



# Effects of meditation on health promoting protective factors of persons with cardiovascular disease – a quasi-experimental pilot study with pre-post comparison

Katharina Weiss<sup>^</sup>, Christian Mahnkopf, Niko Kohls<sup>^</sup>

Faculty for Applied Natural Sciences and Health, Coburg University of Applied Sciences, Coburg, Germany

*Contributions:* (I) Conception and design: K Weiss; (II) Administrative support: N Kohls; (III) Provision of study materials or patients: C Mahnkopf; (IV) Collection and assembly of data: K Weiss; (V) Data analysis and interpretation: K Weiss; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

*Correspondence to:* Niko Kohls, PhD. Faculty for Applied Natural Sciences and Health, Coburg University of Applied Sciences, Friedrich-Streib-Str. 2, 96450 Coburg, Germany. Email: niko.kohls@hs-coburg.de.

**Background:** The aim of this pilot study is to determine, in the context of a controlled intervention study, whether the health-promoting personal protective factors of sense of coherence, resilience, and self-compassion are strengthened by the practice of Metta meditation in individuals with cardiovascular disease. The interactions between mind and body play a pivotal role in health and mortality. Lifestyle factors and especially stress also play a decisive role in the development and progression of cardiovascular diseases. With health-promoting personal protective factors, which can be actively formed over the entire lifespan, stressors can be managed more adequately.

**Methods:** Data collection will be conducted as part of a controlled nonrandomized longitudinal pilot intervention study that will enrol individuals with cardiovascular disease (n=29). After the first interview, a 12-week Metta meditation course will start for the intervention group (IG) (n=9), while the control group (CG) (n=20) will receive no intervention. The Minnesota Living with Heart Failure<sup>®</sup> Questionnaire (MLHFQ), the 13-item Sense of Coherence Scale (SOC-13), the Resilience Scale, the Self-Compassion Scale short form (SCS-sf) German version, the German version of the 10-item Perceived Stress Scale (PSS-10), and the Stress Coping subscale of the Stress and Coping Inventory (SCI) are used at both measurement time (MT) points. In addition, blood pressure parameters are collected. Furthermore, selected literature will be consulted to integrate the evaluated data into existing research findings.

**Results:** The health-promoting personal competencies of sense of coherence, resilience, and self-compassion were not strengthened by the practice of Metta meditation in individuals with cardiovascular disease. However, there was a significant reduction in perceived stress {F[1, 27] =4.351, P=0.047, f=0.402} and improved stress coping skills {F[1, 26] =6.790, P=0.02, f=0.511} in the IG. Furthermore, the frequency of rehospitalization {F[1, 27] =5.607, P=0.03, f=0.456} differed significantly in the pre-post comparison.

**Conclusions:** Due to the insufficient size of the sample, the results are only exploratory in nature and should therefore only be considered preliminary. Also, the correlations between the significant changes in the parameters and Metta meditation cannot be finally assessed. For this purpose, further studies with larger samples are needed.

**Keywords:** Loving-kindness meditation (LKM); sense of coherence; resilience; self-compassion; cardiovascular disease

Submitted Feb 18, 2024. Accepted for publication Jul 08, 2024. Published online Aug 08, 2024.

doi: 10.21037/cdt-24-74

View this article at: <https://dx.doi.org/10.21037/cdt-24-74>

<sup>^</sup> ORCID: Katharina Weiss, 0000-0001-8001-694X; Niko Kohls, 0000-0002-9761-4839.

## Introduction

Cardiovascular diseases are a group of diseases that affect the heart and blood vessels. These are diseases that arise due to atherosclerosis and can have an acute or chronic course. These include, for example, arterial hypertension, coronary heart disease, myocardial infarction, or apoplexy (1,2). There is great potential for health promotion to be integrated into multimodal care or treatment of cardiovascular diseases. Especially in the psychosocial dimensions, evidence-based measures can be implemented at the structural and behavioural level, which ultimately promote health and contribute to the prevention of cardiovascular diseases or, in the case of already existing cardiovascular diseases, improve the quality of life and support coping with the disease.

However, there are only few relevant studies to date that have investigated the effects of interventions specifically for people with cardiovascular diseases on a health-promoting and psychosocial level. For this reason, an explorative controlled intervention study was carried out in the context of this survey, which examined the possible effectiveness of meditation on the strengthening of health-promoting personal competencies in persons with cardiovascular diseases in a before-and-after comparison using the main parameters of sense of coherence, resilience, and self-compassion.

The interconnections and interrelationships, so-called mind-body interactions, between brain, mind, body, behaviour

at the individual level as well as the social dimensions and determinants play a decisive role in health and mortality (3,4). Psychosocial aspects in particular seem to have a significant influence on the entire progression of a disease. But even in the case of already existing health restrictions or illnesses, psychological factors influence the prognostic progression (5). In the meantime, these connections have also been recognised in cardiology and a new discipline of psychocardiology is being established (6). There are already guidelines with therapy options in psychocardiology (7), which, however, have so far insufficiently found their way into practice. In addition, therapeutic care—also due to a lack of specialists and time—can neither be guaranteed adequately nor comprehensively (6,8). Lifestyle factors and above all stress play a decisive role in the development and progression of cardiovascular diseases.

