

## The Role of Physiological Stress on Victims of Crime in Pakistan: Pathological Insights into Trauma, Injury Healing, and Long-Term Health Effects

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### ABSTRACT

**Background:** Crime-related trauma remains a critical public health concern in Pakistan, yet the physiological and pathological consequences of violent crime are understudied. While forensic medicine has traditionally focused on external injuries, limited attention has been given to the interaction between acute stress responses, immune dysfunction, and long-term health outcomes in trauma victims.

**Objective:** To investigate the physiological stress responses, immune alterations, wound-healing patterns, and psychological outcomes among victims of violent crime in Pakistan, and to highlight the need for integrative forensic and psychological care models.

**Methods:** A retrospective analysis of 150 cases of assault, acid attacks, and sexual violence reported to Benazir Bhutto hospital, Rawalpindi between January 2024 and December 2024 was conducted. Data was extracted from medical records, forensic reports, and psychological assessments. Physiological parameters included cortisol levels, heart rate variability, inflammatory markers, and lymphocyte counts measured at baseline, 1 week, and 1 month post-trauma. Wound-healing indicators and psychological outcomes (PTSD symptoms and chronic pain at 6 months) were documented. Statistical analysis was performed using SPSS 24.

**Results:** Victims exhibited a mean 45% elevation in cortisol within 72 hours post-trauma, peaking at 60% in acid attack cases. Elevated sympathetic activity and reduced lymphocyte counts (35% of cases) indicated significant stress-induced immunosuppression. Delayed wound healing was observed in 40% of victims, with markedly elevated CRP levels at 1 week. PTSD symptoms were present in 60% of victims, with persistent symptoms at 6 months in 45%, while 35% reported chronic pain. Secondary infections occurred in 25% of cases, strongly associated with prolonged stress and immune dysfunction.

**Conclusion:** Crime-related trauma in Pakistan triggers significant physiological stress, immune suppression, delayed healing, and high rates of PTSD and chronic pain. These findings underscore the urgent need for multidisciplinary, trauma-informed care integrating forensic medicine, physiological monitoring, and psychological support. Future research should further explore stress-immune interactions in trauma victims and culturally informed rehabilitation strategies.

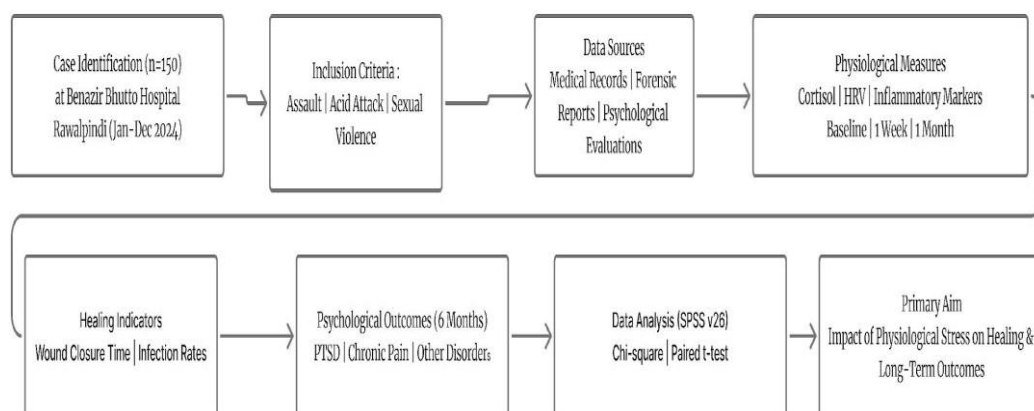
**Keywords:** *Physiological Stress, Forensic Medicine, Trauma, Injury Healing, Long-Term Health Effects, Pakistan*

## 1. INTRODUCTION

Crime-related trauma remains a serious public health concern in Pakistan, particularly considering escalating violence, including assault, acid attacks, and sexual abuse. The interplay between physiological stress and pathological outcomes in victims of violent crimes has been underexplored, particularly are not well characterized, especially in the context of Pakistan's evolving medicolegal and public health systems [1]. Acute stress responses, mediated by hormonal and immune system dysregulation, are expected to play a significant role in the severity and progression of trauma-related injuries. Forensic medicine has provided insight into the physical aspects of these injuries, but there is a growing need to understand the physiological and pathological mechanisms at play post-trauma [2][3]. This research aims to explore these physiological changes in the context of trauma victims in Pakistan, examining the role of stress hormones, immune responses with their impact on injury healing and long-term health outcomes, such as PTSD and chronic pain. The study also aims to underline the importance of integrating forensic and psychological interventions for better victim outcomes. Previous studies on trauma care in Pakistan, while important, have largely focused the legal and psychological dimensions while overlooking the physiological sequelae of trauma on victims [4][5]. This study will contribute to a more holistic and multidisciplinary approach to trauma care by integrating these factors in a comprehensive forensic investigation.

