

# High Intensity Interval Exercise Training in Cardiac Rehabilitation

**Prof. Leonard S.W. Li**

Hon. Clinical Professor, Department of Medicine,

The University of Hong Kong

Director, Rehabilitation

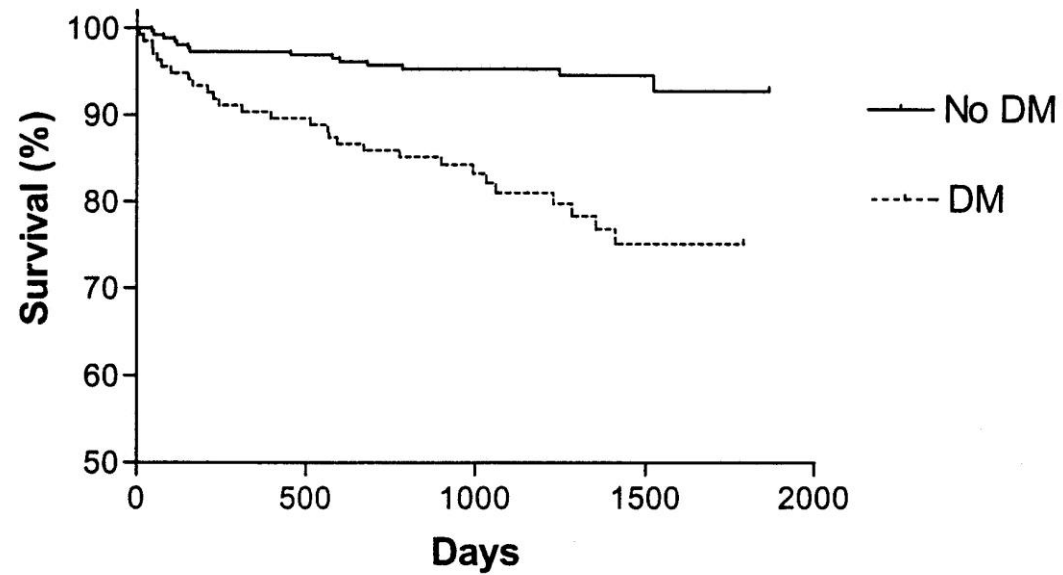
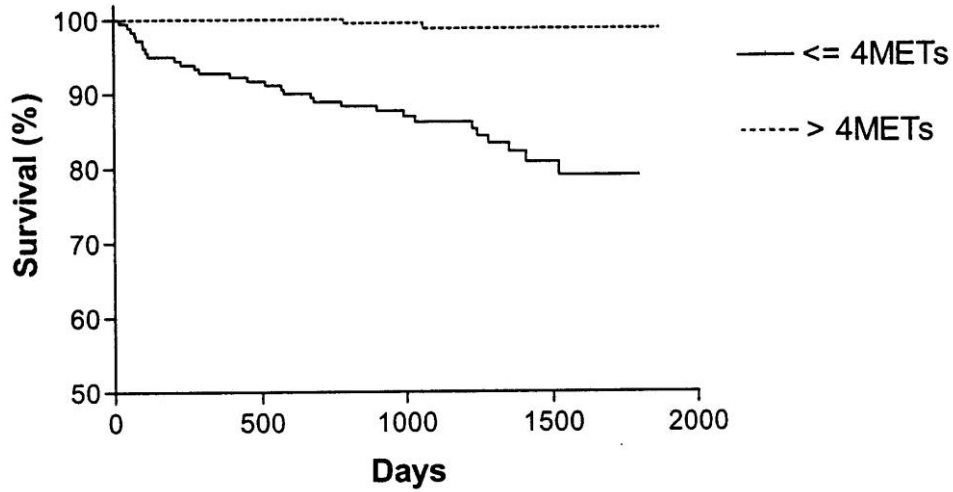
Virtus Medical Group



# Components of Cardiac Rehabilitation

- ♥ Exercise training
- ♥ Physical counseling
- ♥ Weight management
- ♥ Lipid management
- ♥ Psychosocial management
- ♥ Diabetes management
- ♥ HT management
- ♥ Nutritional counseling
- ♥ Smoking cessation

