



**CARDIOVASCULAR FITNESS, QUALITY OF LIFE  
AND DEPRESSION/ANXIETY SCORE IN PATIENTS AFTER  
MYOCARDIAL INFARCTION AND PERCUTANEOUS CORONARY  
INTERVENTION UNDER PHYSIOTHERAPEUTIC TREATMENT -  
OBSERVATIONAL STUDY**

**Kinga Balla<sup>1i</sup>,**

**Karl-Konstantin Haase<sup>2</sup>**

<sup>1</sup>Dr.,

Klinikum am Steinenberg,

72764 Reutlingen,

Steinenberg Str. 31,

Germany

[orcid.org/0000-0002-5569-3487](https://orcid.org/0000-0002-5569-3487)

<sup>2</sup>Prof. Dr.,

Klinikum am Steinenberg,

72764 Reutlingen,

Steinenberg Str. 31,

Germany

**Abstract:**

**Purpose:** The aim of this study was to observe how does cardiovascular fitness, quality of life, and depression/anxiety score change in patients under physiotherapeutic treatment immediately after myocardial infarction (MI) and percutaneous coronary intervention (PCI). **Methods:** Fifty patients with acute MI (NSTEMI = non-ST-elevation myocardial infarction / STEMI = ST-elevation myocardial infarction) who underwent PCI took part in the study on a voluntary basis. The MI mobilization plan consisted of three stages, each stage lasted two days, starting with the PCI day. Vital parameters (blood pressure, pulse, respiratory rate, and oxygen saturation) were measured. The Borg scale and pedometers for measuring the step count were used. The patients completed the questionnaires (the German-language adaptation of the MacNew Heart Disease Quality of Life Questionnaire (MacNew) and of the Hospital Anxiety and Depression Scale (HADS-D)) independently on the first day of treatment and on the day of discharge. The data were compared to reference values from large representative databases. **Results:** In the before/after comparison the deterioration in the quality of life was significantly lower than the recommended MID value for MacNew (0.5 points on the Likert scale). There was

<sup>i</sup> Correspondence: email [kinga.balla@kliniken-rt.de](mailto:kinga.balla@kliniken-rt.de)

a minor improvement (standardized response mean: SRM 0.2) in the global HADS-D scores in the before/after comparison. **Conclusion:** The quality of life results indicate that a lasting positive effect can be achieved in patients through immediate information and early training. The results of the HADS-D confirmed the hypothesis that exercise training and education can improve anxiety and depression scores.

**Keywords:** myocardial infarction, physiotherapy, quality of life, anxiety, depression

### **Zusammenfassung:**

**Das Ziel:** dieser Studie war es zu beobachten, wie sich die Lebensqualität und der Depressions-/Angst-Score bei Patient\*innen unter physiotherapeutischer Behandlung in der akuten Phase eines Myokardinfarkts (MI) nach einer perkutanen Koronarintervention (PCI) verändern. **Methode:** Fünfzig Patient\*innen mit akutem Myokardinfarkt (NSTEMI = Nicht-ST-Hebungsinfarkt / STEMI = ST-Hebungsinfarkt), die sich einer PCI unterzogen, nahmen freiwillig an der Studie teil. Der Herzinfarktmobilisationsplan bestand aus drei Phasen zu je zwei Tagen, beginnend mit dem PCI-Tag. Vitalparameter (Blutdruck, Puls, Atemfrequenz und Sauerstoffsättigung) wurden gemessen. In dieser Studie wurde die Borg-Skala verwendet und die Schrittzahl wurde mit Pedometer gemessen. Die Patient\*innen füllten die Fragebögen (Deutsche Version von MacNew Heart Disease Quality of Life Questionnaire (MacNew) und Hospital Anxiety and Depression Scale (HADS-D)) am ersten Behandlungstag und am Tag der Entlassung selbstständig aus. Die Daten wurden mit Referenzwerten aus großen repräsentativen Datenbanken verglichen. **Ergebnisse:** Im Vorher-Nachher-Vergleich war die Verschlechterung der Lebensqualität deutlich unter dem empfohlenen minimal important difference Wert für MacNew. Es gab eine minimale klinische Verbesserung (standardized response mean: SRM 0,2) bei den globalen HADS-D-Scores im Vorher-Nachher-Vergleich. **Diskussion:** Die Lebensqualität-Ergebnisse deuten darauf hin, dass durch unmittelbare Information und frühzeitige Schulung ein nachhaltig positiver Effekt bei den Patient\*innen erzielt werden kann. Die Ergebnisse des HADS-D bestätigten unsere Hypothese, dass körperliches Training und Schulung die Angst- und Depressionswerte verbessern können.