Stress and various diseases are mutually dependent in this context. Many diseases, such as cancer, chronic pain or depression, are themselves stressors, on the other hand, chronic stress can lead to a variety of different diseases on a physical and/or psychological level (9-12). The triggering of stress as well as the subjective experience of stress and the strength of the stress perception are individual and often depend on life history, upbringing, experience, and imprinting. In connection with this, the way people deal with stress and their ability to cope with stress, so-called coping (11,13), are also individually distinct. Because heart and brain are in constant exchange, stress sensation and stress reactions also affect the heart (14,15). The activation of the sympathetic nervous system because of an acute stress reaction has a direct effect on the cardiovascular system with an increase in heart and respiratory frequency, blood pressure and vasoconstriction of the blood vessels.

If permanent overload and prolonged exposure to stressors lead to a chronicity of stress, the human body can only adapt to a certain degree. As soon as the body can no longer recover and regulate to its normal level due to constantly excessive activation caused by stress, this permanent strain can lead to long-term damage, which can sometimes be severe (9,16,17). If the stress limit is permanently exceeded and a return to a physiological relaxation phase is no longer possible, physical and/or psychological illnesses can be triggered (3,9,18,19). In addition, over the course of the chronification process, the increased and constant release of cortisol leads to permanently elevated cortisol levels. This also inhibits the immune system, as the formation of lymphocytes and antibodies is hindered. This in turn can lead to other secondary diseases (5,20).

### Highlight box

#### Key findings

- A significant reduction in perceived stress and improved stress coping skills in the intervention group (IG).
- Significant difference regarding the frequency of rehospitalization of IG participants in the pre-post comparison.

#### What is known and what is new?

- Interactions between mind and body play a pivotal role in health and mortality; lifestyle factors and especially stress also play a decisive role in the development and progression of cardiovascular diseases; relaxation techniques may reduce stress.
- Significant stress reduction is also achieved by practising Metta meditation.

#### What is the implication, and what should change now?

- Further studies with larger samples are needed; follow-up surveys are necessary to record possible effects of meditation on health-promoting personal competencies; the intervention should also be implemented in people with congenital heart defects and possible effects should be measured.

### ***Strengthening health-promoting competencies through meditation***

The health-promoting personal competencies—and thus also sense of coherence, resilience, and self-compassion—can be learned throughout the entire lifespan and can be strengthened in a targeted manner (21-23). Various mind-body techniques such as Yoga, Tai Chi, Pilates and various meditation techniques are available for this purpose, which focus on the principle of mindfulness (24).

As early as 2017, in a scientific statement on meditation and cardiovascular risk the American Heart Association (AHA) pointed out that meditation could be considered as an additional guideline-based intervention to reduce the risk of cardiovascular disease (25).

### ***Current state of research***

In a scientific statement by the AHA, Levine *et al.* (26) stated that, even if the studies on meditation indicate a possible benefit for cardiovascular risk, the quality and in some cases also the quantity of the study data is modest. There are no studies on the possible effects of Metta meditation on cardiovascular disease. Likewise, there are no studies to date that have investigated possible effects of Metta meditation on health-promoting personal competencies or protective factors or explicitly on sense of coherence.

### ***Objective***

As a result of the previous considerations, a research gap was identified regarding the evidence of the possible effects of Metta meditation on health-promoting personal competencies in people with cardiovascular disease.

The aim of the research project is to investigate possible effects on health-promoting personal competencies—explicitly on sense of coherence, resilience, and self-compassion—in people with cardiovascular disease through the practice of Metta meditation. We present this article in accordance with the TREND reporting checklist (available at <https://cdt.amegroups.com/article/view/10.21037/cdt-24-74/rc>).

## **Methods**

### ***Study design***

To demonstrate the potential impact of health-related interventions, a controlled non-randomised longitudinal pilot intervention study was chosen as study design (27-30).

After the first survey with both groups [ $t_0$ /measurement time (MT)1], the intervention group (IG) started the 12-week Metta meditation programme, which took place online once a week for about 45 minutes. After the 12 weeks, both groups were surveyed again ( $t_1$ /MT2).

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional ethics committee of University of Applied Sciences Coburg (No. HC-Kohls-Weiß-20220708) and informed consent was obtained from all individual participants.

### ***Acquisition of study participants***

Between September 2022 and January 2023, about 335 people were personally informed and invited to participate in the intervention on the cardiology units of the REGIOMED Hospital Coburg. Out of 335 people, 42 people agreed to be contacted and to receive further information about the research project and the offer to participate in a cost-free Metta meditation course. After a first contact with the 40 persons, seven actively communicated their refusal. The information letter on participation in the study was then sent to 33 people, 15 of whom signed and returned the consent form. While 14 people participated in the first interview, nine attended the first intervention unit. The number of participants in the 12 individual meditation sessions varied between four (min) and 11 (max) and averaged six and a half participants per session [mean ( $M$ ) =6.5].

