Paramedic University of Applied Sciences

"Is high intensity training superior to low or moderate intensity training in cardiac rehabilitation?"

A literature review

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Preface

This document is the last and concluding chapter in my physiotherapy bachelor education at Fontys Paramedic University of Applied Sciences in Eindhoven, The Netherlands. After many “ups” and some “downs” it is the time to have the final “up”.

The realization of this project started in June 2012 where different fields of research were presented to students by schools scientific research team (SRT). The research fields presented were fine, but were in one or many ways limiting and out of my interest scope. In order to do the best job possible and achieve the best results possible one must have the motivation to do all the work that is needed in order to succeed. Therefore, I decided to go for the “open field”. Here, the students were permitted to come up with their own project proposal, which would be approved or disapproved by Fontys’ SRT.

The topic I choose is training in rehabilitation of cardiac patients. The reasons for this choice are many. The project is individual and I wanted it to be completely individual. Therefore I chose to do something which no one of my student colleagues had chosen. As I mentioned earlier, the motivation is the crucial factor in succeeding. The positive effect of physical training or activity on cardiac patient’s health presented in available international guidelines and observations of my own done in cardiac rehabilitation settings was also a major motivational factor.

Cardio vascular accidents are the leading cause of mortality and disability in the world. The pre-habilitation and rehabilitation are relatively simple. The physical activity and training or exercise is central in cardiac rehabilitation. There is broad consensus that any physical activity or training compared to no activity and sedentary lifestyle is beneficial for the health of people with cardiac complaints. However there are no recommendations in the existing guidelines about high intensity strength or aerobic training. This is a training variable which will be discussed in this paper.

This project, which is a literature review, went through different phases since the end of June 2012. The most difficult phase was the starting phase; finding the right topic within the field of cardiac rehabilitation which would yield the problem on which the research would be based on.

Preliminary question needed some adjustment on which the preliminary material search was conducted on. This preliminary article search and reading offered a positive answer about the projects feasibility. Since then all the work conducted lead to this point in time; the final chapter of the physiotherapy education – bachelor thesis.

The list of people who deserve to be acknowledged for my success over past four years is substantially long. Therefore, I will apply one simple rule to acknowledge everyone: nobody mentioned – nobody forgotten!

Kind Regards

Bojan Eric´

(Physiotherapy student at Fontys University of Applied Sciences - Graduation class 2013)

Summary

Introduction: Coronary heart disease is the leading cause of morbidity and natural mortality in the world. Physical activity and training are central in rehabilitation of patients suffering from coronary heart disease. Aerobic capacity seems to be a significant predictor of morbidity and mortality of cardiac patients overall. The aim of this study is to find out whether high intensity training is superior to low or moderate intensity training in rehabilitation of patients with CAD/CHD and CHF?"

Method: A literature review was conducted. The search terms, inclusion and exclusion criteria were defined prior to the search process. The online databases PubMed, Cochrane and Pedro were searched for articles that could give an answer to the research question.

Results: The search process yielded nine RCT articles for data extraction. The total amount of patients in the studies combined was 378, 297 male and 81 female. Training intervals lasted from 30 seconds to 10 minutes. Maximal oxygen uptake and six minute walking test were used to assess aerobic capacity of the patients. Seven included studies showed significant improvement of aerobic capacity after training period lasting longer than four weeks. The increase of aerobic capacity varied from 10,9% to 46% for the high intensity training groups and -3% to 17,4% for the low/moderate intensity groups.

Conclusion: High intensity training improves aerobic capacity more than low or moderate intensity training in stable cardiac patients.

Key words: High intensity training/exercise, moderate intensity training/exercise, low intensity training/exercise, coronary artery disease, congestive heart failure, cardiac rehabilitation.

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Introduction

According to World Health Organization, coronary heart disease (CHD) is the leading cause of morbidity and natural mortality in the world. In 2008 heart related complaints accounted for 7,3 million deaths worldwide.[1] The prevalence and costs of cardiac disease rehabilitation is expected to rise substantially in the upcoming years.[2] The costs in European Union (EU) alone were €192 billion in 2006, including both healthcare expenses and lost work productivity.[3] It is a complex condition, many of the cardiac risk factors can and will influence each other.[4]

The secondary cardiac rehabilitation started in late 1960s and evolved into more comprehensive rehabilitation settings in 1980s, on which today's rehabilitation is build.[5] The total cardiac rehabilitation is conducted in three phases: 1.Acute management and mobilization phase; 2.Multidisciplinary, polyclinic rehabilitation; 3.Post rehabilitation aftercare and maintenance phase.[6] The second phase is a multidisciplinary approach where multiple aspects of the disease are addressed. As well as in the primary prevention of the cardiac disease, the secondary rehabilitation also focuses on the removal or reduction of aspects in the risk profile; obesity, tobacco cessation, use of preventive medication and activity enhancement in addition to psycho social management and nutritional management. Overall it can be stated that cardiac rehabilitation is lifestyle rehabilitation.[6-9]

Multiple guidelines offer a multidisciplinary approach to rehabilitation where exercise or training therapy (ET) is central in rehabilitation of patients who suffer from CHD or have undergone operations in relations to CHD and congestive heart failure (CHF). The exercise recommendations focus on what kind of exercises patients may engage into in a safe manner, how much they should do and how often. In addition to optimize their own aerobic capacity level, patients should also learn about their physical limits and how to cope with these physical limitations, overcome fear of movement and learn about secondary prevention.[4,7,9-11] In addition to cardiac guidelines, there are guidelines which offer information about treatment of other conditions that might cause CHD, such as diabetes.[12]

Physical activity (PA) is considered as one of six core components in cardiac rehabilitation.[13] PA and ET are widely used as terms of same explanation value. It is important to separate these two as PA is considered as any bodily movement produced by skeletal muscles that increases energy consumption above basal metabolic level while ET is a subcategory of PA which is planned, structured and repetitive activity with a clear objective of improvement or maintenance of several PA components.[14] The cardiac rehabilitation guidelines, which are based on research conducted in the period from 1980 until today, recommend that polyclinic exercise or training should be adjusted in a manner where patients exhaustion levels range from 40%-80% of maximal oxygen uptake (VO_{2max}) while strength training should be performed with the load equivalent to 40%-50% of one repetition maximum (1RM). The aerobic training sessions should last minimum up to one hour including warm up and cool down. The regime should be repeated 3-5 times a week. The strength training sessions should be performed 2-3 times a week and should include at least 1 set of 12 repetitions.[4, 6, 10, 11]

