan status KHBKM. Terdapat kesan langsung dan tidak langsung fungsi psikososial terhadap KHBKM; yang terakhir, melalui tabiat kesihatan mulut. Kesimpulannya, kajian ini mencadangkan terdapat bukti munasabah untuk kesan terbakar muka ke atas kesihatan mulut. Bergantung pada keterukan, kecederaan itu mengubah ciri-ciri fizikal wajah dan menjadikan penjagaan kesihatan mulut menjadi lebih sukar. Ia juga mempengaruhi fungsi psikososial mangsa yang kemudiannya mempengaruhi tabiat kesihatan. Secara bersama, mereka meningkatkan risiko kesihatan mulut dan KHBKM yang buruk.

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ABSTRACT

There was a limited understanding of the oral health conditions of facial burn victims. Hence, this study aimed to determine the oral health status, oral health-related quality of life and associated risks factors in a sample facial burn patient. This cross-sectional study had randomly and systematically recruited patients with facial burns in Islamabad, Pakistan. Extra and intra-oral examinations were carried out to measure the severity of disfigurement, caries, periodontal and oral hygiene statuses. The socio-demographic characteristics, self-perceived oral health status, oral health behaviours, oral health-related quality of life and psychosocial indicators were assessed using self-administered instruments in Urdu language. Burn injury characteristics were obtained from the medical records. Data were analysed using descriptive and linear regression analysis, and structural equation modelling. A total of 271 facial burn patients participated in the study. The majority were females (68.6%) and under 35-year-old (78.9%). About 48% had a third-degree burn, 46.1% had >20% total body surface area burned and 82.7% had sustained the injuries for more than 2 years. All of the participants had at least one carious tooth and the mean DMFT was 10.96 (sd = 2.41). About 60% had periodontitis and 66%, poor oral hygiene. The majority of participants perceived that their dental (79%) and periodontal (80%)

health status was poor. About 78% brushed their teeth once daily and 89% did not visit the dentist regularly. The DMFT, CPI and OHI-S were associated with the burn characteristics and oral health behaviours ($p<0.05$). Psychological, cost of treatment and distance to the healthcare centre were the most cited main barriers to healthcare service utilisation. Multiple regression analysis showed that a greater burn severity, the longer time elapsed since the burn, age and psychological issues were associated with poorer oral health status and; more frequent tooth brushing and dental visit, with a better status ($p<0.01$). About 94% of the participants had at least one OHIP-14 item impacted. Psychosocially, the majority of participants had low self-esteem (74.5%) and moderate to a high level of social support (95%) and showed a high level of anxiety and depression. More severe facial disfigurement, lower self-esteem, dissatisfaction with appearance, poorer social support and greater anxiety were associated with poor oral health status and oral health-related quality of life ($p<0.05$), but not for resilience and depression. The SEM analysis showed a pathway model that connected facial burn injury to oral health status, oral health-related quality of life and general quality of life. Burn injury was also related to psychosocial functioning, which then, linked to oral health status and quality of life. There was a direct and indirect effect of psychosocial functioning on oral health-related quality of life; the latter, via the oral health behaviours. In conclusion, this study suggests plausible evidence for the effect of facial burn on oral health. Depending on the severity, the injury changes the physical characteristics of facial features and makes oral healthcare maintenance to be more difficult. It also affects the psychosocial functioning of the victims which then adversely influence health behaviours. Together, they increase the risks of poor oral health outcomes and oral health-related quality of life.

CHAPTER 1

INTRODUCTION

"*At 14 years old, Anupama was a beautiful and confident girl from Bihar, India. She and her sister were attacked with acid while sleeping. Her sister survived with minor injuries but unfortunately for her, the acid burned the lower part of her face which left her lip hanging loose and dreadful burn scars down her neck and chest*."

"At least 13 were killed and more than 20 suffered severe burns, when an oil tanker veered off the road, and crash into the bus full of people ingulfed in a fire in Bahawalpur, Eastern Pakistan"

These are true stories of burn cases reported in the media (BBC News, March 27, 2016) (CNN, June 26, 2017). They are neither isolated nor rare incidents globally at the present day, particularly in Pakistan (Aslam *et al.*, 2012; Charity, 2010).

