

ORIGINAL ARTICLE

Evaluating the effectiveness of single-dose intravenous paracetamol for pain management across different diagnoses in the emergency department

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ABSTRACT

Objective: This study aimed to describe the real-world effect of a single 1 g intravenous (IV) paracetamol dose across a broad mix of emergency department (ED) presentations in the current study setting.

Methods: A prospective observational pre–post study of 200 adults was conducted at King Abdulaziz University Hospital, Jeddah. Pain was measured before administration and again 30 minutes to 4 hours later using the Numeric Rating Scale and Wong-Baker FACES scale.

Results: The study population comprised 200 emergency department patients with a male predominance (60.5% vs. 39.5% female). The cohort had a mean age of 37.3 years (SD 14.1). Notably, 47.0% of patients had no documented comorbidities. Both pain assessment scales demonstrated statistically significant reductions in pain scores following single-dose intravenous paracetamol administration ($p < 0.001$). The statistical significance ($Z = -12.51$, $p < 0.001$) confirmed the consistent analgesic effect across both measurement scales. Patients with chest pain had smaller reductions, while those with flank pain showed greater reductions. The multiple linear regression analysis reinforced that paracetamol's analgesic efficacy appeared independent of basic demographic characteristics.

Conclusion: The single-dose IV paracetamol produced meaningful pain relief across common presentations. The degree of improvement differed by complaint, highlighting the importance of multimodal, diagnosis-specific strategies.

Keywords: Intravenous paracetamol, pain management, emergency department, acute pain, analgesia, observational study.

Introduction

Delivering fast and reliable analgesia is a cornerstone of emergency care. In clinical practice, intravenous (IV) paracetamol is often the first non-opioid choice; it is quick to administer, well tolerated, and helps avoid unnecessary opioid exposure. Emergency department (ED) research offers a mixed but valuable picture. One trial found IV paracetamol comparable to IV morphine in traumatic limb pain [1], while another showed that IV and oral paracetamol provided similar analgesic effects in adults with acute pain [2]. However, a large multicenter trial reported no reduction in morphine use when adding IV acetaminophen across general ED presentations [3].

Condition-specific studies provided more encouraging evidence. A meta-analysis of renal colic demonstrated that IV paracetamol offered meaningful analgesia compared with morphine [4]. In perioperative settings, systematic

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44 reviews and meta-analyses consistently confirmed their
45 efficacy and opioid-sparing benefits [5,6].

46 Despite the frequent use of paracetamol in Saudi EDs,
47 little local or international data describe its effectiveness
48 across different clinical complaints. Hence, this study
49 was designed to capture the real-world effect in the
50 current study department. This study aimed to describe
51 the real-world effect of a single 1 g intravenous (IV)
52 paracetamol dose across a broad mix of ED presentations
53 in the current study setting.

54 Subjects and Methods

55 A prospective observational pre-post study was conducted
56 over 6 months in the Emergency Department at King
57 Abdulaziz University Hospital, Jeddah, Saudi Arabia.
58 Pain scores were recorded before administration of
59 intravenous paracetamol and reassessed after treatment
60 to evaluate changes in pain intensity.

61 Adults (≥ 18 years) who presented with acute pain and
62 received a single 1 g IV paracetamol dose were eligible.
63 Exclusion criteria were contraindications to paracetamol,
64 recent use of other analgesics, or inability to complete
65 pain scoring. During the observation period, patients
66 were monitored until pain was reassessed. Administration
67 of additional analgesics before reassessment was avoided
68 whenever possible as part of routine clinical practice.

69 A consecutive sampling technique was employed.
70 All eligible adult patients presenting to the emergency
71 department during the study period who met the inclusion
72 criteria were enrolled until the target sample size of 200
73 participants was achieved. As this was an exploratory
74 observational study aimed at evaluating the real-world
75 effectiveness of intravenous paracetamol in routine
76 clinical practice, a formal sample size calculation was
77 not performed.

