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Long-term effects of outpatient cardiac rehabilitation in Austria: a nationwide registry

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Summary
Aim Our Working Group on Out-Patient Cardiac Rehabilitation (AGAKAR) has previously published guidelines, which were endorsed by the Austrian Society of Cardiology. It was the aim of this study to assess the short-term (phase II) and long-term (phase III) effects of these guidelines by use of a nationwide registry.

Methods All Austrian out-patient rehabilitation facilities entered data into a database of all consecutive patients who completed phase II (4–6 weeks) and/or III (6–12 months) rehabilitation between 1.1.2009–30.11.2011.

Results Data of 1432 phase II and 1390 phase III patients were assessed. Despite the wide spectrum of cardiac diseases patients' exercise capacity improved during phase II by 20 (– 193 to 240) watts; 91.0 % reached a systolic blood pressure < 140 mmHg; 68.1 % an LDL < 100 mg/dl; 69.8 % triglycerides < 150 mg/dl, and 66.2 % of male patients had a waist circumference < 102 cm. During phase III improvement in cardiovascular risk factors, quality of life, anxiety, and depression were further improved in an increasing number of patients.

Conclusions Our data demonstrate beneficial short- and long-term effects of the Austrian model of out-patient cardiac rehabilitation and provide support for comprehensive long-term rehabilitation programs. Furthermore, our model might be helpful for those who are at the verge of initiating or modifying their programs. It is also hoped that these data will motivate colleagues to refer their patients to out-patient cardiac rehabilitation facilities and that our results may stimulate insurance companies to grant further and comprehensive contracts to provide access for all suitable patients.

Keywords Cardiovascular risk factors · Coronary artery disease · Exercise training · Lipids · Myocardial infarction

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Nachhaltige Wirkung der ambulanten kardiologischen Rehabilitation in Österreich: Daten aus einem Österreichweiten Register

Zusammenfassung
Ziel Es war Ziel dieser Studie, die Wirksamkeit der ambulanten kardiologischen Rehabilitation Phase II und III nach dem Modell der Arbeitsgemeinschaft für ambulante kardiologische Rehabilitation (AGAKAR), folgend den Guidelines der Österreichischen Kardiologischen Gesellschaft (ÖKG), zu untersuchen.

Methodik Alle Ambulatorien, die Vertragspartner der Österreichischen Sozialversicherungen sind, gaben die Daten aller Patienten, die zwischen 1.1.2009–30.11.2011

eine ambulante kardiologische Rehabilitation der Phase II und III abschlossen, prospektiv in eine Web-basierte Datenbank ein.

Ergebnisse Es gelangten für die Phase II 1432 und für die Phase III 1390 Datensätze zur Auswertung. Während der Phase II verbesserten sich die Patienten um 20 (-193-240) Watt, erreichten 91,0% einen systolischen Blutdruck von <140 mmHg, 66,1% ein LDL <100 mg/dl, 69,8% Triglyceride <150 mg/dl und bei den Männern 66,2% einen Bauchumfang <102 cm. Am Ende der Phase III wurden die Zielwerte von einem noch größeren Teil der Patienten erreicht, wobei die Ergebnisse dann am besten waren, wenn der Phase III eine ambulante anstelle einer stationären Phase II vorausging. Auch nahmen Depression im Laufe der Phase II und III ab und verbesserte sich die Lebensqualität.

Schlussfolgerungen Diese Daten beweisen die Wirksamkeit und Nachhaltigkeit der ambulanten kardiologischen Rehabilitation der Phase II und III nach dem Modell der AGAKAR und folgend den Guidelines der ÖKG, wobei die Phase III nicht nur nach einer ambulanten, sondern auch nach einer stationären Phase II nachhaltige Wirkung zeigte. Diese Ergebnisse sollten dazu Anlass geben, diese Evidenz-basierte und Leitlinienkonforme ambulante Rehabilitation lückenlos, flächendeckend, berufsbegleitend und wohnortnah anzubieten und nicht mehr nur auf wenige Zentren zu beschränken.

Schlüsselwörter Kardiovaskuläre Risikofaktoren · Koronare Herzkrankheit · Körperliches Training · Lipide · Myokardinfarkt

Introduction

Beneficial effects of out-patient cardiac rehabilitation have been well demonstrated in at least four meta-analyses, which reviewed randomized controlled studies of almost 20,000 patients [1–4]. These analyses identified striking prognostic effects of cardiac rehabilitation after myocardial infarction, coronary bypass surgery, percutaneous coronary intervention, as well as in high-risk patients with stable angina. It was found that the treatment effect was greatest when the time lapse between the event and the rehabilitation program was shortest and the duration of the program was longest [1–5].