Burn injuries are one of the most devastating injuries and a major global public health issue (Ahuja and Bhattacharya, 2004; Forjuoh, 2006). With significant advancements in the medical and burn care techniques, over 50% of all burn patients including the severely burnt have survived (Saffle, 1998). However, the decreased mortality comes at the cost of a longer hospital stay, multiple reconstructive procedures and intensive physiotherapy. Despite these treatments,

some morbidity in the form of permanent scarring, contractures, amputation, pain or difficulties in psychological adjustment remains with the patients for the rest of their lives (Saffle, 1998). There are numerous reports with a focus on the surgical and physiotherapeutic treatments of burns to the head and neck region (Güven *et al.*, 2010; Maïano *et al.*, 2009; Pallua and Demir, 2008; Peck, 2011). There are also interests in the rehabilitation, quality of life of burn patients and their reintegration into the society (Saffle, 2007). However, at present, there has been little understanding on the oral health status and oral health-related quality of life of patients with facial burn injury; and how the post-burn psychological and social factors influence oral health.

This thesis is rooted in the understanding that facial burn may influence a patient's oral health and oral health-related quality of life. Little has been reported about the long-term oral health outcomes after facial burn patients leave the hospital, the influence factors and, how it affects other aspects of life. Burn injury is, in itself a transformational event, change and affect the lives of patients long after recovery and influence their ability to adapt to all these changes. As a dentist, it is important to know and understand the oral health status of these patients and factors that can contribute to the betterment or worsening of the condition and quality of life. Dentists may face a major challenge in caring for burn patients because of the lack of knowledge and understanding about the specific problems and causes and, the complexities of oral healthcare and dental treatment caused by the injuries. This study was triggered by these curiosities and to better understand the patients and explore the different factors and behaviours that influence the oral health conditions of burn patients.

The next chapter presents the review of the literature on burn injury that may be related to oral health, the gaps in the understanding of the topic, hypothesis, aims, and objectives of the present study. It is followed by the methodology in Chapter 3 and then followed by the results, discussion, and conclusion of this study.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction.

This chapter presents the background of burn injury and starts with the definition of burn. It then briefly reviews the literature on the epidemiology of burn injuries, causes, types and severity of burn injuries. Next, the impact of burn injuries on the physical and psychosocial aspects of burn patients were reviewed. Following, it presented the findings from the literature on the evidence for the impact of burn injuries on oral health status and oral health-related quality of life in facial burn patients. Later, a conceptual model to describe the factors that could influence oral hygiene of facial burn patients was discussed. Lastly, the aims, hypothesis, and objectives of this study are presented.

2.2. Burn.

A burn is a type of injury that damages the skin and other tissues, caused by heat, cold, electricity, chemicals, friction, or radiation (Herndon, 2012). The World Health Organization (WHO) defines burn as an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals (WHO, 2018). A burn is one of the severe traumas and injuries a human can experience in which all the integrated body systems are impacted (Esselman, 2007). The phrase “one accident seldom comes

alone" perfectly describes a burn injury. It limits and/or disable functions, impacts on physical health, disfigures appearance and leaves pain for the rest of their lives. It also impacts on the social and mental well-being of burn survivors (Forjuoh, 2006). The effects of burn injuries on the individual depend upon the severity, location of burn on the body and burn care treatment. The disability and morbidity associated with burn injuries pose a major short- and long-term public health issue throughout the world, especially in developing countries (Heimbach, 1999).

2.3. Epidemiology of burn injuries.

It is estimated that 300,000 fire-related burn deaths occurred globally, and an additional 11 million people required medical attention every year from burn injuries (WHO, 2018). Burn injury is in the fourth place after road accidents, falls and violence in the least of the most common substantial injures (WHO, 2018). In the UK, burn injuries affects approximately 250,000 people every year and, in the USA, approximately 1,000,000 people visited the emergency department for burn-related emergency care, and 50,000 people are hospitalized annually with 5% mortality rate (McKibben *et al.*, 2009; Sadeghi Bazargani, 2010).

