ESC HEART FAILURE
ESC Heart Failure 2019; **6**: 658–666
Published online 8 April 2019 in Wiley Online Library (wileyonlinelibrary.com) **DOI:** 10.1002/ehf2.12436

ORIGINAL RESEARCH ARTICLE

Motivational interviewing can support physical activity in elderly patients with diastolic heart failure: results from a pilot study

Anna Schertz[1,2], Birgit Herbeck Belnap[1,3], Mira-Lynn Chavanon[1,4], Frank Edelmann[5,6,7], Rolf Wachter[2,8] and Christoph Herrmann-Lingen[1,2]*

[1]*Department of Psychosomatic Medicine and Psychotherapy, University of Göttingen Medical Center, Von-Siebold-Str. 5, D-37075, Göttingen, Germany;* [2]*German Centre for Cardiovascular Research (DZHK), Göttingen, Germany;* [3]*Center for Behavioral Health and Smart Technology, Division of Internal Medicine, University of Pittsburgh Medical School, Pittsburgh, PA, USA;* [4]*Department of Psychology, Philipps-University Marburg, Marburg, Germany;* [5]*Department of Internal Medicine and Cardiology, Universitätsmedizin Berlin (Charité), Berlin, Germany;* [6]*German Centre for Cardiovascular Research (DZHK), Berlin, Germany;* [7]*Berlin Institute of Health, Berlin, Germany;* [8]*Clinic and Policlinic for Cardiology, University of Leipzig, Leipzig, Germany*

Abstract

Aims Patients suffering from heart failure with preserved ejection fraction (HFpEF) report similar symptoms and reduction in quality of life to those with reduced ejection fraction but remain largely untreated. We conducted a preliminary evaluation of the acceptance, feasibility, and efficacy of a motivational interviewing (MI) intervention to support elderly patients suffering from HFpEF in maintaining or starting physical activity.

Methods and results At the conclusion of the exercise training in diastolic heart failure parent trial that examined the effects of supervised exercise, patients with HFpEF were offered participation in a two-group pilot study. Based on their preference, consenting patients were assigned to either a 6 month MI intervention group (n = 19) or their physicians' usual care (n = 20). To support participants in increasing and/or maintaining their physical activity, counsellors delivered a mean of 6.5 MI sessions (face to face and via telephone) and also provided a physical activity diary as self-management tool. At baseline and 6 months, we assessed participants' physical activity motivation (Sportbezogene Selbstkonkordanz Scale) and their physical improvements with the 6 min walk test and a cardiopulmonary exercise test. Of the entire sample (N = 39), 46% were female, their mean age was 73, 90% were in New York Heart Association Class II, and the mean ejection fraction was 61.4%. The majority of MI participants rated the intervention as acceptable, 90% perceived MI as helpful in setting specific exercise goals and overcoming barriers concerning physical activity, and 58% considered the physical activity diary as very helpful. Three-quarters of MI participants (79%) reported an increase in their physical activity compared with the previous year. Intervention participants showed a greater increase in median peak VO_2 from baseline to 6 months (baseline: 18.4 mL/kg/min; 6 months: 20.4 mL/kg/min) compared with the control group (baseline: 20.0 mL/kg/min; 6 months: 19.2 mL/kg/min; P = 0.015). There was no significant change in motivation on the Sportbezogene Selbstkonkordanz Scale for either group (MI: 1.7 vs. 3, P = 0.55; control: 4.7 vs. 4, P = 0.26) nor did patients show any significant improvements in the 6 min walk test (MI: 549 vs. 540 m, P = 0.80; control: 572 vs. 580 m, P = 0.37). Counsellors rated the implementation of the MI intervention as feasible.

Conclusions The results from this pilot study suggest that our MI intervention was well accepted by participants and deemed feasible. It also appears to be an effective treatment to increase and maintain physical activity and exercise capacity in patients suffering from HFpEF. Our findings need to be confirmed in a randomized clinical trial with larger and unselected patient cohorts.

Keywords Heart failure with preserved ejection fraction; Motivational interviewing; Physical activity; Self-care

Received: 9 April 2018; Accepted: 28 February 2019
**Correspondence to: Christoph Herrmann-Lingen, Department of Psychosomatic Medicine and Psychotherapy, University of Göttingen Medical Center, Von-Siebold-Str. 5, D-37075 Göttingen, Germany. Tel: +49 551 39 66707; Fax: +49 551 39 19150. Email: cherrma@gwdg.de*
Trial registration: ClinicalTrials.gov NCT03402490.

