

Absence of Weekend and Out-of-Hours Effects in Emergency Abdominal Surgery: A Retrospective Cohort Study

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Abstract

Background

The “weekend effect” describes worse outcomes for patients treated on weekends compared with weekdays, but its presence in emergency abdominal surgery remains unclear. This study evaluated the impact of weekend and out-of-hours surgery on clinical outcomes.

Methods

This retrospective cohort study included consecutive patients undergoing emergency abdominal surgery at a single institution between April 2022 and March 2024. Patients were categorized by surgery timing: weekends, weekday working hours, and weekday out-of-hours. Three analytical approaches were used to assess timing effects. The primary outcome was in-hospital mortality; secondary outcomes included postoperative length of stay, surgical site infection (SSI), and total hospitalization costs. Statistical analyses included the Mann–Whitney U test, chi-square test, and univariate logistic regression.

Results

A total of 125 patients were included, with 60.0% undergoing laparoscopic surgery. No significant differences were observed between weekend and weekday groups in patient characteristics, operative variables, or clinical outcomes across all analyses. In-hospital mortality, length of stay, SSI rates, and hospitalization costs were comparable regardless of surgery timing. These findings were consistent across all sub-analyses.

Conclusions

No weekend or out-of-hours effect was observed in emergency abdominal surgery. Outcomes and costs were comparable irrespective of timing, suggesting that in well-resourced systems, surgery timing may not independently influence outcomes. The weekend effect will disappear once the healthcare system is in place.

Background

The “weekend effect” refers to the phenomenon whereby patients undergoing medical procedures on weekends experience worse outcomes compared with those treated on weekdays. In clinical practice, outcomes may vary depending on the timing of care delivery, including the day of the week and time of admission. Numerous studies have demonstrated the presence of a weekend effect across a wide range of conditions, including medical emergencies such as myocardial infarction and pulmonary embolism,

as well as surgical emergencies such as acute abdomen and urgent operations, all of which have been associated with poorer outcomes when managed on weekends [1].

Several explanations for this phenomenon have been proposed. Reduced hospital staffing levels, including limited availability of experienced physicians, nurses, and radiology services during weekends, may adversely affect patient care [2]. Additionally, patients admitted on weekends are often reported to present with greater disease severity or higher comorbidity burden, which may contribute to worse outcomes [3]. However, the weekend effect is not consistently observed across all clinical settings, and some studies have failed to demonstrate its presence in specific diseases, suggesting heterogeneity in its impact [4].

Given these inconsistencies, further investigation into the mechanisms underlying the weekend effect is warranted. In particular, emergency surgical conditions—where timely intervention is critical—raise important concerns regarding whether outcomes differ according to the timing of surgery. Therefore, the present study focuses on emergency abdominal surgery and aims to evaluate whether procedures performed outside regular working hours or on weekends are associated with differences in clinical outcomes.

Ethics Statement

This study was approved by the Ethics Committee of Yao Tokushukai General Hospital (approval number: TGE02554-004; approved on August 5, 2024). The requirement for informed consent was waived due to the retrospective nature of the study. This studies must comply with the Declaration of Helsinki (www.wma.net/e/policy/b3.htm).

Methods

Aim

To investigate the impact of the out-of-hours effect and weekend effect on clinical outcomes in patients undergoing emergency abdominal surgery.

Study Hypothesis

We hypothesized that emergency abdominal surgeries performed during out-of-hours periods or on weekends are associated with worse clinical outcomes compared with those performed during regular working hours. If this hypothesis is confirmed, future studies should explore clinical criteria for safely postponing certain emergency procedures to regular working hours, balancing surgical urgency against the potential risks associated with out-of-hours care.

Study Design

This study was conducted as a retrospective cohort analysis.

Participants

We included all consecutive patients who underwent emergency abdominal surgery at Yao Tokushukai General Hospital between April 2022 and March 2024.

