Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

The Mannheim Peritonitis Index: a prognostic scoring system for in-hospital mortality in peritonitis secondary to hollow viscus perforation

Jabeen Zehra
Jinnah Postgraduate Medical Center
Cheena Kumari
Jinnah Postgraduate Medical Center
Aneela Bibi
Jinnah Postgraduate Medical Center
Rafia Wakil
Jinnah Postgraduate Medical Center
Surrendar Dawani
Jinnah Postgraduate Medical Center
Muhammad Abdullah
Bahria university health Sciences Karachi
Aleena Ihtasham
King Edward Medical University
Saira Shamim
King Edward Medical University
Hudaifa Hassan Salad
Hudaifahassansalad@gmail.com

Salaam University

Article

Keywords: Mannheim Peritonitis Index, prognostic score, secondary peritonitis, exploratory laparotomy, in-hospital mortality, low-resource settings

Posted Date: June 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9066416/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Objective

This study aimed to investigate in-hospital mortality rates among different Mannheim Peritonitis Index (MPI) score groups in patients who underwent emergency laparotomy due to hollow viscus perforation.

Methods

We enrolled 78 patients with hollow viscus perforation who underwent emergency exploratory laparotomy at a tertiary care hospital. We recorded demographic details, comorbidities, MPI scores, and in-hospital outcomes of the patients. Participants were grouped according to MPI score (≤ 14, 15–25, ≥ 25), and chi-square test was used to assess the association with in-hospital mortality.

Results

The in-hospital mortality rate was 44.9%. Most deaths occurred in patients with MPI scores ≤ 14 (62.1%), followed by those with scores between 15 and 25 (46.7%), whereas only 15.8% of deaths occurred in the > 25 group. Among survivors, 84.2% had MPI scores > 25. We found no significant association between mortality and age, sex, or comorbidities. However, MPI score was significantly associated with mortality ($p = 0.01$), although the observed pattern differed from the typical MPI performance.

Conclusion

Our findings show that the MPI does not consistently predict mortality in this cohort. The unexpectedly high mortality in lower MPI groups suggests the need to re-examine the tool's local applicability. Further prospective research should explore additional clinical and system-level factors that may influence patient outcomes in similar settings.

INTRODUCTION

Peritonitis secondary to hollow viscous perforation is a potentially life-threatening condition. Despite advances in the diagnosis and management of this condition, the prognosis of peritonitis remains poor. Early identification of patients with peritonitis may help in selecting patients for accurate surgical treatment [1, 2]. A good scoring system is useful for comparing various groups of patients, different treatment modalities, evaluating new therapies, monitoring resources for effective use, and improving the standard of care [3, 4].

Many scoring systems are available to grade the severity of acute peritonitis, including the Acute Physiology and Chronic Health Evaluation (APACHE) II score, Simplified Acute Physiology Score (SAPS),

Sepsis Severity Score (SSS), Ranson Score, Imrite Score, Sequential Organ Failure Assessment (SOFA) score, and Mannheim Peritonitis Index (MPI) [5, 6]. Among the various scoring systems, the MPI, in particular, seems to be a valid scoring tool capable of predicting the fate of patients with diffuse peritonitis. Different mortality levels have been reported in individual groups based on MPI values, and mortality increases with increasing MPI [7, 8, 9, 10].

The Mannheim Peritonitis Index (MPI) was developed by Wacha and Linder in 1983 based on a retrospective analysis of data from 1253 patients with peritonitis. Twenty possible risk factors were considered, of which only eight proved to be of prognostic relevance and were incorporated into the Mannheim Peritonitis Index. Patients with a score exceeding 26 were defined as having a high mortality rate [11]. Kumar et al. evaluated in-hospital mortality in patients admitted with peritonitis due to hollow viscous perforation who underwent emergency exploratory laparotomy and found it to be 18%. Moreover, out of these 18% in-hospital mortality in patients with Mannheim peritonitis index groups ≤ 14 (0%), 15–25 (6.7%) and > 25 (22.86%) [12].

This study aimed to determine the frequency of in-hospital mortality in Mannheim peritonitis index patients' groups who underwent emergency exploratory laparotomy for hollow viscous perforation to establish a local perspective, as there is a paucity of local data. Multiple studies have repeatedly shown the benefits of using various scoring systems. Due to limited health resources in our country and the increase in the cost of healthcare, determining disease prognosis is vital. Early detection and categorization would help in the timely management of critically ill patients. This study could potentially offer new information to clinicians that can influence clinical practice, help in the development of management guidelines, and improve the quality of life of patients.

