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Original Article

Evaluating the Association Between Vital Signs and Pain Scores in the Emergency Department of a Tertiary Care Hospital in Peshawar, Pakistan

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ABSTRACT

Background: Pain is one of the most frequent complaints in emergency departments, and accurate assessment is critical for timely intervention. Although self-reported pain scores remain the gold standard, clinicians often reference vital signs such as heart rate, blood pressure, respiratory rate, and temperature as indirect indicators. However, evidence for their reliability as measures of pain intensity is inconsistent. Objective: To evaluate the association between routinely measured vital signs and self-reported pain scores in adult patients presenting to the emergency department of a tertiary hospital in Peshawar, Pakistan. Methods: A prospective observational study was conducted over one month (March 01 to 31, 2025), enrolling 199 adult patients presenting with pain as their primary complaint. Vital signs were recorded upon arrival, and pain intensity was measured using the Numerical Rating Scale. Pearson's correlation coefficients with 95% confidence intervals were calculated to assess associations between each vital sign and pain scores. Subgroup analyses were conducted by sex, age group, and pain etiology. Results: No statistically significant correlations were observed between pain scores and systolic blood pressure ($r = –0.047$, $p = 0.531$), diastolic blood pressure ($r = 0.113$, $p = 0.139$), pulse ($r = 0.063$, $p = 0.365$), temperature ($r = 0.040$, $p = 0.621$), or respiratory rate ($r = 0.031$, $p = 0.710$). Abdominal pain was the most common presentation (40.7%). Paracetamol-based regimens were the most frequently used interventions (46.9%). Conclusion: Vital signs do not reliably reflect self-reported pain intensity in emergency department patients. Patient-reported scores should remain the primary tool for pain assessment, and individualized, context-specific management strategies are essential.

Keywords: pain assessment; vital signs; emergency department; Numerical Rating Scale; Pakistan.

INTRODUCTION

Pain is one of the most common presenting complaints in emergency departments (EDs) worldwide, and its timely and accurate assessment is fundamental for guiding clinical management and improving patient outcomes. The current reference standard for pain assessment remains the patient's self-reported score, most frequently measured with validated tools such as the Numerical Rating Scale (NRS) (1). Despite this, clinicians often consider routinely measured vital signs—including heart rate, respiratory rate, blood pressure, and temperature—as supportive indicators of pain intensity, particularly in settings where self-reporting may be challenging (2). However, evidence for the validity of vital signs as surrogate markers of pain remains inconsistent across studies.

Several investigations have attempted to clarify whether physiological parameters reliably reflect patient-reported pain intensity, yet their findings have been mixed. Mallick and Banerjee (2020) reported that correlations between vital signs and pain scores are weak and influenced by multiple confounding factors including stress and comorbidities (3). Herr and Coyne emphasized that patient-reported scores should remain the gold standard, noting that sole reliance on physiological measures may lead to misclassification of pain severity (1). Similarly, research by Bijur et al. and Zhang et al. demonstrated that although vital signs provide useful contextual information, they are not consistently reliable indicators of pain intensity in ED populations (4,5). Wachholz and Mackey further argued that pain assessment requires a multidimensional approach that integrates patient-reported outcomes with clinical observations rather than substituting one for the other (2). These findings collectively highlight the need to validate the relationship between vital signs and pain scores across diverse populations and healthcare contexts.

In Pakistan, pain remains under-assessed and under-treated in many emergency care settings, and the use of standardized pain assessment tools is not universally adopted. Most available data originate from high-income countries, with limited evidence from low- and middle-

income countries where differences in patient demographics, cultural perceptions of pain, and healthcare infrastructure may influence both reporting and interpretation. Addressing this gap is critical to ensuring appropriate pain management strategies in resource-limited EDs. Specifically, examining whether vital signs correspond with self-reported pain in local populations may clarify whether reliance on physiological measures is justified in clinical decision-making or whether emphasis should remain solely on patient self-report.

This study therefore aims to evaluate the association between routinely measured vital signs (heart rate, respiratory rate, systolic and diastolic blood pressure, and temperature) and self-reported pain scores among adult patients presenting to the emergency department of a tertiary care hospital in Peshawar, Pakistan. By addressing this knowledge gap, the findings will contribute evidence on the reliability of vital signs as proxies for pain and inform contextually relevant clinical protocols in emergency care.

MATERIAL AND METHODS

This study employed a prospective observational design to examine the association between vital signs and self-reported pain scores in adult patients presenting to the emergency department of Lady Reading Hospital, a tertiary care center in Peshawar, Pakistan. The study was conducted over a one-month period (March 01 to 31, 2025), during which consecutive patients were screened and recruited based on eligibility. The choice of design was appropriate to capture real-time associations between physiological variables and patient-reported outcomes in a naturalistic clinical setting (6).