Data Collection and Variables

Data were extracted from electronic medical records. The following variables were collected:

1. **Demographic and Preoperative Variables:** included age, sex, Body mass index (BMI), calculated as weight (kg) divided by height squared (m^2), Prognostic Nutritional Index (PNI), American Society of Anesthesiologists Physical Status (ASA-PS) classification, Systemic Immune-Inflammation Index (SII). All preoperative variables were measured prior to surgery. These calculation formulae were as the follows: $\text{PNI} = 10 \times \text{serum albumin (g/dL)} + 0.005 \times \text{total lymphocyte count (/mm}^3\text{)}$ [5], $\text{SII} = (\text{neutrophil count} \times \text{platelet count}) / \text{lymphocyte count (/mm}^3\text{)}$ [6]
2. **Perioperative and Clinical Variables:** included catecholamine use ($\mu\text{g/kg/min}$), surgical approach (laparoscopic vs. open laparotomy), Intraoperative blood loss (mL), operative time (minutes)

3. Outcomes

Primary outcome: In-hospital mortality and secondary outcomes: Length of postoperative hospital stay, the frequency of SSI. In addition, total hospitalization costs, including surgical and intensive care unit (ICU) expenses, were calculated for each patient and compared between groups.

Definitions

Out-of-hours and Working Hours

- Working hours: Weekdays from 8:30 a.m. to 5:00 p.m.
- Out-of-hours: Weekdays from 5:00 p.m. to 8:30 a.m.

Weekend

Weekends were defined as Saturdays, Sundays, and public holidays. All time periods during these days were classified as out-of-hours.

Definition of Emergency Surgery

Emergency surgery was defined as any procedure performed without prior scheduling. In contrast, elective surgery was defined as procedures scheduled in advance.

Method

Comparative Analyses

Comparisons between weekend and weekday cases were conducted using three predefined analytical approaches. A schematic overview of these methods is provided in Fig. 1.

Method 1: A comparison of Out-of-Hours Effect on Weekends versus Weekdays

To evaluate the effect of out-of-hours care independent of weekday working hours, all cases performed during weekends were compared with those performed during out-of-hours periods on weekdays (Monday–Friday nights) (sub-analysis 1–1). To further explore potential temporal trends surrounding weekends, additional analyses were conducted:

- Sub-analysis 1–2: Comparison between Monday and Friday cases
- Sub-analysis 1–3: Comparison between early-week (Monday–Tuesday) and late-week (Thursday–Friday) cases

These analyses were designed to assess whether outcomes differed immediately before or after weekends.

Method 2: A comparison of Data on Weekends versus Working hours of weekdays

To assess the impact of surgery timing relative to optimal staffing conditions, all weekend cases were compared with cases performed during weekday working hours (Monday–Friday, 8:30 a.m.–5:00 p.m.) (sub-analysis 2 – 1).

In addition, temporal comparisons similar to Method 1 were performed:

- Sub-analysis 2–2: Monday vs. Friday
- Sub-analysis 2–3: Early-week (Monday–Tuesday) vs. late-week (Thursday–Friday)

Method 3: A comparison of Data on Weekends versus Entire Weekday Period

To evaluate the overall weekend effect irrespective of time of day, weekend cases were compared with all weekday cases, including both working hours and out-of-hours periods.

Statistical Analysis

Continuous and ordinal variables were analyzed using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher’s exact test, as appropriate. Univariate logistic regression analysis was performed to evaluate associations between exposure variables (weekend vs. weekday timing) and the primary outcome (in-hospital mortality).

All statistical analyses were conducted using standard statistical software, and a two-sided *p* value < 0.05 was considered statistically significant.

Results

Patient Characteristics

A total of 125 patients were included in the analysis. Among them, 75 patients (60.0%) underwent laparoscopic surgery, and 50 patients (40.0%) underwent open laparotomy.

Results for Method 1: A comparison of Out-of-Hours Effect on Weekends versus Weekdays

No statistically significant differences were observed between weekend and weekday out-of-hours groups across any evaluated variables. Specifically, there were no significant differences in:

- Patient characteristics (including demographic and preoperative variables)
- Operative factors
- Clinical outcomes, including in-hospital mortality, length of hospital stay, surgical site infection (SSI), and total hospitalization costs

These findings were consistent across all sub-analyses (sub-analyses 1–1, 1–2, and 1–3) (Tables 1, Supplementary table 1, and Supplementary table 2, respectively).