78 Two validated tools, the Numeric Rating Scale (NRS) and
79 the Wong-Baker FACES Pain Rating Scale, were used.
80 The NRS is commonly used for adult pain assessment,
81 while the Wong-Baker scale was included to provide
82 an additional validated measure and to accommodate
83 patients who might find visual scales easier to interpret
84 [7,8]. Pain was recorded immediately before paracetamol
85 administration and then reassessed between 30 minutes
86 and 4 hours afterward. The timing of reassessment
87 depended on clinical workflow and patient management
88 in the emergency department. In most cases, reassessment
89 occurred around the expected peak analgesic effect
90 of intravenous paracetamol (approximately 1 hour).
91 However, due to variations in patient flow, clinical
92 priorities, and operational constraints, reassessment
93 could occur later within the 30-minute to 4-hour window
94 [2,5,9].

95 Along with pain scores, demographics, comorbidities,
96 chief complaint, and final diagnosis of the participants
97 were documented. Data were collected prospectively at
98 the bedside.

99 All statistical analyses were conducted using IBM
100 Statistical Package for Social Sciences (SPSS) software
101 version 30.0 (IBM Corporation, Armonk, NY, USA).
102 Normality of continuous variables was assessed using

the Shapiro-Wilk test and visual inspection of histograms
and Q-Q plots. Given the non-normal distribution of
pain scores, non-parametric tests were employed for the
primary analysis. Descriptive statistics were presented as
frequencies and percentages for categorical variables, and
as mean $\pm$ standard deviation and median [interquartile
range] for continuous variables.

The primary efficacy analysis utilized the Wilcoxon
signed-rank test to compare pre- and post-treatment
pain scores on both the NRS and Wong-Baker FACES
Pain Scale. Multiple linear regression analyses were
performed to identify predictors of pain reduction
(calculated as before treatment minus after treatment
scores), with higher values indicating greater analgesic
effect.

The regression models included demographic variables
(age, gender), comorbidities, and chief complaints as
potential predictors. Because this study did not include a
comparator or control group, the findings were interpreted
as observational associations rather than definitive causal
effects of intravenous paracetamol. Abdominal pain was
designated as the reference category for chief complaint
comparisons. Statistical significance was set at $p < 0.05$
for all analyses, and 95% confidence intervals were
reported for regression coefficients.

Results

The study population comprised 200 emergency
department patients with a male predominance (60.5%
vs. 39.5% female). The cohort had a mean age of 37.3
years (SD 14.1), with a median age of 34 years, indicating
a relatively young adult population. Diabetes mellitus
was the most prevalent comorbidity, affecting nearly
one-third of patients (31.5%), followed by hypertension
(30.0%) and dyslipidemia (19.0%). Notably, 47.0% of
patients had no documented comorbidities, suggesting
that a substantial proportion of the emergency department
population consisted of previously healthy individuals
(Table 1 and Figure 1).

Both pain assessment scales demonstrated statistically
significant reductions in pain scores following single-
dose intravenous paracetamol administration ($p < 0.001$).
The numeric pain assessment scale showed a substantial
decrease from a baseline mean of 6.3 (SD 1.5) to 3.6
(SD 1.6) after administration, representing a clinically
meaningful reduction of 2.7 points. The median scores
decreased from 6 to 3, with the interquartile range shifting
from [5-7.5] to [2-5], indicating consistent pain reduction
across the patient cohort (Table 2 and Figure 2).

The Wilcoxon signed-rank test results provide statistical
evidence for the efficacy of single-dose intravenous
paracetamol in pain management. For the numeric
pain assessment, 199 patients (99.5%) demonstrated
decreased pain scores, with only one patient (0.5%)
showing increased scores and no patients experiencing
unchanged pain levels. The test statistic ($Z = -12.42$, p
 < 0.001) indicates an extremely significant reduction in
pain scores. The Wong-Baker FACES pain scale yielded
similarly compelling results, with 197 patients (98.5%)
experiencing pain reduction and only one patient (0.5%)

162 **Table 1.** Descriptive characteristics of the study population.