The Austrian Working Group of Out-Patient Cardiac Prevention and Rehabilitation (AGAKAR) has previously authored the Austrian Guidelines of Out-Patient Cardiac Rehabilitation, which have been endorsed by the Austrian Society of Cardiology (ÖKG) [6]. All Austrian out-patient cardiac rehabilitation facilities run programs according to this model. Furthermore, all out-patient rehabilitation facilities continuously enter data on consecutive patients who attend out-patient cardiac rehabilitation phase II (60 h over 6 weeks) and phase III (up to 100 h over 6–12 months) into a nationwide database. Despite the fact that this comprehensive and rather longer term out-patient cardiac rehabilitation model has been built around current literature and guidelines [6], its effects have not yet been assessed.

Table 1 Medical diagnoses accepted for reimbursement by insurance companies for cardiac rehabilitation at the beginning of the out-patient phase II ($n = 1432$)

Medical diagnoses		Percentage
Percutaneous coronary intervention (PCI)	525	36.7
ST segment elevation myocardial infarction (STEMI)	252	17.6
Non ST segment elevation myocardial infarction (NSTEMI)	197	13.8
Coronary bypass surgery	54	3.8
Stable coronary heart disease	46	3.2
Post-pacemaker implantation	34	2.4
Cardiac surgery other than coronary bypass surgery	33	2.3
Congestive heart failure (NYHA II/III)	23	1.6
Prevention for motivated high-risk patients	15	1.0
Post-electrophysiological intervention	7	0.5
Hemodynamically stable arrhythmias	4	0.3
Heart or heart and lung transplantation	2	0.1
Pulmonary arterial hypertension	2	0.1
Symptomatic peripheral arterial disease	2	0.1

NYHA New York Heart Association

It was, therefore, the aim of this study to analyze the efficacy of phase II and the sustainability of the postulated reduction in cardiovascular risk factors during phase III rehabilitation.

Methods

In Austria out-patient cardiac rehabilitation is carried out exclusively in centers accredited by the AGAKAR (see acknowledgment for list of institutions). To be eligible for reimbursement all centers are obliged to enter data of all patients into a web based database at enrolment into phase II, end of phase II/ beginning of phase III, and end of phase III. Data of all patients who completed phase II and/or III rehabilitation between 1.1.2009 and 30.10.2011 were included into this analysis (Table 1). Treatment target values were set according to the guidelines of the Austrian Society of Cardiology (Tables 2, 3, 4, 5, 6 and 7) [7].

This study complied with the Declaration of Helsinki and patients gave informed consent. The research protocol has been presented to the Ethical Committee of the State of Salzburg, and the committee had no objections. This study is registered at ClinicalTrials.gov: NTC01540006.

Hematology and blood chemistry

Venous blood samples (BD Vacutainer®, Heidelberg, Germany) were drawn after a 10-h overnight fast and at least 16 h after training sessions. At the University Institute of Sports Medicine blood samples were analyzed at the University Institute of Laboratory Medicine, Paracelsus

Table 2 Changes in selected cardiac risk factors during out-patient phase II ($n = 1432$)

Variables	Begin phase II	End phase II	*p*-value (Wilcoxon-signed-rank)	Δ	Set target values	Target values reached end of phase II [% of patients]	Δ target values reached begin vs. end phase II [% of patients]
Physical work capacity [watts]	130 (20–320)	150 (33–360)	< 0.001	20 (– 193 to 240)	Age-adjusted work capacity and/or ≥ 20 % ↑	55.8	37.2
BP_{sys} [mmHg]	125 (80–214)	120 (72–200)	< 0.001	– 4 (– 90 to 74)	140	91.0	7.1
BP_{dia} [mmHg]	80 (40–115)	77 (40–111)	< 0.001	0 (– 50 to 65)	90	96.3	4.4
Glucose [mg/dl]	100 (41–320)	98 (43–320)	0.001	–3 (– 234 to 219)	110	74.3	4.9
HDL [mg/dl]	46 (20–197)	46 (20–142)	0.222	1 (– 164 to 97)	45	55.5	0.3
LDL [mg/dl]	100 (21–290)	86 (21–265)	< 0.001	– 16 (– 247 to 239)	100	68.1	18.1
Triglycerides [mg/dl]	121 (27–1020)	116 (29–1020)	0.003	– 7 (– 943 to 946)	150	69.8	4.4
BMI [kg/m^2]	27.3 (14.8–51.6)	27.1 (15.5–50.2)	< 0.001	0.0 (– 7.6 to 9.8)	25	28.7	2.4
Waist circumference ♂ [cm]	99 (65–150)	98 (65–150)	< 0.001	– 1.0 (– 9 to 9)	102	66.2	5.6
Waist circumference ♀ [cm]	99 (67–138)	98 (67–134)	< 0.001	– 2 (– 9 to 6)	89	16.5	2.7