Table 1
Comparison
of data of
Out-of-
hours in
weekdays
vs.
weekend

Results for Method 2: A comparison of Data on Weekends versus Working hours of weekdays

No statistically significant differences were observed across any variables in Method 2, including sub-analyses 2 – 1, 2–2, and 2–3 (Tables 2, Supplementary table 3, and Supplementary table 4, respectively).

Table 2
Comparison
of data of
Out-of-
hours on
weekdays
vs.
weekdays

Results for Method 3: A comparison of Data on Weekends versus Entire Weekday Period

No statistically significant differences were observed between weekend cases and the entire weekday cohort (including both working hours and out-of-hours) for any evaluated variables (Table 3).

Table 3
Weekend
vs. Entire
hours of
Weekdays

Discussion

Principal Findings

The present study found no evidence of a weekend effect or out-of-hours effect in patients undergoing emergency abdominal surgery. Specifically, clinical outcomes—including in-hospital mortality, length of hospital stay, surgical site infection (SSI), and total hospitalization costs—were comparable regardless of whether surgery was performed during weekends, weekday working hours, or weekday out-of-hours.

Comparison with Previous Studies

Previous studies investigating the weekend effect have reported inconsistent findings. While several studies have demonstrated increased mortality associated with weekend care in surgical populations—particularly in procedures such as laparotomy, adhesiolysis for bowel obstruction, colectomy, and small bowel resection [5–7]—these findings have often been attributed to case-mix differences, including a higher proportion of critically ill patients requiring urgent intervention rather than differences in care quality [8].

In contrast, our findings suggest that when healthcare delivery systems are adequately structured, the timing of surgery may not independently influence outcomes.

Potential Explanations for the Absence of a Weekend Effect

Several factors may explain the absence of a weekend effect in our cohort:

1. Consistent Staffing and Resource Availability

At our institution, essential personnel—including radiology technologists, laboratory staff, and board-certified surgeons—are available on-site during both weekends and out-of-hours periods. This ensures timely diagnosis and appropriate surgical decision-making, minimizing delays and variability in care.

1. Standardized Postoperative Management

All postoperative patients are admitted to either the intensive care unit (ICU) or high-care unit (HCU), where nurse staffing ratios are strictly maintained (ICU: 1:2; HCU: 1:4). These ratios represent high staffing standards and likely contribute to uniform postoperative care regardless of timing.

1. Implementation of ERAS Protocols

The use of enhanced recovery after surgery (ERAS) protocols [9], supported by standardized clinical pathways, promotes multidisciplinary care and reduces practice variability. When implemented as a care bundle, ERAS has been shown to improve clinical outcomes and reduce healthcare costs, which may mitigate potential timing-related disparities.

Context from Literature

To determine whether this applies to any disease, we conducted a PubMed search using the keyword 'weekend effect', Exclusion criteria; pediatric subjects, reviews, and studies that did not include weekend effect as an outcome. This search yielded 264 research papers. After eliminating articles based on their abstracts and texts and applying exclusion criteria, the remaining 132 papers were divided into three groups: articles with or without, partly with weekend effect. A substantial proportion of the literature does not support the presence of a weekend effect. In our review of 132 eligible studies, As a result, 66 articles (50%) and three articles (2%) showed a weekend effect, either wholly or partly. Contrary to our speculation, 63 articles (48%) showed no weekend effect. For example, large population-based studies have demonstrated comparable mortality rates between weekend and weekday surgeries after adjusting for confounders [10–12]. These findings suggest that delays in surgical intervention—rather than timing per se—may be a more critical determinant of outcomes. Indeed, delayed surgery has been consistently associated with increased mortality, even in otherwise stable patients [13].

Heterogeneity Across Diseases and Healthcare Systems

Our literature review also demonstrated that the presence of a weekend effect varies by disease category and geographic region.