Variable	Frequency (Percentage) n (%)
Gender	
Female	79 (39.5)
Male	121 (60.5)
Comorbidities	
Hypertension	60 (30.0)
Dyslipidemia	38 (19.0)
Cerebrovascular accident	7 (3.5)
Diabetes mellitus	63 (31.5)
Cancer/Malignancies	2 (1.0)
Sickle cell anemia	12 (6.0)
No comorbidities	94 (47.0)
Chief complaint	
Abdominal pain	70 (35.0)
Back pain	20 (10.0)
Chest pain	30 (15.0)
Flank pain	6 (3.0)
Headache	25 (12.5)
Joint pain	13 (6.5)
Leg pain	10 (5.0)
Others	26 (13.0)
Final diagnosis	
Acute cholecystitis	4 (2.0)
Ankle sprain	9 (4.5)
Appendicitis	11 (5.5)
Biliary colic	12 (6.0)
Cystitis	3 (1.5)
Diverticulitis	5 (2.5)
Diabetic ketoacidosis	5 (2.5)
Deep vein thrombosis	6 (3.0)
Gastroenteritis	15 (7.5)
Migraine	4 (2.0)
Muscular pain	24 (12.0)
Myocardial infarction	5 (2.5)
Osteoarthritis	2 (1.0)
Ovarian torsion	3 (1.5)
Pancreatitis	2 (1.0)
Pericarditis	4 (2.0)
Pneumonia	7 (3.5)
Renal colic	10 (5.0)
Tension headache	16 (8.0)
Vaso-occlusive crisis	11 (5.5)
Others	42 (21.0)
Age (years) Mean (SD), Median [IQR]	37.3 (14.1), 34 [26-46]

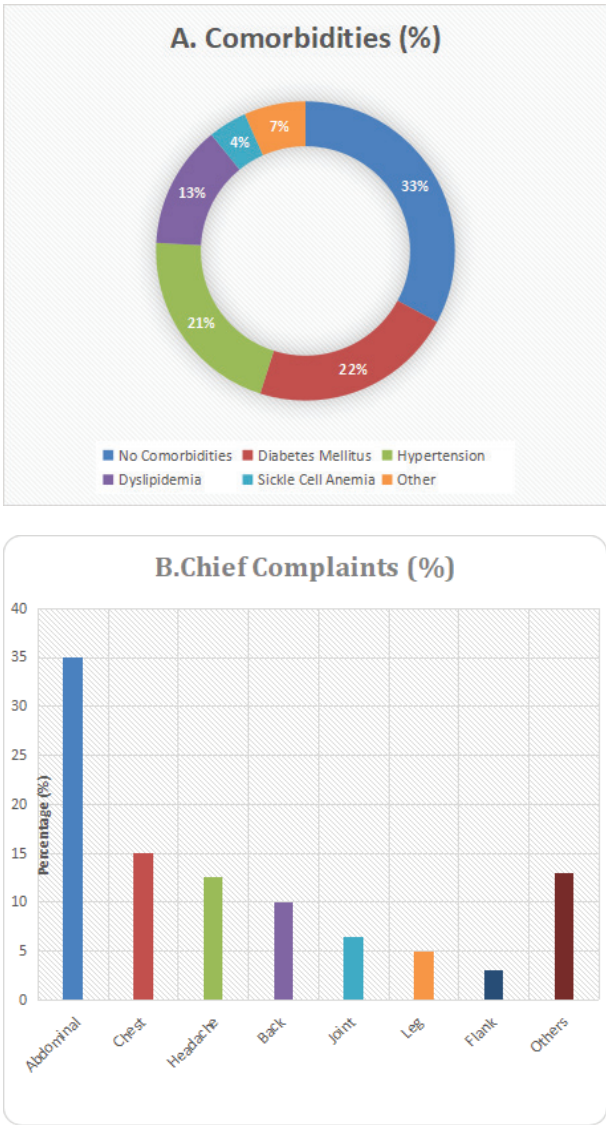


Figure 1. Distribution of study population characteristics and clinical presentations. (A) Distribution of major comorbidities in the study population (n = 200). (B) Distribution of chief complaints leading to emergency department presentation.

Table 2. Pre- and post-administration pain assessment scores using Numeric and Wong-Baker FACES pain scales.