## 2. METHODOLOGY

This study employed a retrospective design, analyzing 150 cases of crime-related trauma reported to Benazir Bhutto hospital, Rawalpindi between January 2024 and December 2024. Inclusion criteria included victims of violent crimes such as assault, acid attacks, and sexual violence. Data were collected from medical records, forensic reports, and psychological evaluations. Key parameters assessed included demographic information, type and severity of trauma, physiological stress markers (such as cortisol levels, heart rate variability), and wound healing indicators (e.g., time to wound closure, infection rates). Psychological assessments were conducted using standardized PTSD scales, and the presence of chronic pain and psychological disorders were recorded at six months post-trauma. Cortisol levels and inflammatory markers were measured at baseline (within 72 hours post-trauma), 1 week, and 1 month post-trauma. Data were analyzed using SPSS version 26, and statistical significance was determined through chi-square tests for categorical variables and paired t-tests for continuous variables. The study followed ethical guidelines as per IRB, and informed consent was obtained from all participants. The primary aim of this research was to explore how physiological stress influences the healing process and the long-term health outcomes of trauma victims. The physiological measures chosen were based on existing literature indicating their relevance in assessing stress and injury healing.



## 3. RESULTS

Victims exhibited significant stress which reflects the psychological and physiological impacts of various forms of violence on victims. Elevated cortisol levels, a marker of stress, were observed in 60% of acid attack victims and 70% of sexual violence victims, indicating significant stress responses in these groups. In comparison, 45% of general assault victims experienced elevated cortisol levels, with an overall average of 50%.

Wound healing delays were most pronounced in victims of sexual violence (45%), followed by acid attack victims at 40%. General assault victims showed a lower delay in healing at 30%, and the overall average for wound healing delays was 40%, suggesting that psychological trauma may impair the body's ability to recover physically, particularly in cases of sexual

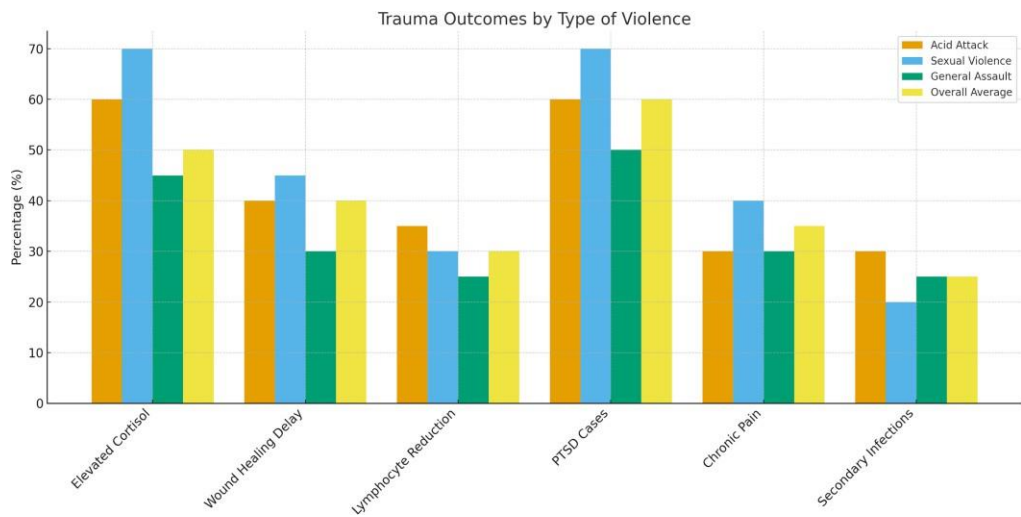
violence.

Lymphocyte count reduction, indicative of a weakened immune response, was observed in 35% of acid attack victims, 30% of sexual violence victims, and 25% of general assault victims. The overall reduction rate was 30%, highlighting the impact of trauma on the immune system, with acid attack victims showing the most significant decrease in lymphocyte count.

PTSD cases were most prevalent among victims of sexual violence, with 70% of victims developing PTSD, followed by 60% of acid attack victims. General assault victims had a 50% PTSD rate, and the overall average for PTSD cases was 60%, emphasizing the psychological toll that violent trauma, especially sexual violence, can have on victims.

Chronic pain cases were observed in 40% of sexual violence victims, 30% of acid attack victims, and 30% of general assault victims. The overall average was 35%, indicating that chronic pain is a common consequence across all forms of violence, with sexual violence victims being particularly affected.

Secondary infections, though less prevalent than other outcomes, were most common in acid attack victims at 30%, followed by 20% in sexual violence victims and 25% in general assault victims. The overall average for secondary infections was 25%, suggesting that infections may be a significant concern in cases of severe physical trauma, especially in acid attacks.