**Keywords:** Myokardinfarkt, Physiotherapie, Lebensqualität, Angst, Depression

## **1. Introduction**

Acute myocardial infarction (MI) is a leading cause of morbidity and mortality globally [1]. The prevalence of the disease approaches three million people worldwide [2]. In Germany in 2020, cardiovascular diseases - especially ischemic heart diseases and myocardial infarction - were responsible for more than a third of deaths [3].

An acute MI may lead to irreversible damage to the heart muscle due to a lack of oxygen caused by decreased coronary blood flow: available oxygen supply cannot meet oxygen demand. Associated symptoms include (AHA 2020 [4,5]) chest pain or pressure, shoulder or arm pain, sweating, shortness of breath, nausea, anxiety, etc.

The primary treatment form for MI is the percutaneous coronary intervention (PCI), which enables the reperfusion of the heart and restores the blood flow [2]. An early PCI treatment is the key to a good prognosis and cardiac rehabilitation [2]. The rehabilitation process is divided into three phases [6]. The first phase is the clinical phase, which begins with the in-hospital setting after intervention (PCI). Phase II is outpatient cardiac rehabilitation, which commences about the third week after PCI and lasts three to four weeks. In the third phase or post-cardiac rehabilitation, patients receive encouragement to maintain an active lifestyle and continue the exercises.

## 2. Literature review

The period of the first phase (clinical) is the most vital phase of cardiac rehabilitation [7]. Haykowsky *et al.* [8] conducted a meta-analysis and found that delaying the start of training leads to a poorer baseline situation in terms of left ventricular function. This confirms the need for daily therapy immediately after MI [9,10]. Ryan *et al.* [11] described that the early start of exercise training and education about the rules of conduct in everyday life has a stress-reducing and behavior-modifying effect, leading to a better quality-of-life score. Increasing the quality of life of MI patients is a general goal of medical measures. The health-related quality of life (HRQoL) is an essential assessment parameter for the effectiveness of therapeutic services in clinical-cardiological research [12,13].

Studies have shown that low values in the quality of life questionnaire indicate an increased risk of recurrence of a cardiac event [14]. Furthermore, depression and anxiety are closely associated with HRQoL after MI [15–18]. Since the prevalence of anxiety and depression is significantly higher in cardiology patients than in the general population, special tests to record mental health (anxiety/depression) have proven to be particularly useful. Depression, which can significantly influence the course of the disease, is considered an independent risk factor for heart disease [19–23]. The HADS-D (Hospital Anxiety and Depression Scale – German version [24]) serves as a simple screening instrument for detecting depression in the field of cardiology. Studies have shown that early identification and intervention against depression and anxiety may help to improve HRQoL in the early stage of recovery from MI [15,16,18,25].

## 3. Our hypothesis

- 1) in the pre/post comparison, the difference in the quality of life is better than the minimal important difference (MID) for MacNew (0.5 points on the Likert scale

[14,26]); (2) the anxiety and depression scores after treatment are better than before.

## 4. Material and Methods

### 4.1 Study type and period

The implementation of this observational study was between July 2021 and March 2022.

### 4.2 Study population

Patients with acute MI (NSTEMI; AW STEMI, anterior wall ST-elevation myocardial infarction; PW STEMI, posterior wall ST-elevation myocardial infarction) with PCI took part in the study voluntarily. The inclusion criteria were acute MI with PCI. The exclusion criteria were MI with conservative therapy, palliative patients, language barrier, patients with dementia or immobility, and isolated patients with acute infection. Ethical approval was obtained from the Ethics Committee of the Hospital Kreiskliniken Reutlingen GmbH before recruitment. The participants were informed that they could withdraw from the study at any time. All the enrolled patients signed an informed consent before participation.

Seventy-two patients consented initially to the study. There were 50/72 (69.4%) patients who also completed the study. 4/72 (5.6%) patients had to withdraw from the study because an urgent coronary bypass surgery had to be performed. 1/72 (1.4%) patients stopped because of the language barrier and 17/72 (23.6%) patients took part in physiotherapy but did not hand in the second questionnaire packages for different reasons on the day of discharge.

The demographic characteristics of the study participants (see below Table 3 and 4): the mean age of the patients was 58.4 (SD 11.3), ranging between 30 and 81 years. More than half of the patients were male (66%), with a diagnosis of NSTEMI (56%) and reduced left ventricular pump function (52%).

### 4.3 Study procedure

Physicians at the intensive care unit, intermediate care unit, or cardiology section in Kreiskliniken Reutlingen identified potential participants based on the inclusion criteria and issued prescriptions for in-hospital physiotherapy treatment. A research assistant (physiotherapist working on the above-mentioned sections) conducted the therapy.