Variable	Mean (SD)	Range	Median [IQR]	p-value
Numeric pain assessment (before)	6.3 (1.5)	3–10	6 [5–7.5]	<0.001
Numeric pain assessment (after)	3.6 (1.6)	1–8	3 [2–5]	
Wong-Baker FACES pain assessment (before)	6.1 (1.5)	4–10	6 [6–8]	<0.001
Wong-Baker FACES pain assessment (after)	3.1 (1.5)	2–8	2 [2–4]	

169 reporting increased pain. Two patients showed no change
170 in pain scores (ties). The statistical significance ($Z =$
171 $-12.51, p < 0.001$) confirms the consistent analgesic effect
172 across both measurement scales. The high proportion
173 of patients reporting reduced pain scores suggests a
174 consistent analgesic effect across this heterogeneous
175 emergency department population (Table 3 and Figure 4).

The multiple linear regression analysis examined
predictors of pain reduction, with higher values indicating
greater analgesic effectiveness. Among demographic
variables, neither age ($\beta = -0.124, p = 0.316$) nor gender (β
 $= 0.123, p = 0.092$) demonstrated statistically significant
associations with pain reduction, although there was a

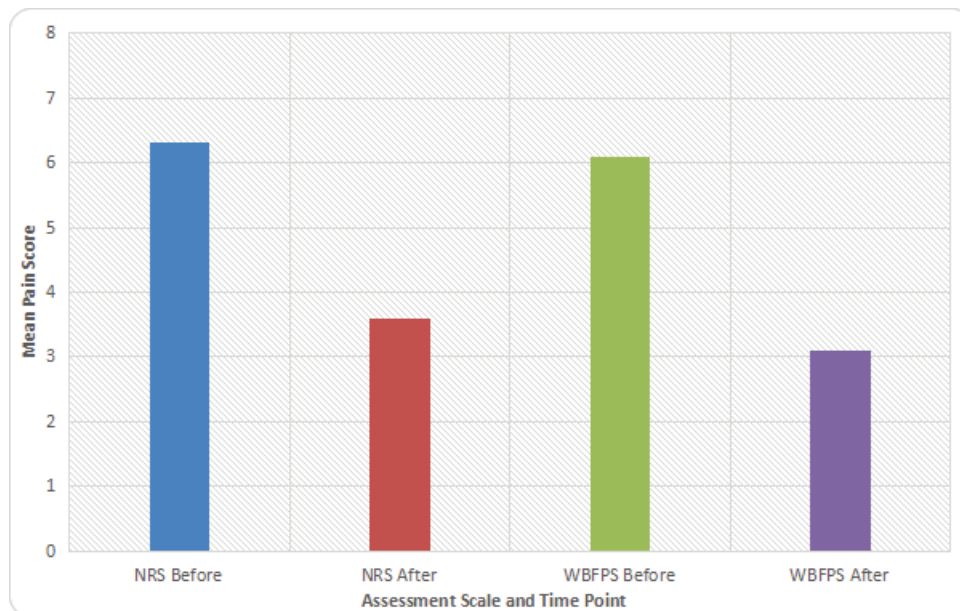


Figure 2. Comparison of pain scores before and after single-dose intravenous paracetamol administration.

Simple bar chart showing mean pain scores before and after single-dose intravenous paracetamol administration using both NRS and Wong-Baker FACES Pain Scale (WBFPS). The NRS showed a reduction from 6.3 ± 1.5 to 3.6 ± 1.6 (mean reduction = 2.7 points), while WBFPS demonstrated a decrease from 6.1 ± 1.5 to 3.1 ± 1.5 (mean reduction = 3.0 points). Both reductions were statistically significant ($p < 0.001$, Wilcoxon signed-rank test).

Table 3. Wilcoxon Signed-Rank test results comparing pain scores.