Introduction

Heart failure (HF) affects about 26 million people worldwide,[1] is a major contributor to morbidity,[2] and the third most common cause of death in Germany with 47 414 cases in 2015.[3] Although HF is often associated with reduced ejection fraction (EF), about 50% of patients suffering from HF have a preserved EF (HFpEF)[4,5] with symptoms similar to those with reduced EF (HFrEF), including shortness of breath, exercise intolerance, and fatigue.[6–8] A clinical study showed that patients suffering from HFpEF are typically female, elderly, and suffering from more co-morbidities,[9] but patients with HFpEF do not differ significantly from those with HFrEF regarding their quality of life and number of hospitalizations..[10] Indeed, prevalence of HFpEF is increasing,[11] which may be explained by the longer life expectancy and improvements in clinical recognition of the condition.[12,13] However, there are few effective treatment options for patients with HFpEF, especially in outpatient settings, often lacking improvements in patients' quality of life.[14–16] This gap of care may also stem from a lack of communication skills among treating physicians and other medical professionals, resulting in suboptimal management of the disease, including patient self-care.[17]

The heart failure: a controlled trial investigating outcomes of exercise training (HF-ACTION) trial showed that exercise training (ET) for patients with HFrEF resulted in a decrease of morbidity and rehospitalizations,[18] and in the Ex-DHF pilot trial, ET for patients with HFpEF improved patients' symptoms, exercise capacity, diastolic function, and quality of life.[19] Thus, ET appears to be an effective component in the treatment of both HFrEF and HFpEF, and the European Society of Cardiology recommends ET for HF patients, regardless of their EF.[20] However, regular physical exercise is often difficult to realize for patients with HF, especially when they are elderly and suffering from numerous co-morbidities. Furthermore, although ET seems to be an effective treatment option for patients with HFpEF, its potential health benefits, such as improvement of diastolic function and quality of life, are rarely emphasized at hospital discharge, probably leading to poor implementation of physical activities in patients' daily lives.[21] Indeed, the Treatment of Preserved Cardiac Function Heart Failure with an Aldosterone Antagonist trial showed that only 11% of participants engaged in physical activity at baseline.[22]

Motivational interviewing

Initially, Miller and Rollnick[23] developed 'motivational interviewing' as a counselling technique for treating substance abuse. It is a client-oriented directive approach with the goal to generate an intrinsic motivation for behaviour change. Furthermore, the technique of motivational interviewing can be taught to various professional groups, and even very brief 15 min sessions yield positive effects. A meta-analysis of motivational interviewing showed that it is also effective in changing behaviour for patients with somatic diseases, where motivational interviewing was superior to traditional counselling techniques in 80% of the cases and impacting patients' physical activity in 72% of the cases.[24] Creber *et al*.[25] showed that self-care of patients with HF also benefited from this technique.

Based on these encouraging results, our pilot study examined the feasibility, acceptance, and effectiveness of motivational interviewing to support elderly patients with HFpEF in implementing and maintaining physical activity in their daily routine.

