Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1350264
J Health Sci Med. 2023;6(5):1133-1141

The effects of frailty on quality of recovery and complications in older adults undergoing major abdominal surgery: a prospective cohort study

Hatice Yüceler Kaçmaz[1], Hilal Kahraman[1], Mustafa Gök[2], Sibel Akın[3], Erdoğan Sözüer[2]

[1]Department of Nursing, Faculty of Health Sciences, Erciyes University, Kayseri, Turkey
[2]Department of General Surgery, Faculty of Medicine, Erciyes University, Kayseri, Turkey
[3]Department of Geriatrics, Faculty of Medicine, Erciyes University, Kayseri, Turkey

Cite this article as: Yüceler Kaçmaz H, Kahraman H, Gök M, Akın S, Sözüer E. The effects of frailty on quality of recovery and complications in older adults undergoing major abdominal surgery: a prospective cohort study. *J Health Sci Med.* 2023;6(5):1133-1141.

Received: 28.08.2023 ◆ **Accepted**: 18.09.2023 ◆ **Published**: 28.09.2023

ABSTRACT

Aims: There is an increase in the number of older people who have undergone surgical intervention in proportion to the aging of the global population. This situation creates the need to adapt surgical care according to the pathophysiological profile of older people. Recently, it has been argued that chronological age alone does not explain biological age, and frailty will be an appropriate parameter in organizing surgical care of older people. This study aimed to determine the effect of frailty on 30-day postoperative complications and quality of recovery in older people undergoing major abdominal surgery.

Methods: A prospective cohort study was conducted in the General Surgery Department of the Erciyes University Medical Center in Türkiye. Overall, 222 patients aged 65 and over underwent major abdominal surgery between February 2021 and 2023. Frailty was determined using Fried Frailty Index. 30-day postoperative complications were evaluated using the Clavien Dindo Classification. Quality of recovery- 40 (QoR-40) was filled three days after surgery to determine the quality of recovery of the patients. Receiver-operating characteristic curves analysis was used to evaluate the ability to predict 30-day complications of frailty. Univariate linear regression analysis was performed to determine frailty to be an independent predictor of the QoR-40.

Results: The majority of the participants were male (56.8%), the mean age was 71.41±5.29 years, and 50% of patients were frail. Frail patients (28.1%) showed a higher rate of major complications compared to non-frail patients (9.3%). The Fried frailty index score significantly predicted 30-day postoperative complications (AUC=0.653, 95%=0.565-0.741). The total mean score of the QoR-40 scale was 147.09±15.82. Univariate linear regression analysis found frailty (OR -3.81, 95% CI -4.79- -2,83), age (OR -0,46, 95% CI -0,79- -0,12), Charlson comorbidity index (OR -2,40, 95% CI -3,23- -1,57), and operation time (OR -0,04, 95% CI -0,06- -0,02) as independent predictors of quality of recovery.

Conclusion: Frailty is a significant predictor for 30-day postoperative complications and quality of recovery in older people undergoing major abdominal surgery.

Keywords: Frailty, abdominal surgery, quality of recovery, postoperative complication, older people

INTRODUCTION

Older adults are the fastest growing group of the population and the proportion of the population aged 65 years or over in the total population is increasing all over the world.[1,2] In proportion to the aging of the global population, the number of surgeries performed on older adults tends to increase. Surgical interventions, considered contraindicated for the aging population in the historical process, can be applied much more frequently and safely thanks to today's techniques and technology.[3] It is reported that 23% of all surgical procedures are performed on older adults.[4] It is estimated that one in five people over the age of 75 will have surgery in the UK and an estimated £2.7 billion will be spent by 2030.[5]

Due to the effects of aging, older adults are prone to postoperative complications and long-term recovery. While the incidence of postoperative complications in patients undergoing abdominal surgery ranges from 34.4% to 66.9%[6,7], older adults are approximately 2.5 times more likely to experience postoperative complications than younger patients.[7] Older adults constitute the majority of the "high risk" surgical population. For all these reasons, there is a need to adapt surgical care according to the pathophysiological profile of older adults.[5]

Corresponding Author: Hatice Yüceler Kaçmaz, haticeykacmaz@gmail.com

A comprehensive preoperative risk assessment is necessary for older adults undergoing surgery for the appropriate management of postoperative care. There is a growing recognition that frailty is a risk factor for postoperative complications in older adults.[8,9] Frailty is a condition characterized by a multidomain decline in physiological reserve and function, which leads to negative consequences such as increased morbidity and mortality in the perioperative period. Not surprisingly, seven out of ten frail patients have multimorbidity.[2,8] Although current guidelines recommend assessing frailty using a valid tool for older adults, the role of frailty in the decision-making on surgery and its importance in assessing the benefits and risks of surgery is often ignored.[8] Recently, it is thought that chronological age is not enough in surgical decision making for older adults. On the contrary, frailty reflecting biological age will be an appropriate parameter for an accurate and individualized decision.[8,10] In a meta-analysis study conducted with patients undergoing major abdominal surgery, frail older adults have a twice greater risk of developing major postoperative morbidity and six times postoperative mortality compared to non-frail.[10]

Based on the studies, it would not be wrong to state that traditionally, the postoperative recovery is usually measured by parameters such as complication and death rates, length of hospital stay, and cost of hospital stay.[6,7,10] These outcomes suggest that the patient's perception is ignored and the patient-reported outcome measures are not focused on. Patient-reported outcome measurement tools should be used to evaluate postoperative recovery, which is defined as patients' return to normal state after surgery. For this purpose, the self-reported quality of recovery scale (QoR), which integrates the physical, emotional, and social aspects of recovery, is the most frequently used tool in postoperative follow-up.[11,12] This study was conducted to investigate the effect of frailty on 30-day postoperative complications and QoR in older adults undergoing major abdominal surgery.