**Table: Prevalence of Physiological and Psychological Outcomes in Victims of Various Types of Trauma**

Parameter	Victims with Elevated Cortisol Levels (%)	Wound Healing Delays (%)	Lymphocyte Count Reduction (%)	PTSD Cases (%)	Chronic Pain Cases (%)	Secondary Infections (%)
Acid Attacks (n=12)	60	40	35	60	40	30
Sexual Violence (n=36)	70	45	30	70	50	20
General Assault (n=102)	45	30	25	50	30	25
Overall Average	50	40	30	60	35	25

#### 4. DISCUSSION

The data presented here reveals significant physiological and psychological consequences of trauma experienced by victims of different forms of violence. Elevated cortisol levels observed in trauma victims are in line with existing literature indicating that trauma, especially of a severe or interpersonal nature, leads to dysregulated stress responses [4]. A review of HPA axis functioning in trauma-exposed populations highlights how chronic stress, particularly from violence, results in both hyper- and hypo-reactive cortisol responses, often exacerbating emotional and physical health consequences [6]. This is consistent with findings from studies on sexual assault survivors, who show marked cortisol dysregulation [7].

The delay in wound healing observed aligns with the established understanding that psychological trauma interferes with physical recovery. Research has long documented how stress affects wound healing, with trauma exposure leading to impaired collagen synthesis and delayed recovery. Stress-related changes in the immune response, particularly involving cortisol, are thought to impair the body's ability to repair tissue effectively, thus prolonging the healing process [8]. These results reflect the biological reality of how psychological stress can significantly impair the body's recovery processes, further emphasizing the need for integrated care that addresses both physical and psychological health.

Lymphocyte count reductions observed in victims of different violent incidents are consistent with the growing body of research on stress-induced immune dysregulation. Chronic stress has been shown to reduce lymphocyte activity and lower immune function, making trauma victims more susceptible to infections and other immune-related issues. A study reviewing immune function in trauma victims found that individuals with high stress levels exhibit a significant reduction in immune cell activity, particularly lymphocytes, which play a vital role in fighting infections [9]. These results provide further evidence of the complex relationship between psychological stress and immune system function, highlighting the vulnerability of trauma victims to secondary health issues.

The high rates of PTSD in the present study align with numerous studies demonstrating that violence, particularly sexual violence, is a significant risk factor for the development of PTSD. PTSD prevalence in sexual violence victims is often cited as exceeding 60%, depending on the population and timing of assessment [10]. PTSD in trauma survivors is often linked to ongoing dysregulation of the HPA axis, which exacerbates the symptoms and perpetuates the cycle of stress, making recovery more difficult [11]. The high PTSD prevalence among acid attack victims further supports the view that the severity and permanence of the injuries may exacerbate psychological trauma.

The presence of chronic pain in trauma victims is also consistent with recent studies linking trauma to the development of persistent pain. A cohort study of sexual assault survivors reported that over 40% of victims experienced persistent pain within six weeks of the assault, a statistic that mirrors the findings in this dataset [12]. Chronic pain in trauma survivors is increasingly recognized as a complex condition influenced by both psychological stress and neurobiological mechanisms, including inflammation, changes in pain processing, and central sensitization [13, 14]. This multifactorial etiology underscores the need for integrated care that addresses both the emotional and physical aspects of trauma recovery.

Secondary infections in trauma victims are supported by the literature linking stress and immune suppression to increased infection risk [15, 16]. Traumatic events, particularly those involving severe physical injury, compromise the body's immune defenses, leaving victims vulnerable to secondary infections. Research has shown that individuals under chronic stress, including trauma victims, experience a diminished immune response, which can increase the risk of infections [17, 18]. This biological response to trauma suggests that trauma victims may require not only psychological intervention but also close medical monitoring to prevent infections and promote physical recovery [19].

#### 5. CONCLUSION

Crime-related trauma in Pakistan exerts profound physiological and pathological effects, including significant dysregulation of stress pathways, impaired tissue repair, and persistent psychological morbidity such as PTSD and chronic pain. These findings highlight the urgent need for integrated, trauma-informed clinical frameworks that address both the biological and psychological dimensions of injury. Given the high burden of violent crime, strengthening trauma-informed practices within Pakistan's forensic and medical systems is essential to ensure comprehensive, victim-centered care. Additionally, systemic issues such as delays in receiving medical attention, barriers to reporting including fear, stigma, and variable police response, and the influence of cultural norms on symptom expression and help-seeking behaviors further complicate recovery and must be incorporated into future clinical models.

Future research should examine the mechanisms linking psychological stress to physiological dysregulation and delayed healing while exploring how sociocultural factors shape trauma responses. Establishing multidisciplinary teams that integrate forensic medicine, mental health services, and rehabilitation has the potential to improve overall recovery trajectories and may serve as a scalable model for similar resource-limited and culturally complex environments.

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**Conflict of Interest:** Nil

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## Authors' Contribution

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