Measure	Negative Ranks n (%)	Positive Ranks n (%)	Ties	Z	p-value
Numeric pain assessment	199 (99.5%)	1 (0.5%)	0	-12.42	<0.001
Wong-Baker FACES	197 (98.5%)	1 (0.5%)	2	-12.51	<0.001

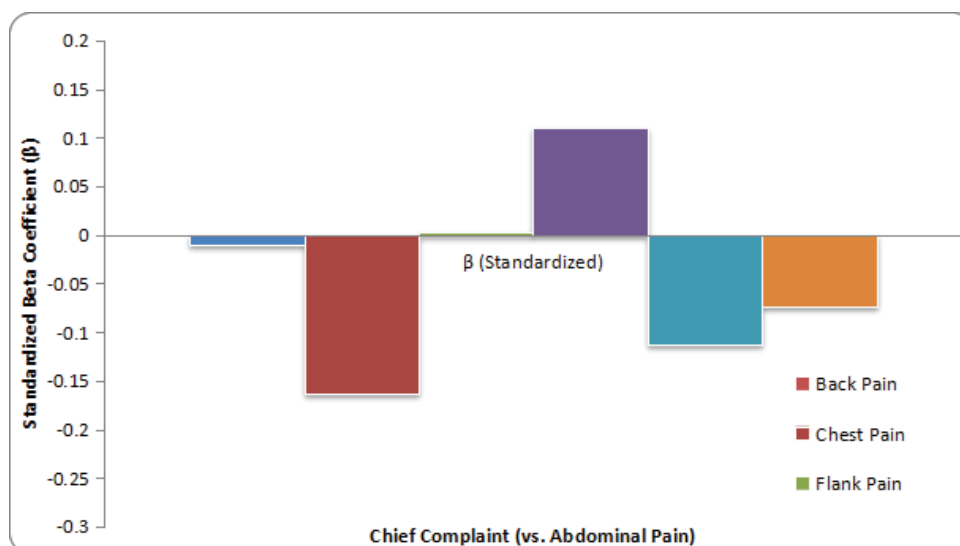


Figure 3. Pain reduction effectiveness by chief complaint category (Numeric Rating Scale, vs. Abdominal pain reference).

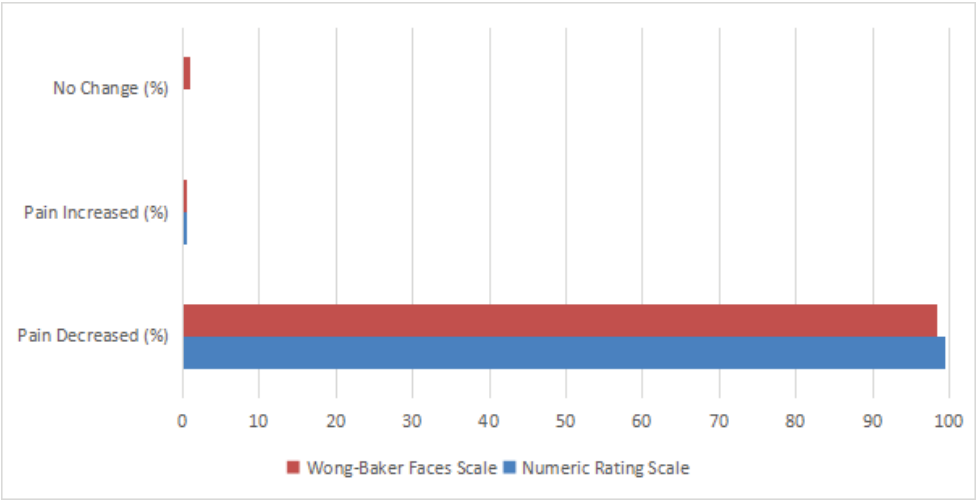
Forest-style plot showing standardized beta coefficients (β) for pain reduction across different chief complaint categories compared to abdominal pain (reference). Positive values indicate greater pain reduction; negative values indicate less pain reduction. Chest pain showed significantly reduced analgesic response ($\beta = -0.164$, $p = 0.042$).

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Table 4. Multiple linear regression analysis of factors associated with pain reduction following single-dose intravenous paracetamol administration (numeric scale).