# Prediction of outcome after cardiac rehabilitation



Am. J. Cardiology 2001

# Exercise Capacity and Prognosis

Prediction of Long- Term Prognosis in 12,126  
Men Referred for Cardiac Rehabilitation

Kavanagh T et al, Circulation. 2002; 106:666-671

Exercise capacity, as determined by direct measurement of  $\text{VO}_{2\text{peak}}$  exerts a major long-term influence on prognosis in men  
After MI, CABG or IHD can play a valuable role in risk stratification and counseling

# Aerobic Exercise Training in Cardiac Rehabilitation

- Improvement in exercise capacity by an average of 15-25%
- for every one metabolic equivalent (MET) improvement: an 8–17% reduction in all-cause mortality
- cardiorespiratory fitness levels can predict prognosis in patients with known CHD

# Exercise in Cardiac Rehabilitation

- exercise programs aim to
  - increase the cardiorespiratory fitness and
  - muscular strength
- moderate- to vigorous-intensity exercise
  - American Heart Association, American College of Sports Medicine,
  - European Association for Cardiovascular Prevention and Rehabilitation,
  - Canadian Association of Cardiac
  - Rehabilitation, American Association of Cardiovascular and Pulmonary Rehabilitation Guidelines
  - Scottish Intercollegiate Guidelines
- lower-intensity exercise
  - Australia,
  - New Zealand,
  - Japan,
  - UK

# Exercise Prescription

- **ExerciseHR**
  - $\text{RestingHR} + (\text{MaxHR} - \text{RestingHR}) \times \%$
  - Or other alternatives
- **RPE 10 - 15**

•Progression

- Supervised
- Home exercise

<b>F – frequency</b>	3X per week
<b>I – intensity</b>	*50 – 80% HRR
<b>T – time</b>	30 minutes
<b>T – type</b>	Aerobic exercise

- Interval
- Cumulative

- Dynamic
- Rhythmic
- Isotonic

# RCT of HIIT in CAD

Sample	n	HIIT	MCT	Duration	Mode	VO <sub>2peak</sub> pre HIIT MCT	VO <sub>2peak</sub> % increase HIIT MCT
CAD	17 (HIIT=8)	3 d/wk 4x4 min@ 80-90%VO <sub>2peak</sub> total 33min	3 d/wk 41min@50-60%VO <sub>2peak</sub> isoload to HIIT	10 wks	TM	31.8 32.1	17.9% <sup>*</sup> 7.9%
CAD (previous CABG or AP)	14 (HIIT=7)	2 d/wk, 2 mins@90%VO <sub>2R</sub> , 2 min recovery, 30 min total	2 d/wk 30mins @65%VO <sub>2R</sub> Average training volume similar to HIIT	16 wks	TM etc <sup>1</sup>	22 21	31.8% <sup>*</sup> 9.5%
Metabolic syndrome	28 (HIIT=9)	3 d/wk 4x4 min @90%HR <sub>max</sub> , 3min active recovery @70% HR <sub>max</sub> , 40 min total	3 d/wk 47 min @70% HR <sub>max</sub> Equalized training volume	16 wks	TM	33.6 36.0	35% <sup>*</sup> 16%
post CABG	59 (HIIT=28)	5 d/wk 4x4 min@90%HR <sub>peak</sub> 3 min recovery	5 d/wk 46 min +Aerobic group exercise Iso energetic to HIIT	4 wks	TM	27.1 26.2	12.1% 8.8%
post MI	89 (HIIT=30)	2 d/wk 4x4 min@ 85-95%HR <sub>peak</sub> 3 min recovery	2 d/wk 60 min@58%PPO	12 wks	TM <sup>1</sup>	31.6 32.2	14.6% <sup>*</sup> 7.8%
CAD	37 (HIIT=17)	3 d/wk 7x3 min@RCP 7x3 min recovery@VAT total 42min	3 d/wk 50 min@VAT	3 months	TM	18.0 17.9	23.3% 24.6%
recent event CAD post PCI, CABG, etc	22 (HIIT=11)	2 d/wk 10x1min@89%(80-104%)PPO, 1 min recovery@10%PPO 1 d/wk home-based@similar intensity	2 d/wk 30-50min@58%PPO 1 d/wk home-based@similar intensity not isocaloric	12 wks	bike	19.8 18.7	24% 19%
Stable CAD (post MI CABG and/or PCI)	28 (HIIT=15)	3 d/wk 4x4 min@80-90%HR	3 d/wk 30 min@60-70%HR	10 wks	TM	22.4 21.8	16% <sup>*</sup> 8%
CAD with stents	36 (HIIT=16)	3 d/wk 4x4 min@85-95%HR <sub>peak</sub> 3 min active recovery@70%HR <sub>peak</sub>	3 d/wk 46 min@ 70%HR <sub>max</sub> isocaloric	12 wks	TM	31.2 29.8	10.6% <sup>*</sup> 6.7%
CAD	173 (HIIT=85)	3 d/wk 4x4 min@90-95%HR <sub>peak</sub> 3 min active recovery	3 d/wk 37 min@ 70-75%HR <sub>max</sub>	12 wks	bike	23.5 22.2	22.7% 20.3%