METHODS

The study was carried out with the permission of Erciyes University Faculty of Medicine Clinical Researches Ethics Committee (Date: 07.01.2021, Decision No: 2021-480). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Participants

This study was a prospective, cohort study. It was conducted in the general surgery department, at a university hospital with 1200 beds in Türkiye.

The inclusion criteria were: patients undergo a major abdominal surgery, were aged ≥65 years as well as being able to speak Turkish. Exclusion criteria included patients having cognitive impairment, and/or neuropsychiatric disease and patients who refused to participate, and who were unable to undergo frailty assessment. Drop out criteria include patients who wanted to withdraw from the study and who were out of reach within 30 days after the operation.

Among 466 patients consecutively admitted in the major abdominal surgery unit between February 2021 and February 2023, 219 were excluded initially: 201 patients were less than 65 years old, 14 patients did not speak Turkish, one patients had a dementia and three patients refused to participate in the study. Additionally, 18 patients' operations were cancelled or postponed, and 7 patients could not be reached within 30 days follow-up (**Figure 1**). Thus, 222 patients were recruited for the study. Written consent forms were obtained from all participants.

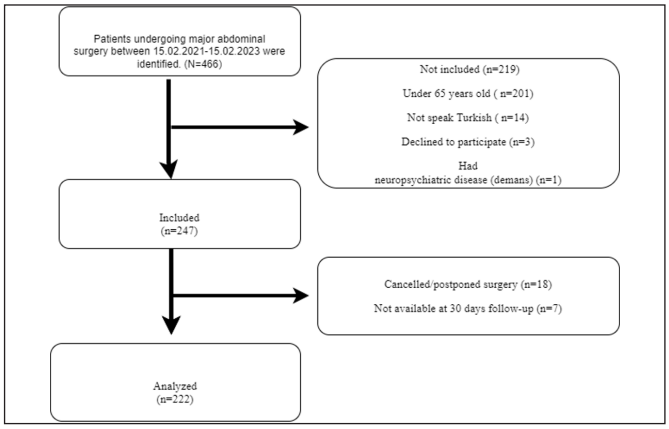

Figure 1. Flow Chart

The variables such as age, gender, diagnosis, malignancy, type of surgery, smoking, weight, height, body mass index (BMI), NRS-2002 score,[13] comorbidities, medications, Charlson comorbidity index,[14] and American Society of Anesthesiologists (ASA) physical status were included, as well as operative variables such as the types of operation (open or laparoscopic), operative time, and wound-type.

After obtaining informed consent for the study, we applied the Fried frailty index,[15] which consists of five questions: unintentional weight loss; weakness or poor handgrip strength; self-reported exhaustion; slow walking speed; and low physical activity. From the Fried Frailty Index, which is a categorical index, 0 (no) or 1 (yes) point is received for each question. Based on the Fried criteria, the three stages of frailty are listed as follows; A score of 0 indicates that the person is robust, a score of 1 or 2 indicates that the person is pre-frail, and a score of 3-5 indicates that the person is frail. In the present study, we divided our sample into two groups based on the scale and classified them as frail, not frail (pre-frail and robust).

Effect Size

The post-hoc power analysis was performed on data which comparison of the QoR-40 mean score of the frail and non-frail older adults was used in G*Power 3.1.9.4. Power (1-β) was found to be 0.97 in the power analysis made with the sample size (222), effect size (0,48), α (0,05).

Outcome Measures

This study primarily measured 30-day postoperative complications. These complications were collected from the hospital medical records and patient interviews. Patients were followed up for thirty days after the operation by researchers using the Clavien-Dindo classification. The Clavien Dindo classification, originally described in 2004, is used to rank the severity of a complication which occurs because of surgical procedure. The scale consists of five grades (Grade I, II, IIIa, IIIb, IVa, IVb, and V) (Figure 2). Clavien-Dindo classification is a very useful method for reporting outcomes of complications after major abdominal surgery.16 The higher grade represents the severity of the complication. Grade I complications are usually mild, but Grade V means the death of a patient.[17] In patients developing more than one complication, the most severe complication was recorded. In addition to 30-day postoperative complications, the length of stay in the intensive care unit (ICU) and hospital stay were followed.