The people for the control group (CG) were recruited in Germany, Austria, and the German-speaking part of Switzerland by contacting and publishing them with or forwarding them to participants, self-help group contact points of the federal states and self-help groups as well as cardiac sports groups. The study participants were also recruited via the social networks Facebook and LinkedIn as well as the research platform SurveyCircle.

This reached 119 people who considered participating and accessed the online questionnaire.

### ***Data collection tools***

The following quantitative measurement instruments were used for both MTs: the Minnesota Living with Heart Failure<sup>®</sup> Questionnaire (MLHFQ) (31), the 13-item Sense of Coherence Scale (SOC-13) (32), the Resilience Scale (33), the Self-Compassion Scale short form (SCS-sf)

German version (34,35), the German version of the 10-item Perceived Stress Scale (PSS-10) (36), the Stress Coping subscale of the Stress and Coping Inventory (SCI) (37), and the blood pressure parameters of the study participants, which had been measured and documented under their own responsibility.

In addition, relevant socio-demographic data as well as some parameters in the IG were asked for the second MT. The data was collected using the online survey tool QuestorPro.

### *Intervention implementation*

The intervention consisted of a 12-week Metta meditation course held online once a week for about 45 minutes. The meditation course was led by a relaxation trainer. Due to the coronavirus disease 2019 (COVID-19) pandemic, this was conducted online via video conference (Zoom). After a brief discussion and short presentation on the topics of heart disease, stress and meditation, the meditation was practised under verbal guidance. After the meditation session, the participants were offered space for further discussion. As with the structure of Metta meditation, the practice of meditation was gradual over the first 6 weeks. The instructions for meditation were compiled according to Haubold (38), Henkelmann (39), and Känner (40). At the end of the course, recorded audio files of the meditation instructions were made available for the participants to download.

The loving-kindness meditation (LKM), also called Metta meditation, is a widely practised form of meditation.

The special feature of Metta meditation—or LKM—is the all-encompassing love that is at the centre of the meditation practice. Metta meditation is a form of mindfulness meditation and is also well suited for beginners to meditation practice. The positive effects of Metta meditation include accepting stressful emotions and transforming them into an accepting attitude, as well as adopting a benevolent attitude towards oneself and all living beings (40).

For Metta meditation, there are already some studies that prove the effects of this form of meditation on different parameters (41-46).

### *Statistical analyses*

Statistical analyses were performed using IBM® SPSS® Statistics software (version 29.0.0.0). Due to the exploratory

nature of the study, the significance level was set at  $P < 0.05$  and the confidence interval (CI) at 95%.

First, the data collected at  $t_0$  and  $t_1$  were analysed descriptively and statistically. Then, all relevant variables were tested for normal distribution using the Kolmogorov-Smirnov test (sample size  $< 50$ ). Inferential statistical procedures were then applied to calculate possible statistically significant results for the pre-post and group comparison. For this purpose, analyses of variance (ANOVAs) with repeated measures were carried out to determine significant differences. For the case of multiple testing, the  $\alpha$ -error was corrected according to Bonferroni (47).

### **Results**

All results were calculated based on the data set that had been compiled by processing the raw data using data set cleaning, mean imputation, or exclusion of data and post-hoc reclassification of variables.

It should be noted that due to the sample size, all results have only an explorative non-representative character. This is also shown by a post-hoc power analysis.

#### *Dropout rate*

The dropout rate between the number of people invited to participate in the intervention and the number of participants in the first intervention session was 97%. Within the IG, the dropout rate between the number of people who gave consent to be contacted and the number of participants who attended the first intervention session was 79%. The dropout rate between the sample size at MT1 and MT2 of the IG was 31%.

Between the preliminary and final CG sample sizes, the dropout rate was 40%.

#### *Characteristics of the sample*

The socio-demographic characteristics of the sample were collected at the first measurement point. The total sample ( $n=29$ ) consisted of 31% female and 69% male participants. The median age of all respondents was 63 years [ $M = 61.66$ ; standard deviation (SD) = 14.072] with a range of 57 years (min-max, 30-87 years). Of the total sample, 3.4% named hypertension as the central diagnosis, 6.9% peripheral arterial occlusive disease, 6.9% entered details in the box other and listed aneurysm surgery with subsequent Dressler's syndrome, Tako-Tsubo syndrome, and vitiation

as well as heart failure and arrhythmia (defibrillator), each 10.3% named a heart attack or chronic heart failure, 17.2% a heart valve insufficiency, 20.7% named coronary heart disease as the central diagnosis and 24.1% cardiac arrhythmias.

### ANOVAs

To answer the scientific question on significant differences, several repeated-measures ANOVAs were conducted. All Mauchly tests for sphericity were not significant, so that the ANOVAs were allowed to be carried out.