The discrepancy and variation in the incidence of burn injuries between regions and countries are mainly influenced by the economic and social environment. The mortality rate from burn injury was found to be eleven times greater in

developing countries compared to developed countries (WHO, 2008). The majority of burn cases are reported in low and middle-income countries, with African and South-East Asian regions contributing two-thirds of these burn cases (WHO, 2018). In the South Asian region, over 1000,000 people in India and 173000 people in Bangladesh are moderately or severely burnt annually, with 17% of them suffer temporary disability and 18%, a permanent disability (WHO, 2018). Despite the improvement in health status and health care in previous decades, fatalities related to burn injuries increase in the low and middle-income countries, accounting to over 96% death from severe burn worldwide (WHO, 2016). Carbon monoxide inhalation is the major cause of death (75%) and followed by sepsis (Pham *et al.*, 2008). In contrast to other injury patterns, burn injuries occurs more often in females compared to males, mainly women and children (WHO, 2018).

The common cause of burn injuries is occupational and accidental related events. There is no difference in the cause of burns in rural and urban areas. It mostly occurs indoors due to fire, flames, and electric short circuits (Vidal-Trecan *et al.*, 2000). In America, more people died from fires than all the natural disasters combined, and the majority of these deaths happen during recreational activities involving propane or natural gas explosions (ABA, 2015). In contrast, the case of fires in the developing countries is related to the use of oil lamps, candles, firewood or coal for cooking and use of substandard kerosene and gas stoves (Cronin *et al.*, 1996).

The electrical system is responsible for more than 30,000 home fires and these electrical accidents not only inflict burns but also damage nerve and tissue (Peck, 2011). Many flammable liquids such as solvents, thinners, cleaners, adhesives, paints, waxes and polishes are commonly found in houses and offices which can easily ignite and cause burn injuries (Peck, 2011).

Acid violence or acid attack is another cause of burn where corrosive substances like acids are thrown to the body particularly on the face with the intention to disfigure, maim, torture or murder (Waldron *et al.*, 2014). The primary agent used for the attacks are sulfuric and nitric acids; commonly found in factories, tanneries, pesticides, laboratories, textile mills, tanneries, battery and fertilizer factories (Begum, 2004). It is easy to access and the low cost of the substances makes them the preferred chemical used in the attacks (Asaria *et al.*, 2004; Branday *et al.*, 1996).

Acid violence is a worldwide phenomenon and it is not restricted to any particular region. The acid attacks have been reported in France, England and other parts of Europe since the 18th century (Forster, 2004). The statistics obtained from the Health and Social Care Information Centre (HICIC) showed that there were 55 burn cases in the hospital caused by an acid attack in England. The most recent data between 2014-15 showed a rise in the number of hospital admissions to 106 cases (HSCIC, 2015).

It was reported that in the past two decades, cases of acid attacks rose to an alarming situation in South and Southeast Asia; with Bangladesh recording the

highest incidence (Mannan *et al.*, 2007). It constitutes almost 9% of all burns in Bangladesh (Shahidul and Mahmud, 2001) and in another study, 92% of a cohort of 158 admissions into the hospital with chemical burns were acid assault cases (Shahidul and Mahmud, 2001). The neighbouring South Asian countries also show a similar increase (Haque and Ahsan, 2014). According to Acid Survivors Trust International (ASTI), more than a thousand acid attacks occur every year in India (Castella, 2013). A more worrisome fact is that there is a notable rise in the number of cases in Colombia, Iran and Italy in 2013 (Castella, 2013).

2.3.1. Epidemiology of burn to head and neck region.

The incidence of burn injuries to the head and neck region varies considerably in the burn literature and the rates range between 6 to 60% of all types of burn (Kara *et al.*, 2008). The main reasons for the difference are due to the geographical and regional differences in the population, work-related hazards, legislation of preventive measures, registration and definition of facial burns cases.

There are very few reports in the literature that specifically focuses on the epidemiology of burns to the facial area. A study in France reported that the cheeks, the forehead, and the chin were the most affected structures and the main cause was hot water splashes and flames (Capon-Degardin *et al.*, 2001). A study in Nigeria reported that burn injury caused by fuel-related flames had led to infected wounds (Fatusi *et al.*, 2006). A facial burn may also be caused by

flambé drinks and airbag infusion (Jang *et al.*, 2006; Masaki, 2005). In Pakistan, 12.1 % of patients who had head and neck burn injury were admitted to the burn care hospital from 2005 to 2006 due to various causes (Hamayun *et al.*, 2008).

