Effects of Yoga in Patients with Chronic Heart Failure: A Meta-Analysis

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Abstract

The use of yoga as an effective cardiac rehabilitation in patients with chronic heart failure (CHF) remains controversial.

We performed a meta-analysis to examine the effects of yoga on exercise capacity and health-related quality of life (HRQOL) in patients with CHF. Methods: We searched MEDLINE, Cochrane Central Register of Controlled Trials, Excerpta Medica database, LILACS, Physiotherapy Evidence Database, The Scientific Electronic Library Online, and Cumulative Index to Nursing and Allied Health (from the earliest date available to December 2013) for randomized controlled trials (RCTs) examining the effects of yoga versus exercise and/or of yoga versus control on exercise capacity (peakVO2) and quality-of-life (HRQOL) in CHF. Two reviewers selected studies independently. Weighted mean differences (WMDs) and 95% confidence intervals (CIs) were calculated, and heterogeneity was assessed using the I^2 test.

Two studies met the selection criteria (total: 30 yoga and 29 control patients). The results suggested that yoga compared with control had a positive impact on peak VO_2 and HRQOL. Peak VO_2, WMD (3.87 95% CI: 1.95 to 5.80), and global HRQOL standardized mean differences (−12.46 95% CI: −22.49 to −2.43) improved in the yoga group compared to the control group.

Yoga enhances peak VO_2 and HRQOL in patients with CHF and could be considered for inclusion in cardiac rehabilitation programs. Larger RCTs are required to further investigate the effects of yoga in patients with CHF.

Introduction

Chronic heart failure (CHF) can be considered the end stage of heart disease. This syndrome is clinically characterized by poor exercise capacity and quality of life. In context, exercise training is widely recognized as non-pharmacological intervention to improve patient's exercise tolerance and quality of life[1].

Despite the well-known benefits of exercise training in patients with CHF, such as improvements in peak oxygen consumption (peak VO_2) and health-related quality of life (HRQOL) and reduced heart failure-related hospitalizations[2], there is no consensus regarding which method of exercise is the most efficient. On the other hand, cardiac rehabilitation teams employ non-conventional methods of exercise training according to patient preference and availability, such as hydrotherapy[3], dance[4], and yoga[5].

Yoga is a relaxation and meditation technique based on postures, exercises, and breathing techniques that have various medical benefits in the treatment of anxiety[6], depression[7], breast cancer[8], chronic low back pain[9], and hypertension[10]. A systematic review on yoga in patients with heart diseases was recently published[11]. It clarified many clinical aspects of yoga; however, the main outcome measures were mortality, non-fatal cardiac events, exercise capacity, HRQOL, and modifiable cardiac risk factors.

Meta-analyses have never been performed to investigate the outcomes of yoga in patients with CHF. It is known that meta-analysis technique minimizes subjectivity by standardizing treatment implications of relevant studies into effect sizes, pooling the data, and then analyzing it to draw conclusions. The aim of this systematic review was to meta-analyze published randomized controlled trials (RCTs) that investigated the effects of yoga in peakVO2 and HRQOL in patients with CHF.

Methods

Eligibility Criteria

Types of studies

This meta-analysis included RCTs that examined the impact of any type of yoga in patients with CHF. Studies were considered for inclusion regardless of their publication status, language, or size.

Types of participants

Trials enrolling patients with systolic or diastolic CHF were included in this meta-analysis. To be eligible, a trial required patients with CHF randomized to at least one group of any type of yoga. The studies that enrolled patients with any kind of respiratory diseases were excluded from this systematic review.

Types of outcome measures

The main outcomes of interest were peak oxygen consumption (mL/kg/min) measured by gas analysis and HRQOL (measured by any questionnaire).

Keywords

Yoga; Heart Failure; Complementary Therapies/utilization; Exercise Therapy; Meta-Analysis.