Data shown as median (range)
BP blood pressure, BP_{sys} systolic blood pressure, BP_{dia} diastolic blood pressure, *HDL* high density lipoprotein, *LDL* low density lipoprotein, *BMI* body mass index

Table 3 Changes in psycho-cardiologic parameters during out-patient phase II ($n = 1432$)

Result parameter	Begin phase II	End phase II	*p* (Wilcoxon-signed-rank)	Δ	Set target values	Begin phase II: Target values reached [% of patients]	End phase II: Target values reached [% of patients]	Begin vs. end phase II: Δ target values reached [% of patients]
HADS-A	4.0 (0–17)	3.0 (0–18)	< 0.001	– 1.0 (– 12 to 12)	< 8	73.5	83.8	+ 10.3
HADS-D	3.0 (0–16)	2.0 (0–18)	< 0.001	– 1.0 (– 12 to 10)	< 8	82.2	88.4	+ 6.2
MacNew global	5.6 (2.4–7.0)	6.2 (2.9–7.0)	< 0.001	0.4 (– 1.6 to 3.2)	+ 0.5		45.8	
MacNew physical	5.5 (1.8–7.0)	6.2 (3.1–7.0)	< 0.001	0.6 (– 1.5 to 3.7)	+ 0.5		53.8	
MacNew social	5.7 (2.4–7.0)	6.4 (2.8–7.0)	< 0.001	0.5 (– 1.7 to 3.5)	+ 0.5		51.5	
MacNew emotional	5.6 (2.2–7.0)	6.0 (2.6–7.0)	< 0.001	0.4 (– 1.9 to 4.4)	+ 0.5		42.8	

Data shown as median (range)
HADS hospital anxiety and depression scale, *HADS-A* HADS anxiety, *HADS-D* HADS depression

Medical University Salzburg, Austria (Roche/Hitachi Systems, Roche Diagnostics® GmbH, Mannheim, Germany).

Exercise testing

Cycle ergometry was performed at the beginning of phase II, end of phase II/beginning of phase III, and end of phase III on an electronically braked ergometer (e.g. Ergoline® ergoselect 200). Individual ramp protocols were used according to current guidelines (Austrian guidelines) [7] and kept identical for each patient during all tests to permit accurate comparison. Heart rates were monitored continuously by a 12-lead electrocardiogram (ECG). Blood pressure was measured manually with a standard medical blood pressure device. All patients performed exercise testing until exhaustion or until ECG criteria for termination were reached.

Endurance and resistance training

Endurance training sessions lasted up to 50 min and consisted of continuous exercise training at 60–70 % of heart rate reserve (HRR; peak heart rate minus resting heart rate) [8] or high intensity exercise training with up to 85–95 % HRR depending on patients' state of fitness and preference. Warm up and cool down lasted 5 min each and were performed at 50 % HRR.

Resistance training protocols differed from site to site. At the University Institute of Sports Medicine resistance training was performed on weight lifting machines for

Table 4 Changes in selected cardiac risk factors during phase III after an out-patient phase II ($n = 600$)