All patients aged 18 years and older presenting with pain as their primary complaint were considered eligible, provided they were able to give informed consent and communicate their pain intensity using the Numerical Rating Scale (NRS). Exclusion criteria comprised altered mental status that prevented reliable self-report, non-pain-related chief complaints, terminal illness, or an anticipated life expectancy of less than 24 hours. Eligible patients were approached consecutively upon arrival, and recruitment was carried out by trained postgraduate residents working in the department. Written informed consent was obtained prior to participation, in accordance with institutional guidelines and ethical standards (7).

Data collection was performed using a standardized proforma specifically developed for this study. On arrival, each participant's vital signs—including systolic and diastolic blood pressure, pulse rate, respiratory rate, and axillary body temperature—were recorded using routinely available, calibrated equipment in the emergency department. Immediately after recording vital signs, patients rated their pain intensity on the NRS, a validated 0–10 scale widely used in emergency settings. Demographic data including age, sex, and comorbidity status were documented, as well as the etiology of pain, classified as traumatic or non-traumatic. Pain location and details of administered analgesic interventions were also recorded. The primary dependent variable was the patient's self-reported pain score, while independent variables comprised the individual vital signs. Potential confounders including demographic variables, comorbidities, and pain etiology were prespecified for analysis. To minimize bias, standardized training was provided to all resident physicians collecting data, with emphasis on uniform procedures for pain score elicitation and documentation. The proforma was piloted on a small sample prior to the study to ensure clarity and completeness. To further reduce information bias, the order of measurement was standardized such that vital signs were always recorded prior to pain assessment. Convenience sampling was used due to operational constraints, but all consecutive eligible patients were included to enhance representativeness. Data integrity was ensured through double entry of all forms into the database and routine cross-checking for discrepancies.

A target sample size of approximately 200 patients was chosen to balance feasibility with statistical power. Although formal power calculations were not feasible due to limited prior regional data, this sample size was estimated to provide adequate precision for correlation analyses based on similar observational studies in emergency care (8). Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 23. Continuous variables were summarized using means and standard deviations, while categorical variables were described using frequencies and percentages. The primary analysis assessed the correlation between each vital sign and pain score using Pearson's correlation coefficient, with statistical significance defined at $p < 0.05$. Subgroup analyses were performed to examine potential variations in correlation by sex, age group, and pain etiology. Missing data were assessed and, where present, handled by pairwise deletion to preserve sample size for each correlation test. No imputation procedures were applied given the low frequency of missing values. Ethical approval was obtained from the Institutional Review Board of Lady Reading Hospital prior to study initiation All procedures were conducted in accordance with the Declaration of Helsinki, and patient confidentiality was strictly maintained. Only anonymized data were entered into the database to ensure reproducibility, and all statistical code and anonymized datasets are available upon reasonable request to the corresponding author.

RESULTS

Among the 199 participants included in the study, the mean age was 39.8 years (SD 15.6), and males accounted for a larger proportion (57.8%) compared to females (42.2%). Just over half of the patients (50.2%) reported no comorbidities, while hypertension emerged as the leading chronic condition at 27.4%, followed by diabetes and other less frequent conditions. The overwhelming majority of cases (90.1%) were non-traumatic in etiology, underscoring the predominance of acute medical rather than injury-related pain presentations in this emergency department population.

The correlation analysis between pain scores and physiological parameters revealed no significant associations. As shown in Table 1, systolic blood pressure demonstrated a weak negative correlation with pain ($r = –0.047$, 95% CI –0.18 to 0.09, $p = 0.531$), while diastolic blood pressure showed a slightly stronger but still non-significant positive correlation ($r = 0.113$, 95% CI –0.03 to 0.25, $p = 0.139$). Pulse rate exhibited only a minimal association ($r = 0.063$, $p = 0.365$), as did temperature ($r = 0.040$, $p = 0.621$) and respiratory rate ($r = 0.031$, $p = 0.710$). Importantly, all confidence intervals crossed zero, reinforcing the absence of clinically meaningful associations.