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Search methods for identification of studies

Electronic searches

We searched for references on MEDLINE via PubMed, LILACS, Excerpta Medica database (EMBASE), The Scientific Electronic Library Online, Cumulative Index to Nursing and Allied Health, Physiotherapy Evidence Database (PEDro), and Cochrane Central Register of Controlled Trials up to December 2013, without language restrictions. A standard protocol for this search was developed and whenever possible, controlled vocabulary (medical subject heading term for MEDLINE and Cochrane, and Emtree (a life science thesaurus) for EMBASE) were used. Keywords and their synonyms were used to sensitize the search. Table 1 presents the search strategy for MEDLINE via PubMed.

For the identification of RCTs in PubMed/MEDLINE, the optimal sensitive strategy developed by the Cochrane Collaboration was used[10]. To identify the RCTs in EMBASE, a search strategy using similar terms was adopted. In the search strategy, there were four groups of keywords: study design, participants, interventions, and outcome measures. All eligible articles for this meta-analysis had their references analyzed in order to detect other potentially eligible studies. For ongoing studies or when the confirmation of any data or additional information was needed, the authors were contacted by e-mail.

Data collection and analysis

Assessment of study eligibility

The previously described search strategy was used to obtain titles and abstracts of studies that might be relevant for this review. Each abstract identified in the research was independently evaluated by two authors. If at least one of the authors considered one reference eligible, the full text was obtained for complete assessment.

In a similar fashion, two authors independently evaluated full-text articles for eligibility and filled inclusion and exclusion criteria in a standard form. A standardized data extraction form was used for the inclusion and exclusion criteria. In case of any disagreement, the authors discussed the reasons for their decisions and a final decision was made by consensus.

Data extraction

Two authors independently extracted data from the published reports using standard data extraction forms adapted from the Cochrane Collaboration's[12] model for data extraction, considering 1) aspects of the study population, such as the average age and sex; 2) aspects of the intervention performed (sample size, type of yoga performed, presence of supervision, frequency, and duration of each session); 3) follow-up; 4) loss to follow-up; 5) outcome measures; and 6) presented results. Disagreements were resolved by one of the authors. Any further information required from the original author was requested by e-mail.

Risk of bias of included studies

The risk of bias of included studies was assessed independently by two authors using the Cochrane Collaboration's Risk of Bias tool[12]. The following criteria were assessed: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, intention-to-treat analysis, and completeness of follow-up.

Quality of meta-analysis evidence

The quality of evidence generated by this meta-analysis was classified using the PEDro scale. There are several scales for assessing the quality of RCTs. The PEDro scale assesses the methodological quality of a study based on important criteria, such as concealed allocation, intention-to-treat analysis, and the adequacy of follow-up. These characteristics make the PEDro scale a useful tool for assessing the quality of physical therapy and rehabilitation trials[13].

Methodological quality was independently assessed by two researchers. Studies were scored on the PEDro scale based on the Delphi list, which consisted of 11 items. One item on the PEDro scale (eligibility criteria) is related to external validity and is generally not used to calculate the method score, leaving a score range of 0 to 10. Any disagreements were resolved by a third rater[14,15].

Statistical assessment

Pooled effect estimates were obtained by comparing the least square mean percentage change from baseline to study end for each group, and were expressed as the weighted mean difference (WMD) between groups. Calculations were performed using a fixed effects model. One comparison was made: yoga versus control group. An α value of 0.05 was considered statistically significant. Statistical heterogeneity of the treatment effect among studies was assessed using Cochran's Q test and the inconsistency I^2 test, in which values above 25% and 50% were considered indicative of moderate and high heterogeneity, respectively[16]. All analyses were conducted using Review Manager version 5.0 (Cochrane Collaboration)[17].

Results

Description of selected studies

The initial search led to the identification of 10 abstracts, from which 4 studies were considered as potentially relevant and were retrieved for detailed analysis. After a complete reading of four articles, two were excluded because although yoga was used as a treatment, the sample had patients with other cardiac diseases. Only two papers[18,19] met the eligibility criteria. Figure 1 shows the PRISMA[20] flow diagram of studies in this review.

The remaining two articles were fully analyzed and approved by both reviewers and data were extracted from each RCT. Table 2 individually displays the results of the assessment of the PEDro scale. The studies failed to provide sufficient detail for us to assess the potential risk of bias. Information regarding the generation and concealment of the random allocation sequence was not reported. The two

studies presented objective evidence of balance in baseline characteristics and stated that they took measures to blind those involved in assessments.