# RCT of HIIT in CHFb

Sample	n	HIIT	MCT	Duration	Mode	VO <sub>2peak</sub> pre HIIT MCT	VO <sub>2peak</sub> %increase HIIT MCT
CHF	24 (HIIT=10)	3 d/wk, 30 seconds@100% WRp 30 seconds rest,	3 d/wk, 40 mins@50%WRp	36 sessions	bike	15.4 15.5	7.8% 5.8%
CHF Post MI	27 (HIIT=9)	3 d(2 d supervised)/wk 4x4 min @90-95%HR <sub>peak</sub> , 3 min active recovery 50-70% HR <sub>peak</sub> , total 38 min	3 d(2 d supervised)/wk 47 min@70-75% HR <sub>peak</sub> , isoload to HIIT	12 wks	TM	13.0 13.0	46%* 14%
CHF	21 (HIIT=11)	3 d/wk 30 secc@WR <sub>peak</sub> 30 sec rest total of 40 mins	3 d/wk 40 min@50%WR <sub>peak</sub> equal to total work of HIIT	36 sessions	bike	14.2 15.3	8.5% 8.5%
CHF (LVEF<35%)	20 (HIIT=10)	3 d/wk 30x 1 min @70%VO <sub>2peak</sub> 1 min recovery	3 d/wk 30 min@70%VO <sub>2peak</sub> same absolute volume of work	16 wks	bike	12.2 12.4	21% 13%
CHF (LVEF<40%)	26 (HIIT=12)	5 d/wk 12x30 sec@50% (4 wks)+ 80% (4 wks) of maximum power** 1 min @ complete rest	5 d/wk 45 min@HRVT1***	8 wks	bike(HIIT) bike+TM( MCT)	10.7 10.8	27.1%* 1.9%
CHF(LVEF≤ 40%) NYHA II,III	45 (HIIT=15)	3 d/wk 5x3 min@80%VO <sub>2peak</sub> 3 min recovery@40% VO <sub>2peak</sub>	3 d/wk 60 min @60%VO <sub>2peak</sub> isoload to Int	12 wks	bike	16.0 15.9	22.5%** 0.6%
CHF with OMI (LVEF<40%)	20 (HIIT=10)	2-5 d/wk 2-4x4 min@75-80%HRR 3 min active pause walk@45-50%HRR	2-5 d/wk 30-45 min @45-60%HRR equated training load (TRIMP)	12 wks	TM	18.8 18.4	22% 22%
diastolic dysfunction with Diabetes mellitus	37 (HIIT=20)	3 d/wk 4x4 min @90-95%HR <sub>peak</sub> , total 40 min	Current guideline 10min/bout 210 min/wk)	12 wks Home-based thereafter	unknown	31.5 33.2	13.0%* 3.6%
CHF with preserved EF	15 (HIIT=9)	3 d/wk 4x4 min @85-90%HR <sub>peak</sub> 3 min active recovery	3 d/wk 30 min@70%HR <sub>peak</sub> ,	4 wks		19.2 16.9	9.4%* 0%
Stable CHF (NYHA2-3)	200 (3 arms)	25 sessions 4x4 min@ 90-95% HR <sub>peak</sub> 3min active recovery 50-70% HR <sub>peak</sub> total 38min	25 sessions 47 min@60-70%HR <sub>peak</sub>	12 wks	bike or TM	?? ??	?? ??
EF ≤ 35% HFpEF	180 (HIIT 60)	3 d/wk 4x4 min@ 90-95% HR <sub>peak</sub> 3 min active recovery 50-70% HR <sub>peak</sub> total 38min	5 d/wk 40 min@60-70%HR <sub>peak</sub>	3, 12 mons home-based after 3mons	bike	?? ??	?? ??