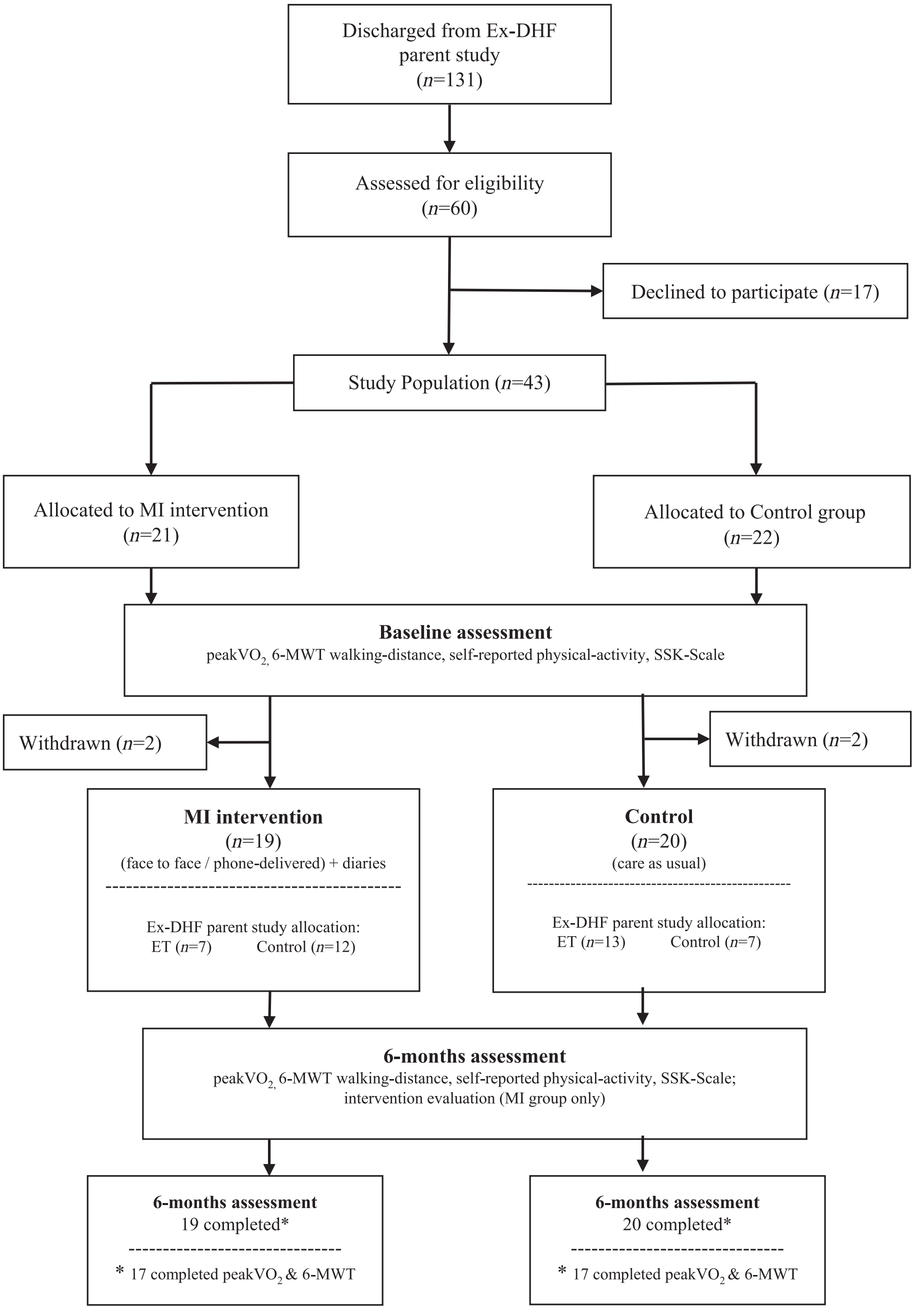
Methods

Study setting

The present study was an add-on at the conclusion of the multicentre Ex-DHF parent study conducted from June 2013 to December 2015.[26] Briefly, at the University of Göttingen Medical Centre trial site, elderly patients with preserved left ventricular systolic function (left ventricular EF $\geq$ 50%), echocardiographically determined diastolic dysfunction (grade $\geq$1), New York Heart Association Functional Classes I to III, and at least one cardiovascular risk factor (overweight, diabetes, hypertension, smoking, or hyperlipidaemia) were randomized to either an ET or a usual care group. The training intervention consisted of supervised endurance and resistance training with three sessions per week over the course of 12 months.

At their last visit for the exercise training in diastolic heart failure (Ex-DHF) study, we offered consecutive participants to enrol in our pilot study. Depending on their interest and motivation, we assigned them either to our motivational counselling group (MI) or those not interested in MI but willing to participate in our assessments, to the usual care control group (control). Because of the rather small local participant pool of the parent study and the goal of this pilot study to gain preliminary results, we did not randomize participants but rather stopped recruitment when enrolment reached 21 participants in the MI and 22 in the control group (*Figure 1*), in order to have at least 15 patients with complete data in each group after accounting for dropouts. Two participants in each group subsequently dropped out; thus, the analyses are based on 19 patients from the MI and 20 from the control group. The local ethics committee approved both study protocols, that of the main Ex-DHF trial and of the pilot study, both conform with the principles outlined in the Declaration of Helsinki, and all participants provided their written informed consent.

Figure 1 Study flow chart. 6-MWT, 6 min walk test; ET, exercise training group; Ex-DHF, exercise training in diastolic heart failure; MI, motivational interviewing; SSK, Sportbezogene Selbstkonkordanz Scale.



Participants

Of the 19 participants remaining in our MI intervention group, seven had received ET in the Ex-DHF parent trial, while 12 had served as controls. Of the 20 control group participants, 13 had received ET, and seven had served as controls in the parent study (total sample size, $N = 39$; *Figure 1*).

Intervention

Participants assigned to the MI intervention group received monthly counselling for 6 months (total of seven sessions). For the first two and the last session, participants met with the counsellor face to face for about 45 min. Based on participants' preference, the remaining sessions could be conducted via telephone or face to face and lasted 15–30 min. Per study protocol, counsellors (a medical resident and two psychologists), trained in motivational interviewing, assisted the participants in (i) setting goals for their physical activity; (ii) developing a plan to increase their physical activities; (iii) setting specific goals for the implementation of that plan; and (iv) overcoming possible barriers. These steps are intended to increase participants' intrinsic and identified motivation to exercise and exercise-related self-efficacy. Participants were also asked to keep track of their daily physical activity in a diary, which counsellors then discussed with them during the face-to-face sessions.

Outcome measures

Study counsellors assessed all participants with structured interview and self-rating scales. At baseline only, sociodemographic information was recorded.