Grade I:	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions Allowed therapeutic regimens are drugs as antiemetics, antipyretics, analectics. diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II:	Requiring pharmacological treatment with drugs other than such allowed for grade I complications Blood transfusions and total parenteral nutrition are also included
Grade III:	Requiring surgical, endoscopic or radiological intervention
Grade IIIa:	Intervention not under general anesthesia
Grade IIIb:	Intervention under general anesthesia
Grade IV:	Life-threatening complication (including CNS complications)* requiring IC/ICU management
Grade IVa:	Single organ dysfunction (including dialysis)
Grade IVb:	Multiorgan dysfunction
Grade V:	Death of a patient

Figure 2: Classification of surgical complications according to Clavien Dindo

*Brain hemorrhage, ischemic stroke, subarrachnoidal bleeding, but excluding transient ischemic attacks. CNS, central nervous system; IC, intermediate care; ICU, intensive care unit.

Additionally, we applied the QoR-40 scale to the patients to determine postoperative recovery on the third day after the operation. The Quality of Recovery Scale (QoR-40) was filled in by interviewing the patient twenty-four hours after the surgical procedure. This scale was developed by Myles et al.[18] (2000) to measure the quality of recovery after the operation. The QoR-40, a 40-item questionnaire, is scored on a five-point Likert-type scale with a total score ranging from 40 (poor QoR) to 200 (excellent QoR). An increase in the scale total score means that the postoperative physical and emotional well-being increase, and a decrease in the score means that they are negatively affected.[18,19]

Statistical Analysis

Analyses were performed using SPSS 22 software (IBM SPSS Statistics Standard Concurrent User ver. 22). Descriptive statistics were expressed as statistical units (n), percent (%), mean (X), standard deviation (SD). The Shapiro-Wilk test was used to examine continuous variables depending on the variable distribution, and Levene test was used to check the homogeneity of the variances. In the comparison of frail and non-frail older adults, two independent samples t-test for numeric variables and chi-square test for categorical variables were used. The chi-square test and relative risk were applied to estimate the risk of developing minor and major complications of frailty according to the Fried frailty index. Multiple logistic regression analysis was used to analyze the associated factors of QoR after major abdominal surgery. $p<0.05$ was considered statistically significant.

RESULTS

Characteristics of the Patients

Among the participants, 56.8% were male, with an mean age of 71.41±5.29 years. The mean BMI of the patients was 26.67±4.97, 77.5% had a chronic illness, and 65.8% were continuously taking medication. The mean CCI was 5.54±1.98 years (Table 1).

There was a relationship among being frail, gender, and chronic disease ($p=0.018$). Although the gender of frail patients was close to each other, it was seen that non-frail individuals are mostly (64.8%) male. Frail older adults had more chronic diseases than non-frail older adults (84.2% vs 70.4%). There was a relationship between hypertension, antihypertensives and frailty ($p<0.05$). Frail patients had significantly higher age and CCI score and lower BMI than non-frail patients ($p<0.05$) (Table 1).

Of the patients, 62.2% underwent colorectal surgery, 88.3% had malignancy, 98.2% had elective and open surgery. The mean operation time was 182.70±74.90, and the mean postoperative length of stay was 11.04±5.64. 51.4% of the older adults were frail (Table 2). There was a relationship between the urgency of the surgery (0.020) and frailty. Frail patients stayed in the hospital longer time after surgery than non-frail ($p=0.014$). The difference was significant between frailty and some laboratory results; in preoperative period, hemoglobin ($p<0.001$) and albumin ($p=0.013$) levels were lower, while blood urea nitrogen levels were significantly higher in frail older adults ($p=0.033$). In the postoperative period, albumin ($p<0.001$) and total protein ($p<0.001$) levels were similarly lower in frail individuals (Table 2).

Table 1. The characteristics of the patients undergoing major abdominal surgery

Characteristics	Overall n (%)	Frail n (%)	Non-frail n (%)	Statistical test; p
Sex				X^2=5,564; p=0,018
Female	96 (43.2)	58 (50.9)	38 (35.2)	
Male	126 (56.8)	56 (49.1)	70 (64.8)	
Chronic disease				X^2=6.088; p=0.014
Yes	172 (77.5)	96 (84.2)	76 (70.4)	
No	50 (22.5)	18 (15.8)	32 (29.6)	
DM	70 (31.5)	42 (36.8)	28 (25.9)	X^2=3.061; p=0.080
HT	120 (54.1)	74 (64.9)	46 (42.6)	X^2=11.124; p=0.001
Cardiovascular diseases	36 (16.2)	22 (19.3)	14 (13.0)	X^2=1.638; p=0.201
Thyroid disorders	24 (10.8)	8 (7.0)	16 (14.8)	X^2=3.497; p=0.061
Chronic pulmonary diseases	34 (15.3)	18 (15.8)	16 (14.8)	X^2=0.041; p=0.840
Regular medication use				
Yes	146 (65.8)	80 (70.2)	66 (61.11)	X^2=2.024; p=0.155
No	76 (34.2)	34 (29.8)	42 (38.9)	
Antihypertensive	114 (51.5)	70 (61.4)	44 (38.5)	X^2=9.478; p=0.002
OAD	50 (22.5)	30 (26.3)	20 (18.5)	X^2=1.932; p=0.165
Insulin	22 (9.9)	14 (12.3)	8 (7.4)	X^2=1.475; p=0.225
Anticoagulant	24 (10.8)	12 (10.5)	12 (11.1)	X^2=0.20; p=0.888
Bronchodilator	30 (13.5)	14 (12.3)	16 (14.8)	X^2=0.305; p=0.581
	$\bar{x}$±SD			
Age	71.41±5.29	73.00±5.64	69.74±4.34	t=-4.839; p<0.001
BMI	26.67±4.97	26.03±5.08	27.35±4.79	t=1.979; p=0.049
CCI	5.54±1.98	5.84±1.69	5.24±2.24	t=-2.277; p=0.024