There were no significant differences in the parameters of sense of coherence, resilience, self-compassion, and in blood pressure parameters in the pre-post comparison within the respective groups nor between the two groups.

A repeated-measures ANOVA showed that there were significant differences within the groups {F[1, 27] =4.590, P=0.041,  $\eta_p^2=0.145$ , n=29} regarding the frequency of rehospitalisation in the pre-post comparison, which corresponded to a strong effect according to Cohen (Cohen's  $f=0.412$ ). There were also significant differences between the two groups when the MT was taken into account as well as without considering the MT. Therefore, there were significant differences in the frequency of rehospitalisation in the pre-post comparison within the respective groups and between both groups.

### Exploratory analyses

During the evaluation process, non-hypothesis-driven but relevant results also emerged, which are reported below.

A repeated-measures ANOVA showed that the health-related quality of life in the pre-post comparison differed significantly within the individuals of both groups {F[1, 26] =11.697, P=0.03,  $\eta_p^2=0.310$ , n=28}. According to Cohen, this corresponded to a strong effect (Cohen's  $f=0.670$ ).

Significant differences were also found in the emotional and physical dimensions of health-related quality of life within both groups.

Furthermore, another ANOVA with repeated measures for perceived stress level showed a significant difference in the pre-post comparison both within the groups {F[1, 27] =5.421, P=0.03,  $\eta_p^2=0.167$ , n=29}, which corresponded to a strong effect according to Cohen (Cohen's  $f=0.448$ ), as well as between both groups taking into account the MT {F[1, 27] =4.351, P=0.047,  $\eta_p^2=0.139$ , n=29}, which also corresponded to a strong effect (Cohen's  $f=0.402$ ) according

to Cohen.

In addition, there was a significant difference in the subscale helplessness within both groups.

Finally, a repeated-measures ANOVA for the Stress Coping subscale of the SCI showed that the total score differed significantly from each other in the pre-post comparison within the individuals of both groups {F[1, 26] =6.790, P=0.02,  $\eta_p^2=0.207$ , n=28}. According to Cohen, this corresponded to a strong effect (Cohen's  $f=0.511$ ). Neither taking into account the MT nor not taking into account the MT showed significant group differences in the before-after comparison. For the coping strategies positive thinking {F[1, 26] =9.951, P=0.004,  $\eta_p^2=0.207$ , n=28}, which corresponded to a strong effect according to Cohen (Cohen's  $f=0.619$ ), and social support {F[1, 26] =4.343, P=0.047,  $\eta_p^2=0.143$ , n=28}, which was a medium effect according to Cohen (Cohen's  $f=0.408$ ), showed significant pre-post differences within individuals of both groups. The differences when MT was taken into account were not significant. No significant differences were found in the pre-post comparison for the coping strategies. Active stress coping, keeping faith as well as alcohol and cigarette consumption.

## Discussion

### Strengths and limitations

Since small sample sizes normally lead to low statistical power, a higher probability of  $\alpha$ -error as well as  $\beta$ -error can be assumed, i.e., a small number of data can pretend the effectiveness of interventions.

It should therefore be noted that statistically significant results (significance level  $P<0.05$ ) can only be regarded as explorative because of the small sample. Furthermore, and due to this, the statistical power is only insufficient, which was confirmed by a post-hoc power analysis.

In addition, the participants were assigned to the two groups without randomisation.

Furthermore, no follow-up survey was conducted that would allow conclusions to be drawn about possible long-term effects and effects that were not yet fully developed at the time of data collection at the second measurement point.

Additionally, it should be noted that because of to the online recruitment of the CG participants, there was no personal interaction with them and no personal assessment could be made. For the persons who gave their consent to participate in the intervention, a personal affinity for



meditation could have been decisive. Overall, no external validity is given due to the sample selection, sample size, and sample composition.

Moreover, the possibility of some distortions in the response behaviour (response bias) of the study participants should be pointed out.

Finally, there are always systematic confounders that can be person-, condition-, or situation-related and are not controlled, such as participant characteristics or external factors (47).

Through the exclusive use of validated questionnaires, the quality criteria of objectivity, reliability and internal validity are fulfilled regarding the measurement instruments.

Finally, the inclusion of a CG also contributes to a higher internal validity of this study. During the implementation of the intervention, the general conditions were maintained as well as possible to control for possible confounders. Finally, this intervention study represents a benefit especially for the persons with cardiovascular diseases.

### **Key findings**

One of the main findings of this study is that a significant reduction in stress was measurable in the IG. Furthermore, there was a significant improvement in stress coping skills in the IG.

Finally, a significant difference was indicated regarding the frequency of rehospitalisation of participants of the IG in the pre-post comparison.

### **Comparison with similar research**

It should be noted that the research hypothesis was investigated for the first time in the context of this pilot study. Due to this, the classification in the existing state of research proves to be difficult.