METHODS

This prospective observational study was conducted in the Department of Surgery at the Jinnah Postgraduate Medical Center, Karachi, over a period of six months, from March 2025 to August 2025. A total of 78 patients were included, and the sample size was determined using WHO software by considering an expected in-hospital mortality rate of 11.1% in the Mannheim Peritonitis Index group of 15–25, with a 7% margin of error and a 95% confidence interval. A non-probability consecutive sampling technique was used for patient recruitment.

Participants were eligible if they were between 20 and 70 years of age, of either gender, and presented with peritonitis due to hollow viscous perforation, subsequently undergoing emergency exploratory laparotomy. Patients were excluded if they did not consent, had primary peritonitis, trauma, or pregnancy confirmed through history and scans, or if they had chronic conditions such as stroke, renal impairment, COPD, asthma, CHF, myocardial infarction, or chronic liver disease, which were likely to affect the outcome more than the disease in the study.

This study was approved by the Institutional Review Board of Jinnah Postgraduate Medical Centre (IRB NO.F.2–81/2025-GENL/211/JPMC), and All methods were performed in accordance with relevant

guidelines and regulations, including the Declaration of Helsinki. Once institutional ethical clearance was granted and informed consent was obtained, demographic and clinical data were collected. Each patient's height and weight were recorded upon admission to calculate body mass index (BMI). The Mannheim Peritonitis Index (MPI) was assessed at the time of admission under the supervision of a consultant with over ten years of experience. Patients were monitored for 28 days postoperatively, and any deaths occurring during this period were classified as in-hospital mortality.

Data was entered and analyzed using SPSS Version 26.0. Means and standard deviations were computed for quantitative variables, such as age, height, weight, BMI, and MPI score. Qualitative variables, including gender, diabetes mellitus type II, hypertension, obesity, smoking status, anemia, and in-hospital mortality, were presented as frequencies and percentages. Stratification was performed for potential confounders, such as age, gender, diabetes, hypertension, smoking, obesity, and anemia, to assess their impact on in-hospital mortality across different MPI categories. The Chi-square test was used for post-stratification, with a p-value ≤ 0.05 considered statistically significant.

RESULTS

The study included 78 patients with an average height of 1.71 ± 0.11 m, average weight of 73.61 ± 13.9 kg, average body mass index (BMI) of 25.30 ± 6.05 kg/m², and average Mannheim Peritonitis Index (MPI) score of 1.87 ± 0.77 (Table 1).

Table 1: Mean and standard deviation of study variables

Variables	Mean±SD
Height (m)	1.71±0.11
Weight (kg)	73.61±13.9
Body Mass Index (kg/m2)	25.30±6.05
Mannheim peritonitis index	1.87±0.77

Among the participants, 48.7% were aged 20–45 years, and 51.3% were aged 46–70 years. Females constituted 55.1% of the sample, whereas males constituted 44.9%.

Comorbidities were common in the study population. Diabetes mellitus and hypertension were recorded in 60.3% and 50.0% of patients, respectively. In addition, obesity (46.2%), smoking history (43.6%), and anemia (48.7%) were prevalent. During the hospital stay, 35 patients (44.9%) died, whereas 43 (55.1%) survived. When categorized by MPI scores, 37.2% of patients had scores of 14 or less, 38.5% had scores ranging from 15 to 25, and 24.4% had scores greater than 25 (as shown in Table 2).

The association between MPI scores and in-hospital mortality was statistically significant (p = 0.01). Among those who died, 62.1% had MPI scores ≤14, 46.7% scored between 15 and 25, and 15.8% scored

>25. In contrast, survivors were more likely to have MPI scores >25 (84.2%). No statistically significant associations were observed between in-hospital mortality and age group (p = 0.66), sex (p = 0.09), diabetes status (p = 0.61), hypertension (p = 0.82), obesity (p = 0.69), smoking (p = 0.30), or anemia (p = 0.98). Table 3 presents the distribution of patient characteristics according to in-hospital mortality.

These findings suggest that the mannheim peritonitis index (MPI) may serve as a useful prognostic indicator for in-hospital mortality in patients with peritonitis, although the unexpected distribution of mortality across MPI categories may reflect limitations in scoring accuracy or other clinical confounders.

Table 2: Distribution of baseline characteristics among the study participants.