Predictor	B [95% CI]	β	p-value
Age (years)	-0.009 [-0.027, 0.009]	-0.124	0.316
Gender (Male)	0.259 [-0.043, 0.562]	0.123	0.092
Hypertension	0.060 [-0.448, 0.569]	0.027	0.815
Dyslipidemia	-0.052 [-0.529, 0.425]	-0.020	0.830
Cerebrovascular accident	-0.316 [-1.217, 0.585]	-0.057	0.489
Diabetes mellitus	-0.269 [-0.776, 0.238]	-0.122	0.296
Cancer/Malignancies	-0.619 [-2.147, 0.909]	-0.060	0.425
Sickle cell anemia	-0.735 [-1.648, 0.178]	-0.170	0.114
Other/ no comorbidities	-0.508 [-1.075, 0.059]	-0.246	0.079
Chief complaint: Abdominal pain	Reference Category		
Back pain	-0.034 [-0.670, 0.601]	-0.010	0.916
Chest pain	-0.470 [-0.923, -0.018]	-0.164	0.042*
Flank pain	0.008 [-0.885, 0.901]	0.001	0.986
Headache	0.347 [-0.152, 0.846]	0.110	0.172
Musculoskeletal	-0.370 [-0.872, 0.132]	-0.113	0.148
Others	-0.226 [-0.711, 0.259]	-0.074	0.360

* $p < 0.05$ indicates statistical significance.



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Figure 4. Distribution of treatment responses following single-dose intravenous paracetamol administration based on Numeric Rating Scale (NRS) and Wong- Baker FACES Pain Scale (WBFPS).

Stacked bar chart showing the distribution of treatment responses across both pain assessment scales. The overwhelming majority of patients (>98%) experienced pain reduction following single-dose intravenous paracetamol administration.
Wilcoxon signed-rank test: NRS $Z = -12.42$, $p < 0.001$; WBFPS $Z = -12.51$, $p < 0.001$.

191 trend suggesting males might experience slightly greater
192 pain relief compared to females. Comorbidity status
193 showed no significant influence on treatment response
194 across all examined conditions. Hypertension ($\beta =$
195 0.027 , $p = 0.815$), dyslipidemia ($\beta = -0.020$, $p = 0.830$),
196 cerebrovascular accident ($\beta = -0.057$, $p = 0.489$), diabetes
197 mellitus ($\beta = -0.122$, $p = 0.296$), and cancer/malignancies
198 ($\beta = -0.060$, $p = 0.425$) all failed to reach statistical
199 significance. Notably, patients with sickle cell anemia
200 showed a trend toward reduced pain relief ($\beta = -0.170$, p
201 $= 0.114$), while those without documented comorbidities
202 also demonstrated a tendency for diminished response (β

$= -0.246$, $p = 0.079$), though neither reached statistical
significance (Table 4 and Figure 3).

The multiple linear regression analysis using the Wong-
Baker FACES Pain Scale as the outcome measure
revealed patterns both consistent with and distinct from
the numeric pain scale results. Demographic variables
showed no significant association with pain reduction,
with age ($\beta = -0.086$, $p = 0.477$) and male gender (β
 $= -0.007$, $p = 0.923$) demonstrating negligible effects
on treatment response. This finding reinforced that
paracetamol's analgesic efficacy appeared independent of
basic demographic characteristics. Comorbidity analysis

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Table 5. Multiple linear regression analysis of factors associated with pain reduction using Wong-Baker FACES pain scale following single-dose intravenous paracetamol administration.