The physiotherapeutic treatment in phase I in Kreiskliniken Reutlingen GmbH, Germany, includes the dose increase in cardiovascular fitness according to the myocardial infarction mobilization plan (A) based on the Heidelberger model [27] and the education about the rules of conduct in everyday life with the help of a myocardial infarction flyer (B).

**A)** The myocardial infarction mobilization plan consisted of three stages, each two days, starting with the coronary angiography day (Table 1).

**Table 1:** The myocardial infarction mobilization plan

Stage I (Day 1*+2)	Stage II (Day 3+4)	Stage III (Day 5+6)
Education with Flyer	Discuss the questions	Discuss the questions
Study own heart rate measure	Own heart rate measure control	-
Bed or chair-exercises with exercise/relaxation 1:2	Chair-exercises with exercise/relaxation 1:1	Chair-exercises with exercise/relaxation 2:1
Walking into the room	Walking on the corridor	Stair climbing
Limitation of the heart rate is 10 more than the resting heart rate	Limitation of the heart rate is 20 more than the resting heart rate	Limitation of the heart rate is 30 more than the resting heart rate
STOP by discomfort, pulse limit exceeded, systolic pressure value 20> mmHg than at rest, respiratory rate >32 min <sup>-1</sup>		

\*Day 1 is PCI day.

To record cardiovascular fitness in patients at each level, the vital parameters (blood pressure, heart rate, respiratory rate, and oxygen saturation) were measured by physiotherapists at rest, after chair exercises, after walking or after climbing stairs, and after 3 min of recovery. The data were supplemented with Borg scale values, the distance covered during mobilization was recorded, and steps were counted using a pedometer (pedometer model: OMRON Walking Style IV). There was no physiotherapy on weekends; the patients carried out their exercises independently, which were previously discussed.

**B)** The educational program about the rules of conduct in everyday life was based on our flyer for MI patients and included general information about MI, symptoms of MI, the goal of physiotherapy by MI, stage of MI mobilization plan, indications (e.g., heart sports group, rehabilitation, endurance sport, healthy nutrition, risk factors, etc.) and contraindications (for six weeks: heart rate > resting heart rate + 30bpm, lifting >5 kg, dyspnea etc.). On discharge, the patients must have been able to correctly assess the intensity of exertion within the specified limits based on the heart rate monitoring and exertion protocol (Borg scale) and to react adequately to any symptoms that may occur.

The German version of the MacNew (MacNew Heart Disease Quality of Life Questionnaire, see below) and the HADS-D (Hospital Anxiety and Depression Scale, see below) were used to examine the quality of life, anxiety, and depression scores. The retrospective questionnaires were filled out independently on the first day of treatment and the day of discharge. The first time, the patients had to think about the week preceding coronary angiography and, on the day of discharge, about the week of hospitalization after PCI. They filled out the questionnaires accordingly (Table 2).

**Table 2:** Study protocol

<b>Study Protocol</b>	
<b>Physiotherapist specialized in cardiology</b>	<b>Patient</b>
MI mobilization and education daily. No therapy on weekends.	Day 1 physiotherapy: MacNew and HADS-D filled out independently
Vital parameter measurements (at rest, after chair-exercises, after walking or after climbing stairs, and then at recovery after 3 min)	Discharge day with physiotherapy: MacNew and HADS-D filled out independently

**Legend:**

MI = myocardial infarction,

Vital parameter (blood pressure, pulse, respiratory rate, and oxygen saturation),

MacNew = MacNew Heart Disease Quality of Life Questionnaire,

HADS-D = Hospital Anxiety and Depression Scale.

#### 4.4 Measurement tools

##### 4.4.1 MacNew Heart Disease Quality of Life Questionnaire

The MacNew instrument [26] consists of 27 items that measure the three inter-related emotional, physical, and social well-being domains. Domain scores are calculated as the average responses to the items in each area. A global HRQoL score results when averaging all 27 items.

The items were answered independently and rated from 1 to 7 (seven-point Likert scale), with a higher score indicating a better quality of life. Missing items did not contribute to the score, and if less than half of the items in a domain have been completed, the score was not calculated for that domain. Values from 1 to 4 (particularly poor quality of life) were regarded as conspicuous, values from 4 to 6 (normal range) as average, and values above 6 (specifically high quality of life) as above average. The clinically important change, calculated by standardized response mean (SRM), played an important role. An SRM (= mean change in score/standard deviation [14]) of 0.2 was considered minimal; 0.5 was moderate, and 0.8 or more was a strong change, respectively [14]. The MID on the MacNew was determined with 0.5 points (on a seven-point scale) as significant [26]. This value corresponds to the “*smallest amount of change required for the difference to represent a clinically meaningful change*” [14].