Study characteristics

The final sample size ranged from 1918 to 4019, and the mean age of participants ranged from 51 to 54 years. The two studies included patients of both genders, but there was a predominance of males. All studies analyzed in this review included out-patients with documented heart failure New York Heart Association class I–III. One study included patients with systolic and diastolic CHF[17], and the other just systolic CHF[18]. Furthermore, one study reported the race of the patients (95% were African American)[19].

Outcomes of included studies

Peak VO_2

In both studies, peak VO_2 was assessed by a cardiopulmonary exercise test and a treadmill was used for the graded exercise test[18,19].

Table 1 – Search strategy for MEDLINE via PubMed for yoga and heart failure trials

1.	Randomized controlled trials/
2.	Random allocation/
3.	Controlled clinical Trials/
4.	Control groups/
5.	Clinical trials OR clinical trials, phase I OR clinical trials, phase II OR clinical trials, phase III OR clinical trials, phase IV/
6.	Clinical trials data monitoring committees/
7.	Double-blind method/
8.	Single-blind method/
9.	Placebos/
10.	Placebo effect/
11.	Cross-over studies/
12.	Multicenter Studies/
13.	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12
14.	Heart failure/
15.	Cardiomyopathy, dilated/
16.	Heart failure, diastolic/
17.	Heart failure, systolic
18.	Cardiac output, low/
19.	14 OR 15 OR 16 OR 17 OR 18
20.	Yoga
21.	Yogic/
22.	Asana/
23.	Pranayama/
24.	20 OR 21 OR 22 OR 23
25.	13 AND 19 AND 24

HRQOL

The Minnesota Living with Heart Failure Questionnaire was used in both studies[18,19]. Table 3 presents summary data from the two RCTs eligible for this systematic review.

Characteristics of intervention programs

The characteristics of the intervention (yoga) were reported in the studies. The duration of the yoga program ranged from 819 to 1018 weeks. Regarding the time of the session, there was a variation from 6018 to 7019 min. In the study by Pullen et al[18], during each session, subjects completed the following: a 10-min warm-up phase, a 40-min period of standing or seated yoga postures (asana), and finally a 20-min relaxation phase including breathing exercises (pranayama), and meditation. A 5-min warm-up phase including breathing exercises (pranayama), a 40-min period of standing and/or seated yoga postures (asana), and finally, a 15-min relaxation phase were used in the other study[19]. Both studies used hatha yoga intervention.

The frequency of sessions was two times a week in both studies[18,19]. Yoga sessions were conducted by a registered yoga teacher (Yoga Alliance) certified by the American College of Sports Medicine.

The analyzed studies reported that both treatment groups (yoga and control) received an educational program and a brochure with instructions for following a home walk program (standard medical treatment). Both groups were followed by blinded researchers from the beginning to the end of the study.

Peak VO_2

Both studies assessed peak VO_2 as an outcome[18,19]. The meta-analyses showed (Figure 2) a significant improvement in peak VO_2 of 3.87 $mL \cdot kg^{-1} \cdot min^{-1}$ (95% confidence interval (CI): 1.95, 5.80, N = 59) for participants in the yoga group compared with controls.

Quality of life

Both studies assessed HRQOL[18,19]. Significant enhancements were found among patients in the yoga group compared to the control group. Due to the difference between the instruments used in the measurement of quality of life, we performed a meta-analysis with a standardized mean difference. The meta-analyses showed (Figure 3) significant improvement in HRQOL of −12.46 (95% CI: −22.49, −2.43, n = 59) for participants in the yoga group in comparison to controls.

Discussion

In the present systematic review, a meta-analysis of two studies demonstrated augmentations in peak VO_2 and HRQOL in patients with CHF after yoga sessions when compared to controls.

Yoga is an emerging therapy for the rehabilitation of chronic diseases. However, to date, no meta-analysis examined the impact of yoga in patients with CHF. This review is important because it analyzes yoga as a potential modality in cardiovascular rehabilitation.