- $VO_{2max}$

Protocol HIIT	Protocol MICT	HIIT mL/kg/min (mean±SD)		MICT mL/kg/min (mean±SD)		Change in $VO_{2peak}$ mL/kg/min (mean±SD)
		$VO_{2peak}$ Pre	$VO_{2peak}$ Post	$VO_{2peak}$ Pre	$VO_{2peak}$ Post	
Walking/running and/or cycle ergometer 45 minutes	Walking/running and/or cycle ergometer 45 minutes	25.3±4.9	6 months: 27.2±5.6 12 months: 28.5±5.9	24.3±4.8	6 months: 26.1±4.4 12 months: 26.6±5.7	HIIT: 1.9±12.355 at 6 months 3.2±1.893 at 12 months MICT: 1.8±12.355 at 6 months 2.3±1.893 at 12 months
Uphill treadmill walking 33 minutes	Continuous uphill treadmill walking 41 minutes	31.8±9.3	37.8±12.4	32.1±5.3	34.8±5.7	HIIT: 6±2.342 MICT: 2.7±2.342
10 minutes each of treadmill, stair climber, arm/leg cycle 3 additional training days @ 60-70 HRR. 30 minutes Uphill treadmill 4x4-minute interval 3 minutes 8 minutes warm up 4x4-minute intervals 5 minutes cool down treadmill	10 minutes each of treadmill, stair climber, arm/leg cycle 3 additional training days @ 60-70 HRR 30 minutes Uphill treadmill 41 minutes Continuous treadmill 46 minutes	$VO_{2peak}$ at anaerobic threshold 22±4	$VO_{2peak}$ at anaerobic threshold 29±8	$VO_{2peak}$ at anaerobic threshold 21±3	$VO_{2peak}$ at anaerobic threshold 23±2	HIIT: 7±7.565 MICT: 2±2.1625
Uphill treadmill 4x4-minute interval 3 minutes 8 minutes warm up 4x4-minute intervals 5 minutes cool down treadmill	Uphill treadmill 41 minutes Continuous treadmill 46 minutes	32±19	37±27	31±9	35±11	HIIT: 5±10.698 MICT: 4±10.698
Aerobic exercise 45 minutes +15 minutes stretching Treadmill	Aerobic exercise 45 minutes +15 minutes stretching 10 minutes warm up Walk/ Jog/Run/Run 35 minutes 5 minutes cool down Stretching/relax Total 60 minutes	29.2±2.2	41.6±3.9	32±5.3	37.1±3.9	HIIT: 4 weeks 3.3±4.7328 6 months 5.1±2.9475 MICT: 4 weeks 2.3±3.5123 6 months 3.3±2.9475
5 minutes warm up and cool down 7x3 minutes RCP and 7x3 minutes VT Treadmill 42 minutes 10x1 minutes intervals at 89% peak power output interspersed with 1 minute at 10% peak power output cycling	5 minutes warm up and cool down Treadmill 50 minutes Continuous cycling 30-50 minutes	31.6±5.8	36.2±8.6	32.2±6.7	34.7±7.9	HIIT: 12.4 ±12.355 MICT: 5.1±12.355 HIIT: 4.6±4.2 MICT: 2.4±3.2
5 minutes warm up and cool down 7x3 minutes RCP and 7x3 minutes VT Treadmill 42 minutes 10x1 minutes intervals at 89% peak power output interspersed with 1 minute at 10% peak power output cycling	5 minutes warm up and cool down Treadmill 50 minutes Continuous cycling 30-50 minutes	17.9±1	22.3±1.1	18±1.2	22.2±1.3	HIIT: 4.4±8.5578 MICT: 4.2±8.9741
5 minutes warm up and cool down 7x3 minutes RCP and 7x3 minutes VT Treadmill 42 minutes 10x1 minutes intervals at 89% peak power output interspersed with 1 minute at 10% peak power output cycling	5 minutes warm up and cool down Treadmill 50 minutes Continuous cycling 30-50 minutes	19.8±3.7	24.5±4.5	18.7±5.7	22.3±6.1	HIIT: 4.7±3.398 MICT: 3.6±2.6