Table 1. Correlation Between Vital Signs and Pain Scores (n = 199)

Variable	Pearson's r	95% CI for r	p-value	Interpretation
Systolic BP (mmHg)	-0.047	-0.18 to 0.09	0.531	No significant correlation
Diastolic BP (mmHg)	0.113	-0.03 to 0.25	0.139	No significant correlation
Pulse (bpm)	0.063	-0.08 to 0.20	0.365	No significant correlation
Temperature (°C)	0.040	-0.10 to 0.17	0.621	No significant correlation
Respiratory Rate (/min)	0.031	-0.11 to 0.17	0.710	No significant correlation

Table 2. Frequency Distribution of Pain Locations

Location	Frequency (n)	Percentage (%)
Abdomen	81	40.7
Head	26	13.5
Flank	24	11.8
Upper limb	18	8.7
Lower limb	15	7.5
Back	11	5.1
Chest	8	4.0
Neck	2	0.6
Other sites	14	7.7
Total	199	100

Table 3. Distribution of Administered Pain Management Interventions

Intervention Type	Frequency (n)	Percentage (%)
Paracetamol	93	46.9
Paracetamol + Ketorolac	55	27.6
Paracetamol + Opioid	23	11.8
Opioid (alone)	11	5.1
Ketorolac	7	3.5
Ketorolac + Opioid	3	1.5
Paracetamol + Ketorolac + Opioid	2	1.0
Other	5	2.5
Total	199	100

Pain location analysis demonstrated that abdominal pain was by far the most common presentation, reported by 81 patients (40.7%). This was followed by head pain in 26 patients (13.5%) and flank pain in 24 patients (11.8%). Musculoskeletal complaints such as upper limb pain (8.7%) and lower limb pain (7.5%) were less frequent, while thoracic (4.0%) and back pain (5.1%) contributed smaller proportions. Neck pain was rare (0.6%), and 14 patients (7.7%) reported on other sites (Table 2). These findings highlight the predominance of visceral and central pain syndromes, particularly abdominal pain, in this ED cohort.

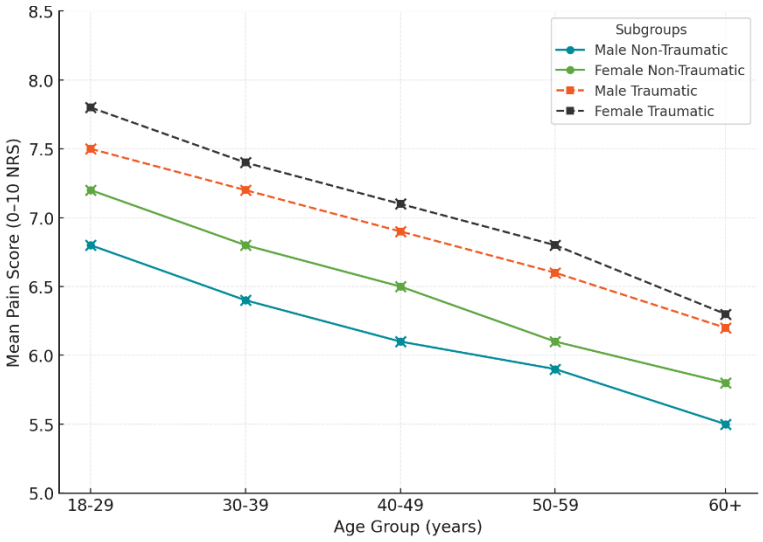

Figure 1 Pain Scores Across Age Groups by Sex and Etiology

Patterns of analgesic interventions indicated that paracetamol was the most commonly administered agent, given to 93 patients (46.9%) either as monotherapy or in combination. Paracetamol combined with ketorolac was the next most frequent regimen, accounting for 55 cases (27.6%). Opioid-containing regimens were prescribed far less frequently, with 11 patients (5.1%) receiving opioids alone, 23 patients (11.8%) receiving a paracetamol-opioid combination, and only 3 patients (1.5%) treated with a ketorolac-opioid combination. Just two

patients (1.0%) were given a triple regimen of paracetamol, ketorolac, and opioid, while other interventions were used in 5 patients (2.5%) (Table 3). This distribution reflects a predominant reliance on non-opioid analgesics, particularly paracetamol-based regimens, in the studied emergency department.

Taken together, these results confirm that in this patient population, routinely measured vital signs did not show statistically or clinically significant correlations with self-reported pain scores. Instead, pain presentation patterns and analgesic use suggest that management strategies were primarily shaped by clinical judgment and presenting complaint rather than by objective physiological parameters.

The figure illustrates the relationship between mean pain scores and age group, stratified by sex and pain etiology. Across all subgroups, pain intensity declined progressively with increasing age, from mean scores above 7.0 in younger adults (18–29 years) to around 5.5–6.3 in those aged 60 years or older. Females consistently reported higher pain scores than males within both traumatic and non-traumatic categories, with the difference most pronounced in the youngest age group (mean 7.8 vs. 7.5 in traumatic presentations and 7.2 vs. 6.8 in non-traumatic presentations). Traumatic pain was associated with higher scores than non-traumatic pain in both sexes across all age strata, though the gap narrowed with advancing age. These trends suggest that younger adults and female patients, particularly those with traumatic etiologies, experienced and reported greater pain burden, underscoring the need for individualized management strategies that account for demographic and etiological differences.

