

# Feasibility of Exercise Stress Test as an Indicator of Disease Severity in Cardiac Rehabilitation Patients

Annett Salzwedel, Angelika Rieck, Heinz Völler

## Objective

Training is a core component of cardiac rehabilitation (CR). There is evidence of a substantial benefit of CR, especially for patients with low exercise capacity at admission. Nevertheless, some patients are not capable to perform the initial exercise stress test (EST). Characteristics of those patients were not sufficiently considered. Therefore, we aimed to identify predictors for the feasibility of EST in patients after a cardiac event.

## Methods and Material

We analysed data of 1,094 patients after an acute coronary event (71 ± 7 years, 78 % men), who were consecutively enrolled in a national multicentric registry. All patients underwent a standardised comprehensive in-patient CR program of 3-4 weeks, starting averagely 9 days after discharge from the hospital.

We analysed sociodemographic and clinical variables (e.g. cardiovascular risk factors, comorbidities, complications at admission to CR, 6-min walking distance [6MWD]) with respect to the feasibility of an EST using a multivariable logistic regression model. For evaluation of the focus of CR, the individual therapy volume (total minutes) in different categories (e.g. physical training, nursing care, patient education) was registered.

**Table 1** Patient characteristics depending on feasibility of an exercise stress test

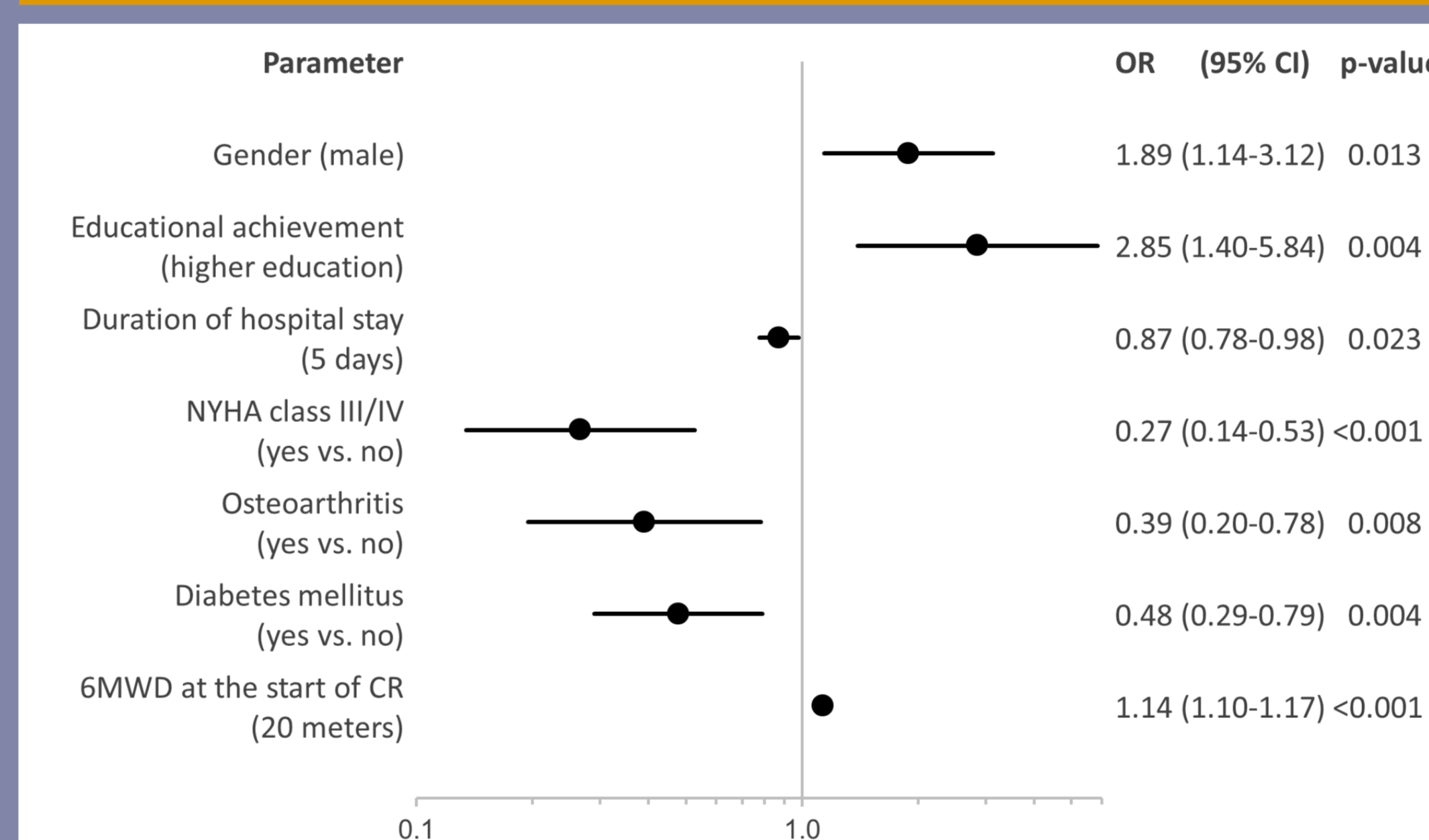
Parameter	Exercise ECG		p-value
	Yes (n = 928)	No (n = 166)	
Age (years)	70.4 ± 6.8	73.3 ± 7.8	<0.001
Gender (male)	81.4	62.0	<0.001
Higher education	31.2	18.1	0.001
CR after surgery	62.3	56.6	0.169
Hospital stay (days)	11.9 ± 7.2	15.8 ± 11.6	<0.001
<b>Risk factors</b>			
Diabetes mellitus	24.3	36.7	0.001
Arterial hypertension	83.1	86.1	0.330
Pulmonary hypertension	10.8	25.9	<0.001
Smokers <sup>a</sup>	14.4	10.8	0.219
Obesity	16.4	17.5	0.728
<b>Clinical characteristics</b>			
Complications <sup>b</sup>	5.0	9.0	0.035
LVEF ≤50 %	28.3	33.7	0.157
Atrial fibrillation	12.2	24.7	<0.001
Pericardial effusion	4.7	4.8	0.963
Pleural effusion	29.9	33.6	0.364
NYHA class III/IV	9.0	27.1	<0.001
<b>Comorbid conditions</b>			
Number	0.7 ± 0.9	1.0 ± 1.1	<0.001
Congestive heart failure	7.9	9.0	0.607
Stroke	4.7	9.0	0.024
PAD	5.9	12.7	0.001
Osteoarthritis	7.4	15.1	0.001
Chronic back pain	11.1	17.5	0.020