Aerobic capacity, measured in maximal oxygen uptake - VO_{2max}, seems to be the most reliable predictor of morbidity and mortality in cardiac patients,[15] in addition to metabolic task equivalent (MET)[16] and heart rate recovery (HRR) after exercise[17,18] which are another two strong parameters that can predict morbidity and mortality in cardiac patients. There is also evidence that resistance

training is associated with increased exercise tolerance, muscular strength and correction of musculoskeletal abnormalities.[19] Both submaximal resistance training and submaximal dynamic condition training combined have shown reduction of physical, psychological and social disabilities by increase of overall physical tolerance in activities of a daily life (ADL).[20,21] However, over the last decade there have been smaller studies on effects of high intensity training/high intensity interval training (HIT) on maximal strength and aerobic endurance. These studies have been conducted on patients with CHD[22] and chronic obstructive pulmonary disease (COPD)[23], subjects with metabolic syndrome[24], healthy subjects[25,26], competitive cyclists[27], professional youth football players[28] and top level football players who participated in UEFA Champions' League.[29] Great improvement in endurance and strength by utilization of HIT has been reported in all of these studies. Also, less time had been spent on training by normal healthy persons as well as by CHD patients than what is prescribed in various, above mentioned guidelines without affecting the general condition negatively.

The aim of this review is to give an overview of recent randomized control trials (RCT) conducted on coronary heart disease/coronary artery disease (CAD) patients and congestive heart failure patients which offer data of condition and strength HIT training compared to low or moderate intensity training (MIT). Therefore the question that would need to be answered by this research is: "Is high intensity training superior to low or moderate intensity training in rehabilitation of patients with CHD/CAD and CHF?"

Method

This literature review comprises scientific articles published from 2000 - the end of 2012, on HIT training compared to MIT training in rehabilitation of CHD/CAD and CHF patients. Previous to data rendition several steps were undertaken; (I) research question elaboration; (II) definition of inclusion/exclusion criteria; (III) search for studies; (IV) data collection; and (V) quality assessment of the included articles. The search strategy itself consisted of three stages: 1.Screening for title; 2.Review of abstracts; and 3.Review of full text articles. The search terms as part of search strategy are presented in the table below (Table 1).

Table 1. *Search terms*

Search terms	High intensity training	Low/moderate intensity training	Heart disease rehabilitation
Synonyms	"High intensity exercise"	"Low intensity training"	"Cardiac rehabilitation"
	"High intensity interval training"	"Low intensity exercise"	"PCI"
	"High intensity interval exercise"	"Moderate intensity training"	"CAD"
		"Moderate intensity exercise"	"CABG"
			"CHF"

PCI=Percutaneous coronary intervention; CAD=Coronary artery disease; CHF=Congestive heart failure; CABG=Coronary artery bypass graft.

The search terms from table 1 were combined to create a general search string: "High intensity training" OR "High intensity exercise" OR "High intensity interval training" OR "High intensity interval

exercise" AND "Low intensity training" OR "Low intensity exercise" OR "Moderate intensity training" OR "Moderate intensity exercise" AND "Heart disease rehabilitation" OR "Cardiac rehabilitation" OR "PCI" OR "CAD" OR "CABG" OR "CHF".

Online databases PubMed, Cochrane and PEDro were searched with the above described approach. In addition to the search procedure, which is schematically presented (Figure 1), the references of the selected articles were searched for further inclusion of articles. After completion of the search by title and review of the abstracts, the inclusion criteria were applied to insure that only relevant studies remained for full text article reviewing. Inclusion criteria were: (I) articles published in period from 1.1.2000–31.12.2012; (II) articles in English, Norwegian and Serbian; (III) RCTs conducted on CHD/CAD and CHF patients; (IV) articles which compare HIT training with MIT training. The full text articles were then reviewed and processed further on the basis of exclusion criteria; (I) studies lasting shorter than 4 weeks; (II) studies conducted on healthy subjects; (III) case studies and RCT studies where no comparison (control) group is present; (IV) no aerobic or physical capacity measurement present.

