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Applications of de Morton Mobility Index on the Middle-Aged Population—Post Cholecystectomy: A Preliminary Report

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ABSTRACT

The aim of this paper is to determine the postoperative outcomes and mobility levels of patients by utilizing DEMMI scores. This is the first study addressing this score in laparoscopic cholecystectomy. This cohort study was conducted at the King Fahad Hospital Al Hofuf and the National Guard Hospital in the Kingdom of Saudi Arabia from January 2022 to January 2023 using a sample of old-age patients undergoing laparoscopic cholecystectomy (LC). The target population comprised of 75 patients aged 50 years and older. Seventy-five patients were included in the study; the median age was 55, with a minimum age of 50 and a maximum age of 72, resulting in a range of 22. The early DEMMI score has a median of 62, a minimum of 53, and a maximum of 100, yielding a range of 47. Regarding the DEMMI score at discharge, the median was 85, with a minimum of 74 and a maximum of 100, resulting in a range of 26. DEMMI scores are a good tool for assessing patients following laparoscopic cholecystectomy.

KEYWORDS

Assessment, complications, geriatric, surgery, movements, postoperative

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1. Introduction

Gallbladder disease is a common surgical disorder, and the risk of developing cholecystitis and cholelithiasis linearly increases among old-age patients (Lo *et al.*, 1996; Bingener *et al.*, 2003). For such patients, laparoscopic cholecystectomy (LC) is the standard method of treatment (Kim *et al.*, 2018; Golden *et al.* 1996; Fried *et al.*, 1994).

In old-age patients, the preoperative risks factors (underlying health conditions), the decision between emergency and elective LC, and postoperative patient mobility levels are main factors affecting the risk of postoperative complications (Majeski, 2004).

In assessing postoperative outcomes, the de Morton Mobility Index (DEMMI) plays an essential role. It has been specifically developed and validated for older patients hospitalized in ward settings (de Morton *et al.*, 2008a). The independent mobility of this index is a key factor in predicting morbidity and determining hospital discharge readiness for older patients (de Morton, 2008b).

There are many published articles about utilization of the DEMMI for older medical and surgical patients (de Morton, 2008b). To the best of our knowledge, no studies have investigated the association between DEMMI and laparoscopic cholecystectomy.

Therefore, the objective of this study is to explore the DEMMI score of old-age patients following LC.

2. Methodology

This cohort study was conducted at King Fahad Hospital Hofuf and National Guard Hospital in the Kingdom of Saudi Arabia from January 2022 to January 2023 with a sample of middle-aged patients undergoing LC. The target population comprised of 75 patients aged 50 years and older who were scheduled for LC due to cholecystitis or cholelithiasis. Those with pre-existing mobility or cognitive impairments unrelated to the LC procedure or undergoing other major concurrent surgeries were excluded. Data collection encompassed demographic information (age, gender, BMI), clinical history (diabetes, hypertension, etc.), surgical details (type of surgery, operative time, anesthesia duration), and hospitalization duration. The primary outcome was mobility, assessed using the DEMMI. Secondary outcomes included length of hospital stay, rehospitalization rates, and patient-reported outcomes. Assessments of DEMMI scores were conducted early on postoperatively and at discharge.

3. Statistical Analysis

The data underwent analysis utilizing the Statistical Package for the Social Sciences (SPSS) version 26, developed by IBM Corp., Armonk, NY. Descriptive statistics involved the examination of categorical data through frequency tables and percentages, while continuous variables were evaluated using metrics such as median and range. Upon data exploration, it was determined that the distribution was not normal. Consequently, nonparametric tests were utilized for further investigation. The statistical tests, namely the Mann–Whitney U test and the Kruskal–Wallis test, along with post-hoc analysis for independent samples, were employed to examine associations between continuous and categorical variables. A p value of 0.05 for a 95% confidence interval was considered significant.

4. Results

Seventy-five patients were included in the study and the median age is 55, with a minimum of 50 and a maximum of 72, resulting in a range of 22. The early DEMMI score has a median of 62, a minimum of 53, and a maximum of 100, yielding a range of 47. Regarding the DEMMI score at discharge, the median was 85, with a minimum of 74 and a maximum of 100, resulting in a range of 26. The gender distribution reveals that females made up the sample's majority, constituting 77.3%, while males made up the remaining 22.7%. Body mass index (BMI) categories illustrate a diverse range, with the

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majority of patients falling within the 35–40 range (57.3%) and the remainder having a BMI below 35 (14.7%) or above 40 (28.0%). A count of the number of attacks experienced prior to surgery shows a relatively balanced distribution, with 28.0% having fewer than three attacks, 44.0% reporting between three and ten attacks, and 28.0% experiencing more than ten attacks. Time from the first attack to surgery displays a spread across various intervals, with 30.7% undergoing surgery within three months, 36.0% within 3–12 months, and 33.3% after more than 12 months. The majority of surgeries were elective procedures (57.3%) as opposed to emergency surgeries (42.7%). Operative and anesthesia times show variability, with 62.7% of operations lasting over 90 minutes and an equivalent percentage of anesthesia durations exceeding 90 minutes.