Variables	n (%)
Age	
20 to 45 years	38 (48.7)
46 to 70 years	40 (51.3)
Gender	
Male	35 (44.9)
Female	43 (55.1)
Diabetes mellitus	
Yes	47 (60.3)
No	31 (39.7)
Hypertension	
Yes	39 (50)
No	39 (50)
Obesity status	
Yes	36 (46.2)
No	42 (53.8)
Smoking status	
Yes	34 (43.6)
No	44 (56.4)
Anemia status	
Yes	38 (48.7)
No	40 (51.3)
In-hospital mortality	
Yes	35 (44.9)
No	43 (55.1)
Mannheim peritonitis index	
≤ 14	29 (37.2)
15-25	30 (38.5)
>25	19 (24.4)

Total	78 (100)

Table 3: Distribution of patient characteristics according to the In-hospital mortality.

Variables	In-hospital mortality Yes n (%)	In-hospital mortality No n (%)	P value
Age			0.66
20 to 45 years	18 (47.4)	20 (52.6)	
46 to 70 years	17 (42.5)	23 (57.5)	
Gender			0.09
Male	12 (34.3)	23 (65.7)	
Female	23 (53.5)	20 (46.5)	
Diabetes mellitus			0.61
Yes	20 (42.6)	27 (57.4)	
No	15 (48.4)	16 (51.6)	
Hypertension			0.82
Yes	17 (43.6)	22 (56.4)	
No	18 (46.2)	21 (53.8)	
Obesity status			0.69
Yes	17 (47.)	19 (52.8)	
No	18 (42.9)	24 (57.1)	
Smoking status			0.30
Yes	13 (38.2)	21 (61.8)	
No	22 (50)	22 (50)	
Anemia status			
Yes	17 (44.7)	21 (55.3)	0.98
No	18 (45)	22 (55)	
Mannheim peritonitis index			0.01
≤ 14	18 (62.1)	11 (37.9)	
15-25	14 (46.7)	16 (53.3)	
>25			

	03 (15.8)	16 (84.2)

DISCUSSION

This study assessed in-hospital mortality among different MPI score groups in patients who underwent emergency laparotomy for hollow viscus perforation. We observed a high overall in-hospital mortality rate of 44.9%, which exceeds rates reported in most international studies [13, 14, 15]. Interestingly, the majority of these deaths occurred in patients with MPI scores ≤ 14, while those with scores > 25 accounted for a much smaller proportion of mortality. This pattern is contrary to that of most published studies, which consistently show a stepwise increase in mortality with higher MPI scores [16, 17, 18, 19]. For instance, Rongpi et al. reported that patients with MPI scores > 29 experienced mortality rates exceeding 60%, [19] while Yadav et al. found mortality rates as high as 95.6% in the same category [13].

The inverse trend observed in this study raises concerns regarding the predictive validity of the Mannheim Peritonitis Index in this setting. Several factors may explain these findings. First, clinicians may have misclassified some MPI components intraoperatively, especially those involving the type of exudate or extent of peritonitis. Both are known sources of variability in MPI scoring [20, 21]. Second, unmeasured clinical variables such as time to hospital presentation, fluid resuscitation quality, or pre-existing sepsis severity could have influenced outcomes independently of MPI [22, 23].

Most patients in our study presented with common comorbidities, including diabetes, hypertension, obesity, and anemia. However, none of these variables showed a significant association with mortality, echoing the findings of prior research that identified physiological derangements. This aligns with previous studies suggesting that physiological derangements and intraoperative findings incorporated into the MPI are more influential in predicting outcomes [20, 24].

Notably, patients with lower MPI scores had disproportionately high mortality rates. One possibility in these patients might be factors outside the MPI. For instance, delays in surgical intervention or resource limitations in perioperative care may have played a significant role. Previous studies conducted in low-resource settings have highlighted such challenges, especially in managing patients with initially stable presentations who then decompensate because of delays in critical care [22, 23, 25].

We also found no significant association between gender or age group and in-hospital mortality, which is consistent with some earlier studies [14, 18, 26]. However, this contrasts with other reports in which age over 50 years and female sex were associated with worse outcomes [13, 27]. These discrepancies may be explained by differences in case-mix, healthcare access, or underlying biological resilience across patient populations.

We recognize that the MPI remains a practical and widely used clinical scoring system, largely because of its simplicity and ease of use. However, our findings indicate that its function may not be consistent across all practice settings. In this population, the observed inverse trend between MPI score and

mortality calls for further investigation. Local validation studies may be necessary to adjust MPI cut-offs or identify adjunct factors that can improve prognostic accuracy.

Future research should consider prospective validation of MPI in larger, multicenter datasets, ideally incorporating process-of-care variables, such as timing of surgery, antibiotic administration, and postoperative support. These data will help determine whether the MPI needs adaptation for use in specific clinical or regional contexts.