DM: Diabetes mellitus, HT: Hypertension, OAD: Oral antidiabetic, CCI: Charlson comorbidity index, $\bar{x}$:mean, SD: standard deviation X^2:Chi-square test, t:Independent t test

Complication Rates of the Patients and Relationship between Frailty and Complications

In Table 3, 30-day postoperative complications of frail and non-frail older adults were presented. This study demonstrated the significant relationship between frailty and postoperative complications (p<0.001). While Grade 1 complications including simple complications had more common in non-frail patients than in frail patients (40.7% vs. 15.8%), Grade 2 and 3 complications were more common in frail individuals. It was found that frail patients experienced anemia (p=0.005), electrolyte disturbance (p=0.000), abdominal distension (p=0.001), hypertension (p=0.012), and nausea and vomiting (p=0.004) more than the non-frail patients. When the complications related to the surgical site problems of the patients were analyzed, the frail patients experienced more complications of seroma (p=0.003) and wound infection (p=0.002) than the non-frail patients (Table 3).

Major complications occurred in 28.1% of the frail patients compared to only 9.3% of the non-frail patients. In bivariate analysis, frail and non-frail older adults undergoing major abdominal surgery showed a significant difference in terms of the incidence of minor or major 30-day post-operative complications (RR 3.824, 95% CI 1.774-8.246; p<0.001). According to the ROC curve analysis shown in Figure 3, the Fried Frailty Scale score effectively predicted the severity of postoperative complications (AUC=0.653, 95%=0.565-0.741) (Table 4).

Table 3. 30-day postoperative complications associated with the frailty of the patients

Complication	Non-Frail n (%)	Frail n (%)	Statistical test, p
Clavien Dindo Classification			X^2=25.843 p<0.001
1	44 (40.7)	18 (15.8)	
2	54 (50.0)	64 (56.1)	
3	6 (5.6)	28 (24.6)	
4-5	4 (3.7)	4 (3.5)	
Anaemia	50 (46.3)	74 (64.9)	X^2=7.795 p=0.005
Electrolyte disorders	70 (64.8)	102 (89.5)	X^2=19.325 p<0.001
Abdominal distension	16 (14.8)	38 (33.3)	X^2=10.332 p=0.001
HT	54 (50.0)	76 (58.6)	X^2=6.348 p=0.012
Hyperglycaemia	16 (14.8)	26 (22.8)	X^2=2.309 p=0.129
Requiring blood transfusions	18 (16.7)	18 (15.8)	X^2=0.31 p=0.859
Seroma	16 (14.8)	36 (31.6)	X^2=8.689 p=0.003
Nausea	36 (33.3)	60 (52.6)	X^2=8.415 p=0.004
TPN requirement	22 (20.4)	36 (31.6)	X^2=3.601 p=0.057
Wound infection	6 (5.6)	22 (19.3)	X^2=9.503 p=0.002
Ex	0 (0.0)	2 (1.8)	X^2=1.590 p=0.207

HT: Hypertension, TPN: Total Parenteral Nutrition, Ex: Exitus, X2:Chi-square test, Percentages show patients who was developed postoprative complications.

Table 2. The characteristics of patients related to surgery

Characteristics	Overall n (%)	Frail n (%)	Non-frail n (%)	Statistical test, p
Type of surgery				X^2=5.479; p=0.242
Colorectal surgery	138 (62.2)	72 (63.3)	66 (61.1)	
Gastrectomy	70 (31.5)	38 (33.3)	32 (29.6)	
Pancreatectomy	8 (3.6)	2 (1.8)	6 (5.6)	
Liver resection	4 (1.8)	2 (1.8)	2 (1.9)	
Whipple	2 (0.9)	0 (0.0)	2 (1.9)	
Malignancy				X^2=0.318; p=0.573
Yes	196 (88.3)	102 (89.5)	94 (87.0)	
No	26 (11.7)	12 (10.5)	14 (13.0)	
ASA				X^2=0.695; p=0.404
ASA I-II	180 (81.1)	90 (79.0)	90 (83.3)	
ASA III-IV	42 (18.9)	24 (21.0)	18 (16.7)	
Urgency				X^2=5.401; p=0.020
Emergency	4 (1.8)	4 (3.5)	0 (0.0)	
Elective	218 (98.2)	104 (96.5)	108 (100)	
Surgical approach				X^2=0.003; p=0.956
Open	218 (98.2)	112 (98.2)	106 (98.1)	
Laparoscopic	4 (1.8)	2 (1.8)	2 (1.9)	
Stay in the ICU				X^2=2.502; p=0.114
Yes	90 (40.5)	52 (45.6)	38 (35.2)	
No	132 (59.5)	62 (54.4)	70 (64.8)	
		$\overline{x}$±SS		
Operation time	182.70±74.90	180.43±67.55	185.09±82.20	t=0.462; p=0.645
Postoperative length of stay (day)	11.04±5.64	12.01±6.05	10.00±5.56	t=-2.475; p=0.014
Preoperative laboratory testing				
Hgb	12.21±1.97	11.63±1.90	12.82±1.86	t=4.697; p<0.001
Alb	4.09±0.79	3.97±1.01	4.23±0.41	t=2.512; p=0.013
BUN	15.75±5.46	16.51±5.46	14.95±5.37	t=-2.145; p=0.033
CR	1.04±0.88	1.03±0.87	1.05±0.90	t=0.096; p=0.924
AST	22.13±9.7	21.31±7.91	22.99±11.29	t=1.283; p=0.201
ALT	16.65±11.89	14.99±8.13	17.41±14.70	t=1.157; p=0.235
Total protein	6.82±0.78	6.63±0.87	7.02±0.61	t=3.895; p<0.001
Postoperative laboratory testing				
Hgb	10.91±2.23	10.69±2.63	11.15±1.70	t=1.534; p=0.127
Alb	3.19±0.62	3.01±0.62	3.37±0.57	t=4.521; p<0.001
BUN	16.46±14.00	17.71±18.49	15.15±6.37	t=-1.397; p=0.165
CR	0.85±0.40	0.87±0.51	0.83±0.23	t=-0.715; p=0.476
AST	37.54±62.74	33.63±52.73	41.67±71.84	t=0.954; p=0.341
ALT	28.14±39.03	26.44±37.76	29.93±40.42	t=0.666; p=0.506
Total protein	5.47±0.79	5.29±0.83	5.66±0.70	t=0.206; p<0.001

