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Original Article

Physiotherapy Section

Heart Rate Variability Biofeedback Psychophysiological Rehabilitation in Coronary Artery Disease Patients: State of Heart as the State of Brain

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ABSTRACT

Introduction: Psychological therapies in cardiac rehabilitation programs were found to be effective for patients with Coronary Artery Disease (CAD). Heart Rate Variability Biofeedback (HRV-BF) is a behavioural neuro-cardiac intervention designed as a natural oscillation between the breathing cycle and Heart Rate (HR), also known as refractory sinus rhythm biofeedback.

Aim: To find the potential effects of heart rate variability biofeedback for psychophysiological rehabilitation in CAD patients.

Materials and Methods: In this systematic review included five databases (PubMed, Scopus, web of science, and Google Scholar) were searched for publications between January to December 2021. Randomised control trials published in the English language, done on the effect of HRV-BF on psychophysiological rehabilitation in CAD, were included. High-quality experimental trials were chosen for the study, using Arksey and O'Malley framework. The records were screened against eligibility criteria and methodological quality analysis was done using Downs and Black N checklist.

Results: Overall, 11,048 articles were extracted, from which 56 records were screened, and three randomised control trials were included in the study. All the three studies scored within a range of 20-25, with good methodological quality. They demonstrate practical feasibility of HRV-BF device with both short-term and long-term effect on psychophysiological rehabilitation in CAD patients.

Conclusion: This systematic review showed the potential effects of HRV-BF for psychophysiological rehabilitation in CAD patients. Patients have reported the benefits of HRV-BF therapies by patient reported as well as therapies reported outcome measures.

Keywords: Cardiovascular morbidity, Outcome, Practical feasibility

INTRODUCTION

Cardiac autonomic dysregulation is a significant predictor anchored to the development of cardiovascular disorders that can be assessed non invasive via Heart Rate Variability (HRV) analysis. It indicates the temporal difference between successive sinus heartbeats induced by the equilibrium of the parasympathetic and sympathetic nervous systems [1]. It is most often assessed between QRS complexes at each Normal-to-Normal (NN) interval [2]. The ability of the cardiovascular system to adapt to changes in sympathetic influences is reflected in HRV. Thus, increased HRV indicates good heart health, whereas low variability has been linked to poor cardiac health and poor cardiac outcomes, and is an independent predictor for cardiovascular morbidity and mortality, and cardiac event recurrence [3,4]. Furthermore, poor HRV, hyperactivity of the vagus nerve and sensitivity of the pressure sensors (baroreflex system) when combined with depression symptoms were strong predictors of mortality in Coronary Artery Disease (CAD) patients [5].

Reduced cardiovascular morbidity and death are two well-known benefits of multidisciplinary Cardiac Rehabilitation (CR). Psychological therapies in CR programs were found to be effective for patients with CAD during short and long-term follow-ups, primarily in minimising depression and anxiety, symptom recurrence and death [6]. Biofeedback is a type of self-regulation therapy in which the patient learns to manage the function of their autonomic nervous system to improve the overall health. Patients with a variety of cardiovascular illnesses, including hypertension, CAD and heart failure, have benefited from biofeedback [5]. The Heart Rate Variability Biofeedback (HRV-BF) is a behavioural neuro-cardiac intervention that involves breathing six times per minute to stimulate efferent vagal activity to the Sinoatrial (SA) node, modulate HR and Blood Pressure (BP), increase HRV indices, and achieve a power spectral distribution of Low Frequency (LF) at 0.1 Hz. HRV-BF is a natural oscillation between the breathing cycle and HR, also known as refractory sinus rhythm biofeedback.

The primary aim of this study was to undertake a review of the literature to investigate the effectiveness of psychophysiological interventions using HRV-BF in CAD patients. The secondary aim was to identify the various HRV-BF devices utilised in the psychosocial interventions. The aim of this review was to evaluate the current efficacy of additional, well-defined psycholophysiological interventions using HRV-BF compared with CR alone on depression, anxiety, Quality of Life (QOL), cardiovascular morbidity, cardiovascular mortality and total mortality in CAD patients.

MATERIALS AND METHODS

A wide electronic search was performed for trials available from January to December 2021 in the Web of Science, Google Scholar, Scopus, and PubMed databases. The five stage review framework suggested by Arksey H and O'Malley L, which was used to select studies [7]. The following MeSH terms were used: CAD, HRV-BF, psychological intervention, cardiac rehabilitation.

Inclusion criteria: The human experimental clinical trials, in the study period for the data collection (January to December 2021) and English language articles were included in the study.

Exclusion criteria: All review articles, meta-analyses, or case series were excluded from the study. Articles with only abstracts, having no control group, and HRV-BF in other conditions were also excluded.