Result parameter	Begin phase III	End Phase III	*p*-Value (Wilcoxon-signed-rank)	Δ	Set target values	End phase III: Target values reached [% of patients]	Begin vs. end phase III: Δ target values reached [% of patients]
Physical work capacity [watts]	150 (50–300)	166 (51–390)	< 0.001	15 (– 60 to 200)	Age-adjusted work capacity and/or ≥ 20 % ↑	62.9	26.8
BP_{sys} [mmHg]	120 (72–180)	120 (81–185)	0.971	0 (– 60 to 79)	140	94.2	1.4
BP_{dia} [mmHg]	75 (40–110)	75 (42–119)	0.013	0 (– 55 to 32)	90	97.4	0.1
Glucose [mg/dl]	94 (40–320)	96 (60–320)	0.056	1 (– 142 to 186)	110	76.7	–2.4
HDL (mg/dl)	45 (20–100)	49 (21–191)	< 0.001	3 (– 26 to 139)	45	64.6	11.5
LDL (mg/dl)	83 (22–191)	85 (20–233)	0.011	3 (– 102 to 128)	100	72.7	0.0
Triglycerides [mg/dl]	117 (29–1020)	115 (28–753)	0.912	0 (– 476 to 506)	150	69.3	– 0.2
BMI (kg/m^2)	27.1 (17.2–50.2)	27.0 (17.8–51.2)	0.196	0.0 (– 6.1 to 7.1)	25	27.9	– 0.6
Waist circumference ♂ [cm]	99 (57–150)	99 (67–150)	0.803	0.0 (– 19 to 35)	102	62.6	– 1.2
Waist circumference ♀ [cm]	94 (69–118)	93 (67–124)	0.200	– 1.0 (– 15 to 24)	89	36.7	1.3

Data shown as median (range)
BP blood pressure, BP_{sys} systolic blood pressure, BP_{dia} diastolic blood pressure, *HDL* high density lipoprotein, *LDL* low density lipoprotein, *BMI* body mass index

Table 5 Changes in psycho-cardiologic parameters during phase III after an out-patient phase II ($n = 600$)

Result parameter	Begin phase III	End phase III	*p* (Wilcoxon-signed-rank)	Δ	Set target values	Begin phase III: Target values reached [% of patients]	End phase III: Target values reached [% of patients]	Begin vs.end phase III: Δ target values reached [% of patients]
HADS-A	3 (0–17)	3 (0–17)	0.717	0.00 (– 11 to 15)	< 8	85.2	85.5	+ 0.3
HADS-D	2 (0–18)	2 (0–13)	0.006	0.00 (– 13 to 12)	< 8	88.7	90.4	+ 1.7
MacNew global	6.2 (3.0–7.0)	6.2 (3.4–7.0)	0.015	0.11 (– 2.60 to 2.15)	+ 0.5		17.4	
MacNew physical	6.3 (3.1–7.0)	6.3 (3.7–7.0)	0.015	0.08 (– 2.66 to 2.23)	+ 0.5		20.6	
MacNew social	6.5 (2.9–7.0)	6.5 (3.7–7.0)	< 0.001	0.08 (– 2.77 to 2.23)	+ 0.5		20.6	
MacNew emotional	6.1 (2.6–7.0)	6.1 (3.1–7.0)	0.215	0.07 (– 2.86 to 2.43)	+ 0.5		20.3	

Data shown as median (range)
HADS Hospital Anxiety and Depression Scale, *HADS-A* HADS anxiety, *HADS-D* HADS depression

each of the following muscle (m.) groups: dorsal latissimus m., trapezius m., brachial biceps m., brachial triceps m., deltoideus m., erector spinae m., rectus abdominis m., minor pectoralis m., major pectoralis m., rhomboid m., femoral quadriceps m., major gluteal m. and ischiocrural m. During the first resistance training session, the ten-repetition maximum was assessed for the above exercises. Resistance training was carried out with one set per muscle group and 8–15 repetitions. Weights were increased whenever more than 15 repetitions could be performed.

During phase II endurance as well as resistance training took place three times a week and during phase III once or twice per week depending on patients' availability.

Exercise training was performed under the supervision of a physician and a physiotherapist or exercise physiologist.

Psychological tests

The Hospital Anxiety and Depression Scale was used to determine patients' anxiety (HADS-A) and depression (HADS-D). In each of these tests scores of > 8 are indicative for anxiety or depression, respectively.

Quality of life was determined by the MacNew questionnaire, which includes the three specific domains physical, social, and emotional as well as the global score. Scores of 4–6 indicate normal and 7 indicates high quality of life.