LIMITATIONS

This study was conducted at a single tertiary care center, which may limit the broader applicability of our findings. We also acknowledge that variations in how surgical teams assessed MPI components intraoperatively, along with unmeasured factors such as delays in referral or preoperative care, may have influenced patient outcomes.

CONCLUSIONS

Our findings show that the Mannheim Peritonitis Index does not consistently predict in-hospital mortality in patients undergoing emergency laparotomy for hollow viscus perforation in our setting. Despite its clinical value, the MPI may underestimate risk in patients with lower scores, indicating that its use should be critically re-evaluated in local settings. We recommend further prospective studies to refine its applicability and identify additional factors that may influence outcomes in resource-constrained settings.

Abbreviations

MPI
Mannheim Peritonitis Index
APACHE II:Acute Physiology and Chronic Health Evaluation II
SAPS:Simplified Acute Physiology Score
SSS:Sepsis Severity Score
SOFA:Sequential Organ Failure Assessment
BMI:Body mass index
CHF:Congestive heart failure
COPD:Chronic obstructive pulmonary disease
SD:Standard deviation
WHO:World Health Organization
SPSS:Statistical Package for the Social Sciences

Declarations

Ethics Approval and Consent to Participate

The study was approved by the Institutional Review Board of Jinnah Postgraduate Medical Centre, Karachi, Pakistan, and written informed consent was obtained from all participants.

Consent for Publication

Not applicable, as this study does not contain any identifiable patient data.

Availability of Data and Materials Statement

All data supporting the conclusions of this article are held by the authors and are available on reasonable request.

Competing Interest

The authors declare that they have no financial or personal competing interest that could have affected the work reported in this manuscript.

Funding

The authors received no specific funding for this work.

Authors' Contributions

JZ (Jabeen Zahra): Conceptualization, Methodology, Investigation, Writing – Original Draft.

CK (Cheena Kumari): Conceptualization, Methodology, Investigation.

AB (Aneela Bibi): Visualization, Data Curation, Investigation.

RW (Rafia Wakil): Data Curation, Investigation, Methodology Oversight.

SD (Surrender Dawani): Data Curation, Resources, Software.

MA (Muhammad Abdullah): Formal Analysis, Data Curation, Writing – Original Draft, Writing – Review & Editing.

AI (Aleena Ihtasham): Statistical Analysis Support, Validation.

SS (Saira Shamim): Literature Review, Validation, Writing – Review & Editing.

HHS (Hudaifa Hassan Salad): Project Administration, Supervision, Writing – Review & Editing, Correspondence.

*All authors have reviewed and approved the manuscript.

Acknowledgments

None

References

1. Doklestić, S. K. et al. Secondary peritonitis - evaluation of 204 cases and literature review. *J. Med. Life*. **7** (2), 132–138 (2014).
2. Neupane, S., Koirala, D. P., Kharel, S., Silwal, S. & Yadav, K. K. Clinical profile and management of perforation peritonitis in Bharatpur hospital, Nepal: A prospective study. *Ann. Med. Surg. (Lond)*. **82**, 104528 (2022).
3. Panhofer, P. et al. Age, microbiology and prognostic scores help to differentiate between secondary and tertiary peritonitis. *Langenbecks Arch. Surg.* **394** (2), 265–271 (2009).
4. Toloui, A., Kiah, M., Zarrin, A. A., Azizi, Y. & Yousefifard, M. Prognostic accuracy of emergency surgery score: a systematic review. *Eur. J. Trauma. Emerg. Surg.* **50** (3), 723–739 (2024).
5. Rasslan, R. et al. da,, Damage control surgery in non-traumatic abdominal emergencies: prognostic value of SOFA, APACHEII, and Mannheim peritonitis index. Updates Surg. ;77(1):255–262. (2025).
6. Bosscha, K., Reijnders, K., Hulstaert, P. F., Algra, A. & van der Werken, C. Prognostic scoring systems to predict outcome in peritonitis and intra-abdominal sepsis. *Br. J. Surg.* **84** (11), 1532–1534 (1997).
7. Nachiappan, M. & Litake, M. M. Scoring Systems for Outcome Prediction of Patients with Perforation Peritonitis. *J. Clin. Diagn. Res.* **10** (3), PC01–5 (2016).
8. Sharma, R. et al. A prospective study evaluating utility of Mannheim peritonitis index in predicting prognosis of perforation peritonitis. *J. Nat. Sci. Biol. Med.* **6** (Suppl 1), S49–52 (2015).
9. Sharma, S., Singh, S., Makkar, N., Kumar, A. & Sandhu, M. S. Assessment of Severity of Peritonitis Using Mannheim Peritonitis Index. *Niger J. Surg.* **22** (2), 118–122 (2016 Jul-Dec).
10. Karki, O. B., Hazra, N. K., Timilsina, B., Kunwar, D. & KUMJ. Effectiveness of Mannheim Peritonitis Index in Predicting the Morbidity and Mortality of Patients with Hollow Viscus Perforation. *Kathmandu Univ. Med. J.* **16** (64), 296–300 (2018 Oct.-Dec.).
11. Wacha, H. et al. Mannheim peritonitis index-prediction of risk of death from peritonitis: construction of a statistical and validation of an empirically based index. *Theoretical Surg.* **1**, 169–177 (1987).
12. Kumar, P., Singh, K. & Kumar, A. A comparative study between Mannheim peritonitis index and APACHE II in predicting the outcome in patients of peritonitis due to hollow viscous perforation. *Int. Surg. J.* **4**, 690–696 (2017).
13. Yadav, S., Suthar, R., Meena, R. & Meena, R. S. A prospective study of effectiveness of Mannheim peritonitis index scoring system in predicting the morbidity and mortality in peritonitis due to hollow viscous perforation. *Int. Surg. J.* **7** (7), 2255–2260 (2020).
14. Pathak, A. A. et al. Prediction of mortality in secondary peritonitis: a prospective study comparing p-POSSUM, Mannheim Peritonitis Index, and Jabalpur Peritonitis Index. *Perioper Med. (Lond)*. **12** (1), 65 (2023).