Study Procedure

In the second stage, the relevant studies related to HRV, HRV-BF, and their impact on psychophysiological rehabilitation in CAD was noted down. The selection of studies was done in the third step by one reviewer going over the titles and abstracts (MJJ). The three complete studies were chosen, reviewed, and rated following the eligibility requirements using Downs SH and Black N checklist for methodological quality index score [8]. The checklist consists of 27 items that address the following methodological components: reporting, external validity, internal validity (bias and confounding) and power. The scores range from 0-28 with higher scores indicating a better methodological quality of the study. The following cutpoints have been suggested to categorise studies by quality: excellent (26-28), good (20-25), fair (15-19) and poor (<14) [8]. Year, research design, participants, HRV-BF intervention, CAD patients, and the major findings of the studies were all retrieved from the final three studies and used to evaluate the entire review. The reviewer (MJJ) completed data extraction independently, and both reviewers agreed to include the articles in the fourth stage. The data was methodically categorised and structured at the survey's final step, utilising a data charting form created in Microsoft excel. A flow diagram illustrated the process of the research selection, and the findings were presented with a narrative synthesis in table form [Table/Fig-1].

RESULTS

In summary, extensive database and additional hand-search resulted in 11,048 records, after exclusion from which 56 were screened. Only 36 records were excluded and 20 full-text articles were assessed for eligibility and qualitative analysis and three studies were finally included into the quantitative synthesis [Table/Fig-1].

Study design: There were three Randomised Clinical Trials (RCT) included in the review. The study size ranged from 31 CAD patients to 210 patients in total and follow-up periods ranged from one month to one year and one study with no follow-up.

Populations: All the three studies included mixed CAD populations {either undergone Percutaneous Coronary Intervention (PCI) or Coronary Artery Bypass Grafting (CABG)}.

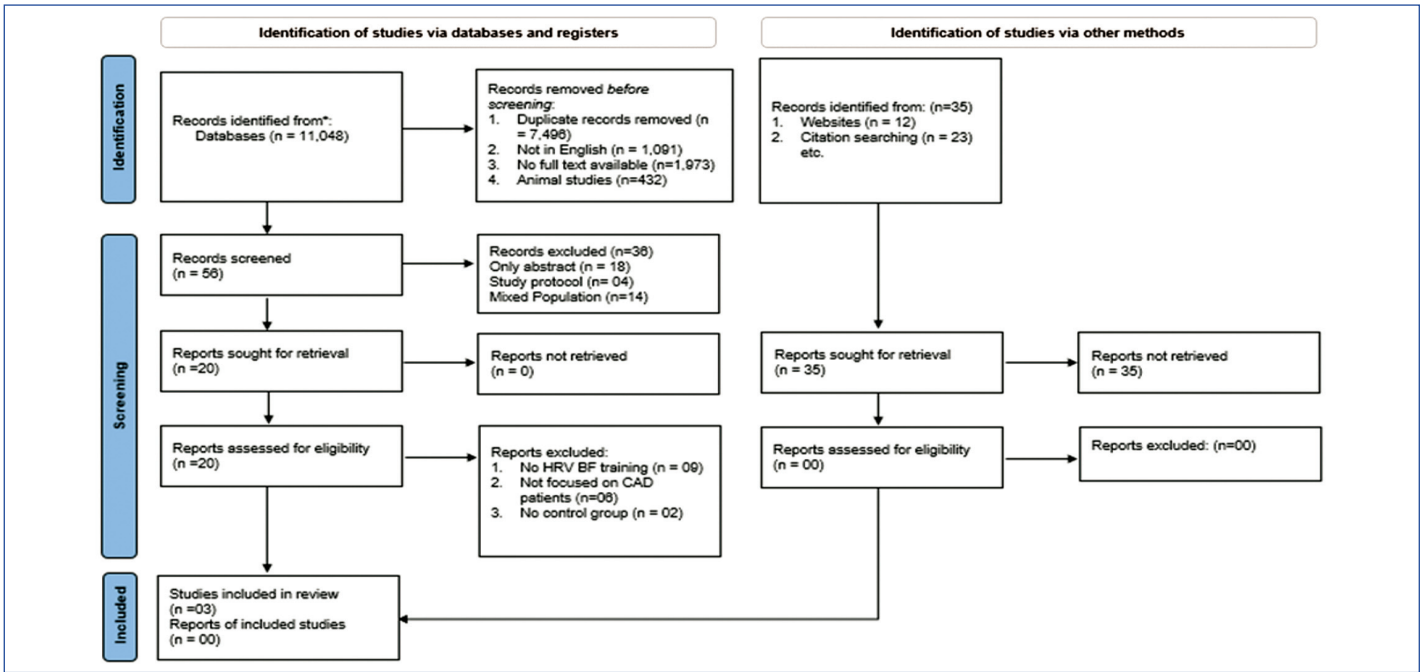
Study characteristics: The characteristics of the all three included articles are summarised in [Table/Fig-2] [6,9,10].

Interventions: Experimental group: There was a considerable heterogeneity with respect to duration and content of the psychological interventions. The duration of intervention range from: Number of session: 6 sessions-10 sessions; Number of session in a week: once a week- twice a week; Each session duration: 45-60 minutes.