- Among studies reporting a weekend effect, the majority were in internal medicine (63%), followed by emergency medicine (19%) and surgery (17%).
- Among studies reporting no weekend effect, surgical studies accounted for a larger proportion (28%), suggesting that surgical systems may be more resilient to timing-related disparities.

(1) Country-specific analyses on Diseases trends

(1-1) Presence of Weekend Effect

The country-specific analyses indicated differences in disease distribution and reporting trends between the United States, the United Kingdom, and Japan. These discrepancies may reflect variations in healthcare systems, staffing models, and access to care during weekends (Fig. 2).

(1-2) Absence of Weekend Effect

Similar analyses were conducted on country-level disease trends, excluding the weekend effect. The results suggest that while many reports from the United States indicate that there is no weekend effect in general surgery, fewer reports exist from Japan. This discrepancy may be due to differences in medical systems and weekend care in the two countries (Fig. 3). However, the details are unclear due to the limited number of relevant reports.

(2) Comprehensive Summary of Literature Review on Weekend Effect

A comprehensive literature review revealed that the presence or absence of the weekend effect varies by country and disease, with each showing a distinct trend. In addition, the literature did not explain the reason why the weekend effect is not observed in emergency surgery, citing the immediate availability of operating theatres and the management of out-of-hours work [14]. Considering together, even when considering the same disease, it is important to acknowledge the role of the country in this issue.

Strengths

This study has several notable strengths:

1. **Single-Institution Consistency:** All surgeries were performed within a single institution with a consistent medical team and standardized care protocols, minimizing inter-institutional variability.
2. **Comprehensive Outcome Assessment:** In addition to clinical outcomes, this study evaluated economic outcomes, including total hospitalization costs, providing a broader perspective on the weekend effect.
3. **Novel Analytical Approach:** By stratifying weekday time into working hours and out-of-hours and performing temporal analyses around weekends (early-week vs. late-week comparisons), this study offers a more granular evaluation of timing effects than previous studies.

Limitations

Several limitations should be acknowledged as follows:

1. **Retrospective Design:** The retrospective nature of the study introduces potential selection bias and limits causal inference.
2. **Residual Confounding:** Differences in patient severity between groups could not be fully adjusted. Future studies should incorporate multivariable analysis or propensity score matching to improve comparability.
3. **Single-Center Study:** The findings may not be generalizable to other institutions with different staffing models or resource availability.
4. **Limited Sample Size:** The relatively small cohort size limits statistical power, particularly for subgroup analyses such as the “Friday effect.”
5. **Lack of Medical Cohort Comparison:** As the study included only surgical patients, comparisons with internal medicine populations were not possible.

Conclusion

No weekend or out-of-hours effect was observed in emergency abdominal surgery. Outcomes and costs were comparable irrespective of timing, suggesting that in well-resourced systems, surgery timing may not independently influence outcomes. The weekend effect will disappear once the healthcare system is in place.

Declarations

- **Ethics approval and consent to participate:**
- This study was approved by the Ethics Committee of Yao Tokushukai General Hospital (approval number: TGE02554-004; approved on August 5, 2024). The requirement for informed consent was waived due to the retrospective nature of the study. This studies must comply with the Declaration of Helsinki (www.wma.net/e/policy/b3.htm).
- **Consent for publication:** Not applicable.
- **Availability of data and materials:** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
- **Competing interests:** The authors declare that they have no competing interests.
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- **Authors' contributions**

Concept-OS and TA, design-OS and TA, literature search-OS, SO, AT and TA, data acquisition and data analysis-OS, HS, HK, NM, statistical analysis-OS, SO and TA, manuscript preparation-OS and TA, manuscript editing and manuscript review.- HS, HK, NM, SO, AT.