ICU: Intensive care unit, ASA: American Society of Anesthesiologists physical status classification system, Min: Minute, Hgb: Haemoglobin, Alb: Albumin, BUN: Blood urea nitrogen, CR: Creatine, AST: Aspartat aminotransferaz, ALT: Alanin aminotransferaz, $\overline{x}$:mean, SD: standard deviation, X^2:Chi-square test, t:Independent t test

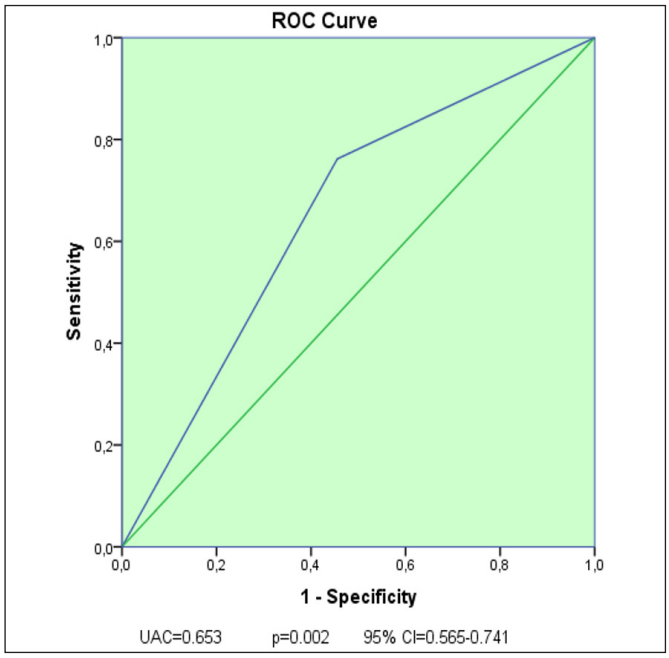

Figure 3. Roc analysis

Table 4. Bivariate Analysis between Frailty Impact on 30-day Major Abdominal Surgery Complications

Frailty	Complications		Relative Risk	95% CI	p*
	Minor	Major			
Non-frail	98 (90.7)	10 (9.3)	3.824	1.774-8.246	<0.001
Frail	82 (71.9)	32 (28.1)	Ref.		

*Chi-square test

The Relationship between Patients' Quality of Recovery Scale Scores and Frailty

In Table 5, QoR-40 scores of older adults who underwent major abdominal surgery are presented. The mean QoR-40 total score of the patients were 45.63±5.18 for the comfort subscale, 33.93±4.35 for the emotional state subscale, 9.77±3.58 for physical independence, 29.00±4.30 for the psychological support subscale, 28.75±3.41 for the pain subscale, and 147.09±15.82 for the total score.

Total and sub-scale scores of the QoR-40 of frail patients were lower than the non-frail patients, and this difference was statistically significant (p<0.05) (Table 5).

The model constructed to determine the risk factors affecting the quality of recovery in elderly individuals after major abdominal surgery explained 45% of the QoR score (R2=0.451, F=46.338, p<0.001). Multiple logistic regression analysis showed that the Fried Frailty Scale was associated with postoperative complications (OR -3.81, 95% CI -4.79- -2.83). In addition, QoR decreased as the age increases (OR -0.46, 95% CI -0.79- -0.12), CCI (OR -2.40, 95% CI -3.23- -1.57), and operation time (OR -0.04, 95% CI -0.06- -0.02) (Table 6).