At baseline and at the final 6 month visit, participants rated their motivation to be physically active in the upcoming weeks using the Sportbezogene Selbstkonkordanz Scale (SSK), which assesses the self-concordance of sports-related and exercise-related goals.[27] The instrument contains 12 items measuring four modes of motivation on a scale ranging from 1 'corresponds not at all' to 6 'corresponds exactly' (internal consistency for subscales ranged from α = 0.70 to α = 0.82). The four modes are intrinsic motivation (e.g. 'I intend to be physically active on a regular basis … because physical activity simply belongs to my life'), identified motivation (e.g. '… because the positive effects are worth it'), introjected motivation (e.g. '… to avoid self-reproach'), and extrinsic motivation (e.g. '… because others tell me I should'). Because motivational interviewing attempts to increase intrinsic and identified motivation to replace introjected and extrinsic motivation, we also calculated a new parameter (SSK index) by subtracting the sum of the introjected plus extrinsic motivation from the sum of the intrinsic plus identified motivation (range -10 to +10; higher value = higher self-concordance.[27]

In addition, patients completed the sports-related self-efficacy scale, which measures how much individuals feel able to follow up on planned physical activities in the face of possible barriers such as work overload, low energy, or distractors such as interesting TV programme).[28] Daily physical activity over the last 7 days was evaluated with the International Physical Activity Questionnaire, yielding intensity-weighted numbers of minutes per week for various types of physical activities.[29]

We also conducted a symptom-limited cardiopulmonary exercise test on a bicycle ergometer in order to assess changes in maximum rate of oxygen consumption during the last 30 s before the termination of the exercise [peak VO_2 (mL/min/kg)] as measure of maximal exercise capacity. Furthermore, participants completed the 6 min walk test on flat surface (6-MWT) to assess submaximal exercise capacity. At the end of the study, we extracted the data recorded in participant's diaries about the kind and extent of their daily physical activity. Finally, at the 6 month assessment, intervention participants filled out a questionnaire about their subjective evaluation of the counselling programme (*Figure 1*).

Statistical analysis

Group allocation (MI vs. control) for this pilot study was based on patient preferences rather than randomization, due to the limited patient pool, time constraints, and number of patients not interested in participating in an additional intervention. Pilot group assignment (MI vs. control) was independent of randomization status in the parent study (ET or control). This resulted in four rather small subgroups: (i) ET followed by MI; (ii) ET followed by control; (iii) control followed by MI; and (iv) control followed by control. Because of the relatively small and unequal sample sizes of these four subgroups, we primarily chose non-parametric tests to analyse the data. Differences between the groups regarding changes in peak VO_2, distance on the 6-MWT, and changes concerning the motivation to be physically active, exercise-related self-efficacy, and self-rated everyday activities were evaluated using the Mann–Whitney *U* test. To test for differences within the groups regarding the changes in peak VO_2 and distance in the 6-MWT, the Wilcoxon signed-rank test was executed. We made no adjustments for multiple testing due to the exploratory approach of this study.

All tests were two tailed, and a *P*-value $<$0.05 was considered statistically significant. Statistical analysis was performed with SPSS Statistics software version 24.

Results

Of the 39 participants, 18 (46%) were female, their mean age was 73 years, 90% were in New York Heart Association Class II, and the mean EF was 61.4% (*Table 1*). At baseline, participants in the MI intervention differed from those in the control group in heart rate (mean 62 vs. 69; *P* = 0.03) and EF (mean 62.8 vs. 61.1; *P* = 0.04) but were similar on all other baseline characteristics, risk factors, and baseline clinical measures (*Tables 1* and *2*).

Between baseline and 6 month assessment, participants in both groups did not report significant changes in their median SSK scores, and the changes did not differ significantly between the groups ($Z = -1.2$; $P = 0.27$; *Table 2*), although intervention participants tended to increase, those in the control group decreased their sports-related self-concordance over 6 months. Similar descriptive effects were found for the SSK subscales on intrinsic and identified motivation and

DOI: 10.1002/ehf2.12436

Table 1 Baseline data

	All subjects (n = 39)	Motivational interviewing (n = 19)	Control (n = 20)	P value
Ex-DHF exercise training, n (%)		7 (37)	13 (65)	
Ex-DHF control, n (%)		12 (63)	7 (35)	
Gender (female), n (%)	18 (46)	10 (53)	8 (40)	
Age (years)	72.7 ± 5	72.8 ± 4.6	72.6 ± 5.7	0.79
Waist/hip ratio	0.93 ± 0.08	0.95 ± 0.08	0.92 ± 0.09	0.55
Heart rate (b.p.m.)	65.4 ± 9.9	61.6 ± 8.7	69 ± 9.9	0.03
Systolic blood pressure (mmHg)	127 ± 17.5	122.7 ± 19.3	131.4 ± 15	0.4
Diastolic blood pressure (mmHg)	74 ± 11.5	70.2 ± 13.9	77.6 ± 7.3	0.06
Characterization of heart failure, NYHA functional class, n (%)				0.51
I	3 (8)	1 (5)	2 (10)	
II	35 (90)	18 (95)	17 (85)	
III	1 (2)	0	1 (5)	
Left ventricular ejection fraction (%)	61.4 ± 4.3	62.8 ± 3.8	60.1 ± 4.4	0.04
Risk factors and co-morbidity, n (%)				
Diabetes	7 (17)	2 (11)	5 (25)	0.28
Hypertension	35 (89)	18 (95)	17 (85)	0.61
Hyperlipidaemia	26 (66)	13 (68)	13 (65)	0.61
Coronary artery disease	22 (56)	10 (53)	12 (60)	0.75
Myocardial infarction	13 (33)	4 (21)	9 (45)	0.18
COPD	4 (10)	1 (5)	3 (15)	0.60

COPD, chronic obstructive pulmonary disease; Ex-DHF, exercise training in diastolic heart failure; NYHA, New York Heart Association.