Regarding length of hospital stay, 53.3% of participants remained hospitalized for more than 24 hours, while 32.0% were discharged within 24 hours and 13.3% within 12 hours. In terms of comorbidities, diabetes mellitus (DM) was present in 28.0% of participants, while 26.7% had hypertension (HTN), as shown in Table 1.

Table 1: The frequencies and percentages of the different patients' characteristics.

Variable		Frequency	Percent
Gender	F	58	77.3
	M	17	22.7
Body mass index	<35	11	14.7
	35-40	43	57.3
	>40	21	28
Number of attacks before surgery	<3	21	28
	3-10	33	44
	>10	21	28
Time from first attack to surgery	< 3 months	23	30.7
	3 – 12 months	27	36
	> 12 months	25	33.3
Type of surgery	Elective	43	57.3
	Emergency	32	42.7
Operative time	< 45 minutes	8	10.7
	45 – 90 minutes	20	26.7
	> 90 minutes	47	62.7
Anesthesia time	< 60 minutes	4	5.3
	60 – 90 minutes	24	32
	> 90 minutes	47	62.7
Hospital stay	< 12 hours	10	13.3
	< 24 hours	24	32
	> 24 hours	40	53.3
DM	N	54	72
	Y	21	28

The Kruskal–Wallis test indicated a noteworthy association between the number of attacks prior to surgery and early DEMMI scores ($\chi2(2) = 9.192$, $p = 0.01$). Patients experiencing fewer than 3 attacks displayed a significantly lower MR (28.07) compared to those who experienced 3 to 10 attacks (MR 45.64, $p = 0.003$). However, no significant association was observed with DEMMI scores at discharge ($\chi2(2) = 0.290$, $p = 0.865$) (Table 2) (Figures 1 and 2).

Furthermore, the Kruskal–Wallis test revealed a significant link between the time from the first attack to surgery and early DEMMI scores ($\chi2(2) = 6.266$, $p = 0.044$). Patients undergoing surgery within less than 3 months from the first attack demonstrated a lower MR (31.28) compared to those undergoing surgery within 3 to 12 months (MR 45.75, $p = 0.016$). However, no statistically significant association was found with DEMMI scores at discharge ($\chi2(2) = 0.502$, $p = 0.778$) (Table 2) (Figures 1 and 2).

Similarly, both early DEMMI scores ($\chi2(2) = 43.685$, $p < 0.001$) and DEMMI scores at discharge ($\chi2(2) = 23.184$, $p < 0.001$) showed significantly lower mean rank scores for operative times exceeding 90 minutes, anesthesia durations exceeding 90 minutes (early DEMMI: $\chi2(2) = 38.234$, $p < 0.001$; DEMMI at discharge: $\chi2(2) = 20.311$, $p < 0.001$), and hospital stays exceeding 24 hours (early DEMMI: $\chi2(2) = 13.234$, $p = 0.001$; DEMMI at discharge: $\chi2(2) = 6.424$, $p = 0.04$) (Table 2) (Figures 1 and 2).

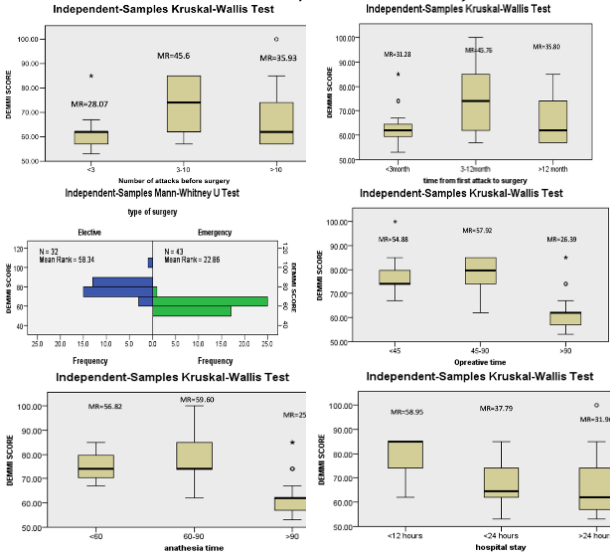
In addition, patients undergoing emergency surgery exhibited significantly lower MR scores for both early DEMMI scores ($U = 1,339$, $p < 0.001$) and DEMMI scores at discharge ($U = 1,093$, $p < 0.001$) compared to those undergoing elective surgery, as revealed by the Mann–Whitney U test (Table 2) (Figures 1 and 2).