2.4. Types of burns.

Burns can be classified based on the cause and the severity of the injury. Understanding the cause of burns is important as different treatment procedures and techniques are applied in each case. In general, the cause of burn can be thermal, electrical, radiation and chemical (WHO, 2018).

2.4.1. Thermal burns.

A thermal burn occurs when the skin comes in contact with a heated object like steam, boiling water, fire or any hot item. Fire is the most common cause of thermal burns in adult patients and, scalds in children (Rice and Orgill, 2008). For instance, more than 50% of all cases of thermal burns in the USA are caused by fire and more frequently by house fires. Fireworks have become a major cause of thermal burn suffered by adolescent males during celebrations of different events (Peden, 2008). Besides, wildfire is another cause of thermal burn especially of firefighters fighting forest fires.

2.4.2. Electrical burns.

Electrical burns occur when the skin comes into contact with live electrical sources such as electrical sockets and faulty electrical equipment. Lightning strikes are also a cause of an electric burn, but it is not that common. Commonly, an electric burn has less effect on the surface of the body compared to other types of burn (Tredget *et al.*, 1999). Children are more at risk at getting electrical burns and this was usually related to them biting on electrical cords, and the current that passes across a child's mouth may result in a deformity to the oral and facial structures (Toon *et al.*, 2010).

2.4.3. Radiation burns.

A radiation burn can occur as a result of exposure to thermal radiation, radiofrequency energy, ultraviolet, and ionizing radiation. Sunburn is the most common radiation burn caused by UV rays. A more severe burn can occur as a result of exposure to radiation from X-rays and MRI during diagnostic medical imaging and radiotherapy (Prahlow, 2010). In this type of burn, the tissues are damaged and resulted in erythema around the affected area.

2.4.4. Chemical burns.

There are over 25,000 substances which can cause chemical burns (Dooley-Hash, 2011). A chemical burn occurs when the skin comes into contact with

corrosive substances such as strong base, strong acids, industrial chemicals (oxidizers or reducing agents), solvents and alkylates (Hardwicke *et al.*, 2012). These agents may cause extensive tissue damage. Other substances include chemical weapons, such as mustard gas in bombs and urticants containing phosgene oxime (Khateri *et al.*, 2003). Between 2 and 11% of all burn injuries are caused by chemical agents contributing to 30% of burn-related deaths (Hardwicke *et al.*, 2012).

2.5. Severity and size of burn injuries.

The severity and size of burn injuries are described based on the extent and depth of an injury to the skin. The severity of a burn can be classified into four categories based on the skin depth of the burn. A first-degree burn (superficial) only affects the outer layer of skin, causes redness and swelling in the outermost layers of skin (epidermis) without any blisters and long-term damage to the skin. Sunburn is a good example of a first-degree burn.

A second-degree burn (partial thickness) involves the outer layer (epidermis) as well as an inner layer of skin (dermis). In this type of burn, the skin has redness, swelling, blistering, and burn skin may appear shiny and wet. Splash scalds burn is a common example.

A third-degree burn is also called a full-thickness burn, where both epidermis and dermis are destroyed and may extend to underlying fat and muscle. The skin

appears brown, white or yellow, and leathery with damage to the capillary network and nerve endings after being exposed to the source. Chemicals, flames and high-voltage electrical injuries are the common cause of this type of burn. The fourth-degree burn has similar characteristics, appearance, and symptoms to the third-degree burn, but the depth of the burn injury extended beyond the layers of skin into tendons and bones (Hettiaratchy and Papini, 2004).

Another measure of severity is the amount of total body surface area (TBSA) involved. A system, known as the "rule of nines" is used by the medical professionals to report the percentage of TBSA in burn patients. This system provides a comparison of burn skin to the healthy skin percentage in the burn patients. Children have a higher TBSA than adults for the same size of injury due to the difference in the body size ratio (Enoch *et al.*, 2009).

The American Burn Association has published the guidelines for measuring the area of burns based on TBSA and classified them into minor, moderate and major burns. TBSA of 10% and lower in adults and 5% and lower in children are classified as minor burns. TBSA between 10 - 20% per cent in adults and 5 – 10% in children are classified as moderate burns, and lastly TBSA of more than 20% in adults and more than 10% in children placed in major burns (Alharbi *et al.*, 2012; Enoch *et al.*, 2009).