Table 2 Changes of the endpoints

	MI	CO	Group comparison V6 vs. baseline MI vs. CO
6-MWT distance[a]			
Baseline	523.8 ± 75.7	534.3 ± 102.5	
6 months	516.8 ± 93.4	556.9 ± 85.8	
6 months vs. baseline	P = 0.80	P = 0.37	Z = −1.49; P = 0.14
Peak VO_2[b]			
Baseline	18.3	19.8	
6 months	19.5	19.5	
6 months vs. baseline	P = 0.24	P = 0.92	Z = −2.4; P = 0.015
SSK index[b]			
Baseline	1.7	4.7	
6 months	3	4	
6 months vs. baseline	P = 0.55	P = 0.26	Z = −1.2; P = 0.27

6-MWT, 6 min walk test; CO, control; MI, motivational interviewing; SSK, Sportbezogene Selbstkonkordanz Scale.
Changes from the baseline to the final assessment 6 months later for within and between the groups.
[a]Mean ± standard deviation.
[b]Median.

on sports-related self-efficacy, while extrinsic motivation numerically decreased in the MI group (Supporting Information, *Figure S1*).

Self-reported strenuous leisure time activity and activity for transportation showed a stronger numerical increase in the MI than in the control group (*Figure 2*), although these results also did not reach statistical significance. There were no significant intragroup and intergroup changes in distance walked in the 6-MWT.

However, participants in the MI group showed an improvement in median peak VO_2, while those in the control group did not (MI: +2.0 mL/min/kg; control: −0.8 mL/min/kg; Z = −2.4; P = 0.015). Specifically, participants' peak VO_2 increased at 6 months for both MI subgroups, regardless of their parent study assignment (+2.0 mL/min/kg and + 1.1 mL/min/kg), while in the control group, peak VO_2 decreased for those patients who had received ET in the parent study (−1.3 mL/min/kg) but showed a slight mean increase in peak VO_2 (0.6 mL/min/kg) for those in the parent study's control group (*Table 3*).

The average number of attended appointments per participant in the intervention group was 6.5 out of 7, reflecting a high adherence. The majority of participants regarded our MI intervention as helpful, especially the elements: 'setting goals for physical activity' and 'overcoming barriers' (both 90%), suggesting good participant acceptance. Furthermore, the majority (79%) of our intervention participants found the activity diary helpful, while only 16% did not. Fifteen (79%) participants in the MI group reported an increase in their physical activity compared with the year before the intervention.

Figure 2 Change in physical activity by study group as reported on the International Physical Activity Questionnaire (IPAQ). Blue lines: motivational interviewing group; green lines: control group. (A) IPAQ strenuous leisure time activity (MET * min). (B) IPAQ total exercise for transportation (MET * min). MET, metabolic equivalent of task.

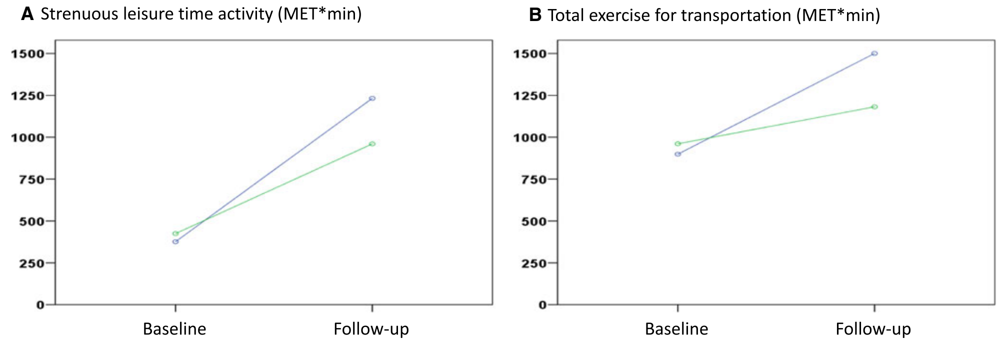


Table 3 Peak VO_2 data by subgroup

	Ex-DHF			
	Ex-DHF ET		Ex-DHF no ET	
	Add-on MI	Add-on CO	Add-on MI	Add-on CO
Baseline peak VO_2				
Mean	17.8	20.8	17.8	19.1
SD	4.0	4.0	5.1	5.4
6 month peak VO_2				
Mean	19.6	19.7	18.8	19.9
SD	4.9	3.6	5.8	4.9

Mean and SD regarding the peak Vo_2 at baseline and V6.
CO, control; ET, exercise training; Ex-DHF, exercise training in diastolic heart failure; MI, motivational interviewing; SD, standard deviation.