Predictor	B [95% CI]	β	p-value
Age (years)	-0.008 [-0.029, 0.014]	-0.086	0.477
Gender (Male)	-0.018 [-0.381, 0.345]	-0.007	0.923
Hypertension	-0.256 [-0.867, 0.355]	-0.093	0.409
Dyslipidemia	-0.006 [-0.578, 0.567]	-0.002	0.984
Cerebrovascular accident	0.788 [-0.295, 1.870]	0.115	0.153
Diabetes mellitus	-0.198 [-0.807, 0.411]	-0.073	0.522
Cancer/Malignancies	-1.489 [-3.325, 0.346]	-0.118	0.111
Sickle cell anemia	-0.284 [-1.381, 0.812]	-0.054	0.610
Other/ no comorbidities	-0.631 [-1.312, 0.050]	-0.249	0.069
Chief complaint: Abdominal pain	Reference Category		
Back pain	0.118 [-0.646, 0.881]	0.027	0.761
Chest pain	-0.565 [-1.108, -0.021]	-0.160	0.042*
Flank pain	1.550 [0.477, 2.622]	0.210	0.005**
Headache	0.397 [-0.202, 0.997]	0.103	0.193
Musculoskeletal	-0.364 [-0.967, 0.239]	-0.090	0.236
Others	-0.167 [-0.749, 0.416]	-0.045	0.573

* $p < 0.05$ indicates statistical significance.

** $p < 0.01$ indicates statistical significance.

218 yielded no statistically significant predictors of pain
219 relief, though several trends warranted attention. Patients
220 without documented comorbidities showed a tendency
221 toward reduced pain relief ($\beta = -0.249$, $p = 0.069$),
222 approaching statistical significance and consistent with
223 findings from the numeric pain scale analysis. Cancer/
224 malignancies demonstrated the largest negative effect
225 size ($\beta = -0.118$, $p = 0.111$), though this did not reach
226 significance, likely due to the small sample size ($n = 2$).
227 Other comorbidities, including hypertension ($\beta = -0.093$,
228 $p = 0.409$), diabetes mellitus ($\beta = -0.073$, $p = 0.522$),
229 and sickle cell anemia ($\beta = -0.054$, $p = 0.610$), showed
230 minimal impact on treatment response (Table 5).

231 Discussion

232 In this real-world ED cohort, a single 1 g dose of
233 intravenous paracetamol was associated with clinically
234 and statistically significant reductions in pain scores
235 on both the NRS and Wong-Baker FACES scale. Most
236 patients experienced some degree of pain improvement
237 after administration. The absolute change exceeded
238 commonly cited thresholds for clinical relevance in acute
239 pain, supporting the practical value of IV paracetamol
240 as an early non-opioid option in heterogeneous ED
241 presentations.

242 The study population included a heterogeneous mix
243 of diagnoses commonly encountered in emergency
244 departments, including abdominal pain, musculoskeletal
245 conditions, renal colic, and cardiac-related presentations.
246 Because the mechanisms underlying pain differ
247 substantially between these conditions, the overall
248 analgesic effect observed in the cohort should be
249 interpreted cautiously. To partially address this
250 heterogeneity, regression analyses evaluated treatment
251 response across presenting complaints. These analyses

suggested that analgesic response varied by complaint, 252
with chest pain showing smaller reductions and flank 253
pain demonstrating greater reductions. 254

The current study findings align with randomized 255
emergency department trials in which IV paracetamol 256
achieved analgesia comparable to IV morphine for 257
traumatic limb pain [1] and similar effectiveness to oral 258
paracetamol in general ED pain [2]. At the same time, 259
they should be interpreted alongside evidence showing 260
no morphine-sparing effect when IV acetaminophen was 261
added broadly in ED populations [3]. For condition- 262
specific contexts, particularly renal colic, pooled 263
analyses indicated that IV paracetamol can produce 264
lower short-term pain scores than morphine, consistent 265
with the stronger response as observed in flank pain [4]. 266
Perioperative syntheses, including Cochrane, further 267
supported efficacy over several hours post-dose, while 268
reminding clinicians that absolute responder rates are 269
modest and context-dependent [5,6]. 270

The complaint-specific pattern in the current cohort, 271
attenuated effect in chest pain and larger reductions in 272
flank pain, had face validity. Chest pain often reflected 273
pathophysiology less responsive to central antipyresis/ 274
analgesia alone and was managed within diagnosis-driven 275
pathways (e.g., ACS, pericarditis, and musculoskeletal 276
pain). By contrast, renal colic-type presentations might 277
benefit more from paracetamol's analgesic mechanisms, 278
mirroring meta-analytic findings favoring IV paracetamol 279
over morphine on early pain outcomes [4]. Clinically, this 280
supported using IV paracetamol as a first-line, opioid- 281
sparing step while tailoring expectations and adjuncts by 282
presenting complaint. 283