<sup>a</sup> Current and former smokers with less than five years of abstinence.  
<sup>b</sup> Complications at CR admission. The most frequent condition was impairment of wound healing impairment (n = 50, 4.6 %).

## Results

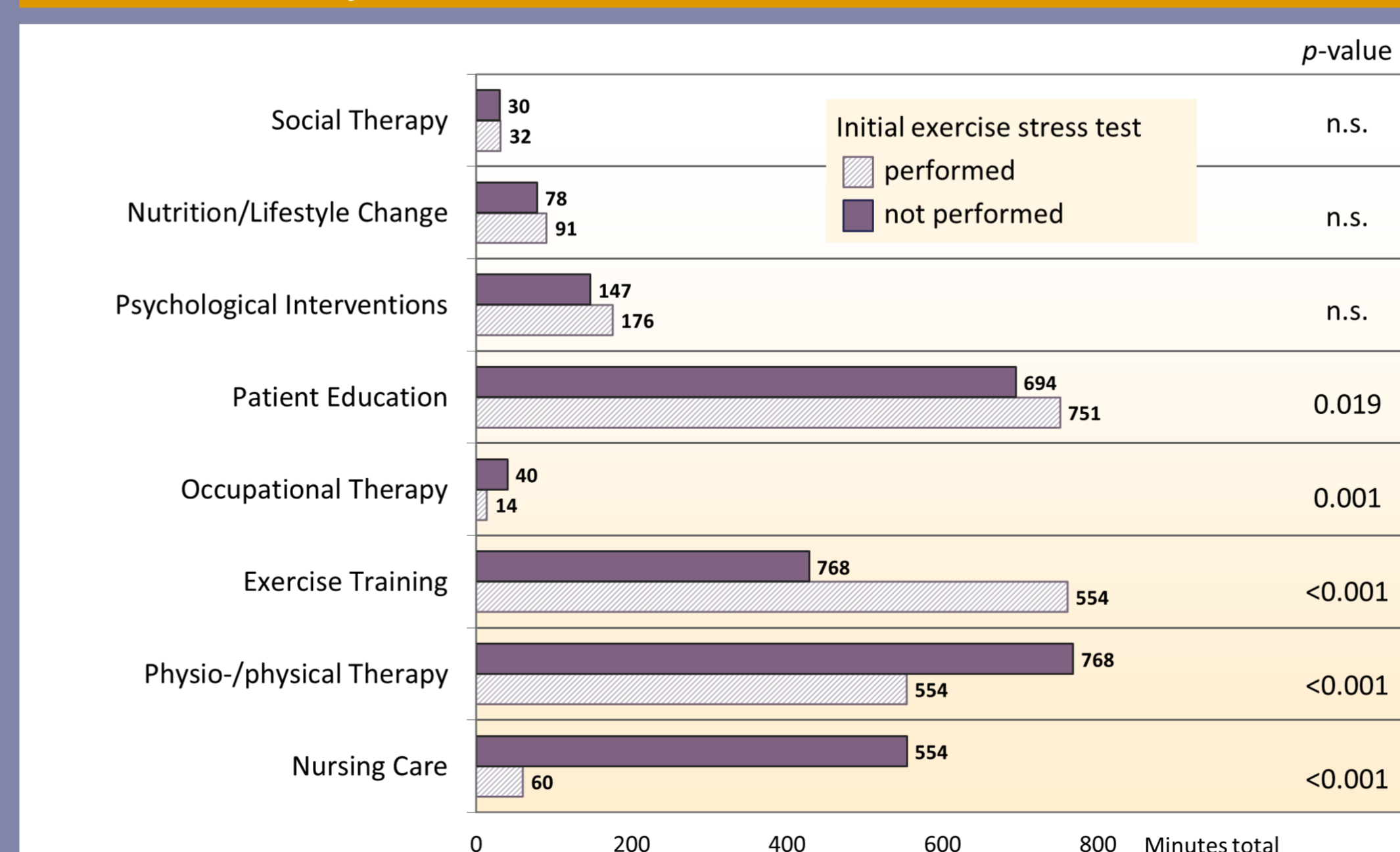
In the investigated population, the most common indications for CR were CABG (33 %), PCI (21 %), and heart valve replacement (14 %). 166 patients (15 %) were unable to perform an initial EST. They were older, had a longer in-hospital stay, more complications and comorbidities, and more often NYHA class III/IV than patients with EST (Tab. 1).

**Fig. 1** Predictors of feasibility of exercise stress test



OR odds ratio, CI confidence interval, NYHA New York Association; Regression model, adjusted for age and cardiac rehabilitation center effect.

**Fig. 2** Therapy volume (total minutes) during CR with respect to feasibility of an initial exercise stress test



**Table 2** Improvement of 6-min. walk distance during cardiac rehabilitation

6-min walk distance (meters)	Exercise ECG		p-value (group differences)
	yes	no	
Admission	369.8 ± 135.9	204.8 ± 169.4	<0.001
Discharge	469.6 ± 133.7	325.8 ± 175.9	<0.001
Difference	102.8 ± 103.8	123.0 ± 129.9	0.122
p-value (within group)	<0.001	<0.001	

Values are presented as mean ± SD.

In the multivariable logistic regression, the probability of obtaining an EST was significantly higher for men, a longer 6MWD, and a higher education level, but lower for patients with diabetes mellitus, NYHA class III/IV, osteoarthritis, and a longer hospital stay (Fig. 1). Patient age failed to achieve significance in the multivariate analysis (p=0.67).

Patients who did not perform an EST received less therapy units of training and education, but more units of nursing care and physiotherapy (Fig. 2). However, these patients could increase their maximum walk distance during CR as well as patients who performed the EST (Tab. 2).

## Conclusion

Feasibility of an initial EST early after an acute cardiac event is an indicator of disease severity. However, patients without EST benefit from CR though exercising less. There is a justified need not only for exercise based, but also for the comprehensive, interdisciplinary CR.