Counsellors were also satisfied with the intervention concept and found it feasible for use with the elderly cardiac patient population, although sometimes non-cardiac co-morbidities prevented participants from becoming as active as intended.

Discussion

This pilot study investigated the feasibility and acceptance of motivational interviewing to enhance physical activity and outcomes in elderly patients with HFpEF and generated preliminary data on its effectiveness.

In terms of feasibility and acceptance, over one-third of all patients we approached accepted the invitation to participate in the intervention after having completed the parent trial. Reasons for declining were mainly related to unwillingness or perceived inability to participate in another intervention trial in general and not in a motivational intervention *per se*. Some patients already felt sufficiently motivated to continue exercising after having participated in supervised training for 1 year.

Over 90% of those who started the MI intervention attended at least six of the seven counselling sessions (face to face or via telephone per preference), indicating a high treatment adherence. As hypothesized, most participants in the MI group (79 to 90%) accepted the components of the intervention. In particular, they appreciated the provided self-care support, such as the activity diary and counselling, and reported them as helpful in staying motivated to exercise. Counsellors also found our intervention a feasible and easy to deliver support for physical activity in elderly patients with HFpEF.

At 6 months, MI participants reported a larger increase in physical activity compared with the control group participants and benefitted more in change in their peakVO_2, as an objective measure of exercise capacity, compared with the control group. Especially the subgroup of participants who had received supervised ET in the parent Ex-DHF trial and had learned in a safe environment how to be physically active seemed to benefit from the additional motivational counselling. This subgroup increased their maximum rate of oxygen consumption during the exercise testing procedure from baseline to 6 month assessment the most, while those who had received ET in the parent study but chose not to receive motivational counselling showed a drop in peakVO_2. Given the small sample sizes. these subgroup effects were not statistically significant, but if confirmed in future trials, they could provide a strong rationale to offer motivational interviewing to HF patients following a course of supervised exercise.

In general, elderly individuals experience an increase in physical limitations and tend to reduce their physical activity for amelioration and presumed safety, which applies even more so for patients suffering from HFpEF with co-morbid diseases. But although the American Heart Association and American College of Cardiology recommend ET and congestive HF disease-related self-care counselling as components of HF treatment,[6] many patients with HF are still advised by their physicians, for safety reasons, to rest and refrain from physically demanding activities, often resulting in patients avoiding physical activities altogether and leading to physical deconditioning.[30] Research has shown that physical activity has positive effects for patients with HF. The results from the HF-ACTION trial indicate that even low doses of exercise may be beneficial in patients with HFrEF.[31] Our Ex-DHF pilot study expanded on this result for patients with HFpEF, where ET significantly improved symptoms, exercise capacity, diastolic function, and quality of life,[19] which was confirmed by a systematic review that analysed eight randomized controlled trials studying the effects of ET in patients with HFpEF.[2] Given this evidence, ET seems to be a promising tool to target exercise capacity alongside quality of life in patients both with HFrEF and HFpEF and should be an integral part of their treatment.[32] However, there are no evidence-based treatment plans that are sustainable.[16] Indeed, in the HF-ACTION trial, only a minority of patients continued exercising at the recommended level by the end of the study, and as patients decreased their physical activity after participating in a 16 week training programme, Willenheimer *et al*.[33] emphasized that ET should be continued to show lasting benefits. Similarly, our pilot study showed a slight (though not significant) decrease in peak VO_2 in patients who had participated in the Ex-DHF exercise arm but did not receive the MI intervention. Motivational interviewing may therefore be an important add-on to supervised exercise, in order to sustain physical activity over time, thereby improving self-care and health behaviour in HF patients.[22,24]

In our pilot study, we integrated motivational interviewing in a customized patient-centred treatment plan that accounted for the patient's physical abilities and their personal preferences adapted to their daily routines.

Limitations

Beyond the relatively small sample size, the generalizability of our findings is further limited because group assignment was based on patient preference, as randomization was not feasible for this pilot study. This might have biased our results in that patients in the MI group could have been a priori more motivated to be physically active. However, the observed baseline differences indicated that participants in the MI group had less often received supervised ET in the parent study and tended to report lower sports-related self-concordance than those who volunteered for the control arm, indicating that they were less rather than more prepared for physical activities at baseline and thus may have had a specific need for motivational counselling. Even if the MI intervention only benefitted those participants with a specific need for support, this would still be a relevant subgroup to target for this treatment strategy. In contrast, patients with sufficient motivation from the beginning who were more likely to self-select into our control group may indeed benefit less from such interventions. Still, their physical activity and exercise capacity did not increase further, in contrast to the intervention group.

In the end, the relevance for our results of the previous participation in a supervised exercise trial, non-random group allocation, and baseline differences remains unclear and calls for replication of our findings. It is also of interest how many elderly patients with HFpEF will participate in an MI intervention under routine conditions, although in our pilot study, once patients chose to participate, they showed high adherence and acceptance.