Normative reference data are essential for the interpretability of HRQoL scores. The updated reference data for MacNew relies on the International HeartQoL Project database consisting of data from 2.299 patients with myocardial infarction [26]. This instrument has been proven valid, reliable, sensitive to minimal and clinically significant changes, and is widely used in German-speaking countries.

##### 4.4.2 German-language adaptation of the Hospital Anxiety and Depression Scale - HADS-D

The questionnaire is processed independently (approximately 5 minutes) and tracks the most frequently occurring psychological symptoms in the field of somatic medicine: anxiety and depression [24]. This questionnaire serves as a simple screening instrument

for identifying depression, particularly in the case of heart disease. The HADS-D contains 14 items (seven per subscale anxiety or depression, in alternating order) with four-level answer options (0-3). This results in a possible range of values from 0 to 21 for each subscale. Values are considered normal ( $\leq 7$ ), borderline (8-10), severe symptoms (11-14), and very severe symptoms (15-21). There is an age- and gender reference-value table for patients with cardiac disorders and the general German population [28].

#### 4.5 Statistics

We use descriptive statistics to present the sample characteristics, including means, standard deviations (SD), and percentages. We also calculate SRM and CI 95%. One sample Wilcoxon test is used to compare the values with the MID. For the pre/post comparison regarding anxiety and depression, Wilcoxon matched-pairs signed rank test (in case of normal distribution) or paired-sample T-test is applied to compare the data, using GraphPadPrism10 (Graph Pad, USA). After applying the Bonferroni correction, the significance level is set at  $p=0.007$ , global 5%.

### 5. Results and Discussion

#### 5.1 Quality of life

A deterioration (SRM 0.2 = minimal important change) was found in the global health-related quality of life. Table 3 shows that in the pre/post comparison, the deterioration in the quality of life was significantly lower than the recommended MID value for MacNew (0.5 points on the Likert scale).

Matching our expectations, the health-related quality of life of the patients participating in this study was slightly lower on the day of discharge than at the beginning. In light of the fact that MacNew is a retrospective questionnaire, it is understandable that the patients showed a limited quality of life in the physical, emotional, and social areas, owing to their heart attack and acute treatment in the hospital. Movement restrictions and exercise limitation in the first few days, the emotional processing of the potentially life-threatening MI event, the restricted visiting opportunities during the coronavirus pandemic, and the resulting reduction of social contacts, probably played a major role in the deterioration of the QoL.

When interpreting the MacNew values, we relied not only on statistical significance, but also on clinical importance. The MID of 0.5 is considered significant and represents a minor change in the quality of life outcome measure, which is large enough to trigger a change in management [14,15,26]. The result that our patients experienced a lower deterioration than the MID in the before/after comparison on the MacNew questionnaire suggests that a lasting positive effect can be achieved in patients through immediate information and early training.

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**Table 3:** Demographic characteristics of the study participants and the pre/post results of the MacNew questionnaire

	N	MacNew pre	CI95% pre	MacNew post	CI95% post	Difference pre/post	SRM	MacNew (Western Europe N=583) [26]	MacNew (Total cohort N=2.299) [26]	Kang <i>et al.</i> N=150 [30]	P MacNew pre/post One sample Wilcoxon Test (MID 0.5)	
<b>Global MacNew</b>	50	5.48 ±1	5.21-5.75	5.24±0.9	4.97-5.51	0.24±1.1	0.2	5.3±1	5.27±1	4.46±0.83	<b>P&lt;0.0001</b>	
<b>Dimensions</b>	Physical	50	5.66±1.1	5.36-5.96	5.28±1	5.01-5.55	0.38±1.2	0.3	5.4±1.1	5.28±1.1	4.43±0.99	P=0.58
	Emotional	50	5.21±1.1	4.91-5.51	5.2±1.1	4.9-5.50	0.02±1.3	0.01	5.23±1.1	5.27±1.1	4.42±0.82	P=0.015
	Social	50	5.84±1	5.56-6.12	5.18±1.1	4.90-5.46	0.66±1.3	0.5	5.4±1.1	5.27±1.2	4.83±0.93	P=0.37
<b>Age</b>	<65 Y	39	5.45 ±1	5.18-5.72	5.21 ±0.9	4.95-5.47	0.24±1.2	0.2	-	5.26 ±1	4.7±0.83	
	65-75 Y	9	5.66 ±1	5.38-5.94	5.53 ±0.8	5.31-5.75	0.13±1	0.1	-	5.33 ±1.1	4.41±0.74	
	> 75 Y	2	5.21 ±1.1	4.91-5.51	4.64 ±0.9	4.4-4.88	0.57±0.9	0.7	-	5.2 ±1.1	4.03±0.82	
<b>Gender</b>	Male	33	5.54±1.1	5.26-5.82	5.21±0.9	4.97-5.45	0.33±1.2	0.3	-	5.11±1.1	4.57±0.83	
	Female	17	5.36±0.9	5.10-5.62	5.31±1	5.04-5.58	0.06±1.1	0.05	-	4.83±1.1	4.17±0.79	
<b>NSTEMI /STEMI</b>	NSTEMI	28	5.2±1	4.88-5.44	5.4±0.8	5.13-5.63	0.2±1	0.2	-	-	4.37±0.83	
	AW STEMI	10	6.1±0.5	5.99-6.27	4.9±1.1	4.63-5.23	1.19±1	1.1	-	-	4.58±0.83	
	PW STEMI	12	5.7±0.9	5.45-5.93	5.2±0.8	4.95-5.39	0.52±1	0.54	-	-		
<b>LV Function</b>	Normal	24	5.5±1.1	5.14-5.76	5.3±0.9	5.02-5.50	0.2±1.1	0.17	-	-	-	
	Mildly red.	11	5.1±0.8	4.89-5.33	5.3±0.9	5.07-5.59	0.22±1.1	0.2	-	-	-	
	Moderately + severe red	15	5.8±0.8	5.58-6.0	5.1±1	4.88-5.42	0.63±1.2	0.53	-	-	-	