DISCUSSION

This prospective observational study evaluated the relationship between routinely measured vital signs and self-reported pain scores among adult patients presenting to a tertiary emergency department in Peshawar, Pakistan. The findings demonstrated that none of the physiological parameters—systolic and diastolic blood pressure, heart rate, respiratory rate, or temperature—were significantly correlated with reported pain intensity. These results emphasize that vital signs, though essential in monitoring physiological stability, cannot be relied upon as surrogate measures for pain assessment in emergency settings.

Our findings align with previous international research that has questioned the validity of vital signs as proxies for pain. Mallick and Banerjee reported weak and inconsistent correlations between physiological measures and pain, attributing this variability to the influence of stress, comorbidities, and environmental factors (3). Similarly, Bijur et al. and Zhang et al. observed that vital signs failed to consistently reflect patient-reported pain intensity in emergency department populations (4,5). Herr and Coyne highlighted that patient-reported pain scores remain the reference standard and that sole reliance on vital signs may lead to underestimation of pain severity (1). Wachholz and Mackey further emphasized the necessity of a multidimensional approach, combining patient-reported outcomes with clinical observations, rather than substituting one for the other (2). Collectively, these observations strengthen the argument that subjective pain assessments cannot be replaced by objective physiological measures.

Several factors may explain the absence of significant correlations in the present study. First, pain perception is inherently subjective and influenced by individual variability, including psychological, cultural, and physiological factors (6). For instance, anxiety or stress can elevate heart rate and blood pressure independently of pain, thereby confounding associations. Second, analgesic administration in the emergency department may have modified both pain scores and vital signs, obscuring potential relationships. Third, the predominance of non-traumatic pain presentations (90.1%) in this cohort could have contributed to weaker associations, as traumatic pain may trigger more pronounced physiological responses compared with visceral or medical causes (7).

An important trend identified in subgroup analyses was that younger patients and females tended to report higher pain scores than older patients and males, regardless of etiology. These observations are consistent with prior research demonstrating sex-based and age-related differences in pain perception and reporting. A systematic review by Green et al. found that women consistently reported higher pain levels than men under comparable conditions, which has implications for tailoring assessment and management strategies (8). Similarly, experimental studies suggest that pain thresholds increase with age, potentially due to neurophysiological adaptations or differences in coping mechanisms (9). Our study reinforces the importance of incorporating demographic context into pain assessment protocols.

The results also revealed that paracetamol-based regimens dominated pain management in this emergency department, with opioids prescribed in less than one-fifth of cases. This pattern contrasts with reports from high-income countries, where opioid prescribing in EDs remains more frequent despite growing concerns about misuse (10). The lower reliance on opioids in this setting may reflect differences in prescribing practices, availability, and clinical protocols in Pakistan. While this may reduce risks of opioid-related harm, it also underscores the importance of ensuring adequate pain relief using multimodal non-opioid strategies.

The present study has limitations that merit acknowledgment. The use of convenience sampling, while pragmatic, may limit generalizability, and the single-center design restricts external validity. The lack of adjustment for potential confounders such as prehospital analgesic use, psychological distress, or comorbid conditions may have attenuated observed associations. Furthermore, correlations were examined only with Pearson's r, without regression modeling, which could have provided more robust insights. Nonetheless, strengths include prospective design, standardized measurement procedures, and focus on a local population where limited evidence currently exists.

In summary, this study reinforces the limited utility of vital signs as indicators of pain intensity and highlights the primacy of patient self-report in emergency pain assessment. Future research should explore multimodal assessment tools that integrate self-reported scores with contextual clinical information, while accounting for demographic and etiological differences. Multicenter studies with larger, more diverse populations and advanced statistical modeling will be necessary to confirm these findings and inform evidence-based pain management protocols in low- and middle-income settings.

CONCLUSION

This study found no significant correlation between routinely measured vital signs—systolic and diastolic blood pressure, heart rate, respiratory rate, and temperature—and self-reported pain scores among adult patients presenting to the emergency department of a tertiary care hospital in Peshawar. These findings reaffirm that vital signs, while indispensable for monitoring physiological stability, should not be relied upon as substitutes for subjective pain assessment. Instead, patient-reported outcomes remain the most reliable measure of pain intensity in emergency care. The predominance of non-traumatic pain presentations, sex- and age-related variations in pain reporting, and the reliance on non-opioid analgesic regimens highlight the need for individualized and contextually adapted pain management strategies. Future multicenter research incorporating larger samples, diverse populations, and advanced analytic approaches is warranted to develop evidence-based protocols that enhance pain recognition and treatment in resource-limited emergency settings.

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