Furthermore, we did not collect detailed information about the physical activities of the control group performed between baseline and the 6 month assessment; thus, we do not know if they engaged in external training opportunities, which may have affected their outcomes.

Conclusions

In our pilot study, we integrated motivational interviewing in a customized patient-centred treatment plan that accounted for the patient's physical abilities and their personal preferences adapted to their daily routines. Despite some limitations, the results of our pilot study suggest that our MI intervention is a feasible, acceptable, and effective tool to support patients with HFpEF in maintaining or starting appropriate physical activity, at least for patients motivated to enter a behavioural intervention. Larger randomized clinical trials need to confirm whether a motivational interviewing treatment strategy—either alone or as an adjunct to supervised ET—can support a sustained motivation to exercise in HF patients and whether this translates into improved exercise capacity, quality of life, and possibly also prognosis.

Acknowledgement

We wish to thank Karima von Oehsen for her support in the realization of the trial.

Conflict of interest

None declared.

Funding

This study was funded by a grant from the German Ministry of Education and Research to the German Centre for Cardiovascular Research (DZHK), trial site Göttingen (PIs: C.H.-L. and

R.W.). We acknowledge the support by the German Research Foundation and the Open Access Publication Funds of the University of Göttingen.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. Change in exercise-related motivation and self-efficacy; Blue lines: Motivational Interviewing group; Green lines: control group. (A) Overall motivation (SSK index), (B) Intrinsic motivation, (C) Identified motivation, (D) Introjected motivation, (E) Extrinsic motivation, (F) Sports-related self-efficacy.

References

1. Ponikowski P, Anker SD, AlHabib KF, Cowie MR, Force TL, Hu Saarsma T, Krum H, Rastogi V, Rohde LE, Samal UC, Shimokawa H, Budi Siswanto B, Sliwa K, Filippatos G. Heart failure: preventing disease and death worldwide. *ESC Heart Fail* 2014; **1**: 4–25.
2. Palau P, Núñez E, Domínguez E, Sanchis J, Núñez J. Physical therapy in heart failure with preserved ejection fraction: a systematic review. *Eur J Prev Cardiol* 2014; **23**: 4–13.
3. DESTATIS Statistisches Bundesamt. Die 10 häufigsten Todesursachen insgesamt—Sterbefälle insgesamt nach der ICD-10 im Jahr 2015. https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/Gesundheit/Todesursachen/Tabellen/SterbefaelleInsgesamt.html (10 November 2017).
4. Bishu K, Redfield MM. Acute heart failure with preserved ejection fraction: unique patient characteristics and targets for therapy. *Curr Heart Fail Rep* 2013; **10**: 190–197.
5. Borlaug BA, Paulus WJ. Heart failure with preserved ejection fraction: pathophysiology, diagnosis, and treatment. *Eur Heart J* 2011; **32**: 670–679.
6. Yancy CW, Jessup M, Bozkurt B, Butler J, Casey DE Jr, Drazner MH, Fonarow GC. 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2013; **62**: e147–e239.
7. Gupte AA, Hamilton DJ. Exercise intolerance in heart failure with preserved ejection fraction. *Methodist Debakey Cardiovasc J* 2016; **12**: 105–109.
8. Chung CJ, Schulze PC. Exercise in patients with heart failure. *Phys Sportsmed* 2011; **39**: 37–43.
9. Goyal P, Almarzooq ZI, Horn EM, Karas MG, Sobol I, Swaminathan RV, Feldman DN, Minutello RM, Singh HS, Bergman GW, Wong SC, Kim LK. Characteristics of hospitalizations for heart failure with preserved ejection fraction. *Am J Med* 2016; **129**: 635.e15–e26.
10. Hoekstra T, Lesman-Leegte I, van Veldhuisen DJ, Sanderman R, Jaarsma T. Quality of life is impaired similarly in heart failure patients with preserved and reduced ejection fraction. *Eur J Heart Fail* 2011; **13**: 1013–1018.
11. Owan TE, Hodge DO, Herges RM, Jacobsen SJ, Roger VL, Redfield MM. Trends in prevalence and outcome of heart failure with preserved ejection fraction. *N Engl J Med* 2006; **355**: 251–259.
12. Oktay AA, Rich JD, Shah SJ. The emerging epidemic of heart failure with preserved ejection fraction. *Curr Heart Fail Rep* 2013; **10**: 401–410.
13. Bhuiyan T, Maurer MS. Heart failure with preserved ejection fraction: persistent diagnosis, therapeutic enigma. *Curr Cardiovasc Risk Rep* 2011; **5**: 440–449.
14. Kondamudi N, Haykowsky M, Forman DE, Berry JD, Pandey A. Exercise training for prevention and treatment of heart failure. *Prog Cardiovasc Dis* 2017; **60**: 115–120.
15. Kanwar M, Walter C, Clarke M, Patarroyo-Aponte M. Targeting heart failure with preserved ejection fraction: current status and future prospects. *Vasc Health Risk Manag* 2016; **12**: 129–141.
16. Oktay AA, Shah SJ. Diagnosis and management of heart failure with preserved ejection fraction: 10 key lessons. *Curr Cardiol Rev* 2015; **11**: 42–52.
17. Gallagher J, James S, Keane C, Fitzgerald A, Travers B, Quigley E, McDonald K. Heart failure virtual consultation: bridging the gap of heart failure care in the community—a mixed-methods evaluation. *ESC Heart Fail* 2017; **4**: 252–258.
18. O'Connor CM, Whellan DJ, Lee KL, Keteyian SJ, Cooper LS, Ellis SJ, Leifer ES, Kraus WE, Kitzman DW, Blumenthal JA, Rendall DS, Miller NH, Fleg JL, Schulman KA, McKelvie RS, Zannad F, Piña IL. Efficacy and safety of exercise training in patients with chronic heart failure HF-ACTION randomized controlled trial. *JAMA* 2009; **301**: 1439–1450.
19. Edelmann F, Gelbrich G, Düngen HD, Fröhling S, Wachter R, Stahrenberg R, Binder L, Töpper A, Lashki DJ, Schwarz S, Herrmann-Lingen C, Löffler M, Hasenfuss G, Halle M, Pieske B. Exercise training improves exercise capacity and diastolic function in patients with heart failure with preserved ejection fraction: results of the Ex-DHF (exercise training in diastolic heart failure) pilot study. *J Am Coll Cardiol* 2011; **58**: 1780–1791.
20. Gevaert AB, Lemmens K, Vrints CJ, van Craenenbroeck EM. Targeting endothelial function to treat heart failure with preserved ejection fraction: the promise of exercise training. *Oxid Med Cell Longev* 2017; **2017**: 4865756.
21. Darden D, Richardson C, Jackson EA. Physical activity and exercise for secondary prevention among patients with cardiovascular disease. *Curr Cardiovasc Risk Rep* 2013; **7**: 1007.
22. Hegde SM, Claggett B, Shah AM, Lewis EF, Anand I, Shah SJ, Sweitzer NK, Fang JC, Pitt B, Pfeffer MA, Solomon SD. Physical activity and prognosis in the TOPCAT trial (Treatment of Preserved Cardiac Function Heart Failure with an Aldosterone Antagonist). *Circulation* 2017; **136**: 982–992.
23. Miller WR, Rollnick S. *Motivational Interviewing, Preparing People to Change Addictive Behavior*. New York: The Guilford Press; 2013.
24. Rubak S, Sandbæk A, Lauritzen T, Christensen B. Motivational interviewing: a systematic review and meta-analysis. *Brit J Gen Pract* 2005; **55**: 305–312.
25. Creber RM, Patey M, Dickson VV, DeCesaris M, Riegel B. Motivational interviewing tailored interventions for heart failure (MITI-HF): study design and methods. *Contemp Clin Trials* 2015; **41**: 62–68.
26. Edelmann F, Bobenko A, Gelbrich G, Hasenfuss G, Herrmann-Lingen C, Duvinage A, Schwarz S, Mende M, Prettin C, Trippel T, Lindhorst R, Morris D, Pieske-Kraigher E, Nolte K, Düngen HD, Wachter R, Halle M, Pieske B. Exercise training in diastolic heart failure (Ex-DHF): rationale and design of a multicentre, prospective, randomized,