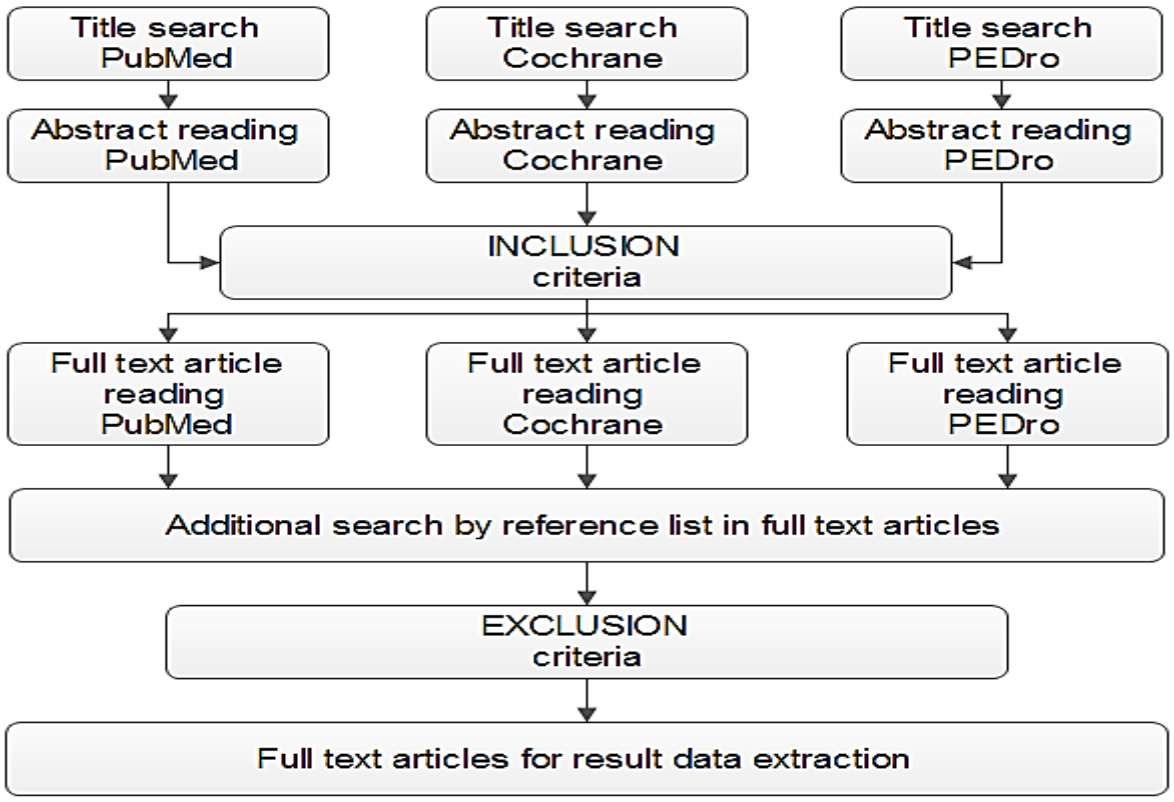

Figure 1. *Search strategy flowchart.*

The results from eligible studies were assessed for methodological quality with PEDro rating scale which is considered valid[30] and reliable[31]. The scale consists of 11 different sections where the RCT is awarded by 1 or 0 points, depending on whether the criterion is satisfied or not (Appendix I). The maximal achievable PEDro score is 10. The studies ranging: from 0-3 are considered to have "poor" quality; 4-5 "fair" quality; 6-8 "good" quality, and 9-10 "excellent" quality.[32]

Results

The PubMed database provided the most full text articles (12), followed by Cochrane (4) and concluded by PEDro (1). The additional search for articles by references did not yield any additional studies that had not been found through preliminary search in the online databases. Nine full text articles satisfied inclusion and exclusion criteria and were used for data extraction. The complete overview of the result synthesis is presented in figure 2.

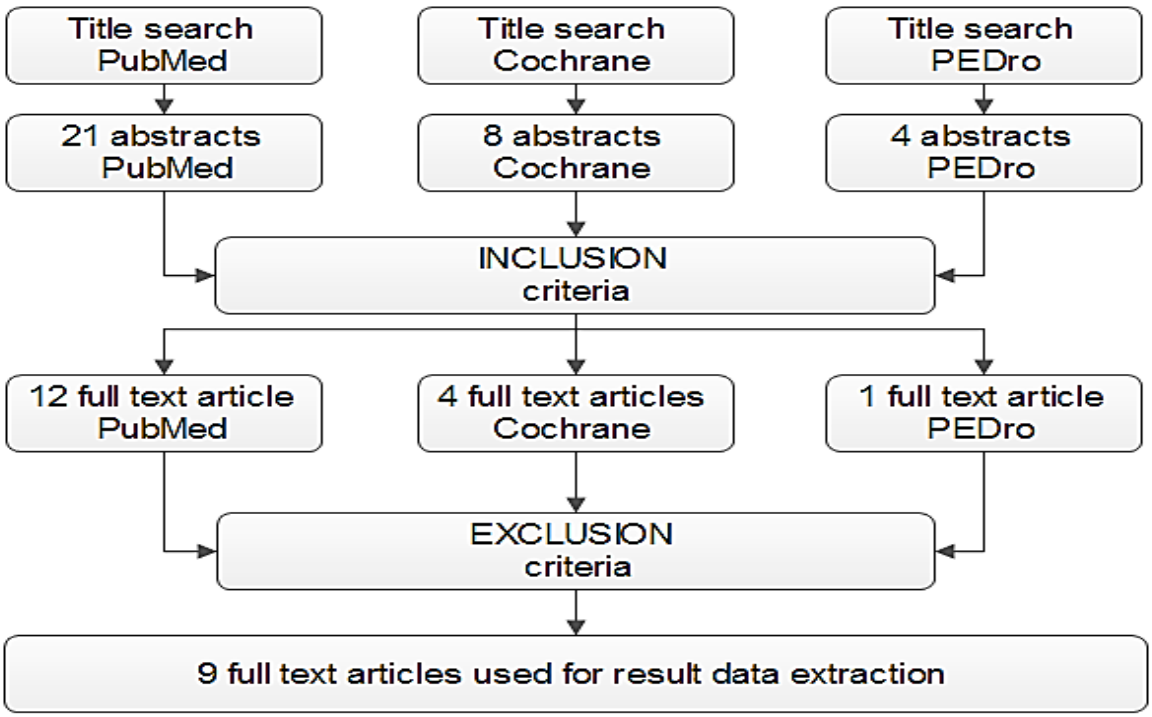

Figure 2. Result synthesis.

The studies included were relatively small with subject amount ranging from 17 in the two smallest studies and 89 subjects in the biggest study. The total amount of subjects was 378; 297 males and 81 females. The countries of origin for included articles were Norway[33-34,36-41] and France[35]. Seven of the studies utilized 4x4 minutes protocol for HIT intervention. The intensity was above 80% of maximal heart rate (HRmax) or $VO_{2max(peak)}$ for the HIT groups. The two remaining studies used relatively long and short training intervals: 3x5-10 minutes and 3 series x12 repetitions of 30 seconds, respectively. (Table 2)

PEDro score varied greatly; with 4 being the lowest and 8 highest score (Table 2). The full PEDro score overview for each of the included articles is to be found in the appendices II-X. The majority of the studies contained multiple measurement parameters. Eight of the studies utilized VO_{2max} measurement to assess aerobic capacity, while in the remaining study the six- minutes walking test (6MWT) was performed. The primary and secondary measurement parameter of the studies in addition to the cardiac conditions are presented in table 3.The increase of aerobic capacity between the baseline and follow-up varied from 10,9% to 46% for the HIT groups and -3% to 17,4% for the MIT groups. The baseline and follow-up measurements of physical capacity are presented in table 4.