Statistical analysis

Nominal and ordinal parameters are presented as absolute and relative numbers in the tables. The Kolmogorov–Smirnov test has been used for the testing of normality. All variables assessed were not normally distributed and

Table 6 Changes in selected cardiac risk factors during phase III after an inpatient phase II ($n = 790$)

Result parameter	Begin phase III	End phase III	*p*-Value	Δ	Set target values	End of phase III: Target values reached [% of patients]	Begin vs. end phase III: Δ target values reached [% of patients]
Physical work capacity [watts]	125 (25–347)	150 (15–390)	< 0.001	25 (– 111 to 240)	Age-adjusted work capacity and/or ≥ 20 % ↑	68.0	51.7
BP_{sys} [mmHg]	120 (73–225)	120 (12–342)	0.004	0 (– 98 to 117)	140	89.7	4.6
BP_{dia} [mmHg]	80 (40–165)	75 (40–240)	< 0.001	0 (– 50 to 75)	90	95.5	3.8
Glucose [mg/dl]	97 (64–262)	92 (35–256)	< 0.001	– 3 (– 162 to 111)	110	85.1	3.7
HDL [mg/dl]	45 (21–152)	48 (23–144)	< 0.001	2 (– 44 to 60)	45	59.6	9.5
LDL [mg/dl]	85 (23–287)	83 (24–241)	0.003	– 2 (– 138 to 182)	100	74.0	5.8
Triglycerides [mg/dl]	119 (37–1020)	122 (26–1020)	0.021	3 (– 435 to 788)	150	64.9	– 4.7
BMI [kg/m²]	27.0 (14.2–49.3)	27.3 (14.9–51.9)	< 0.001	0.0 (– 5.9 to 8.2)	25	27.9	0.7
Waist circumference ♂ [cm]	98 (64–150)	98 (63–150)	0.002	– 0.0 (– 22 to 34)	102	65.9	0.8
Waist circumference ♀ [cm]	93 (70–129)	92 (68–126)	0.279	– 0.0 (– 14 to 19)	89	41.3	2.5

Data shown as median (range)
BP blood pressure, BP_{sys} systolic blood pressure, BP_{dia} diastolic blood pressure, *HDL* high density lipoprotein, *LDL* low density lipoprotein, *BMI* body mass index

Table 7 Changes in psycho-cardiologic parameters during phase III after an inpatient phase II ($n = 790$)

Result parameter	Begin phase III	End phase III	*P* (Wilcoxon-signed-rank)	Δ	Set target values	Begin phase III: Target values reached [% of patients]	End phase III: Target values reached [% of patients]	Begin vs. end phase III: Δ target values reached [% of patients]
HADS-A	4 (0–18)	4 (0–18)	0.096	0.00 (– 13 to 13)	< 8	74.3	75.8	+ 1.5
HADS-D	3 (0–17)	2 (0–19)	0.024	0.00 (– 16 to 15)	< 8	84.0	83.6	– 0.4
MacNew global	5.6 (0.0–7.0)	6.0 (2.0–7.0)	< 0.001	0.23 (– 3.74 to 6.65)	+ 0.5		34.9	
MacNew physical	5.7 (0.0–7.0)	6.1 (2.2–7.0)	< 0.001	0.25 (– 4.23 to 6.42)	+ 0.5		37.2	
MacNew social	5.8 (0.0–7.0)	6.2 (2.3–7.0)	< 0.001	0.31 (– 4.00 to 6.77)	+ 0.5		38.4	
MacNew emotional	5.6 (0.0–7.0)	5.9 (1.4–7.0)	< 0.001	0.15 (– 3.28 to 6.79)	+ 0.5		32.6	

HADS Hospital Anxiety and Depression Scale, *HADS-A* HADS anxiety, *HADS-D* HADS depression

are, therefore, shown as median with minimum and maximum values. All parameters were assessed with regard to changes during the course of rehabilitation (Tables 2, 3, 4, 5, 6 and 7). Comparisons within groups were made using the nonparametric Wilcoxon signed-rank test. All statistical analyses were performed with IBM SPSS Statistics version 21. p values < 0.05 were considered statistically significant. The proportion of patients who achieved a prespecified rehabilitation goal is given as percentage (Tables 2, 3, 4, 5, 6 and 7).

Results

Out-patient Phase II

Medical diagnoses accepted for reimbursement by insurance companies for cardiac rehabilitation are presented in Table 1. There were 1,432 patients admitted to out-patient cardiac rehabilitation phase II (age: 58.4 ± 11.2 years; men:women = 83.9:16.1 %).

At baseline mean values of systolic and diastolic blood pressure, glucose, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides were largely within target range. Nevertheless, during phase II these key clinical variables continued to improve even further, leading to values within normal limits for the vast majority of patients (Table 2). Also, body mass index (BMI) and waist circumference showed modest but statistically significant improvement, and the majority of patients increased their physical work capacity by ≥ 20 % and/or reached age-adjusted target values.