Table 2: The associations between the patients' variables and the early DEMMI score and DEMMI score at discharge using Mann–Whitney U and Kruskal–Wallis tests.

Variables	Early DEMMI score		DEMMI at discharge score	
	Test statistics (df)	p value	Test statistics (df)	p value
Number of attacks	$\chi2(2) = 9.192$	0.010	$\chi2(2)=0.290$	0.865
Time from first attack to surgery	$\chi2(2)= 6.266$	0.044	$\chi2(2)=0.502$	0.778
Type of surgery	U = 1,339	<0.001	U = 1,093	<0.001
Operative time	$\chi2(2) =43.685$	<0.001	$\chi2(2) = 23.184$	<0.001
Anesthesia duration	$\chi2(2) = 38.234$	<0.001	$\chi2(2) = 20.311$	<0.001
Hospital stay	$\chi2(2) = 13.234$	0.001	$\chi2(2) = 6.424$	0.040

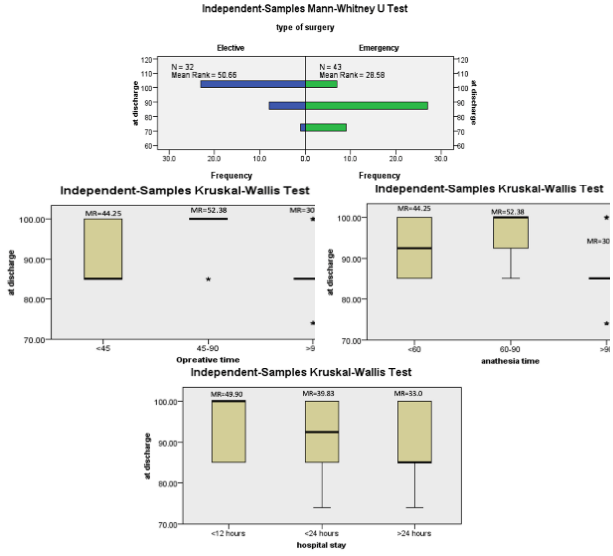
$\chi2$ is Chi square and U is the test statistics for the Mann–Whitney test.

Figure 1: The graphical representations of the Mann–Whitney U and Kruskal–Wallis tests, which were used to test the association between patients' variables and early DEMMI scores.



MR: Mean Rank

Figure 2: The graphical representations of the Mann–Whitney and Kruskal–Wallis tests, which were used to test the association between patients' variables and early DEMMI scores at discharge.



MR: Mean Rank

5. Discussion

The de Morton Mobility Index (DEMMI) was developed and validated through several reliability assessments. Studies examining the reliability of instruments confirm the DEMMI's outstanding reliability, with errors accounting for only around 9% of the scale width. This

indicates that, when applied to an older acute general medical population, the DEMMI demonstrates desirable dependability (de Morton *et al.*, 2008a). The study focused on evaluating the effectiveness of the DEMMI in examining five variables influenced by gender, BMI, DM, and HTN. This was done by comparing early DEMMI scores and DEMMI scores at discharge in older patients undergoing either elective or emergency LC. This cohort study involved 75 patients, predominantly female (77.3%), with a median age of 55. A notable 57.3% of these patients had a BMI between 35 and 40, highlighting high rates of obesity and overweight conditions in the group. Additionally, a significant number of patients had DM (28%) and HTN (26.7%). The study's findings were contrasted with another study indicating no significant differences in operative and postoperative outcomes due to obesity with regard to similar surgical procedures (Nassar *et al.*, 2022). This study identified a significant correlation between DEMMI scores and the frequency of attacks before surgery, revealing that fewer attacks led to higher scores. Additionally, a shorter interval between the first attacks and surgery correlated with increased scores. On the contrary, extended hospital stays over 24 hours resulted in lower scores both initially and at discharge. An additional report highlighted the benefits of early LC in acute cholecystitis, including safer procedures and potentially shorter hospital stays (Gurusamy *et al.*, 2013). However, diabetic patients had higher morbidity rates, though this did not affect surgery duration or hospitalization length (Bedirli *et al.*, 2001). Our study predominantly featured elective procedures (57.3%), highlighting their planned nature. Conversely, emergency surgeries correlated with lower mean rank scores and, thus, lower DEMMI scores both upon initial assessment and upon discharge compared to elective surgeries. Additionally, surgeries and anesthesia lasting over 90 minutes were significantly tied to lower DEMMI scores. Complementing this, another study discovered that aging was significantly related to increased complications in both elective and emergency LC, with the impact varying based on the urgency of the procedure (Kamarajah *et al.*, 2020). These results underscore the importance of considering surgical variables, the number of attacks, and the time before surgery when predicting early functional outcomes. Longer hospital stays, anesthesia durations, and surgical times were associated with poorer functional outcomes. Emergency procedures were linked to lower functional scores, highlighting the significance of careful consideration in such situations.