**Legend:**

MacNew = MacNew Heart Disease Quality of Life Questionnaire,

CI = Confidence interval,

NSTEMI = non-ST-elevation myocardial infarction,

STEMI = ST-elevation myocardial infarction,

LV Function = Left Ventricular pump function,

SRM = Standardized Response Mean.



Reference data enabled the meaningful interpretation of MacNew results for individual patients. When comparing the HRQoL results of this study from the day of discharge with the MacNew reference values for patients with MI completed three weeks or more after the MI event, similar results were found (Table 3).

A related study with 150 patients with MI was conducted in Korea in 2021 [29]. Patients completed the MacNew questionnaire within the first week after the MI event. No physiotherapy treatment was carried out and no repeated completion of the questionnaire took place on the day of discharge. Comparing our results to theirs (Table 3), the participants of our study seem to have a higher average quality of life score on the day of discharge.

## 5.2 Anxiety and depression

There was a minor improvement (SRM = 0.2) in the global and anxiety subscale HADS-D scores in the pre/post comparison, but no significant improvement was found (Table 4).

The results of the HADS-D confirmed the expectations that exercise training and education can improve anxiety and depression scores. This, in turn, is an optimal prerequisite for reducing the risk of recurrence of a cardiac event [24,28,30–32]. The American Heart Association reported that patients with repeated acute coronary syndrome had higher depression, anxiety, and stress levels than those with the first syndrome [32]. The patients with acute MI in this study showed on the day of discharge lower anxiety and depression scores (lower values on the HADS-D mean better anxiety and depression levels) than the reference values [24] for coronary heart disease (CHD) patients (N=2385) and for the German population [28] (N=4410). These results emphasize the beneficial role of physiotherapy in the acute MI phase.

A recent prospective observational study was performed in 2023 by Turen *et al.* [33]. A total of 188 patients with acute MI were included in that study and data were collected within 72 hours after hospital admission. The participants received treatment as usual without physiotherapy session. A similar, previous prospective cohort study was led in 2006 by Dickens *et al.* [34]. 314 patients with acute MI were enrolled (on average 3.6 days after admission) and completed the HADS questionnaire. Participants received treatment as usual, no physiotherapy treatment took place. In both prospective studies mentioned above, the HADS values are much higher (meaning worse) as the HADS-D results from this study, which supports the assumption that with immediately education and physical activity better anxiety and depression scores can be achieved (Table 4).

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**Table 4:** Pre/post results of the HADS-D questionnaire