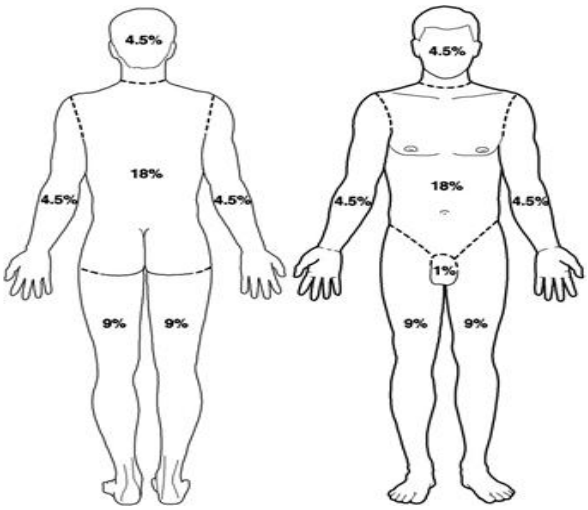

Figure 2.1. Adult rule of nines chart (Kyle and Wallace, 1950).

The rule of nines uses a percentage of nine or multiples of nine to measure how much body surface area is affected by burns. For example, if an adult burned both arms the TBSA will be 9%×2=18%, similarly, if both legs are involved it will be 18% x 2 = 36% and if a patient's entire back (18%) and only half of their left leg (9%) are burned, the body surface area will be 18% + 9% = 27%. It is important to know about the type, severity, and size of a burn injury before planning any burn treatment. This determines the patients' hospital stay and recovery period. It may also play a role in predicting long-term outcomes such as physical and psychological effects following burn injury.

2.6. Epidemiology, types, and characteristics of burn injury in Pakistan.

The incidence of burns in Pakistan is much higher than what is reported for the rest of the world. There were 1,388 cases reported per 100,000 population

compared to the global incidence of 110 annually (Aslam *et al.*, 2012). Accordingly, the burn-related mortality rate is also high. The Global Burden of Disease 2016 reported that the age-standardized mortality rate from burn injury was at 5.8 per 100,000 population (GBD, 2016). A study in Karachi found that that adults between 15-55 years have a higher burn-associated mortality rate at 10.2 per 100,000 population (Marsh *et al.*, 1996). A greater proportion of burn injuries occur in homes and kitchens due to domestic accidents; commonly involving stoves and loose fire that catches clothing. These events occur in residential households and camps of those in the relatively lower socioeconomic background. This community uses firewood for cooking and heating purposes (Hashmi and Kamal, 2013). Domestic accidents also partly explain the reason for the higher ratio of female burns compared to males in Pakistan (Rooh-ul-Muqim *et al.*, 2007). However, some studies had reported a greater proportion among the urban dwellers (77%) compared to the rural areas (24%) (Afzal *et al.*, 2014; Anwer *et al.*, 2016; Siddiqui *et al.*, 2015).

Acid attacks are also common in Pakistan. Several reports, non-governmental organizations, scholars and news agencies have reported that more than 300 girls and women fall victim every year to acid and kerosene attacks (Arif, 2014; Castella, 2013; Ilahi, 2014; Shah, 2008). However, the real numbers of victims are probably much higher as many incidents are never reported due to fear of stigmatization, lack of awareness and perpetrators' threat of further harassing, hurting and harming the victims themselves and their families (Anwary, 2003; Solberg, 2010; Zia, 2013).

2.7. Impact of burns.

A burn injury is often considered a devastating injury that may affect the burn victim and the entire family. The impact of burn is not only on physical health, but it also impacts their psychological and social life.

2.7.1. Physical impact.

Lifelong bodily disfigurement and scarring are the most common and visible effect of a burn injury. Although the survival rate is high in burn patients (Khan, 2012) they, however, have to face long-term challenges. The bodily disfigurement does not only have a deleterious impact on the physical activities and psychological behaviour of burn patients but may also affect their social and economic viability (Waldron *et al.*, 2014). These challenges, in turn, require an in-depth intervention from both physicians and psychologists to encourage and bolster the confidence in them.