Table 2. *Overview of included studies*

Authors	Nr. of subjects (Male/female)	PEDro score	Intervention protocol
Amundsen *et al.*[33]	14/3	4/10	10 weeks of uphill treadmill walking. HIT group performed 4x4 min. intervals at an intensity of 80-90% $VO_{2peak,}$ interrupted by 3 min. active pauses at 50-60% $VO_{2peak.}$ Warm-up and cool-down were performed at 50-60% VO_{2peak}. HIT group trained 35 min.***** MIT sessions lasted 41. min.* and consisted of continues walking at 50-60% of $VO_{2peak.}$
Rognmo *et al.*[34]	14/3	5/10	10 weeks of uphill treadmill walking, 3 times/week. HIT lasted 33 min.* and MIT 41 min.* per session. HIT group performed 4x4 min. intervals at 80-90%of VO_{2peak} interrupted by 3min. active pauses at 50-60% of VO_{2peak}. MIT group performed continues walking at an intensity of 50-60% of $VO_{2peak.}$
Freyssin *et al.*[35]	13/13	5/10	8 weeks of regular rehabilitation. 5 days/week. HIT group trained 168 min.*****/week and MIT 360 min.*/week. HIT sessions consisted of 3 series x 12 repetitions lasting 30s. Every series was followed by 60s of complete rest. The exercise intensity was at 50% (the first 4 weeks) and 80% (the last 4 weeks) of maximal power reached during a steep ramp test. MIT sessions consisted of 45 min. of continues cycling or treadmill walking at heart rate intensity achieved at first ventilator threshold during a steep ramp test. Both groups also participated in ordinary rehabilitation sessions.
Moholdt[c] *et al.*[36]	20/6	6/10	26 weeks of home based exercise after preliminary rehabilitation at Feiring rehabilitation centre. The HIT group got instructed on how to perform HIT. The patients had free choice of exercise. The total exercise time was 38 min.* and included 4x4 min. protocol at an intensity of 85-95% of individual HRmax. interrupted by 3 min. active pauses at an intensity of 70% of HRmax. MIT group was just encouraged to continue exercising at home without any further instructions.
Wisløff *et al.*[37]	20/7	5/10	12 weeks of uphill treadmill walking. HIT and MIT groups had 2 weekly supervised sessions in addition to 1 session at home where they performed uphill walking. Control group met for supervised training every 3 weeks. HIT group performed 4x4min. intervals at 90-95% of HR max. interrupted by 3 min. active pauses at an intensity of 50-70% HRmax. Total training time was 38 min.* MIT group trained continuously for 47 min.***** at 70-75% of HRmax. The control group was advised to follow their family doctor instructions for physical activity. The supervised training this group performed was 47 min. of continuous walking at 70% of HRmax.

Table 2. *Continued*

Authors	Nr. of subjects (Male/female)	PEDro score	Intervention protocol
Munk *et al.*[38]	32/6	5/10	26 weeks of HIT vs. usual care. HIT group had 2 weekly supervised sessions in addition to 1 session at home where they performed uphill walking. HIT group performed 4x4min. intervals at 90-95% of HRmax. interrupted by 3 min. active pauses at an intensity of 50-70% HRmax. Total training time was 41 min.* MIT group was offered usual cardiac care.
Moholdt[a] *et al.*[39]	48/11	6/10	4 weeks of treadmill walking. 5 days/week. HIT group performed 4x4 min. intervals at 90% of HRmax. interrupted by 3 min. active pauses at 70% HRmax. Training sessions lasted 38 min.***** MIT group performed continues walking at 70% HRmax for 46min. In addition to this training, both groups participated in ordinary rehabilitation sessions consisting of various exercise modes and intensities for 45-60 min.
Nilsson *et al.*[40]	63/17	8/10	16 weeks of aerobic interval training 2 days/week lasting 50 min.***** + 15-30 min. of counseling. HIT consisted of 3 intervals of high intensity (Borg 15-18) and 2 intervals of moderate intensity (Borg 11-13) in-between. All intervals lasted 5-10 min. with gradual intensity increase. MIT group was referred to standard/usual unsupervised care by their primary care physician.
Moholdt[b] *et al.*[41]	74/15	6/10	4 weeks of aerobic interval training 2 times/week at the hospital + 1 day individually at home. Training at the hospital lasted 38 min.***** for HIT group and 60 min.***** for the MIT group where the subjects performed aerobic exercises to music. HIT group performed 4x4min. at the intensity of 85-95% of their HRmax interrupted by 3 min. active pauses at 70% of HRmax.

*****Training sessions included warm-up and cool-down; VO_{2peak}=Peak oxygen consumption; HIT=High intensity training; MIT=Low/medium intensity training; [a]Moholdt et al. 2009; [b]Moholdt et al. 2011; [c]Moholdt et al. 2012; HRmax=Maximal heart rate.

Table 3. *Measurement parameters and cardiac conditions*

Authors	Primary measurement	Secondary measurement	Cardiac condition
Amundsen *et al.*[33]	VO_{2peak}	LV function	CAD
Rognmo *et al.*[34]	VO_{2peak}	resBP	CAD
Freyssin *et al.*[35]	VO_{2max}	6MWT	CHF
Moholdt[c] *et al.*[36]	VO_{2max}	Quality of Life	CHD
Wisløff *et al.*[37]	VO_{2max}	LV function	CHF
Munk *et al.*[38]	HRV	VO_{2max}	CAD
Moholdt[a] *et al.*[39]	VO_{2max}	HR recovery	CAD
Nilsson *et al.*[40]	6MWT	MLHFQ score	CHF
Moholdt[b] *et al.*[41]	VO_{2max}	Quality of Life	CAD

[a]Moholdt et al. 2009*;* [b]Moholdt et al. 2011*;* [c]Moholdt et al. 2012*;* VO_{2peak}=Peak oxygen consumption; LV function=Left ventricular function; HRV=Heart rate variability; resBP=Resting blood pressure; VO_{2max}=Maximal oxygen consumption; 6MWT=Six-minutes walking test; N.A.=Not applicable; HR recovery=Heart rate recovery; MLHFQ score=Minnesota Live with Heart Failure Questionnaire; CAD=Coronary artery disease; CHF=Chronic heart failure; CHD=Coronary heart disease.