controlled, parallel group trial. *Eur J Heart Fail* 2017; **19**: 1067–1074.
27. Seelig H, Fuchs R. Messung der sport- und bewegungsbezogenen Selbstkonkordanz. *Z Sportpsychol* 2006; **13**: 121–139.
28. Fuchs R, Schwarzer R. Selbstwirksamkeit zur sportlichen Aktivität: Reliabilität und Validität eines neuen Meßinstruments. *Z Diff Diagnost Psychol* 1994; **15**: 141–154.
29. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003; **35**: 1381–1395.
30. Myers J, Brawner CA, Haykowsky MJ, Taylor RS. Prognosis: does exercise training reduce adverse events in heart failure? *Heart Fail Clin* 2015; **11**: 59–72.
31. Cooper LB, Mentz RJ, Sun JL, Schulte PJ, Fleg JL, Cooper LS, O'Connor CM. Psychosocial factors, exercise adherence, and outcomes in heart failure patients: Insights from HF-ACTION. *Circ Heart Fail* 2015; **8**: 1044–1051.
32. Ades PA, Keteyian SJ, Balady GJ, Houston-Miller N, Kitzman DW, Mancini DM, Rich MW. Cardiac rehabilitation exercise and self-care for chronic heart failure. *JACC Heart Fail* 2013; **1**: 540–547.
33. Willenheimer R, Rydberg E, Cline C, Broms K, Hillberger B, Öberg L, Erhardt L. Effects on quality of life, symptoms and daily activity 6 months after termination of an exercise training programme in heart failure patients. *Int J Cardiol* 2001; **77**: 25–31.