The skin is the largest organ of the body and it is the first to get damaged in a burn injury. In case of severe thermal and chemical burns, the skin gets damaged rapidly and deteriorates, and the damage may even penetrate deep into the underlying fat and bones. The normal skin consists of two layers: epidermis and dermis and the subcutaneous tissue, which itself is not part of the skin but it provides the connection between skin and underlying muscle and bone. Histologically, the epidermis is subdivided into four layers: stratum corneum,

stratum lucidum, stratum granulosum, and stratum germinativum (Arda *et al.*, 2014).

During a burn injury, the epidermis, a thin keratinised layer, is the first to be affected but it does not contribute significantly to the thermal response. Underneath is the dermis which is composed mostly of connective tissues, dense collagen and elastin networks, sensory receptors, blood vessels, hair follicles, sebaceous and sweat glands, and an extensive network of nerves (Arda *et al.*, 2014). Primary response to burn in this area is swelling and homogenization and, includes detachment from the epidermis, degeneration of the epidermis, coagulation necrosis, haemorrhages of keratin in the corium, cell swelling/vacuolization of keratinocyte cytoplasm and nuclear elongation in epidermal cells (Meyerholz *et al.*, 2009). Histochemically, there may be reduced activity of NAD-diaphorase, acid phosphatase and alkaline phosphatase in both epidermis and dermis. The most prominent features of the burn zone are the morphological appearance of the collagenous and oedematous dermis with necrotic cells in dermis having a hyalinized collagen matrix (Shpichka *et al.*, 2019). The secondary response is the interference of the normal functioning of the skin which includes disruption of the skin's sensation, ability to prevent water loss through evaporation, and the ability to control body temperature. The damage to the cell membranes leads to losing potassium extracellularly and taking up water and sodium (Tintinalli, 2010).

In second and third-degree burns the sweat glands and blood vessels are damaged and cause itching and abnormal sweating as a result of the inability to produce moisture on the skin surface.

Healing of the skin follows the phases of haemostasis (coagulation), inflammation (mononuclear cell infiltration), proliferation (epithelialization, fibroplasia, angiogenesis, and formation of granulation tissue), and maturation (collagen deposit or scaring tissue formation) (Shpichka *et al.*, 2019). These phases are influenced by the severity, extent of the injury, general health condition, and the type of burn treatment received. Initially, a lighter coloured skin replaces the open burn wounds and after 3 to 4 months the skin becomes stiffer, raised and turns darker in colour. In 1 to 2 years, the burn scar goes through the maturation phase, but sometimes contraction of the skin occurs as the body uses the surrounding skin to cover the open wound in severe burn cases. The scar contraction can result in limited or complete loss of normal body movement of that part of the body especially if it involves the joints.

Apart from the skin, severe thermal and chemical burns to the face can lead to damage, and in the worst case, destruction of the lips, eyelids, nose, and ears (Faga *et al.*, 2000). Injury to the eye and other structures of the head (scalp, neck) are common. If the eyelids are involved, it can lead to dry eyes and blindness. Direct contact of acid into the eyes may result in partial or total loss of sight. Burn to the ear cartilage may partly or totally destroy it and can result in deafness. The nose may be deformed and sometimes shrunken along with obstructed nostrils (Wahidulla, 2011).

Inhalation of acid vapours or the acid itself may cause respiratory problems by exacerbating the restricted airway pathways (the oesophagus and nostrils), which makes eating and swallowing difficult. Besides, burn and acid victims have the risk of having septicemia, renal failure, skin depigmentation, and even death (Piper *et al.*, 2011; Wahidulla, 2011). Burn injuries involving the head and neck may lead to oral health complications especially in the case of acid attacks where the target is the face of a victim (Mannan *et al.*, 2007). Delayed complications of oral health are not well described in the literature.