First, it should be noted that within this pilot study, the practice of Metta meditation in people with cardiovascular disease did not strengthen the health-promoting personal competencies sense of coherence, resilience, and self-compassion. This was also shown for the parameters resilience and self-compassion in an RCT by Pidgeon *et al.* (48) After an intervention with Metta meditation, no significant differences were found between the IG and CG with regard to the variables resilience, self-compassion and mindfulness. Only after 4 months a strengthening of resilience could be measured. A meta-analysis by Reilly and Stuyvenberg (49), on the other hand, proved the effectiveness of Metta

meditation in strengthening self-compassion. To date, there are no studies on a possible effect of Metta meditation on sense of coherence. It is therefore possible that the variables of sense of coherence, resilience and self-compassion can only be determined after a longer period of meditation practice and/or only in follow-up measurements.

Only the hypothesis that the practice of Metta meditation significantly reduces the number of rehospitalizations could be confirmed {MT:  $F[1, 27] = 4.590$ ,  $P = 0.041$ ,  $f = 0.412$ ; MT  $\times$  group:  $F[1, 27] = 5.607$ ,  $P = 0.03$ ,  $f = 0.456$ ; group:  $F[1, 27] = 11.129$ ,  $P = 0.002$ ,  $f = 0.642$ }.

However, the explorative analyses revealed significant pre-post differences in stress perception {MT:  $F[1, 27] = 5.421$ ,  $P = 0.03$ ,  $f = 0.448$ ; MT  $\times$  group:  $F[1, 27] = 4.351$ ,  $P = 0.047$ ,  $f = 0.402$ }, which corresponded to a strong effect and could be attributed to the individuals in the IG ( $t_0$ : IG:  $M = 26.33$  with  $SD = 6.93$ ; CG:  $M = 26.45$  with  $SD = 8.71$ ;  $t_1$ : IG:  $M = 21.78$  with  $SD = 5.78$ ; CG:  $M = 26.20$  with  $SD = 7.05$ ). This was accompanied by a significant improvement in coping strategies in the IG at the second MT, corresponding to a strong effect [ $F[1, 26] = 6.790$ ,  $P = 0.02$ ,  $f = 0.511$ ]. With regard to health-related quality of life, it was noticeable that the values improved significantly in the before-after comparison {MT:  $F[1, 26] = 11.697$ ,  $P = 0.002$ ,  $f = 0.670$ } and showed a strong effect. The quality of life in both groups was already significantly better than that of the comparison sample at the first MT. Surprisingly, however, the change in the pre-post comparison was evident in both groups ( $t_0$ : IG:  $M = 35.11$  with  $SD = 28.55$ ; CG:  $M = 30.74$  with  $SD = 18.52$ ;  $t_1$ : IG:  $M = 23.22$  with  $SD = 25.45$ ; CG:  $M = 24.95$  with  $SD = 18.26$ ).

### **Explanations of findings**

Thus, the practice of Metta meditation in people with cardiovascular disease is likely to have reduced the perceived stress load and strengthened the health-promoting personal competencies regarding stress management strategies. However, it cannot be conclusively assessed whether the significant change in health-related quality of life in the IG was also caused by the practice of Metta meditation or by other disturbance effects, as this also occurred in the CG. A so-called spring effect (50,51) could possibly explain the improvement in quality of life and especially in the emotional dimension of quality of life in both groups.

It is also possible, referring to chapter 1—health-promoting personal competencies, that there is a directed connection between the protective factor of stress management

and the other health-promoting personal competencies sense of coherence, resilience, and self-compassion. It is conceivable, for example, that the reduction of stress and the strengthening of coping strategies are prerequisites for a stronger development of sense of coherence, resilience, and self-compassion. Only when the physiological stress reaction is gradually restored and the cortisol level and the function of the immune system are normalised, there could be a basis for the body to carry out other processes of change in its entirety—such as strengthening health-promoting personal protective factors.

## Conclusions

### *Implications and actions needed*

However, only based on the results of several large-scale studies can verifiable conclusions be drawn about a strengthening of health-promoting personal protective factors in people with cardiovascular diseases through the practice of Metta meditation, and possible correlations be recognised. Follow-up surveys are also mandatory for this.

Due to the complex interrelationships outlined above, interdisciplinary multimodal treatment approaches for cardiovascular diseases are absolutely indicated. Socio-economic and psychosocial factors should already be assessed during the diagnostic phase and psychological tests should be carried out to be able to make recommendations for individually specific interventions. In addition to imparting knowledge and recommendations on exercise and dietary behaviour, these should above all include measures for coping with stress, promoting motivation and learning relaxation techniques. In principle, patient-centred, participatory communication should be aimed for (52). However, such health-promoting and (secondary) preventive offers are not available nationwide and are hardly or not at all accessible, especially for patients in rural areas (53). The results of surveys on the health care situation, which were carried out primarily among adults with congenital heart defects, unanimously show major deficits, especially in general and family doctor care (54–56). An exploratory analysis of needs and requirements on the care structure of specific health-promoting services for adults with congenital heart defects in Germany showed that counselling on health-promoting services received an average grade of still sufficient 4.4 (M = 4.41, SD = 1.404, n = 74). Furthermore, 75.6% (n = 86) were not aware of any such health-promoting services specifically for adults with congenital heart defects (57).