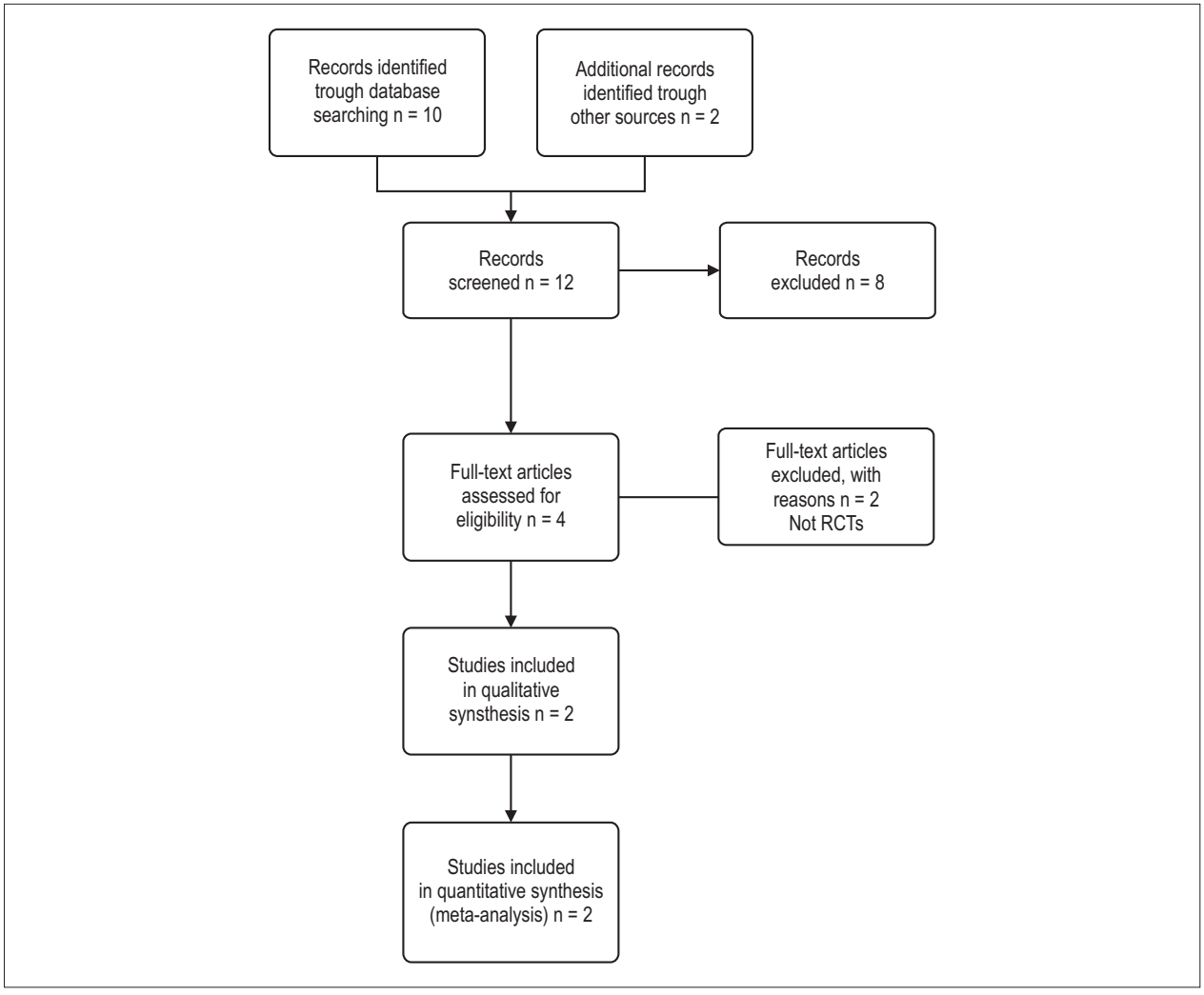

Figure 1 – *Search and selection of studies for systematic review according PRISMA.*

Table 2 – Study quality on the PEDro scale

Study		1	2	3	4	5	6	7	8	9	10	11	Total
1	Pullen et al[18]	✓	✓		✓			✓	✓		✓	✓	6
2	Pullen et al[19]	✓	✓		✓			✓	✓		✓	✓	6