	N	HADS-D pre	CI95% pre	HADS-D post	CI95% post	Difference pre/post	SRM	HADS-D CHD Patients N=2.385 [28]	HADS-D German Population N=4.410 [24]	Turen <i>et al.</i> N=188 [33]	Dickens <i>et al.</i> N=314 [34]	P HADS-D pre/post T Test	
<b>Global HADS-D</b>	50	9.32±7	7.38-11.3	8.28±6.6	6.45-10.1	1.04±5.7	0.2	11.3±7.7	9.5±6.8	-	-	P=0.2	
<b>Subscale HADS-D</b>	Anxiety (A)	50	5.5±3.8	4.45-6.55	4.8±3.6	3.81-5.83	0.68±3.6	0.2	6.3±4.0	4.7±3.4	10.21±4.3	7.4±4.9	P=0.18
	Depression (D)	50	3.8±3.8	2.78-4.86	3.46±3.3	2.55-4.37	0.36±2.7	0.1	5.0±3.7	4.8±3.8	7.38±3.29	4.9±4.0	P=0.36
<b>Age</b>	30-39 Y	3	5.3±3.8	4.5-6.6	8.3±4.5	7.08-9.58	3±2.0	1.5	12.1±7.9	8.3±6.3	-	-	
	40-49 Y	8	15.38±9.5	12.75-18	11.75±8.6	9.38-14.1	3.6±6.6	0.55	12.9±8	9.8±6.6	-	-	
	50-59 Y	14	7.14±5.6	5.6-8.68	6.71±5.8	5.09-8.33	0.4±3.8	0.11	13.8±8.5		-	-	
	60-69 Y	18	9.28±6.3	7.53-11.0	7.67±6	6.02-9.32	1.5±6.9	0.22	11.5±7.6	10.8±7.1	-	-	
	70> Y	7	8.57±6.8	6.68-10.5	9±8.3	6.7-11.3	0.4±3.9	0.11	12.1±8.6		-	-	
<b>Gender</b>	Male	33	8.36±7	6.42-10.3	8.24±6.9	6.32-10.2	0.12±6.1	0.02	10.9±7.6	9.2±6.7	A:8.9±3.5 D:6.6±2.6	-	
	Female	17	11.18±6.9	9.27-13.1	8.35±6.2	6.63-10.1	2.8±4.1	0.7	13.4±3.8	9.7±6.9	A:13.0±4.6 D:9.0±4.0	-	
<b>NSTEMI /STEMI</b>	NSTEMI	28	9.8±7.5	7.74-11.9	6.8±6.1	5.13-8.51	3±5.5	0.5	-	-	-	-	
	AW STEMI	10	7.5±5	6.11-8.89	10.5±7	8.59-12.4	3±6.0	0.5	-	-	-	-	
	PW STEMI	12	9.7±7.7	7.54-11.8	9.8±7.2	7.83-11.8	0.17±3.6	0.04	-	-	-	-	
<b>LV Function</b>	Normal	24	9.1±6.9	7.17-11.0	7.1±6.0	5.46-8.78	1.96±5.0	0.39	-	-	-	-	
	Mildly red.	11	12.5±8.4	10.2-14.9	9.5±7.2	7.45-11.5	3.1±6.4	0.48	-	-	-	-	
	Moderately + severe red	15	7.3±5.7	5.75-8.91	9.3±7.3	7.24-11.3	1.93±5.3	0.36	-	-	-	-	

**Legend:**

HADS-D = Hospital Anxiety and Depression Scale,  
 CI = Confidence interval,  
 NSTEMI = non-ST-elevation myocardial infarction,  
 STEMI = ST-elevation myocardial infarction,  
 LV Function = Left Ventricular pump function,  
 SRM = Standardized Response Mean,  
 A = Anxiety,  
 D = Depression.

### **5.3 Functional capacity changes during hospitalization**

A significant improvement in cardiovascular endurance ( $p < 0.001$ ) and a strong clinical difference (SRM = 2.3) were registered. In stage I, the patients walked an average of 45.9 steps ( $\pm 26.8$ ), and in stage II, 311.5 steps ( $\pm 105.9$ ).

At stage III, patients (N=45) were able to manage an average of 36.6 ( $\pm 17.4$ ) stairsteps with an average of 4.3 ( $\pm 1.9$ ) Borg scale score. No therapy sessions were discontinued due to symptoms or excessively high Borg values.

The improvement in functional capacity and the low Borg scale values indicated that after a few days of health education and exercise training, the patients correctly assessed the exertion intensity within the specified limit, developing a better self-perception.

## **6. Recommendations**

The goal of the cardiac rehabilitation (CR) programs in the first and most important phase is not only to extend the patient's life, but also to improve physical performance, mental health and in the long term to decrease health care costs. We found a large number of studies which support the benefits of CR in the second phase, but only a few papers which accentuate the role of the rehabilitation (including physiotherapy) in the clinical phase. Our recommendation would be to research and emphasize this phase more. That's why we would like to develop a contemporary mobilization plan for the first rehabilitation phase, so that the MI patients receive the best possible care during their short stay in the hospital.

## **7. Conclusion**

- The deterioration in the quality of life (before/after comparison) was significantly lower than the minimal important difference value (0.5), which indicates that a lasting positive effect can be achieved in patients in the acute myocardial infarction stage by immediate information and an early start of training
- Exercise training and education starting in the acute myocardial infarction phase can improve anxiety and depression scores

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## Declarations

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## Conflict of interest statement

The authors declare that they have no conflict of interest.