However, health promotion is an element that should not be neglected, as it makes a decisive contribution to creating, increasing, maintaining and restoring quality of life and well-being. Due to the salutogenetic approach, the focus here is primarily on strengthening health and personal resources, which are to be distinguished as personal protective factors from risk factors (58).

Furthermore, it is indispensable to create low-threshold and barrier-free health promoting offers for people with cardiovascular disease, especially for those with congenital heart defects. Because the number of adults with congenital heart defects is steadily increasing, while the care situation is not improving fast enough. A holistic treatment approach is urgently needed, especially with regard to the psychological stress situations of these patients (57,59,60).

## Acknowledgments

We thank all participants for their support. Parts of the present study were submitted by K.W. as a master's thesis as part of the health promotion course at Coburg University of Applied Sciences, which was supervised by N.K. After grading, the manuscript of the present study was prepared based on the data collected during the master's thesis.

*Funding:* None.

## Footnote

*Peer Review and Provenance:* This article was commissioned by the Guest Editor (Harald Kaemmerer) for the series “Current Management Aspects in Adult Congenital Heart Disease (ACHD): Part VI” published in *Cardiovascular Diagnosis and Therapy*. The article has undergone external peer review.

*Reporting Checklist:* The authors completed the TREND reporting checklist. Available at <https://cdt.amegroups.com/article/view/10.21037/cdt-24-74/rc>

*Data Sharing Statement:* Available at <https://cdt.amegroups.com/article/view/10.21037/cdt-24-74/dss>

*Peer Review File:* Available at <https://cdt.amegroups.com/article/view/10.21037/cdt-24-74/prf>

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <https://cdt.amegroups.com/article/view/10.21037/cdt-24-74/coif>). The series

“Current Management Aspects in Adult Congenital Heart Disease (ACHD): Part VI” was commissioned by the editorial office without any funding or sponsorship. The authors have no other conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional ethics committee of University of Applied Sciences Coburg (No. HC-Kohls-Weiß-20220708) and informed consent was obtained from all individual participants.

*Open Access Statement:* This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

## References

- Bobinger T. Alles zum Thema Kardiovaskuläre Erkrankungen. 2024 [cited 2024 May 11]. Available online: <https://klinikradar.de/kardiovaskulaere-erkrankungen/>
- Haas I, Unterhofer M, Antwerpes F, et al. Cardiovascular disease. 2022 [cited 2024 May 11]. Available online: [https://flexikon.doccheck.com/de/Kardiovaskul%C3%A4re\\_Erkrankung](https://flexikon.doccheck.com/de/Kardiovaskul%C3%A4re_Erkrankung)
- Albus C. Basic concepts of psychosomatic medicine. In: Herrmann-Lingen C, Albus C, Titscher G. editors. Psychocardiology. 3rd ed. Berlin, Heidelberg: Springer Berlin Heidelberg; 2020:39-46.
- Esch T. The benefits of self-healing potential in professional healthcare using the example of mind-body medicine. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2020;63:577-85.
- Knoll N, Scholz U, Rieckmann N, et al. Introduction to health psychology. 4. aktualisierte Auflage. München: Ernst Reinhardt Verlag; 2017.
- German Heart Foundation e.V. Help for the heart - and for the soul. Special print Soul and Heart (SD39). 2020.
- Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). Eur Heart J 2016;37:2315-81.
- Herrmann-Lingen C. Psychocardiology-current guidelines and clinical reality (reprinted). Psychother Psychosom Med Psychol 2019;69:237-52.
- Ernst G, Franke A, Franzkowiak P. Stress und Stressbewältigung. In: Bundeszentrale für gesundheitliche Aufklärung (BZgA). editor. Leitbegriffe der Gesundheitsförderung und Prävention. Glossar zu Konzepten, Strategien und Methoden. 2022. Available online: <https://doi.org/10.17623/BZGA:Q4-i118-2.0>
- Gaab J, Rohleder N, Nater UM, et al. Psychological determinants of the cortisol stress response: the role of anticipatory cognitive appraisal. Psychoneuroendocrinology 2005;30:599-610.
- Lazarus RS, Folkman S. Stress, appraisal, and coping. New York: Springer Publishing Company; 1984.
- Plaumann M, Busse A, Walter U. The basics of stress. In: KKH Kaufmännische Krankenkasse. editor. White Book on Prevention 2005/2006. Berlin, Heidelberg: Springer Berlin Heidelberg; 2006:3-12.
- Kaluza G. Stressbewältigung: trainingsmanual zur psychologischen gesundheitsförderung. 4th ed. Berlin, Heidelberg: Springer-Verlag; 2018.
- German Health Foundation e.V. High blood pressure - helpful relaxation techniques. 2019.
- Novartis Pharma GmbH. Our body: The brain. Heart mail for heart patients and their families. 2020.
- Chaddha A, Robinson EA, Kline-Rogers E, et al. Mental Health and Cardiovascular Disease. Am J Med 2016;129:1145-8.
- Selye H. The evolution of the stress concept. Stress and cardiovascular disease. Am J Cardiol 1970;26:289-99.
- Goh C, Agius M. The stress-vulnerability model how does stress impact on mental illness at the level of the brain and what are the consequences? Psychiatr Danub 2010;22:198-202.
- Mohr B, Korsch S, Roch S, et al. Unipolar depression disorder. In: Mohr B, Korsch S, Roch S, et al. editors. Debora – Training manual for back pain competence and depression prevention. Berlin, Heidelberg: Springer;