At the beginning of out-patient cardiac rehabilitation phase II most patients displayed rather normal HADS scores for anxiety and depression (< 8) and MacNew scores (4–6) for quality of life (Table 3). During the course of the rehabilitation program, scores were further improved and > 80 % of the patients reached target values for HADS-A and HADS-D, whereas > 40 % surpassed the

minimum requirement for clinical relevance of +0.5 in each of the four MacNew scores.

Out-patient phase III

Data of 1,390 patients (age: 58.5 ± 10.6 years; men:women = 84.5:15.5 %), who completed phase III rehabilitation were analyzed separately depending on whether the preceding phase II rehabilitation was performed as out- or in-patient rehabilitation.

Results of out-patient phase II and out-patient phase III (*n* = 600)

Even though physical work capacity had already improved during out-patient rehabilitation phase II a further increase was achieved during phase III (Fig. 1). Systolic blood pressure, glucose, triglycerides, BMI, and waist circumference remained essentially unchanged during phase III (Table 4). LDL showed a modest but significant increase, but was still well within the lower range of normal. HDL increased significantly, and there was a significant but in absolute numbers rather modest reduction in diastolic blood pressure.

Scores for HADS-A remained essentially unchanged while HADS-D scores improved significantly. Also, there was a greater proportion of patients who showed normal values. Quality of life improved in all but the emotional domain, resulting in a further > 17 % of patients to surpass the minimum requirement for clinical relevance of +0.5 in all domains (Table 5).

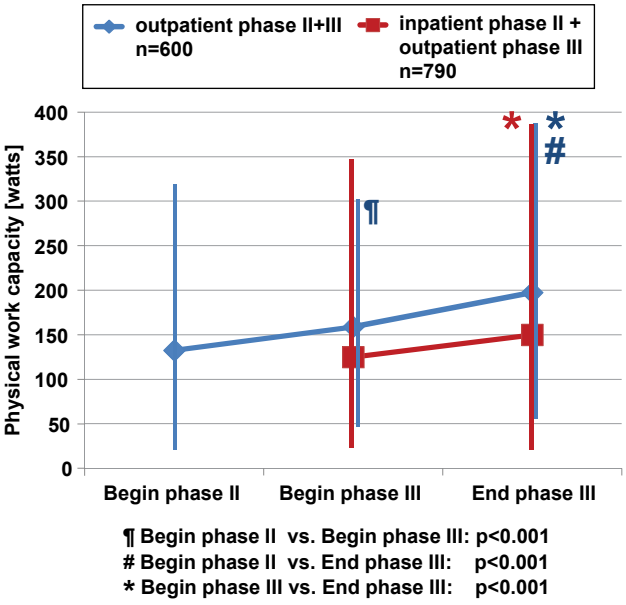

Fig. 1 Physical work capacity in out-patient cardiac rehabilitation phase II and III. Physical work capacity improved in response to out-patient rehabilitation phase II as well as III regardless of whether phase II was carried out as in- or out-patient rehabilitation

Results of inpatient phase II and out-patient phase III (*n* = 790)

Whereas patients who completed inpatient phase II started out with inferior physical work capacity at the beginning of phase III compared with those who completed an out-patient phase II rehabilitation, mean values improved by a similar extent during phase III (Fig. 1). Systolic and diastolic blood pressure, glucose HDL, LDL, and waist circumference in men improved significantly while there was a modest increase in BMI and triglycerides, and no change in waist circumference in women.

At the end of phase III the vast majority of patients had reached target values for systolic and diastolic blood pressure, glucose, HDL, LDL, triglycerides, waist circumference in men, and physical work capacity.

HADS-A scores for anxiety remained essentially unchanged and HADS-D scores for depression continued to improve during phase III rehabilitation. In the MacNew questionnaire the minimum requirement for clinical relevance of +0.5 was surpassed in all domains by an additional > 32 % of patients (Table 7).