The control group received usual medical care and medical care in all the three studies, whereas only one study provided 10 minutes of psychological education after postintervention assessment.

Effectiveness of the intervention: All the three studies reported increase in HRV and positive effect on psychophysiological intervention with short-term and long-term effects in cardiac rehabilitation programs in CAD patients. They also demonstrate practical feasibility of HRV-BF in CAD patients.

Study quality: According to the Downs SH and Black N, checklist, all the three studies ranged from 20-25 with good methodological quality [Table/Fig-3] [6,9,10].



[Table/Fig-1]: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram 2020.

Author (Year)	Study design	Sample size	HRV-BF device	Intervention	Outcome measures	Result
Climov D et al., (2014) [9]	RCT	31 CAD patients	Electromagnetic wave	The experimental group received 10 sessions of cardiac coherence biofeedback training.	Physiological variables and psychosocial variables (anxiety, depression, type D personality).	Biofeedback training on HRV is feasible for CAD patients participating in a multidisciplinary CR programme.
Yu LC et al., (2018) [10]	RCT	210 CAD patients	CardioPro Infiniti HRV analysis module	Diaphragmatic breathing, timed breathing, pursed-lip breathing, and home training, weekly 60 minute class.	Five minutes Electrocardiography (ECG), hospital readmission, emergency revisits, and mortality.	HRV-BF could be used as an effective and non invasive psychophysiological intervention in CR programme.
Lin IM et al., (2015) [6]	RCT	154 CAD patients	ProComp Infiniti™	Six weeks of HRV-BF, along with standard medical care.	Five minutes ECG, blood pressure and hostility.	Following HRV-BF, patients with CAD had higher HRV and less expressive and suppressive hostile behaviour.

[Table/Fig-2]: Summary of articles included in the review (N=3) [6,9,10].
RCT: Randomised clinical trials; ECG: Electrocardiography; CAD: Coronary artery disease

Author/Year	Reporting	Validity	Bias	Confounding	Power	Total
Climov D et al., (2014) [9]	10	3	6	4	0	23
Yu LC et al., (2018) [10]	11	3	6	4	1	25
Lin IM et al (2015) [6]	9	3	5	5	0	22

[Table/Fig-3]: Evaluation of Quality index score using Downs SH and Black N checklist [6,9,10].

DISCUSSION

Heart rate variability biofeedback has the potential to reduce stress levels while also improving autonomic nervous system function and cardiovascular endpoints. It can be used both as short-term and long-term psychophysiological intervention used in CR programme [10]. Psychological stress level monitoring and management has fascinating implications for HRV measurement [11]. The results of the study by Amjadian M et al., also revealed a significant inverse relationship between patients' HRV and depression and anxiety. In fact, breathing strategies with HRV feedback were significantly effective in alleviating depression, as well as increasing the patients' psychophysiologic coherence [12]. Breathing techniques with HRV-BF were found to be very beneficial in improving psychophysiologic coherence, physical and mental health, and decreasing depression and anxiety in patients [13]. For patients with CAD, HRV-BF may increase overall HRV, ANS control and baroreflex activation during rage events, and maybe a good program for CR [14].

Psychophysiological rehabilitation programs that aim to increase the provision of psychosocial interventions and prepare and endorse participants to interact outside of the traditional CR setting may reduce inequities in access to services and improve patient outcomes through support and self-management. Through, assistance and self-management, it is possible to eliminate disparities in service delivery and enhance patient outcomes. The review analysis shows the potential effects of HRV-BF for psychophysiological rehabilitation in CAD patients. Patients have reported the benefits of HRV-BF therapies by patient reported as well as therapies reported outcome measures.

Limitation(s)

The inclusion criteria was mainly concentrated on the experimental trials, therefore some relevant other type of studies like observational studies might have been missed. The removal of research publications written in languages other than English during the searching and screening process is one constraint that could have affected the present findings.

CONCLUSION(S)

The current study was carried out to give a snapshot of research regarding incorporating HRV-BF as an effective psychological intervention in CR. Such observations open a window of opportunity for anchoring psychosocial intervention along with cardiac rehabilitation to gain better outcomes among such patients. HRV-BF increased efferent vagal activity to moderate the SA node, increased baroreflex gain, and overall HRV, and reduced expressive and suppressive hostile behaviour. The report concludes with a broad description of how to manage such individuals from a psychiatrist's perspective. In the long run, a collaborative strategy is likely to be beneficial to the patient and cost-effective. The research finishes with a basic review of how such patients should be managed from the psychiatrist's standpoint.

A standard protocol can be made concerning psychophysiological rehabilitation in CAD patients both operative and non operative. More high-quality RCTs should be done in other cardiac patients. Further, more studies can be done on the community level where the lack of educational material is present to spread awareness regarding psychophysiological health in cardiac patients.

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