This study's strengths included prospective bedside 284
scoring with two validated tools (NRS; Wong-Baker) 285

at pragmatic intervals reflecting ED workflow, and inclusion of diverse real-world presentations. Limitations included a single-center design, the absence of a randomized comparator, and variation in the timing of pain reassessment (30 minutes to 4 hours), which might have introduced variability in the measured analgesic effect. Earlier reassessments might capture peak drug effect, whereas later assessments might reflect natural pain resolution or additional clinical interventions. Self-reported pain was inherently subjective, and unmeasured confounders were possible.

Future work should evaluate diagnosis-stratified, multimodal pathways that position IV paracetamol alongside NSAIDs, regional techniques, or carefully titrated opioids, with standardized reassessment timepoints and patient-centered outcomes (e.g., functional improvement, need for rescue therapy). Pragmatic randomized studies in ED subpopulations (renal colic, chest pain, and headache) would clarify where IV paracetamol added the most value, and health-economic analyses could inform protocol adoption at scale. Because this study lacked a control group and relied on subjective pain assessment, some of the observed improvement might reflect placebo effects or the natural course of pain resolution.

Contemporary emergency department pain management increasingly emphasizes multimodal strategies that combine non-opioid medications such as paracetamol with NSAIDs, regional anesthesia techniques, or carefully titrated opioids when necessary. Within this framework, intravenous paracetamol might serve as an early non-opioid component of multimodal analgesia rather than as a stand-alone therapy. The current study findings, therefore, support its role as part of broader ED pain management strategies.

A key strength of this study was that it reflected everyday ED practice, using subjective assessment tools (NRS and Wong-Baker). The sample size was relatively large, and data were collected prospectively, improving reliability. Limitations included the single-center design, the absence of a comparator group, heterogeneity in underlying diagnoses, and variation in the timing of pain reassessment (30 minutes to 4 hours). In addition, several diagnostic categories included small numbers of patients, limiting meaningful condition-specific interpretation.

The regression models also included multiple predictors relative to the sample size, which might increase the risk of model instability or overfitting; therefore, these findings should be interpreted cautiously. Pain scores were subjective and might be influenced by unmeasured factors. Additionally, although patients who recently used analgesics were excluded, the possibility of rescue analgesia during the observation period cannot be completely ruled out and might represent a potential confounding factor. Even so, the consistency across two scales lends confidence to the overall findings.

Conclusion

This study suggested that single-dose intravenous paracetamol was found to be associated with meaningful reductions in pain scores across diverse emergency

department presentations on both numeric and Wong-Baker FACES pain scales. The treatment showed generally consistent analgesic effects across different demographic groups and comorbidity profiles, suggesting potential applicability in emergency medicine practice. However, the regression analyses revealed important insights into treatment response based on presenting complaints. Patients with chest pain consistently showed reduced analgesic response across both pain scales, suggesting that chest pain etiologies might be less responsive to paracetamol's mechanism of action. Conversely, flank pain presentations demonstrated superior response on the Wong-Baker FACES scale, potentially reflecting the particular suitability of paracetamol for renal colic and related conditions. These findings supported the use of intravenous paracetamol as a useful non-opioid analgesic option in emergency departments, although results should be interpreted cautiously given the absence of a control group. These findings also highlighted the importance of considering the presenting complaint when predicting treatment response and planning multimodal pain management strategies.

Acknowledgment

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List of Abbreviations

CI	Confidence interval	
ED	Emergency department	
IQR	Interquartile range	
IV	Intravenous	
NRS	Numeric Rating Scale	
REC	Research Ethics Committee	
SD	Standard deviation	
SPSS	Statistical Package for the Social Sciences	

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent to participate

Informed consent was obtained from all the participants.

Ethical approval

Ethical approval for this study was obtained from the Unit of Biomedical Ethics, Research Ethics Committee (REC), Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia via reference number 347-25. Dated: 20-08-2025.

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