15. Shakya, V. C., Pangeni, A., Karki, S. & Sharma, L. R. Evaluation of Mannheim's Peritonitis Index in Prediction of Mortality in Patients with Non-traumatic Hollow Viscus Perforation Peritonitis. *J. Nepal. Health Res. Counc.* **19** (1), 179–184 (2021).
16. Budzyński, P. et al. The usefulness of the Mannheim Peritonitis Index score in assessing the condition of patients treated for peritonitis. *Pol. Przegl Chir.* **87** (6), 301–306 (2015).
17. Gueiros, L. D. S., Fonseca, C. M. D., Duarte, N. M. D. M. & Antunes, O. S. Mannheim's peritonitis index in the prediction of postoperative outcome of peritonitis. *Rev. Col Bras. Cir.* **49**, e20222991 (2022).
18. Dalai, P., Chawla, A., Samal, S. R., Behera, S. & Mishra, D. N. Study of Mannheim peritonitis index for predicting morbidity and mortality in patients of hollow viscous perforation: in a tertiary care hospital of Eastern India. *Asian J. Med. Sci.* **14** (12), 216–221 (2023).
19. Rongpi, R., Bhattacharjee, G. G., Deuri, N., Baro, A. C. & S., & A prospective study evaluating utility of Mannheim peritonitis index in predicting the outcome of peritonitis following hollow viscus perforation. *Int. Surg. J.* **9** (6), 1188–1192 (2022).
20. Thorsen, K., Søreide, J. A. & Søreide, K. Scoring systems for outcome prediction in patients with perforated peptic ulcer. *Scand. J. Trauma. Resusc. Emerg. Med.* **21**, 25 (2013).
21. Malik, A. A. et al. Mannheim Peritonitis Index and APACHE II-Prediction of outcome in patients with peritonitis. *Turkish J. trauma. Emerg. Surg.* **16** (1), 27–32 (2010).
22. Rhodes, A. et al. Surviving Sepsis Campaign: International guidelines for management of sepsis and septic shock: 2016. *Intensive Care Med.* **43**, 304–377 (2017).
23. Søreide, K. et al. Perforated peptic ulcer. *Lancet* **386** (10000), 1288–1298 (2015).
24. Joshi, P., Poudel, R. & Chandra, K. Mannheim Peritonitis Index (MPI) score as a predictor of outcome in patients with secondary peritonitis. *J. Univ. Coll. Med. Sci.* **4** (2), 6–9 (2018).
25. Hynninen, M., Wennervirta, J., Leppäniemi, A. & Pettilä, V. Organ dysfunction and long term outcome in secondary peritonitis. *Langenbecks Arch. Surg.* **393** (1), 81–86 (2008).
26. Sharma, V. K. & Basnet, R. B. Evaluation of predictive power of Mannheim Peritonitis Index. *Postgrad. Med. J. NAMS*. **10** (2), 10–13 (2010).
27. Gaurav, K. et al. Effectiveness of Mannheim's Peritonitis Index in Patients With Peritonitis Secondary to Hollow Viscus Perforation in a Tertiary Care Hospital in Jharkhand, India. *Cureus* **16** (5), e59631 (2024).