- 2017:25-43.
20. Osterkamp J. Stress öffnet Erkrankungen Tür und Tor. 2012 [cited 2023 Mar 5]. Available online: <https://www.spektrum.de/news/stress-oeffnet-erkrankungen-tuer-und-tor/1147677>
  21. Huber M. Resilienz im Team: Ideen und Anwendungskonzepte für Teamentwicklung. Wiesbaden: Springer-Verlag; 2019.
  22. Neff KD. Self-Compassion: Theory, Method, Research, and Intervention. *Annu Rev Psychol* 2023;74:193-218.
  23. Wiesmann U, Rölker S, Ilg H, et al. On the stability and modifiability of the sense of coherence in active seniors. *Zeitschrift für Gerontologie und Geriatrie* 2006;39:90-9.
  24. Gok Metin Z, Ejem D, Dionne-Odom JN, et al. Mind-Body Interventions for Individuals With Heart Failure: A Systematic Review of Randomized Trials. *J Card Fail* 2018;24:186-201.
  25. Krittana Wong C, Kumar A, Wang Z, et al. Meditation and Cardiovascular Health in the US. *Am J Cardiol* 2020;131:23-6.
  26. Levine GN, Lange RA, Bairey-Merz CN, et al. Meditation and Cardiovascular Risk Reduction: A Scientific Statement From the American Heart Association. *J Am Heart Assoc* 2017;6:e002218.
  27. Deutsches Netzwerk Evidenzbasierte Medizin e.V. Arbeitsmaterialien. 2023 [cited 2023 Mar 4]. Available online: <https://www.ebm-netzwerk.de/de/service-ressourcen/ebm-basics/arbeitsmaterialien>
  28. Donnellan MB, Conger RD. Designing and Implementing Longitudinal Studies. In: Robins RW, Fraley RC, Krueger RF. editors. *Handbook of research methods in personality psychology*. New York: Guilford Press; 2007:21-36.
  29. Hering T. Quantitative methods in prevention and health promotion. In: Niederberger M, Finne E. editors. *Research methods in health promotion and prevention*. Wiesbaden: Springer VS; 2021:139-70.
  30. Röhrig B, du Prel JB, Blettner M. Study design in medical research: part 2 of a series on the evaluation of scientific publications. *Dtsch Arztebl Int* 2009;106:184-9.
  31. University of Minnesota. Minnesota living with heart failure® questionnaire: Instructions for Data Collection and Scoring.
  32. Singer S, Brähler E. The "Sense of Coherence Scale": Test manual for the German version. Göttingen: Vandenhoeck & Ruprecht; 2007.
  33. Leppert K, Koch B, Brähler E, et al. The Resilience Scale (RS)—Review of the long form RS-25 and a short form RS-13. *Clin Diagnosis Evaluation* 2008;1:226-43.
  34. Neff KD. The development and validation of a scale to measure self-compassion. *Self and Identity* 2003;2:223-50.
  35. Raes F, Pommier E, Neff KD, et al. Construction and factorial validation of a short form of the Self-Compassion Scale. *Clin Psychol Psychother* 2011;18:250-5.
  36. Schneider EE, Schönfelder S, Domke-Wolf M, et al. Instructions, items and subscales of a German adaption of the 10-item Perceived Stress Scale (PSS-10). [Cited 2023 Mar 26]. Available online: [https://www.klinische-psychologie-und-neuropsychologie.uni-mainz.de/files/2020/02/PSS\\_English\\_German\\_Link\\_on\\_Homepage\\_070220.pdf](https://www.klinische-psychologie-und-neuropsychologie.uni-mainz.de/files/2020/02/PSS_English_German_Link_on_Homepage_070220.pdf)
  37. Satow L. Stress und Coping Inventory (SCI): Test- und Skalendokumentation. 2012 [cited 2023 Feb 3]. Available online: <https://www.dr-satow.de/tests/stress-und-coping-inventar/SCI-Testdokumentation-2024.pdf>
  38. Haubold S. Metta Meditation. 2020.
  39. Henkelmann A. Meditation of loving kindness. 2021 [cited 2021 Mar 11]. Available online: <https://youtu.be/oJBjHEI8Lb4?si=Mw2x3w-7T47z9BEC>
  40. Känner S. Metta-Meditation. Liebende Güte, Herzenswärme & Wohlwollen kultivieren. 2020 [cited 2022 Jun 27]. Available online: <https://www.sylke-kaenner.de/mitgefuehlsuebungen/metta-meditation/>
  41. Galante J, Galante I, Bekkers MJ, et al. Effect of kindness-based meditation on health and well-being: a systematic review and meta-analysis. *J Consult Clin Psychol* 2014;82:1101-14.
  42. Chen H, Liu C, Cao X, et al. Effects of Loving-Kindness Meditation on Doctors' Mindfulness, Empathy, and Communication Skills. *Int J Environ Res Public Health* 2021;18:4033.
  43. Telke S, Leininger B, Hanson L, et al. A Randomized Trial of 21 Days of Loving Kindness Meditation for Stress Reduction and Emotional Well-being Within an Online Health Community for Patients, Family, and Friends Experiencing a Cancer Health Journey. *J Integr Complement Med* 2022;28:158-67.
  44. Wang Y, Fu C, Liu Y, et al. A study on the effects of mindfulness-based cognitive therapy and loving-kindness mediation on depression, rumination, mindfulness level and quality of life in depressed patients. *Am J Transl Res* 2021;13:4666-75.
  45. Leung MK, Chan CC, Yin J, et al. Increased gray matter volume in the right angular and posterior parahippocampal gyri in loving-kindness meditators. *Soc Cogn Affect Neurosci* 2013;8:34-9.
  46. Yordanova J, Kolev V, Mauro F, et al. Common and

