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Letter to the Editor

Hydrotherapy on exercise capacity, muscle strength and quality of life in patients with heart failure: A meta-analysis

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Heart failure (HF) is clinically characterized by exercise intolerance, poor health related quality of life (HRQOL) and high mortality [1–3]. Exercise training is a well-established method to improve exercise intolerance and to restore HRQOL in patients with HF [4]. However, the most efficient modality is unknown. In this context, hydrotherapy (i.e. exercise in warm water) has been proposed as an alternative tool in the rehabilitation of patients with HF.

There is no meta-analysis of the efficacy of this intervention in HF patients. The aim of this systematic review with meta-analysis was to analyze the published randomized controlled trials (RCTs) that investigated the effects of hydrotherapy on exercise capacity and HRQOL in HF patients.

This review was planned and conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [5]. We searched for references on MEDLINE, EMBASE, CINAHL, PEDro, and the Cochrane Library up to May 2014 without language restrictions. This systematic review included all RCTs that studied the effects of hydrotherapy in aerobic capacity, muscle strength and/or HRQOL of the HF patients.

Two authors independently evaluated and extracted data from the published reports. Methodological quality was also independently assessed by two researchers. Studies were scored on the PEDro scale a useful tool for assessing the quality of physical therapy trials [6] based on a Delphi list [7] that consisted of 11 items with a score range of 0 to 10 [8].

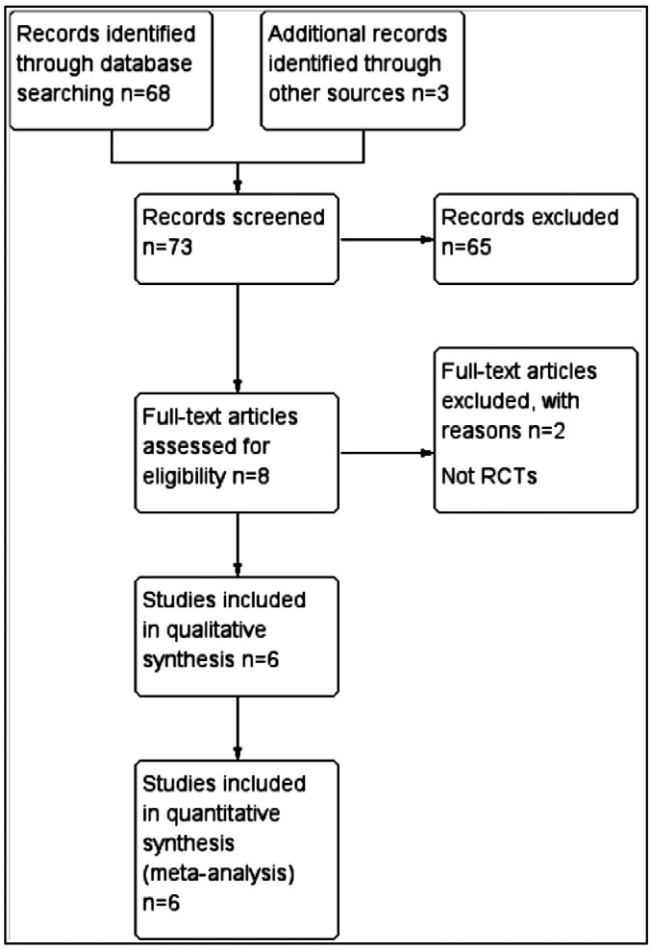

Fig. 1. Search and selection of studies for systematic review according to PRISMA.

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Table 1
Study quality on the PEDro scale.

	Study	1[a]	2	3	4	5	6	7	8	9	10	11	Total
1	Cider et al. (2012)		✓		✓				✓	✓	✓	✓	6
2	Cider et al. (2003)		✓		✓				✓	✓	✓	✓	6
3	Teffaha et al. (2011)		✓		✓				✓		✓	✓	5
4	Michalsen et al. (2003)	✓	✓		✓				✓	✓	✓	✓	6
5	Caminiti et al. (2011)	✓	✓		✓				✓		✓	✓	5
6	Laurent et al. (2009)	✓	✓	✓	✓				✓	✓	✓	✓	7

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; 11: point estimates and variability.

[a] Item 1 does not contribute to the total score.

Pooled-effect estimates were obtained by comparing the least square mean percentage change from baseline to study end for each group. Two comparisons were made: hydrotherapy versus control group (nonexercise) and hydrotherapy versus aerobic exercise group. All analyses were conducted using Review Manager Version 5.0 (Cochrane Collaboration) [9].

Six papers [10–15] met the eligibility criteria. Fig. 1 shows the PRISMA flow diagram of studies in this review. The results of the assessment of the PEDro scale are presented individually in Table 1.

The final sample size for the selected studies ranged from 14 [13] to 25 [11] and mean age of participants ranged from 51 to 75 years. All studies analyzed in this review included outpatients with documented HF and New York Heart Association (NYHA) classes II–III. Table 2 summarizes the characteristics.

Hydrotherapy was considered as aerobic and strength exercises in warm water and the duration of the programs ranged from 3 [15] to 24 [14] weeks. Regarding the time of the session, there was a variation from 30 [14] to 90 [13] minutes. The frequency of sessions was three times per week in three studies [10,11,14] and five times per week in others [12,13,15].