Table 6. Factors affecting quality of recovery after major abdominal surgery

Model	OR	95 % CI	p
Fried frailty scale	-3.816	-4.796- -2.837	<0.001
Age	-0.460	-0.793- -0.127	0.007
CCI	-2.403	-3.232- -1.575	<0.001
Operation time	-0.042	-0.063- -0.021	<0.001

CCI: Charlson comorbidity index, OR: Odss ratio, Cl: confidence interval, *Multiple logistic regression

DISCUSSION

Considering the increase in the number of surgical interventions and the high prevalence of frailty in the geriatric population, studies on predicting and improving geriatric patient outcomes have become a necessity. Much research has been devoted to the prediction of surgical complications and its demonstrated relationship with many healthcare quality indicators such as length of hospital stay and healthcare costs.[10,20-22] In both clinics and studies, parameters such as the quality of recovery based on patient's self-assessment, in which the traditional approach is adopted, appear to be an overlooked outcome of surgical care. To our knowledge, the present study is the first study to examine the relationship between frailty and quality of recovery in older adults undergoing major abdominal surgery. Our findings demonstrated the effect of frailty on predicting postoperative complications and quality of recovery in older adults undergoing major abdominal surgery.

Table 5. Quality of recovery scale scores of the patients undergoing major abdominal surgery

QoR-40	Min-Max	Overall $\bar{x}$±SS	Frail $\bar{x}$±SS	Non-frail $\bar{x}$±SS	p
Comfort	34-71	45.63±5.18	44.66±5.44	46.64±4.71	t=2.891; p=0.004
Emotional state	24-45	33.93±4.35	32.03±3.68	35.99±4.11	t=7.466; p<0.001
Physical independence	5-23	9.77±3.58	8.12±2.21	11.51±3.92	t=7.887; p<0.001
Psychological support	13-35	29.00±4.30	27.54±4.51	30.53±3.47	t=5.511; p<0.001
Pain	18-34	28.75±3.41	28.17±3.02	29.37±3.69	t=2.629; p=0.009
Total scale	109-136	147.09±15.82	140.54±14.01	154.01±14.69	t=6.993; p<0.001

QoR-40:quality of recovery-40 scale, $\bar{x}$:mean, SD: standard deviation, t:Independent t test

First, given the results of the present study regarding postoperative complications, frailty is significantly associated with the severity of 30-day postoperative complications following major abdominal surgery. It has been revealed that frail individuals have three times higher risk of developing major complications (Clavien Dindo Classification 3-5) than the non-frail individuals (28.1% vs 9.3%). In a meta-analysis study focusing on older adults undergoing emergency abdominal surgery, frailty was identified as a risk factor for 30-day mortality. Frail patients have four times greater risk of 30-day mortality compared to the non-frail patients (OR 4.3, 95% CI 2.25-8.19).[23] In a prospective cohort study of patients (n=245) undergoing major thoracic and abdominal surgery, Han et al.[24] (2019) found frailty to be an effective predictor of postoperative complications. Moreover, the area under the curve (AUC) for frailty for prediction of postoperative complications was 0.762 (95% CI 0.703-0.814). Similarly, in our study, frailty was predicted as a tool to assess the risk of complications (AUC 0,653, %95 0,565-0,741). Aceto et al.[25] (2021) conducted a prospective cohort study (n=105) to determine the effect of frailty in predicting pulmonary complications after major abdominal surgery. It was demonstrated that frail patients were exposed to a higher risk of pulmonary complications after major abdominal surgery, and frailty was an important factor in predicting postoperative pulmonary complications (AUC 0,90, %95 Cl 0,565-0,741). In a prospective cohort study to examine the effect of frailty after emergency abdominal surgery in older adults (n=109), loss of functional independence at first year was researched using two frailty measures (Fried and Frailty index-11). In the study, Fried frailty Index was significantly associated with loss of functional independence at first year (OR 13.00, 95% CI 2.21-76.63).[26] In another study (n=104) in which frailty was evaluated as a predictor for postoperative complications in older adults undergoing major abdominal surgery, frail patients showed significantly longer hospital stays, ICU admissions, readmissions, and higher mortality rates. In addition, frailty was identified as an independent predictor for 30-day perioperative complications (AUC 0.75).[21] In another study, the Fried frailty index were found to be predictive of one-year mortality in major abdominal surgery.[27] The findings of our study corroborate the findings of the previous studies.

Considering the existing literature, there is no common tool used in assessment of frailty. More than 70 documented frailty measurement tools have been reported in the literature, ranging from short questionnaires to long assessments and patient examinations.[23] It has also been observed that the FRAIL scale,[24] frailty scale,[25] modified Rockwood frailty index,[21] fried frailty index,[27] and clinical frailty scale[28] are used in patients undergoing major abdominal surgery. It is important to agree on a common frailty tool in the assessment of frailty in surgical patients.

In our study, the mean score of the QoR-40 on the postoperative third day of the older adults who had major abdominal surgery was 147.09±15.82. According to these results, it can be stated that the recovery of quality of the patients is above the medium level. Oreskov et al.[29] (2020) used the QoR-15 scale in a prospective observational cohort study in which they evaluated the quality of recovery of patients undergoing emergency major abdominal surgery. In the study, it was reported that patients showed poor and moderate quality of recovery in the first seven days postoperatively. It is considered that this may be because patients who are taken to emergency surgery have worse patient outcomes in the preoperative period. In another cross-sectional study (n=105), which was conducted to examine the relationship between frailty level and quality of recovery in elderly patients hospitalized in the neurosurgery clinic, the mean QoR-40 score of the patients was found to be 134.49±11.09.[30] When studies on the quality of recovery are examined, there is a limited number of studies involving orthopedic surgery,[31] day surgery,[32] oncologic surgery,[33] and/or all elective surgery patients,[34,35] in the literature. It would not be wrong to claim that the quality of recovery is a patient outcome criterion that is less valued in the post-surgical follow up of patients.