- distinct lateralised patterns of neural coupling during focused attention, open monitoring and loving kindness meditation. *Sci Rep* 2020;10:7430.
47. Eid M, Gollwitzer M, Schmitt M. *Statistics and research methods*. 5th cor ed. Weinheim, Basel: Beltz; 2017.
  48. Pidgeon AM, Ford L, Klaassen F. Evaluating the effectiveness of enhancing resilience in human service professionals using a retreat-based Mindfulness with Metta Training Program: a randomised control trial. *Psychol Health Med* 2014;19:355-64.
  49. Reilly EB, Stuyvenberg CL. A meta-analysis of loving-kindness meditations on self-compassion. *Mindfulness* 2023;14:2299-310.
  50. Hellbrueck J, Kals E. *Environmental psychology*. Wiesbaden: Springer VS; 2012.
  51. Jaworeck S, Stemler S, Kriwy P. "It's sunny, be happy!" Ein internationaler Vergleich des Einflusses von Sonnenstunden und Breitengraden auf das Glücksempfinden. *Prävention und Gesundheitsförderung* 2023;18:211-20.
  52. Albus C, Waller C, Fritzsche K, et al. Significance of psychosocial factors in cardiology—Update 2018: Position paper of the German Cardiac Society. *Der Kardiologe* 2018;12:312-31.
  53. Albus C. Outpatient treatment options. In: Herrmann-Lingen C, Albus C, Titscher G. editors. *Psychocardiology*. 3rd ed. Berlin, Heidelberg: Springer Berlin Heidelberg; 2020:246-7.
  54. Angermann CE, Faller H, Ertl G, et al. Coaching and multidisciplinary care for patients with cardiovascular disease: HeartNetCare-HF© as a model for comprehensive disease management in heart failure. In: Schmacke N, Günster C, Klose J. editors. *Healthcare Report 2011: Focus on chronic diseases*. Stuttgart: Schattauer; 2011:179-95.
  55. Nebel K. *The care situation of adults with congenital heart defects from the patient's perspective*. München: Ludwig-Maximilians-Universität; 2022.
  56. Neidenbach R, Achenbach S, Andonian C, et al. Medical care of adults with congenital heart diseases: Present and future. *Herz* 2019;44:553-72.
  57. Weiss K. Examination paper in the module "Deepening quantitative research methods" of the Master's degree programme "Health promotion" at Coburg University of Applied Sciences. 2022.
  58. Röhrich C, Giordano J, Kohls NB. Narrative view of the role of health promotion and salutogenesis in the treatment of chronic disease: viability and value for the care of cardiovascular conditions. *Cardiovasc Diagn Ther* 2021;11:591-601.
  59. Andonian C, Beckmann J, Ewert P, et al. Assessment of the Psychological Situation in Adults with Congenital Heart Disease. *J Clin Med* 2020;9:779.
  60. Andonian C, Beckmann J, Biber S, et al. Current research status on the psychological situation of adults with congenital heart disease. *Cardiovasc Diagn Ther* 2018;8:799-804.

**Cite this article as:** Weiss K, Mahnkopf C, Kohls N. Effects of meditation on health promoting protective factors of persons with cardiovascular disease—a quasi-experimental pilot study with pre-post comparison. *Cardiovasc Diagn Ther* 2024;14(4):537-546. doi: 10.21037/cdt-24-74