Discussion

The main findings of our nationwide registry on the effects of phase II and III out-patient cardiac rehabilitation according to the guidelines of the AGAKAR of the ÖKG in a large number of consecutive patients were fourfold:

- 4–6 weeks of out-patient cardiac rehabilitation phase II led to improvement in cardiovascular risk factors which included blood pressure, glucose, LDL, triglycerides, BMI, waist circumference in men, and physical work capacity, as well as in psycho-cardiac parameters of anxiety, depression, and health-related quality of life;
- subsequent out-patient cardiac rehabilitation phase III consolidated or even further improved these beneficial changes;
- target values were reached by the vast majority of patients during out-patient phase II and/or III;
- even though results were best if an out-patient phase III was preceded by an out-patient instead of inpatient phase II, phase III rehabilitation was effective by a similar extent.

As outlined also in the current guidelines of the European Society of Cardiology on cardiovascular disease prevention [7], cardiac rehabilitation is a coordinated effort by an interdisciplinary team which aims at achieving a sustainable reduction of cardiovascular risk factors to stabilize or even slow the progression of cardiovascular diseases. Furthermore, it is of paramount importance to attenuate anxiety and depression associated with the event, and to optimize health-related quality of life.

Exercise training has been included in current guideline [7] as the mainstay of both in- and out-patient cardiac rehabilitation as it ameliorates symptoms, reduces ischemia, improves endothelial function [9], induces regression or attenuation of progression of the disease [10–12], and reduces morbidity and mortality [1–4]. Furthermore, a large proportion of patients with coronary artery disease who do not engage in regular exercise achieve neither lifestyle changes nor a reduction in cardiovascular risk factors, despite a reasonably well-implemented medical therapy [13]. Consequently, exercise training has found entry into guidelines and position papers of most cardiac societies [6, 7, 14, 15], and has become the centerpiece of our Austrian model of cardiac rehabilitation [6].

In Austria, inpatient rehabilitation is traditionally the preferred form of rehabilitation and it has been shown several times that positive changes of cardiovascular risk factors can be achieved [16–19]. However, benefits achieved during inpatient cardiac rehabilitation could not be sustained during one year follow-up [17–19]. In a recent meta-analysis out-patient rehabilitation yielded better results with regards to the control of cardiovascular risk factors than inpatient rehabilitation [20]. As there was a need for an assessment of the effects of long-term out-patient cardiac rehabilitation we performed this analysis and we were able to show that comprehensive out-patient rehabilitation phase III succeeded in stabilizing if not even in further improving phase II results. These data strongly support the need for phase III rehabilitation of sufficient length, which is in line with the finding that an attendance of more rather than fewer sessions did lead to a reduced risk of further myocardial infarction or death [5], and the observation that successful completion of long-term cardiac rehabilitation was associated with improved survival and decreased hospitalization [21].

Unfortunately, also our model of rehabilitation failed to achieve a meaningful reduction in BMI. Ideally, all patients should reach the set goals. However, it has to be kept in mind that the target of an ideal BMI <25 is not only missed by a large percentage of our patients but also by almost half of the general population in Austria, as 48 % currently have a BMI of >25, a finding not exclusive to Austria. Despite optimal therapy and optimal cardiac rehabilitation and in keeping with current literature it has to be understood that a relevant percentage of patients will not be able to reach goals which are also not met by the general population. Even though ambitious and beneficial goals ought to be set, for the evaluation of the success of a program, more moderate and thus realistic aims may need to be defined.

Also, it should be emphasized that mortality risk is significantly reduced in overweight individuals who are fit instead of unfit, revealing that fitness is a more powerful determinant for mortality risk than body mass index [22]. Very likely, the improvement in aerobic capacity that is associated with decreased mortality occurs already at an overall caloric expenditure below that necessary to effectively decrease BMI.

Summary

Out-patient cardiac rehabilitation phase II and III were carried out according to the AGAKAR guidelines and emerged to be feasible and effective in improving cardiovascular risk factors at large. Also, improvement achieved during phase II rehabilitation was sustained if not even further improved during phase III rehabilitation. This held true after both in- and out-patient cardiac rehabilitation phase II, proving phase III rehabilitation an effective intervention also after phase II inpatient rehabilitation.

We have now for the first time provided evidence for the effectiveness of our model of out-patient cardiac rehabilitation guidelines. Therefore, we trust that our guidelines will appear even more relevant to an even greater number of colleagues, and that our findings will foster a European wide cluster of out-patient cardiac rehabilitation programs. Furthermore, it is hoped by the authors that these data will convince insurance companies to grant contracts to further out-patient rehabilitation facilities to provide most if not all patients with access to a mode of rehabilitation that has exercise training as its centerpiece and to motivate colleagues to refer all suitable patients to such facilities.

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Conflict of interest

None declared.

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