1: eligibility criteria and source of participants; 2: random allocation; 3: concealed allocation; 4: baseline comparability; 5: blinded participants; 6: blinded therapists; 7: blind assessors; 8: adequate follow-up; 9: intention-to-treat analysis; 10: between-group comparisons; and 11: point estimates and variability.
**Item 1 does not contribute to the total score.*

Table 3 – Characteristics of the outcomes, measures, and results of yoga therapy in the trials included in the review

	Study	Participants	Outcomes	Measures		Results	
				Aerobic capacity	HRQOL	Aerobic capacity	HRQOL
1	Pullen et al[18]	130 CHF NYHA I, II, and III	Aerobic capacity HRQOL	Graded exercise testing	Minnesota LHFQ	↑ VO2 peak	↑ HRQOL
2	Pullen et al[19]	51 CHF NYHA I, II, and III	Aerobic capacity HRQOL	Graded exercise stress test	Minnesota LHFQ	↑ VO2 peak	↑HRQOL

CHF: Chronic Heart Failure; NYHA: New York Heart Association; MHFLQ: Minnesota Living with Heart Failure Questionnaire; HRQQL: Health-related quality of life.

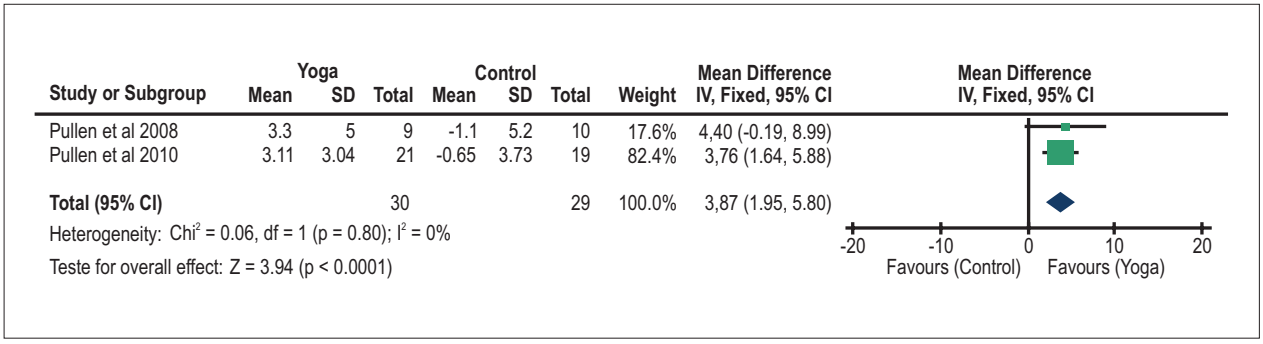

Figure 2 – *Yoga versus controls: VO_2 Peak. Review Manager (version 5.2; the Cochrane Collaboration, 2013). SD: standard deviation; CI = Confidence intervals*

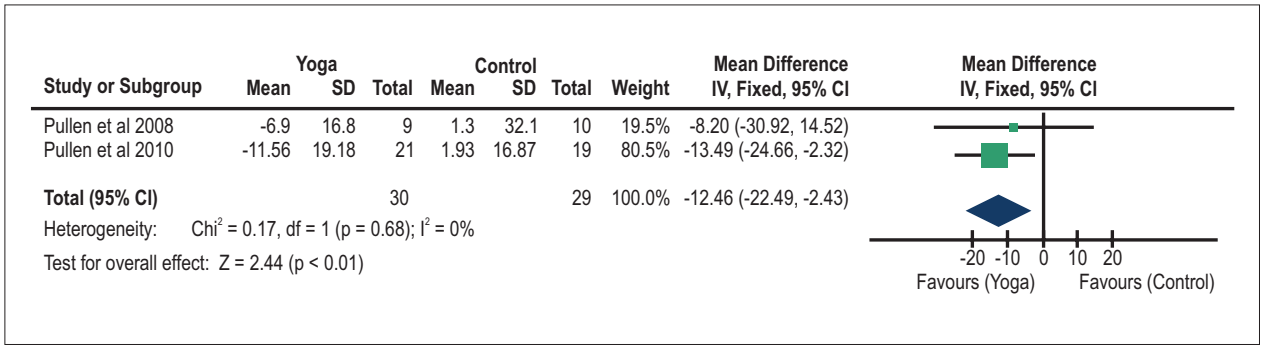

Figure 3 – *Yoga versus controls: Quality of Life. Review Manager (version 5.2; the Cochrane Collaboration, 2013). SD: standard deviation; CI: Confidence intervals.*