## About the authors

**Dr. Kinga Balla** is currently working as a project leader for clinical studies and practical instructor for physiotherapy at Klinikum am Steinenberg, Reutlingen, Germany. She has completed her PhD, has specialized in cardiology and pulmonology and has four years of lecturer experience.

**Professor Dr. Karl-Konstantin Haase** is currently working as Head of Department of Cardiology at Klinikum am Steinenberg, Reutlingen, Germany.

## References

- [1] Salari N, Morddarvanjoghi F, Abdolmaleki A, *et al.* The global prevalence of myocardial infarction: a systematic review and meta-analysis. *BMC Cardiovasc Disord* 2023; 23: 206. doi:10.1186/s12872-023-03231-w
- [2] Mechanic OJ, Gavin M, Grossman SA. *Acute Myocardial Infarction*. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2023
- [3] Radke R. Todesfälle in Deutschland - Anzahl nach häufigsten Diagnosen 2020. Statista 2022; Im Internet: <https://de.statista.com/statistik/daten/studie/1042272/umfrage/anzahl-der-todesfaelle-nach-den-haeufigsten-diagnosen/>; Stand: 30.01.2023
- [4] Antman EM, Anbe DT, Armstrong PW, *et al.* ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction--executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). *Circulation* 2004; 110: 588–636. doi:10.1161/01.CIR.0000134791.68010.FA
- [5] DeVon HA, Mirzaei S, Zègre-Hemsey J. Typical and Atypical Symptoms of Acute Coronary Syndrome: Time to Retire the Terms? *J Am Heart Assoc Cardiovasc Cerebrovasc Dis* 2020; 9: e015539. doi:10.1161/JAHA.119.015539
- [6] de Macedo RM, Faria-Neto JR, Costantini CO, *et al.* Phase I of cardiac rehabilitation: A new challenge for evidence based physiotherapy. *World J Cardiol* 2011; 3: 248–255. doi:10.4330/wjc.v3.i7.248

- [7] Tessler J, Bordoni B. Cardiac Rehabilitation. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2023
- [8] Haykowsky M, Scott J, Esch B, *et al.* A meta-analysis of the effects of exercise training on left ventricular remodeling following myocardial infarction: start early and go longer for greatest exercise benefits on remodeling. *Trials* 2011; 12: 92. doi:10.1186/1745-6215-12-92
- [9] Zhang Y-M, Lu Y, Tang Y, *et al.* The effects of different initiation time of exercise training on left ventricular remodeling and cardiopulmonary rehabilitation in patients with left ventricular dysfunction after myocardial infarction. *Disabil Rehabil* 2016; 38: 268–276. doi:10.3109/09638288.2015.1036174
- [10] Mayrhofer / Krenek | Fallbuch Physiotherapie: Innere Medizin mit Schwerpunkt Kardiologie/Pulmologie. . Im Internet: [https://www.beck-shop.de/mayrhofer-krenek-fallbuch-physiotherapie-innere-medizin-schwerpunkt-kardiologie\\_pulmologie/product/15477322](https://www.beck-shop.de/mayrhofer-krenek-fallbuch-physiotherapie-innere-medizin-schwerpunkt-kardiologie_pulmologie/product/15477322); Stand: 12.08.2023
- [11] Ryan TJ, Antman EM, Brooks NH, *et al.* 1999 update: ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: Executive Summary and Recommendations: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *Circulation* 1999; 100: 1016–1030. doi:10.1161/01.cir.100.9.1016
- [12] Höfer S, Kullich W, Graninger U, *et al.* Cardiac rehabilitation in Austria: short term quality of life improvements in patients with heart disease. *Wien Klin Wochenschr* 2006; 118: 744–753. doi:10.1007/s00508-006-0727-6
- [13] Benzer W, Platter M, Oldridge NB, *et al.* Short-term patient-reported outcomes after different exercise-based cardiac rehabilitation programmes. *Eur J Cardiovasc Prev Rehabil Off J Eur Soc Cardiol Work Groups Epidemiol Prev Card Rehabil Exerc Physiol* 2007; 14: 441–447. doi:10.1097/HJR.0b013e32802bf7ae
- [14] Dixon T, Lim LLY, Oldridge NB. The MacNew heart disease health-related quality of life instrument: reference data for users. *Qual Life Res Int J Qual Life Asp Treat Care Rehabil* 2002; 11: 173–183. doi:10.1023/a:1015005109731
- [15] Kang K, Gholizadeh L, Han H-R, *et al.* Predictors of health-related quality of life in korean patients with myocardial infarction: a longitudinal observational study. *Heart Lung J Crit Care* 2018; 47: 142–148. doi:10.1016/j.hrtlng.2017.12.005
- [16] Arnold SV, Masoudi FA, Rumsfeld JS, *et al.* Derivation and Validation of a Risk Standardization Model for Benchmarking Hospital Performance for Health-Related Quality of Life Outcomes after Acute Myocardial Infarction. *Circulation* 2014; 129: 313–320. doi:10.1161/CIRCULATIONAHA.113.001773
- [17] Hosseini SH, Ghaemian A, Mehdizadeh E, *et al.* Contribution of depression and anxiety to impaired quality of life in survivors of myocardial infarction. *Int J Psychiatry Clin Pract* 2014; 18: 175–181. doi:10.3109/13651501.2014.940049