In the model established to determine the quality of recovery in older adults undergoing major abdominal surgery; age, CCI, frailty, and operation time were significantly associated with the quality of recovery. Our results show that as patients' Fried frailty index score increases, their Q0R-40 total score decreases (OR -3.81, 95% CI -4.79- -2,83). In an observational prospective study (n=138), which was conducted to determine the predictors of poor-quality recovery after cancer surgery, one-third of the patients consisted of gastrointestinal cancer patients. In the study, there is a relationship between poor healing quality and frailty, and it was reported that patients with poor healing quality were frailer.[36] In a prospective cohort study evaluating frailty's ability to predict the quality of postoperative recovery in patients with gynecological cancer, Liu et al.[37] (2023) determined that frailty was a significant predictor of the 3-day QoR-15 score (OR 11.69, 95% CI 4.26-32.08). Günel and Özşaker[30] (2021), in their study dealing with the neurosurgery clinic, stated that there was a negative and weak correlation between frailty and the total score of the QoR-40. (r=-0,336, p<0,05). Despite the limited number of studies, it may be possible to say that frailty is a determinant of poor quality of recovery.

Limitations

There are some limitations in this study. First, it may be that the study included results from a single center. In addition, not following the long-term complications of the patients is a limitation of the study.

CONCLUSION

In this study, frailty is a significant predictor for 30-day postoperative complications and poor quality of recovery older adults undergoing major abdominal surgery. The Fried frailty index can be used in preoperative risk examination because of its ability to predict postoperative complications and quality of recovery. In both clinical and studies, there is a need for using more patient outcome parameters based on patient self-assessment. Long-term studies are recommended to search the effect of frailty on the long-term patient outcomes of older adults undergoing major abdominal.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Erciyes University Faculty of Medicine Clinical Researches Ethics Committee (Date: 07.01.2021, Decision No: 2021-480).

Informed consent: Informed consent was obtained from the participants.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Rafalimanana H. World Population Ageing. Economic and Social Affairs United Nations. 2020. 1-47 p. Available from: http://link.springer.com/chapter/10.1007/978-94-007-5204-7_6
2. Mohanty S, Rosenthal RA, Russell MM, Neuman MD, Ko CY, Esnaola NF. Optimal Perioperative Management of the Geriatric Patient: Best Practices Guideline from ACS NSQIP® /American Geriatrics Society. *J Am Coll Surg.* 2016;222:930-4(5):930-934.
3. Ayan FS, Dagtekin T. Geriatrik cerrahide güncel yaklaşımlar. *İstanbul Gelişim Üniv Sağ Bil Derg.* 2020;12(12):460-474.
4. Office for National Statistics. Estimates of the Very Old (including Centenarians): England and Wales, and United Kingdom, 2002 to 2014. 2015. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/bulletins/estimatesoftheveryoldincludingcentenarians/previousReleases
5. Partridge JSL, Moonesinghe SR, Lees N, Dhesi JK. Perioperative care for older people. *Age Ageing.* 2022;51(8):1-6.
6. Simões CM, Carmona MJC, Hajjar LA, et al. Predictors of major complications after elective abdominal surgery in cancer patients. *BMC Anesthesiol.* 2018;18(1):1-8.
7. Kassahun WT, Babel J, Mehdorn M. Assessing differences in surgical outcomes following emergency abdominal exploration for complications of elective surgery and high-risk primary emergencies. *Sci Rep.* 2022;12(1):1-10. doi:10.1038/s41598-022-05326-4
8. British Geriatrics Society. Guideline for the care of people living with frailty undergoing elective and emergency surgery that encompasses the whole perioperative pathway. 2021. Available from: https://www.bgs.org.uk/cpocfrailty
9. Pang CL, Gooneratne M, Partridge JSL. Preoperative assessment of the older patient. *BJA Educ.* 2021;21(8):314-320. doi:10.1016/j.bjae.2021.03.005
10. Sandini M, Pinotti E, Persico I, Picone D, Bellelli G, Gianotti L. Systematic review and meta-analysis of frailty as a predictor of morbidity and mortality after major abdominal surgery. *BJS Open.* 2017;1(5):128-137.
11. Chen Y, Wang J, Liu S, et al. Development and validation of the Chinese version of the quality of recovery-40 questionnaire. *Ther Clin Risk Manag.* 2020;16:1165-1173.
12. Gornall BF, Myles PS, Smith CL, et al. Measurement of quality of recovery using the QoR-40: a quantitative systematic review. *Br J Anaesth.* 2013;111(2):161-169.
13. Christner S, Ritt M, Volkert D, Wirth R, Sieber CC, Gaßmann KG. Evaluation of the nutritional status of older hospitalised geriatric patients: a comparative analysis of a Mini Nutritional Assessment (MNA) version and the Nutritional Risk Screening (NRS 2002). *J Hum Nutr Diet.* 2016;29(6):704-713.
14. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis.* 1987;40(5):373-383.
15. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: Evidence for a phenotype. *J Gerontol A Biol Sci Med Sci.* 2001;56(3):146-156.
16. Manekk RS, Gharde P, Gattani R, Lamture Y. Surgical complications and its grading: a literature review. *Cureus.* 2022;14(5):e24963.
17. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004;240(2):205-213.
18. Myles P, Weitkamp B, Jones K, Melick J, Hensen S. Validity and reliability of a postoperative quality of recovery score: The QoR-40. *Br J Anaesth.* 2000;84(1):11-15.
19. Karaman S, Arici S, Dogru S, et al. Validation of the Turkish version of the quality of recovery-40 questionnaire. *Health Qual Life Outcomes.* 2014;12(1):1-6.
20. Yin Y, Jiang L, Xue L. Comparison of three frailty measures for 90-day outcomes of elderly patients undergoing elective abdominal surgery. *ANZ J Surg.* 2021;91(3):335-340.
21. Aguilar-Frasco JL, Rodríguez-Quintero JH, Moctezuma-Velázquez P, et al. Frailty index as a predictive preoperative tool in the elder population undergoing major abdominal surgery: a prospective analysis of clinical utility. *Langenbeck's Arch Surg.* 2021;406(4):1189-1198.
22. Than TNH, Nguyen T, Nguyen TTT, Pham T. Frailty and adverse outcomes among older patients undergoing gastroenterological surgery in vietnam. *J Multidiscip Healthc.* 2021;14:2695-703.
23. Kennedy CA, Shipway D, Barry K. Frailty and emergency abdominal surgery: a systematic review and meta-analysis. *Surgeon.* 2022;20(6):307-314. doi:10.1016/j.surge.2021.11.009
24. Han B, Li Q, Chen X. Effects of the frailty phenotype on post-operative complications in older surgical patients: a systematic review and meta-analysis. *BMC Geriatr.* 2019;19(1):1-9.
25. Aceto P, Perilli V, Luca E, et al. Predictive power of modified frailty index score for pulmonary complications after major abdominal surgery in the elderly: a single centre prospective cohort study. *Eur Rev Med Pharmacol Sci.* 2021;25(10):3798-3802.