In cases of large burns area (over 30% of the TBSA), complications such as pneumonia, cellulitis, urinary tract infections are common. In other complications such as respiratory failure, there is a significant inflammatory response that results in increased leakage of fluid from the capillaries and subsequent tissue oedema (Brunicardi, 2010). This causes blood volume loss, with the remaining blood suffering significant loss of plasma, making the blood more concentrated. Renal failure and stomach ulcers may result from poor blood flow to organs such as the kidney and the gastrointestinal tract (Hannon, 2010). Increased levels of catecholamine and cortisol may result in a hypermetabolic state which can last for years. This is associated with increased cardiac output metabolism, tachycardia, and poor immune function (Rojas *et al.*, 2012). The presence of a smoke inhalation injury, other significant injuries such as long bone fractures and serious comorbidities (e.g. heart disease, diabetes, psychiatric illness, and suicidal intent) also influence prognosis. The prognosis is worse in older female victims with a larger burn area (Tintinalli, 2010).

2.7.2. Psychological impact.

In addition to the physical sequelae, burn survivors may face mental health issues and at high risk of developing various psychological disorders. The loss of family members or friends in a burn incident may add grief and impacts them psychologically. Several major psychological problems after burn injuries have been reported, including depression, anxiety and body image dissatisfaction (Lawrence *et al.*, 2006; Tebble *et al.*, 2006; Ullrich *et al.*, 2009).

2.7.2(a) Depression.

Depression is a major long-term complication experienced by the majority of burn patients (Dalal *et al.*, 2010). In a qualitative study in Norway, the burn survivors reported experiencing feelings of isolation, social withdrawal and stigmatization, which predisposes them to depression and leaves them susceptible to other psychological problems (Moi *et al.*, 2008). Lawrence et al. (2006) reported that depression is the most common complication after burn injury. One-third of patients with major burns had clinically significant stress and depression at a later period, greater than at the time of discharge and higher than that of the normal population (Dalal *et al.*, 2010; Mannan *et al.*, 2006).

People under stress and depression tend to engage in poor health practices such as smoking, drinking alcohol and eating poorly and thus increase the of risk of chronic illness (Cohen and Williamson, 1988), which cause them to view their

oral health more negatively than normal individuals (Locker *et al.*, 2000). Similarly, higher perceived stress and depression is also associated with low self-rated oral health, poorer general and oral health, after adjusting for gender, age, income, and missing teeth (Sanders and Spencer, 2005; Watson *et al.*, 2008)

2.7.2(b) Anxiety.

Anxiety is also found to be prevalent among burn patients which are associated with psychosocial concerns, such as the loss of the previous appearance or troubled by the reactions of other people (Partridge and Robinson, 1995). Evidence also showed a direct relationship between the size of a scar caused by burn injury and increased the level of anxiety (Tebble *et al.*, 2004).

A study that used the Hospital Anxiety and Depression Scale (HADS) to investigate the psychological stress and anxiety in 44 acid burn victims in Bangladesh found a higher level of anxiety in acid burn victims than the normal population (Mannan et al., 2006). Depression and anxiety associated with facial trauma are often coupled with worries regarding recovery, and length of the treatment process (Enqvist *et al.*, 1995). The association between oral health behaviours such as dental care treatments, dental visit and anxiety have been reported in many studies (Hakeberg *et al.*, 2001; Schuller *et al.*, 2003; Sohn and Ismail, 2005). Because the burn victims have high depression and anxiety level,

these might have affected their oral health behaviours and thus increase the risk of oral diseases.

2.7.3. Social issues.

Apart from physical and psychological problems, burn patients face immense social challenges, particularly in women. For example, for many victims, they are left with some form of handicap which makes them dependent on either their spouse or family for daily activities such as eating and running errands. Due to impaired vision, facial disfigurement and physical handicap, these victims find difficulty in finding employment which negatively impacts their economic viability and causes hardships to their family members and complicates relationships (De Sousa, 2010).

Facial disfigurement also affects the social image of the patient (McGrouther, 1997). Stigmatisation impact the self-esteem, sense of social isolation and violation of privacy (Bull and Rumsey, 2012).

Patients may express dissatisfaction with their facial appearance after facial trauma and this leads to social withdrawal and isolation. They may feel inferior to others in their social environment and feel stigmatized because of their disfigurement (Newell and Marks, 2000). In Uganda, 25% of acid assault cases in women results in divorce compared to only 3% of wives abandoning their disfigured husband (Uganda, 2011). Moreover, the chances of marriage are slim

in single acid victims and they may have to live by themselves for the remaining of their lives (Piper *et al.*, 2011).