- [18] Rafael B, Simon A, Drótos G, *et al.* Vital exhaustion and anxiety are related to subjective quality of life in patients with acute myocardial infarct before cardiac rehabilitation. *J Clin Nurs* 2014; 23: 2864–2873. doi:10.1111/jocn.12563
- [19] Reavell J, Hopkinson M, Clarkesmith D, *et al.* Effectiveness of Cognitive Behavioral Therapy for Depression and Anxiety in Patients With Cardiovascular Disease: A Systematic Review and Meta-Analysis. *Psychosom Med* 2018; 80: 742–753. doi:10.1097/PSY.0000000000000626
- [20] Barth J, Schumacher M, Herrmann-Lingen C. Depression as a risk factor for mortality in patients with coronary heart disease: a meta-analysis. *Psychosom Med* 2004; 66: 802–813. doi:10.1097/01.psy.0000146332.53619.b2
- [21] Rugulies R. Depression as a predictor for coronary heart disease. a review and meta-analysis. *Am J Prev Med* 2002; 23: 51–61. doi:10.1016/s0749-3797(02)00439-7
- [22] Iozzia G, de Miranda Azevedo R, van der Harst P, *et al.* Association of Recognized and Unrecognized Myocardial Infarction With Depressive and Anxiety Disorders in 125,988 Individuals: A Report of the Lifelines Cohort Study. *Psychosom Med* 2020; 82: 736–743. doi:10.1097/PSY.0000000000000846
- [23] Mayou RA, Gill D, Thompson DR, *et al.* Depression and anxiety as predictors of outcome after myocardial infarction. *Psychosom Med* 2000; 62: 212–219. doi:10.1097/00006842-200003000-00011
- [24] Herrmann-Lingen C, Buss U, Snaith PR. Deutschsprachige Adaptation der Hospital Anxiety and Depression Scale (HADS) von R.P. Snaith und A.S. Zigmond. 4. aktualisierte Auflage. Bern: hogrefe; 2018
- [25] Wang W, Chow A, Thompson D, *et al.* Predictors of Health-Related Quality of Life Among Patients with Myocardial Infarction. *West J Nurs Res* 2014; 38. doi:10.1177/0193945914546201
- [26] Höfer S, Turk-Adawi K, Oldridge N. The MacNew heart disease health-related quality of life questionnaire: Updated reference data for users. *Eur J Pers Centered Healthc* 2016; 4: 221–229. doi:10.5750/ejpc.v4i1.1076
- [27] *Physiotherapie in der Inneren Medizin* : Hüter-Becker, Antje, Dölken, Mechthild, Göhring, Hannelore, Solodkoff, Christiane von, Solodkoff, Michael. 2004; Stand: 12.08.2023
- [28] Hinz A, Brähler E. Normative values for the Hospital Anxiety and Depression Scale (HADS) in the general German population. *J Psychosom Res* 2011; 71: 74–78. doi:10.1016/j.jpsychores.2011.01.005
- [30] Kang K, Gholizadeh L, Han H-R. Health-related Quality of Life and Its Predictors in Korean Patients with Myocardial Infarction in the Acute Phase. *Clin Nurs Res* 2021; 30: 161–170. doi:10.1177/1054773819894692
- [31] Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Ascertaining the minimal clinically important difference. *Control Clin Trials* 1989; 10: 407–415. doi:10.1016/0197-2456(89)90005-6

- [32] Benyamini Y, Roziner I, Goldbourt U, *et al.* Depression and anxiety following myocardial infarction and their inverse associations with future health behaviors and quality of life. *Ann Behav Med* 2013; 46: 310–321. doi:10.1007/s12160-013-9509-3
- [33] Turen S, Turen S. Gender differences in early complications after STEMI and their associations with anxiety and depression. *Eur Rev Med Pharmacol Sci* 2023; 27: 2936–2945. doi:10.26355/eurrev\_202304\_31925
- [34] Dickens CM, McGowan L, Percival C, *et al.* Contribution of depression and anxiety to impaired health-related quality of life following first myocardial infarction. *Br J Psychiatry J Ment Sci* 2006; 189: 367–372. doi:10.1192/bjp.bp.105.018234

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