26. Tan HL, Chia STX, Nadkarni NV, Ang SY, Seow DCC, Wong TH. Frailty and functional decline after emergency abdominal surgery in the elderly: A prospective cohort study. *World J Emerg Surg.* 2019;14(1):1-7.

27. Li JL, Henderson MA, Revenig LM, et al. Frailty and one-year mortality in major intra-abdominal operations This study was presented at the World Congress of Endourology in London in October 2015. *J Surg Res.* 2016;203(2):507-512. doi:10.1016/j.jss.2016.03.007

28. Parmar KL, Pearce L, Farrell I, Hewitt J, Moug S. Influence of frailty in older patients undergoing emergency laparotomy: a UK-based observational study. *BMJ Open.* 2017;7(10):1-5.

29. Oreskov JO, Burcharth J, Nielsen AF, Ekeloef S, Kleif J, Gögenur I. Quality of recovery after major emergency abdominal surgery: a prospective observational cohort study. *Minerva Chir.* 2020;75(2):104-110.

30. Günel B, Özşaker E. Investigation of the relationship between the level of vulnerability and recovery quality of elderly patients hospitalized in the neurosurgery clinic. Ege üniversitesi; 2021.

31. Wessels E, Perrie H, Scribante J, Jooma Z. Quality of recovery following orthopedic surgery in patients at an academic hospital in South Africa. *Anesth Analg.* 2021;133(2):507-514.

32. Chazapis M, Walker EMK, Rooms MA, Kamming D, Moonesinghe SR. Measuring quality of recovery-15 after day case surgery. *Br J Anaesth.* 2016;116(2):241-248.

33. Marinho R, Lusquinhos J, Carvalho B, Azevedo J, Santos A, Abelha F. Quality of recovery after surgery for cancer treatment. *Rev Española Anestesiol y Reanim.* 2018;65(8):426-433. doi:10.1016/j.redare.2018.04.012

34. Ferraz SM, Moreira JP, Mendes LC, et al. Evaluation of the quality of recovery and the postoperative health status after elective surgery. *Brazilian J Anesthesiol.* 2018;68(6):577-583.

35. Guimarães-Pereira L, Costa M, Sousa G, Abelha F. Quality of recovery after anaesthesia measured with QoR-40: a prospective observational study. *Brazilian J Anesthesiol.* 2016;66(4):369-375.

36. Marinho R, Lusquinhos J, Carvalho B, Azevedo J, Santos A, Abelha F. Quality of recovery after surgery for cancer treatment. *Rev Española Anestesiol y Reanim.* 2018;65(8):426-433.

37. Liu C, Gao W, Zhou L, et al. Can the Tilburg Frailty Indicator predict post-operative quality of recovery in patients with gynecologic cancer? a prospective cohort study. *Int J Gynecol Cancer.* 2023;33(5):1-6.