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Figures

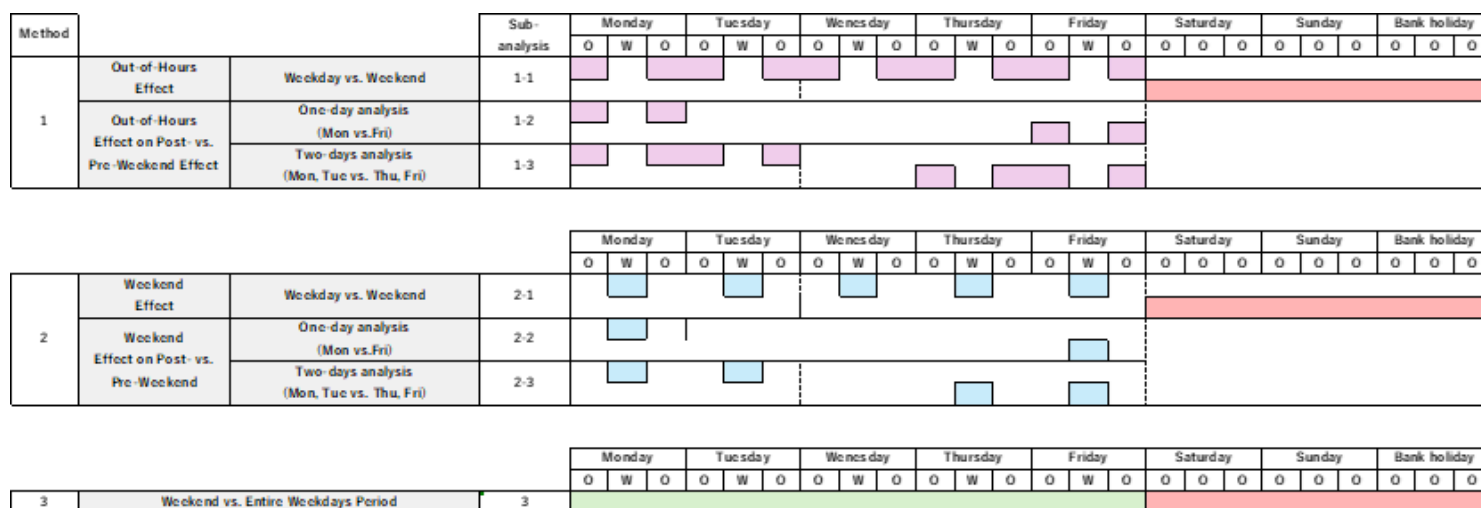


Figure 1

A schematic overview of the methods and sub-analyses

Country \ Clinical area	Circulatory	GI	Stroke	Kidney	Infection	General medicine	Respiratory	General surgery	Neuro-surgery	Ortho-pedics	Urology	ICU
USA	2.64	1.21	-0.41	-0.12	1.05	-1.47	-2.35	2.71	0.44	2.18	-2.04	-0.68
UK	-2.31	-1.46	-1.67	-0.98	-1.23	4.82	0.32	-0.41	-1.02	-0.61	-0.74	-0.12
Japan	2.02	-1.41	-0.82	-0.91	-0.44	-2.18	-1.02	-0.36	-0.92	0.12	2.06	-0.88
Others	2.51	1.09	2.94	0.38	-0.63	2.67	0.81	2.11	-2.44	-0.81	-0.44	2.39

Figure 2

This heatmap is showing the number of published articles reporting a weekend effect by country and disease. Each cell represents the number of studies reporting a weekend effect for a given country–disease combination.

Country\Clinical area	Circulatory	GI	Stroke	Kidney	Infection	General medicine	Respiratory	General surgery	Neuro-surgery	Ortho-pedics	Urology	ICU
USA	2.64	1.21	-0.41	-0.12	1.05	-1.47	-2.35	2.71	0.44	2.18	-2.04	-0.68
UK	-2.31	-1.46	-1.67	-0.98	-1.23	4.82	0.32	-0.41	-1.02	-0.61	-0.74	-0.12
Japan	2.02	-1.41	-0.82	-0.91	-0.44	-2.18	-1.02	-0.36	-0.92	0.12	2.06	-0.88
Others	2.51	1.09	2.94	0.38	-0.63	2.67	0.81	2.11	-2.44	-0.81	-0.44	2.39

Figure 3

This heatmap is showing the number of published articles reporting no weekend effect by country and disease.

Supplementary Files

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- [Supplementaryfiles.docx](#)