2.8. Impact of burn injuries on oral health.

At present, the search in the literature found no report on the oral health status of burn patients. It is plausible that the oral health conditions of burn patients deteriorate after the incident due to changes in their oral physiology and health-related and psychosocial behaviours that later lead to the development of periodontal disease, dental caries, edentulous, oral ulcers, halitosis, xerostomia, and salivary gland disorders.

It is plausible that burn patients have a greater risk of developing oral diseases, based on previous evidence for the association between the oral disease and risk factors like depression, anxiety, and adverse life events (Lawrence *et al.*, 2006; Peruzzo *et al.*, 2007; Tebble *et al.*, 2006; Vettore *et al.*, 2005). Various studies show the experience of negative life events, financial strain, (Genco *et al.*, 1999) domestic and health problems might contribute to the diminution of general health, facilitate bacterial invasion that resulted from poor oral hygiene and periodontal destruction. In addition, psychological stress, such as depression and anxiety as experienced by the burn victims, is strongly associated with the progression of periodontal disease (Cakmak *et al.*, 2014; López *et al.*, 2012). Psychological and physiological health is also related to sleep disorders, and studies showed significant evidence that links periodontal disease and, apnoea

and insomnia (Al-Jewair *et al.*, 2015; Babson and Feldner, 2010; Tsuchiya *et al.*, 2015). Facial burn patients, because of their condition, are under duress and this puts them at risk of periodontal disease but there is limited evidence found in the literature.

While burn can occur on any part of the body, the neck and face regions are exposed to relatively more diverse types of injuries, such as scalds, electrical shocks, and splashes. In the case of neck and face burns, the traction forces caused by scar contractures may pull and cause insufficient neck extension, incomplete oral occlusion, oro-maxillofacial skeletal deformities and other complications (Makboul and El-Oteify, 2013). The extrinsic contractile forces from the neck may cause facial deformities and can adversely affect the maturation of facial scars (Güven *et al.*, 2010).

In severe cases of facial injuries involving partial or total destruction of the lips, the mouth shrinks and narrows, causing a loss of full range of mastication movement. At times, a shrunken mouth exposes the teeth and makes eating and speaking difficult. Scars that run down from the chin to the neck area may shrink the chin and result in an extremely difficult and limited range of motion of the neck and face. Such scars can even make brushing of teeth and keeping oral hygiene more challenging due to the difficulty in opening the mouth (Mickenautsch *et al.*, 2007). Microstomia, as a result of scarring and/or plastic surgery, may lead to difficulties in performing daily activities such as swallowing, mastication, brushing; poor oral hygiene, facial expression, dental treatment and social interaction (Bahnof, 2000; Johnson *et al.*, 1992; Mordjikian,

2002; Wust, 2006). As a consequence of poor oral hygiene and limited mouth opening for treatment, the risk of oral diseases such as caries, periodontal diseases or other types of oral infections is greater (Jaminet *et al.*, 2010; McKenna *et al.*, 2012; Mickenautsch *et al.*, 2007). However, oral health status and oral health behaviours of burn patients have not been reported.

Only a limited number of reports have described the disastrous influence of burn sequelae on oral-motor structural morphology, mobility, and functions, such as mastication, swallowing, and speech. One study reported the complications of severe burn injury to the face, including facial and labial sensation deficits, poor oral access for oral/dental hygiene, and inadequate oral competence, causing chronic drooling and poor articulation (Clayton *et al.*, 2009). Oral burn contracture, a condition where the skin tightens as a result of scarring, resulting in microstomia that adversely effects on the patient's ability to perform activities of daily living, including swallowing (Bahnof, 2000; Johnson *et al.*, 1992; Wust, 2006).

Electrical burn injuries that affect the lips, cheeks, tongue, and hard and soft palates severely limit the movement of the mandible and tongue, movement due to adhesions to the floor of the mouth, leads to speech problems and difficulty in maintaining oral hygiene (Johnson *et al.*, 1992). Perilabial burn areas, results in retractable scars at the perioral or facial tissues, that deform and tighten the corners of lips, which will likely change their eating habits and make it difficult to speak properly and to keep oral hygiene may result in changes in their oral health behaviours (Ayhan *et al.*, 2006; Mickenautsch *et al.*, 2007).