Table 4. *Aerobic capacity measurement*

Authors	HIT α		%	MIT α		%	p
	T1	T2		T1	T2		
Amundsen *et al.*[33]	32,0	37,0	17,0	31,0	35,0	8,0	0.01γ
Rognmo *et al.*[34]	31,8	37,8	17,9	32,1	34,8	7,9	0.011γ
Freyssin *et al.*[35]	10,7	13,6	27,0	10,6	10,8	2,0	0.001γ
Moholdt[c] *et al.*[36]	23,8	27,7	18,8	25,6	30,2	17,4	>0.05δ
Wisløff *et al.*[37]	13,0	19,0	46,0	13,0	14,9	14,0	0.001γ
Munk *et al.*[38]	23,2	27,1	16,8	19,1	20,6	7,8	0.01γ
Moholdt[a] *et al.*[39]	27,1	30,4	10,9	26,2	28,5	8,1	>0.05δ
Nilsson *et al.*[40]	457β	515β	11,3	455β	440β	-3,0	0.001γ
Moholdt[b] *et al.*[41]	31,6	36,2	14,0	32,2	34,7	7,5	0.014γ

[a]Moholdt et al. 2009*;* [b]Moholdt et al. 2011*;* [c]Moholdt et al. 2012*;* HIT=High intensity training; MIT= Low/ medium intensity training; T1=Baseline; T2=Follow-up; %=Change in the increase of aerobic capacity between baseline and follow-up; α=Aerobic capacity/ $VO_{2max(peak)}$ measured in (ml/kg/min); β=Distance walked in meters; γ=Significant differences of increasement between two groups/methods; δ=No significant differences of increasement between two groups/methods.

Discussion

The aim of this study was to assess whether HIT is superior to MIT in rehabilitation of patients with a heart disease. It is widely accepted that ET offers a wide range of beneficial aspects in rehabilitation of CHD/CAD and CHF patients: Improvement of functional capacity and strength[22,33-51], slowing down of heart rate[52], increase in quality of life[36,40,41,53], improvement or decrease of blood pressure[54,55], insulin sensitivity alternation[56] and endothelial function improvement[57], in addition to positive body composition alternations[58,59] and reduction of inflammation after percutaneous coronary intervention (PCI).[60] However, the reviewed literature suggests that health benefits, in particular by increased aerobic capacity achieved by application of ET are significantly greater when HIT is implemented as a training variable. [33-35,37,38,40,41]

There is no consensus about where the MIT stops and where HIT starts.[61] However, the studies included in this review consider the intensity of 80% of VO_{2max} (85% of HRmax) and higher as HIT. The biggest argument against utilization of HIT is safety of the patients conducting this form of training, but the studies by Rognmo et al.[62], Meyer et al.[63] and Guiraud et al.[64] present data which implies that both MIT and HIT have low risk of cardiac events. Since the available studies are small and comprise stable, uncomplicated, post cardiac event- patients it is difficult to debate whether the results would also be the same in more fragile groups of patients.

The preliminary search was conducted on PubMed followed by Cochrane and PEDro. Thus, PubMed provided the most abstracts and full text articles and PEDro the least. Because of the duplicates and differences in search engines the amount of titles found was not reported due to its irrelevancy. The methodological quality of the studies varied from 4 to 8 on PEDro scale, which is considered fair to good quality. Eight of the studies[33-35,37-41] received same score as what is proposed by the PEDro database while Moholdt et al.[36] scored one point higher than the original. The item 3 - concealed allocation was awarded 1 point vs. 0 points on PEDro (Appendix V).

Study by Nilsson et al.[40] measured aerobic capacity of the subject by conducting 6MWT. 6MWT is found to be suitable for outcome in cardiac rehabilitation.[65] Correlation between increased VO_{2max} and increased walked distance during a 6MWT has also been reported.[66] In above mentioned study of Nilsson et al. the MIT group did not achieve any gains in aerobic capacity. Contrarily, this is the only training group included in this review where decrease of aerobic capacity was reported. This might be attributed to the standard, usual care these patients received from their primary care physician where no supervised exercise was offered. The significant increase of aerobic capacity in the HIT group compared to the MIT group has to be questioned because the MIT group did not receive any supervised exercise. The chance is substantial that many of the patients in the MIT group exercised irregularly and in the worst case refrained from exercise completely.

Two of the studies from Moholdt et al.[36,39] did not find any significant difference in improvement of aerobic capacity between a HIT and MIT group. The reason for this might be that in the first study[36] the HIT training was unsupervised. Even though the patients were instructed how to perform the HIT routine it is quite likely that patients did not always perform within or above prescribed intensity. Some of the patients reported this in their training logs. The second study[39] showed slightly bigger, but insignificant, increase in aerobic capacity between groups in favor of HIT. This could be explained by

relatively short intervention time, lasting four weeks. Both groups were enrolled in the same rehabilitation program at the same centre. This might have affected the MIT group to perform better.

HIT is perceived as more enjoyable both by healthy people[67] and cardiac patients.[68] This is a very important aspect that speaks in favor of HIT due to the fact that the adherence to PA in general population is only 62%, six months after the initiation of the programe.[69] In cardiac patients the adherence to minimum PA is under 50%, one year after ended cardiac rehabilitation programs.[70,71] Therefore, if the patients got involved in the activities which they would find enjoyable and inspiring, it would be more likely that the long term adherence to exercise could increase, especially after ended rehabilitation programs. If the PA after cardiac rehabilitation is discontinued the physical gains; aerobic capacity and strength are lost within three months.[44,48] As mentioned earlier, the gains achieved by utilization of HIT are greater than of MIT and also long term gains in aerobic capacity were greater in HIT groups in the studies by Nilsson et al.[72] and Moholdt et al.[73] However, it has to be pointed out that in both these studies the HIT group was long-term followed up and encouraged to continue exercising on their own while MIT was not. Even when this fact is taken into consideration, it is quite remarkable that in the study by Moholdt et al.[73] 82% of patients in the HIT group still exercised twice a week or more, thirty months after initial rehabilitation. The number for the MIT group was 58%. Whether the remarkable long-term adherence to exercise in the HIT group was due to the more enjoyable nature of HIT alone, the follow-up and encouragement the patients received in addition or some other, unreported aspects remains a point of speculation.