5.1. Limitations, Strengths, and Recommendations:

This study's limitations include its relatively small sample size and lack of analyses of social and demographic factors. Our study's strength is that it is the first study to evaluate DEMMI scores in patients undergoing LC, marking a significant contribution to the existing literature and expanding our knowledge in this area.

6. Conclusion

To our knowledge, this is the first study to investigate the efficacy of applying the DEMMI to a middle-aged population, although it has been applied to the geriatric population. It also focused on patients post LC. The limitation of the study may be its relatively low cohort. However, future studies with larger cohorts would be beneficial in highlighting the efficacy of applying this index to such patients.

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References

Bedirli, A., Sözüer, E.M., Yüksel, O. and Yilmaz, Z. (2001). Laparoscopic cholecystectomy for symptomatic gallstones in diabetic patients. *Journal of Laparoendoscopic and Advanced Surgical Techniques*, **11**(5), 281–284. DOI: 10.1089/109264201317054564

Bingener, J., Richards, M.L., Schwesinger, W.H., Strodel, W.E. and Sirinek, K.R. (2003). Laparoscopic cholecystectomy for elderly patients: gold standard for golden years? *Archives of surgery*, **138**(5), 531–536. DOI:10.1001/archsurg.138.5.531

de Morton, N.A., Davidson, M. and Keating, J.L. (2008 a). The de Morton Mobility Index (DEMMI): an essential health index for an ageing world. *Health and quality of life outcomes*, **6**(n/a), 1–15. DOI: 10.1186/1477-7525-6-63

de Morton, N.A., Keating, J.L. and Davidson, M. (2008 b). Rasch analysis of the barthel index in the assessment of hospitalized older patients after admission for an acute medical condition. *Archives of physical medicine and rehabilitation*, **89**(4), 641–647. DOI: 10.1016/j.apmr.2007.10.021

Fried, G.M., Clas, D. and Meakins, J.L. (1994). Minimally invasive surgery in the elderly patient. *Surgical Clinics of North America*, **74**(2), 375–387. PMID: 8165473

Golden, W.E., Cleves, M.A. and Johnston, J.C. (1996). Laparoscopic cholecystectomy in the geriatric population. Journal of the *American Geriatrics Society*, **44**(11), 1380–1383. DOI: 10.1111/j.1532-5415.1996.tb01412.x

Gurusamy, K.S., Davidson, C., Gluud, C. and Davidson, B.R. (2013). Early versus delayed laparoscopic cholecystectomy for people with acute cholecystitis. *Cochrane Database of Systematic Reviews*, **n/a**(6), CD005440. DOI: 10.1002/14651858.CD005440.pub3

Kamarajah, S.K., Karri, S., Bundred, J.R., Evans, R.P., Lin, A., Kew, T. and Griffiths, E.A. (2020). Perioperative outcomes after laparoscopic cholecystectomy in elderly patients: a systematic review and meta-analysis. *Surgical endoscopy*, **34**(n/a), 4727–4740. DOI:10.1007/s00464-020-07805-z

Kim, S.S. and Donahue, T.R. (2018). Laparoscopic cholecystectomy. *Jama*, **319**(17), 1834–1834. DOI: 10.1001/jama.2018.3438.

Lo, C.M., Lai, E.C., Fan, S.T., Liu, C.L. and Wong, J. (1996). Laparoscopic cholecystectomy for acute cholecystitis in the elderly. *World Journal of Surgery*, **20**(8), 983–987. DOI: 10.1007/s002689900148

Majeski J. (2004). Laparoscopic cholecystectomy in geriatric patients. *The American journal of surgery*. **187**(6), 747–50. DOI: 10.1016/j.amjsurg.2003.11.031

Nassar, A.H., Khan, K.S., Ng, H.J. and Sallam, M. (2022). Operative difficulty, morbidity and mortality are unrelated to obesity in elective or emergency laparoscopic cholecystectomy and bile duct exploration. *Journal of Gastrointestinal Surgery*, **26**(9), 1863–1872. DOI: 10.1007/s11605-022-05344-7

Thorsted, A.B., Thygesen, L.C., Jezek, A.H., Pedersen, M.M., Jorgensen, M.G., Vinding, K. and Pedersen, S.G. (2024). The De Morton Mobility Index (DEMMI) in hospitalized geriatric patients is associated with risk of readmission, mortality, and discharge to a post-acute care facility: A nationwide register-based cohort study. *Archives of Gerontology and Geriatrics*, **120**(n/a), 105325. DOI: 10.1016/j.archger.2024.105325