Four studies assessed peak VO_2 as an outcome [10–12,15], two compared hydrotherapy versus no exercise [10,11] and two hydrotherapy versus conventional aerobic exercise in land [12,15].

The meta-analyses showed a significant improvement in peak VO_2 of 2.97 $mL \cdot kg^{-1} \cdot min^{-1}$ (95% CI: 1.99, 3.94, $N = 42$) for participants in the hydrotherapy group compared with the no exercise group (Fig. 2A).

A nonsignificant change in peak VO_2 of -0.66 $mL \cdot kg^{-1} \cdot min^{-1}$ (95% CI: -2.05, 0.72, N = 48) was found for participants in the hydrotherapy group compared with conventional aerobic exercises (Fig. 2B).

Three studies assessed the 6-minute walk test (6WMT) as an outcome [10,11,14], two compared hydrotherapy versus no exercise [10,11] and one hydrotherapy versus aerobic exercises in land [14]. Significant improvements were found when comparing hydrotherapy with no exercise controls. The meta-analyses showed (Fig. 3) a significant improvement in 6WMT of 43.8 m (95% CI: 7.36, 80.16, $N = 42$) for participants in the hydrotherapy group compared with the no exercise group.

Three studies assessed muscle strength as an outcome [10,11,15], two compared hydrotherapy versus no exercise [10,11] and one hydrotherapy versus aerobic exercise in land [15]. Significant improvements were found when comparing hydrotherapy with no exercise controls. The meta-analyses showed (Fig. 4) a significant improvement in muscle strength of 23.7 Nm (95% CI: 4.49, 42.89, $N = 42$) for participants in the hydrotherapy group compared with the no exercise group.

Two studies measured HRQOL [10,11]. The meta-analyses showed nonsignificant improvement in HRQOL of -4.5 (95% CI: -14.40, 5.49, $N = 42$) for participants in the hydrotherapy group compared with the no exercise group (Fig. 5).

Meta-analysis demonstrated a significant difference in peak VO_2, distance in the six-minute walking test, muscle strength and DBP between patients with HF submitted to hydrotherapy and controls. Moreover, hydrotherapy was as efficient as conventional aerobic exercise in land for peak VO_2.

It is now known that cardiac function actually improves during water immersion due to the increase in early diastolic filling and decrease in heart rate, resulting in improvements in stroke volume and ejection fraction [16]. These data created a positive scenario to discuss hydrotherapy as a potential tool in cardiovascular rehabilitation. This systematic review with meta-analysis is important because it analyzes the hydrotherapy as a potential co-adjuvant modality in the rehabilitation of patients with HF.

The mean of peak VO_2 in the analyzed studies was 17.05 at the beginning and 18.3 $mL \cdot kg^{-1} \cdot min^{-1}$ at the end of the intervention. It has been demonstrated that improvements above 10% after a cardiovascular rehabilitation program represent a good prognosis in patients with HF [17]. It has also been demonstrated that a minimum VO_2 peak of 15 $mL \cdot kg^{-1} \cdot min^{-1}$ in women and 18 $mL \cdot kg^{-1} \cdot min^{-1}$ in men aged 55–86 years seems to be necessary for full and independent living [18]. Thus the improvement generated by the hydrotherapy program

Table 2
Characteristics of the outcomes and results in the trials included in the review.

	Study	P (M; F)	Outcomes	Specific outcomes						Result	
				Exercise capacity (EC)	Walk capacity (WC)	Muscle function (MF)	HRQOL	EC	WC	MF	HRQOL
1	Cider et al. (2012)	HF 20 (16;4)	EC WC MF HRQOL	Work rate VO_2 peak	6WMT	Strength and endurance	SF-36 LHFQ	↑ WR ↑VO_2	↑	↑	↑ SF-36 ↑ LHFQ
2	Teffara et al. (2011)	HF (I) (24) 48 (48:0)	Exercise capacity	NA	NA	NA	NA	↓Ve/VCO_2 ↓HR	NA	NA	NA
3	Cider et al. (2003)	HF (I–III) 25 (13;8)	EC WC MF HRQOL	Work rate VO_2 peak	6WMT	Strength and endurance	SF-36 LHFQ	↑ WR ↑VO_2	↑	↑	↑ SF-36 ↑ LHFQ
4	Michalsen et al. (2003)	HF (II–III) 15 (5;10)	Exercise capacity HRQOL	Heart rate	NA	NA	NA	↓ HR	NA	NA	PLC
5	Caminiti et al. (2011)	HF 24 (M)	WC MF	NA	6WMT	MVC	NA	↑VO_2	↑	↑	NA
6	Laurent et al. (2009)	HF 21 (M)	Exercise capacity	VO_2 peak	NA	NA	NA	↑VO_2	NA	NA	NA

Male and female (M/F); heart failure (HF); health-related quality-of-life (HRQOL); 6WMT = 6-minute walk test; WR = work rate; VO_2 peak = peak oxygen uptake; VE/VCO_2 = ventilation–carbon dioxide production ratio; LHFQ = Minnesota living with heart failure questionnaire; PLC = quality of life profile for chronic diseases; HR = heart rate; MVC = maximal voluntary contraction; NA = not assessed; ↑ significant improvement before and after the intervention and/or between groups ($p < 0.05$); ↓ significant reduction before and after the intervention and/or between groups ($p < 0.05$).