The positive results of this review have to be interpreted with caution. Because the patients included in the studies on which this research is based on were stable, without significant cardiac complaints, it would only be reasonable to recommend HIT to same groups of patients in the future. These recommendations are in line with two recent reviews on cardiovascular health[74] and HIT in cardiac rehabilitation.[75]

Cardiac rehabilitation has evolved tremendously since its start in the 1930's where the patients were prescribed six weeks of bed rest, to present day where the patients are encouraged to engage in physical activities with almost no restrictions.[76] If and when the HIT proves to be safe for all groups of cardiac patients, it would not be overly ambitious to claim that HIT could be the next milestone of cardiac rehabilitation. Exercise adherence and aerobic capacity would translate into better health. This could possibly lead to less use of medication and quicker, full return to normal ADL. The reflection of these positive aspects might be noticeable economically, by decrease of lost working hours and direct expenses decrease of medical management of cardiac related complaints.

The limitations of this study are few. It is written by a single author, which may make it narrow in the way it was conducted. Amount of studies included is small, with small subject population which limits the power of conclusion drawn on this topic. PEDro scale was the only method used to assess quality of the included studies. Even though PEDro scale is considered valid and reliable it is not perfect. The review is based on primary sources only, form 01.01.2000-31.12.2012. However, this might be considered as strength also, because it comprises the most recent studies in the field. In the future, if this study was to be repeated, it would be highly beneficial to conduct a systematic review of all the available literature on HIT vs. MIT. The review of the complete literature may increase the

amount of studies and thus also subjects, which in return might underpin a more powerful conclusion. Other parameters, than just aerobic capacity could also be included in order to assess complete usefulness of HIT in cardiac rehabilitation.

There is a need for large, multicenter, high quality RCTs which would address overall safety and health gains as well as economic benefits of HIT in cardiac rehabilitation. As so far, the HIT should be implemented in rehabilitation of stable cardiac patients to a great degree in order to achieve best and optimal results possible.

Conclusion

The reviewed studies indicate that high intensity training is superior to low and moderate intensity training in improving aerobic, physical capacity of coronary heart disease/coronary artery disease patients and chronic heart failure patients. The quality of the studies ranged from fair to good. Even though the results are very promising, it has to be stressed that these must be interpreted with caution due to small sample size and the fact that patients in the studies were in a stable, uncomplicated state post cardiac events.

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Appendices

Appendix I : PEDro – Quality rating scale: protocol sheet

Appendix II : PEDro score: Amundsen et al.

Appendix III : PEDro score: Rongmo et al.

Appendix IV : PEDro score: Freyssin et al.

Appendix V : PEDro score: Moholdt[c] et al.

Appendix VI : PEDro score: Wisløff et al.

Appendix VII : PEDro score: Munk et al.

Appendix VIII : PEDro score: Moholdt[a] et al.

Appendix IX : PEDro score: Nilsson et al.

Appendix X : PEDro score: Moholdt[b] et al.

Appendix XI : Approval - Project plan

Appendix I

PEDro scale:

1.	eligibility criteria were specified	no ❑ yes ❑ where:
2.	subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	no ❑ yes ❑ where:
3.	allocation was concealed	no ❑ yes ❑ where:
4.	the groups were similar at baseline regarding the most important prognostic indicators	no ❑ yes ❑ where:
5.	there was blinding of all subjects	no ❑ yes ❑ where:
6.	there was blinding of all therapists who administered the therapy	no ❑ yes ❑ where:
7.	there was blinding of all assessors who measured at least one key outcome	no ❑ yes ❑ where:
8.	measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	no ❑ yes ❑ where:
9.	all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat"	no ❑ yes ❑ where:
10.	the results of between-group statistical comparisons are reported for at least one key outcome	no ❑ yes ❑ where:
11.	the study provides both point measures and measures of variability for at least one key outcome	no ❑ yes ❑ where:

The PEDro scale is based on the Delphi list developed by Verhagen and colleagues at the Department of Epidemiology, University of Maastricht (*Verhagen AP et al (1998). The Delphi list: a criteria list for quality assessment of randomised clinical trials for conducting systematic reviews developed by Delphi consensus. Journal of Clinical Epidemiology, 51(12):1235-41*).

The list is based on "expert consensus" not, for the most part, on empirical data. Two additional items not on the Delphi list (PEDro scale items 8 and 10) have been included in the PEDro scale. As more empirical data comes to hand it may become possible to "weight" scale items so that the PEDro score reflects the importance of individual scale items.

The purpose of the PEDro scale is to help the users of the PEDro database rapidly identify which of the known or suspected randomized clinical trials (ie RCTs or CCTs) archived on the PEDro database are likely to be internally valid (criteria 2-9), and could have sufficient statistical information to make their results interpretable (criteria 10-11). An additional criterion (criterion 1) that relates to the external validity (or "generalisability" or "applicability" of the trial) has been retained so that the Delphi list is complete, but this criterion will not be used to calculate the PEDro score reported on the PEDro web site.

The PEDro scale should not be used as a measure of the "validity" of a study's conclusions. In particular, we caution users of the PEDro scale that studies which show significant treatment effects and which score highly on the PEDro scale do not necessarily provide evidence that the treatment is clinically useful. Additional considerations include whether the treatment effect was big enough to be clinically worthwhile, whether the positive effects of the treatment outweigh its negative effects, and the cost-effectiveness of the treatment. The scale should not be used to compare the "quality" of trials performed in different areas of therapy, primarily because it is not possible to satisfy all scale items
in some areas of physiotherapy practice.

Last amended June 21st, 1999

Notes on administration of the PEDro scale:

All criteria	**Points are only awarded when a criterion is clearly satisfied**. If on a literal reading of the trial report it is possible that a criterion was not satisfied, a point should not be awarded for that criterion.
Criterion 1	This criterion is satisfied if the report describes the source of subjects and a list of criteria used to determine who was eligible to participate in the study.
Criterion 2	A study is considered to have used random allocation if the report states that allocation was random. The precise method of randomization need not be specified. Procedures such as coin-tossing and dice-rolling should be considered random. Quasi-randomization allocation procedures such as allocation by hospital record number or birth date, or alternation, do not satisfy this criterion.
Criterion 3	*Concealed allocation* means that the person who determined if a subject was eligible for inclusion in the trial was unaware, when this decision was made, of which group the subject would be allocated to. A point is awarded for this criteria, even if it is not stated that allocation was concealed, when the report states that allocation was by sealed opaque envelopes or that allocation involved contacting the holder of the allocation schedule who was "off-site".
Criterion 4	At a minimum, in studies of therapeutic interventions, the report must describe at least one measure of the severity of the condition being treated and at least one (different) key outcome measure at baseline. The rater must be satisfied that the groups' outcomes would not be expected to differ, on the basis of baseline differences in prognostic variables alone, by a clinically significant amount. This criterion is satisfied even if only baseline data of study completers are presented.
Criteria 4, 7-11	*Key outcomes* are those outcomes which provide the primary measure of the effectiveness (or lack of effectiveness) of the therapy. In most studies, more than one variable is used as an outcome measure.
Criterion 5-7	*Blinding* means the person in question (subject, therapist or assessor) did not know which group the subject had been allocated to. In addition, subjects and therapists are only considered to be "blind" if it could be expected that they would have been unable to distinguish between the treatments applied to different groups. In trials in which key outcomes are self-reported (e.g., visual analogue scale, pain diary), the assessor is considered to be blind if the subject was blind.
Criterion 8	This criterion is only satisfied if the report explicitly states *both* the number of subjects initially allocated to groups *and* the number of subjects from whom key outcome measures were obtained. In trials in which outcomes are measured at several points in time, a key outcome must have been measured in more than 85% of subjects at one of those points in time.
Criterion 9	An *intention to treat* analysis means that, where subjects did not receive treatment (or the control condition) as allocated, and where measures of outcomes were available, the analysis was performed as if subjects received the treatment (or control condition) they were allocated to. This criterion is satisfied, even if there is no mention of analysis by intention to treat, if the report explicitly states that all subjects received treatment or control conditions as allocated.
Criterion 10	A *between-group* statistical comparison involves statistical comparison of one group with another. Depending on the design of the study, this may involve comparison of two or more treatments, or comparison of treatment with a control condition. The analysis may be a simple comparison of outcomes measured after the treatment was administered, or a comparison of the change in one group with the change in another (when a factorial analysis of variance has been used to analyze the data, the latter is often reported as a group × time interaction). The comparison may be in the form hypothesis testing (which provides a "p" value, describing the probability that the groups differed only by chance) or in the form of an estimate (for example, the mean or median difference, or a difference in proportions, or number needed to treat, or a relative risk or hazard ratio) and its confidence interval.
Criterion 11	A *point measure* is a measure of the size of the treatment effect. The treatment effect may be described as a difference in group outcomes, or as the outcome in (each of) all groups. *Measures of variability* include standard deviations, standard errors, confidence intervals, interquartile ranges (or other quintile ranges), and ranges. Point measures and/or measures of variability may be provided graphically (for example, SDs may be given as error bars in a Figure) as long as it is clear what is being graphed (for example, as long as it is clear whether error bars represent SDs or SEs). Where outcomes are categorical, this criterion is considered to have been met if the number of subjects in each category is given for each group.

Appendix II

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	Yes / **No** Where: N.A.
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Materials and methods"
3.	Allocation was concealed	Yes / **No** Where: N.A.
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Results – table 1-3"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	Yes / **No** Where: "Discussion"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results – table 2&3"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results – table 2&3"

N.A.= Not applicable

Score: 4/10

***Criterion 1 is not included in final score.*

Amundsen BH. Rognmo O. Hatlen-Rebhan G. Slordahl SA. High-intensity aerobic exercise improves diastolic function in coronary artery disease. *Scandinavian Cardiovascular Journal.* 2008;42(2):110-117.

Appendix III

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: "Methods – subjects"
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Methods – randomization procedure"
3.	Allocation was concealed	**Yes** / No Where: "Methods – randomization procedure"
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Results – table 1&2"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	Yes / **No** Where: "Methods – figure 1"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results – table 2"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results – figure 2"

N.A.= Not applicable

Score: 5/10

***Criterion 1 is not included in final score.*

Rognmo Ø. Hetland E. Helgerud J. Hoff J. Slørdahl SA. High intensity aerobic interval exercise is superior to moderate intensity exercise for increasing aerobic capacityin patients with coronary artery disease. *Eur J Cardiovasc Prev Rehabil.* 2004;11(3):216-222.

Appendix IV

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: "Methods – participants"
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Methods – participants"
3.	Allocation was concealed	Yes / **No** Where: N.A.
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Methods – participants; table 1&2"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	**Yes** / No Where: "Results"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results – table 2"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results – table 2"

N.A.= Not applicable

Score: 5/10

***Criterion 1 is not included in final score.*

Freyssin C. Verkindt C. Prieur F. Benaich P. Maunier S. Blanc P. Cardiac rehabilitation in chronic heart failure: effect of an 8-week, high-intensity interval training versus continuous training. *Archives of Physical Medicine and Rehabilitation.* 2012;93(8):1359-1364.

Appendix V

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: ”Materials and methods”
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: ”Materials and methods”
3.	Allocation was concealed	**Yes** / No Where: “Materials and methods”
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: ”Results – table 1&2 ”
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	**Yes** / No Where: ” Results – figure 1”
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by “intention to treat”.	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: ”Materials and methods”, “Results”
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: “Results – table 2”

N.A.= Not applicable

Score: 6/10

***Criterion 1 is not included in final score.*

Moholdt T. Bekken Vold M. Grimsmo J. Slørdahl SA. Wisløff U. Home-based aerobic interval training improves peak oxygen uptake equal to residential cardiac rehabilitation: a randomized, controlled trial. *PLoS One.* 2012:7(7).

Appendix VI

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: ”Methods – patients”
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: ”Methods – randomization procedure”
3.	Allocation was concealed	Yes / **No** Where: N.A.
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: ”Results – table 2-4”
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	**Yes** / No Where: ”Results”
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by “intention to treat”.	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: ”Results – Exercise capacity and systolic function”
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: ”Results – table 2-4”

N.A.= Not applicable

Score: 5/10

***Criterion 1 is not included in final score.*

Wisløff U. Støylen A. Loennechen JP. Bruvold M. Rognmo Ø. Haram PM. Tjønna AE. Helgerud J. Slørdahl SA. Lee SJ. Videm V. Bye A. Smith GL. Najjar SM,Ellingsen Ø. Skjaerpe T. Superior cardiovascular effect of aerobic interval training versus moderate continuous training in heart failurepatients: a randomized study. *Circulation*. 2007;19:115(24):3086-3094.