Our meta-analysis showed 22.0% improvement in peak VO_2 in the yoga group. The mean peak VO_2 in the two studies analyzed was 15.85 mL·kg^{-1}·min^{-1} at baseline and 19.05 mL·kg^{-1} ·min^{-1} at the end of the intervention. Specifically, the WMD in peak VO_2 peak was 3.97 mL·kg^{-1} ·min^{-1} from baseline to post-intervention. The magnitude of change is similar to a previous meta-analysis that evaluated the effect of different modalities of exercise in patients with CHF[21,22].

Another important factor to be described is the extent of the improvement and the peak VO_2 of 19.05 mL·kg^{-1} ·min^{-1} achieved after the intervention. A minimum peak VO_2 of 15 mL·kg^{-1} ·min^{-1} in women and 18 mL·kg^{-1} ·min^{-1} in men aged 85 years has been demonstrated to be necessary for full and independent living (e.g., garden activities, walking up stairs, etc.)[23]. Thus, yoga patients with CHF improve their medical condition, so they can productively carry out everyday activities.

In this study, yoga is shown to be effective in the rehabilitation of patients with CHF. Considering peak VO_2, it is well known that improvements above 10% after a cardiovascular rehabilitation program are satisfactory and represents a good prognosis in patients with CHF[24].

The assessment of the HRQOL is an essential outcome in the rehabilitation process. It is recognized that HRQOL is also associated with mental and physical status. Yoga is reported to improve important mental endpoints, such as anxiety and depression. In addition, yoga has been found to be critical for the enhancement of patients' exercise capacity.

In regards to HRQOL, our meta-analysis showed a 24.1% increase in the yoga group. The mean of MLFHQ of both studies analyzed was 37.5 at baseline and 28.45 at the end of the intervention, demonstrating an improvement of nine points on the scale. The study by Arnold et al[25] showed that the minimal clinically important difference for the MLFHQ is five points. The WMD in the MLFHQ was −12.46 from baseline to post-intervention. The magnitude of change is similar to that reported in a previous meta-analysis study that included six RCTs about exercise in CHF[25].

Our results are similar to the ones found in previous studies concerning exercise training[21,22,26]. The adherence of patients with CHF to exercise training is low; therefore, the investigation of new strategies is important in the context of rehabilitation. Despite the best method to improve exercise capacity and/or HRQOL, the first point that should be considered is patient preference. Taking this into account, the number of subjects that drop out of cardiovascular rehabilitation programs could possibly be decreased.

This review is limited because we did not consider the strict description of the criteria used by the authors to diagnose CHF, which can compromise the reliability of the results. It is not possible to consistently recommend yoga in patients with CHF. Our search strategy only found two RCTs with small samples and low duration of intervention. Furthermore, different variables may influence the effects of yoga as a therapy, such

as personal approach and culture. Despite this, yoga appears to be an interesting means of cardiac rehabilitation and deserves further investigation with better-controlled RCTs.

Conclusion

Considering the available data, our meta-analysis showed that yoga improved peak VO_2 and HRQOL in patients with CHF. Yoga should be considered as an alternative method of exercise training in patients with CHF.

Author contributions

Conception and design of the research and Writing of the manuscript: Gomes-Neto M, Rodrigeus-Jr ES, Carvalho VO; Acquisition of data: Rodrigeus-Jr ES, Carvalho VO; Analysis and interpretation of the data and Statistical analysis: Gomes-Neto M, Silva-Jr WM; Critical revision of the manuscript for intellectual content: Gomes-Neto M, Silva-Jr WM, Carvalho VO.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

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