Appendix VII

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: "Methods – subjects and study design"
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Methods – subjects and study design"
3.	Allocation was concealed	Yes / **No** Where: N.A.
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Results"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	**Yes** / No Where: "Results – subjects"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results"

N.A.= Not applicable

Score: 5/10

***Criterion 1 is not included in final score.*

Munk PS. Butt N. Larsen AI. High-intensity interval exercise training improves heart rate variability in patients following percutaneouscoronary intervention for angina pectoris. *Int J Cardiol.* 2010;19:145(2):312-314.

Appendix VIII

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: «Methods»
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Methods – sample size and randomization procedure"
3.	Allocation was concealed	**Yes** / No Where: "Methods – sample size and randomization procedure"
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Results – table 1-3"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	Yes / **No** Where: N.A.
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	**Yes** / No Where: "Results – figure 1"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results – table 2&3"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results – table 2&3"

N.A.= Not applicable

Score: 6/10

***Criterion 1 is not included in final score.*

Moholdt T. Amundsen BH. Rustad LA. Wahba A. Løvø KT. Gullikstad LR. Bye A. Skogvoll E. Wisløff U. Slørdahl SA. Aerobic interval training versus continuous moderate exercise after coronary artery bypass surgery: a randomized study of cardiovascular effects and quality of life. *Am Heart J.* 2009;158(6):1031-1037.

Appendix IX

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: "Methods"
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Methods"
3.	Allocation was concealed	**Yes** / No Where: "Methods"
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Results – table 1&2"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	**Yes** / No Where: "Methods"
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	**Yes** / No Where: "Methods – figure 1"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	**Yes** / No Where: "Methods – figure 1"
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results – table 1&2"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results – table 1&2"

N.A.= Not applicable

Score: 8/10

***Criterion 1 is not included in final score.*

Nilsson BB. Westheim A. Risberg MA. Effects of group-based high-intensity aerobic interval training in patients with chronic heart failure. *Am J Cardiol.* 2008;15:102(10):1361-1365.

Appendix X

PEDro score:

Nr.	Criteria	Rating *Yes = 1 point* *No = 0 points*
1.	Eligibility criteria were specified.	**Yes** / No Where: "Methods"
2.	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).	**Yes** / No Where: "Methods"
3.	Allocation was concealed	**Yes** / No Where: "Methods"
4.	The groups were similar at baseline regarding the most important prognostic Indicators.	**Yes** / No Where: "Methods"
5.	There was blinding of all subjects.	Yes / **No** Where: N.A.
6.	There was blinding of all therapists who administered the therapy.	Yes / **No** Where: N.A.
7.	There was blinding of all assessors who measured at least one key outcome.	**Yes** / No Where: "Methods"
8.	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.	Yes / **No** Where: "Results – figure 1"
9.	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case; data for at least one key outcome was analyzed by "intention to treat".	Yes / **No** Where: N.A.
10.	The results of between-group statistical comparisons are reported for at least one key outcome	**Yes** / No Where: "Results – table 1&2"
11.	The study provides both point measures and measures of variability for at least one key outcome.	**Yes** / No Where: "Results – table 2"

N.A.= Not applicable

Score: 6/10

***Criterion 1 is not included in final score.*

Moholdt T. Aamot IL. Granøien I. Gjerde L. Myklebust G. Walderhaug L. Brattbakk L. Hole T. Graven T. Stølen TO: Amundsen BH. Mølmen-Hansen HE. Støylen A. Wisløff U. Slørdahl SA. Aerobic interval training increases peak oxygen uptake more than usual care exercise training in myocardial infraction patients: a randomized controlled study. *Clin Rehabil*. 2012;26(1):33-44.

Appendix XI

Name student: BOJAN ERIĆ
Student number: 2143520
Project Title: * Is high intensity training superior to low or moderate intensity training in cardiac rehabilitation ?
Name assessor: STEVEN ONKELINX
Date assessment: 01. 02. 2013

Fontys Paramedische Hogeschool

Assessment criteria	Assessment
General	
• The (concept) project plan is drawn up according to format	YES / NO
• All sections of the format are filled in correctly	YES / NO
• Correct spelling and use of language	YES / NO
• The project is practical and achievable within the available time	YES / NO
Hypothesis and background	
• The hypothesis (or possible occasion) is formulated in a sufficiently clear way.	YES / NO
• The problem definition and background reflect the social and physiotherapeutic relevance.	YES / NO
• Based on the problem definition of the case a concrete and relevant \ hypothesis for literature research is formulated	YES / NO
Objective	
• The objective is:	
- formulated in a sufficiently clear and concrete way	YES / NO
- relevant to the selected target group within the physiotherapeutic	
- professional practice	YES / NO
Method	
• Is the methodology adequate and effective	YES / NO
• Is the planned selection procedure and data extraction adequate and effective.	YES / NO
• Is the planned quality or outcome assessment adequate and effective.	YES / NO

Recommendations and/or products

- The recommendations and/or product(s):
  - are in keeping with the problem definition as formulated in the proposal YES / NO
  - are usable for the selected target group and setting YES / NO

Product requirements

- The preconditions are in keeping with the project (research / development) YES / NO
- The quality requirements are accurately described (cf. SMART criteria) YES / NO
- Project limitations are formulated, including possible solutions YES / NO

Planning

- The planning offers the whole project a global phasing and time spending schedule and a continuously detailed time schedule for the coming weeks YES / NO
- Important deadlines are included in the planning (typographically marked), e.g. meetings, hand-in deadlines YES / NO

Literature list

- Used literature is sufficiently specified YES / NO
- Relevant and recent literature is referred to YES / NO
- Literature references, in running text and in literature list, are given according to international guidelines YES / NO

Appendices

- The obligatory appendices are present YES / NO
- Optional extra appendices are relevant and clear YES / NO

Final assessment GO / NO GO

Clarification final assessment

- If all points have been answered YES by the supervisor, the student has successfully concluded the preparation phase; this is the formal beginning of the realization phase.
- If this is not the case, the student has to supplement and/or adjust the project plan on some of the points. The project leader discusses which points need modification with the student.

Steven Ambelinx
1/02/2013