Protocol HIIT	Protocol MICT	HIIT mL/kg/min (mean±SD)		MICT mL/kg/min (mean±SD)		Change in V̇O <sub>2max</sub> mL/kg/min (mean±SD)
		V̇O <sub>2max</sub> Pre	V̇O <sub>2max</sub> Post	V̇O <sub>2max</sub> Pre	V̇O <sub>2max</sub> Post	
5 minutes warm up 3 minutes 60–70% HRR 4×4 minutes 80–90% HRR: 3 minutes 60–70% 4 minutes cool down Treadmill	5 minutes warm up Treadmill 30 minutes aerobic	22.4±4.2	26±5.9	21.8±4	23.5±4.6	HIIT: 3.6±3.1 MICT: 1.7±1.7
2 minutes treadmill 2 minutes treadmill 30 minutes	Continuous aerobic exercise Treadmill 30 minutes	20.6±5	24.4±5	21.8±6	21.9±6	HIIT: 3.8±12.35 MICT: 0.1±12.355
Bicycle	Bicycle	23.5±5.7	6 weeks 26.7±6.7 12 weeks 28.6±6.9	22.4±5.6	6 weeks 25.2±6.2 12 weeks 26.6±6.7	HIIT: 3.4±4.7 (6 weeks) 5.1±4.0 (12 weeks) MICT: 2.8±2.7 (6 weeks) 4.4±3.3 (12 weeks)
10 minute warm up and 3 min cool down Total: 38 minutes	5 minutes warm up and cool down 37 minutes exercise time Total: 47 minutes	21.1±3.3	12 weeks 26.4±5.2 6 months 27.2±6	19.8±7.3	12 weeks 23.2±7.4 6 months 24.2±7.8	HIIT: 12 weeks 5.275±2.954 6 months 5.908±3.587 MICT: 12 weeks 3.762±3.168 6 months 5.148±5.742
First 3 sessions MICT 10 minutes warm up 4×4 minutes treadmill 10 minutes cool down Total: 45 minutes	10 minutes warm up 25 minutes walk 10 minutes cool down Treadmill Total: 45 minutes	29.15±5.46	35.61±7.71	27.12±8.19	29.59±8.65	HIIT: 12 weeks 6.46±4.296 MICT: 2.47±4.296
Steady state test on cycle 25 W increment then 20 seconds @ 50% steady state test: 40 seconds recovery at 10% 4×10s	Bicycle	19.4±4.7	24±4.8	20.3±5	22.8±6.5	HIIT: 4.5±4.7 MICT: 2.5±3.6
30 minutes per session Not stated	6–8×10s 20 minutes per session multimodal Intervention	23.1±5.2	26.1±5.7	22.8±4.8	27±5.9	HIIT: 3.1±2.34 MICT: 3.88±3.01
5 minutes warm up and cool down treadmill 42 minutes	5 minutes warm up and cool down treadmill 50 minutes	17.9±1	22.3±1.1	18.8±1.2	23±1.3	HIIT: 4.4±8.5578 MICT: 4.2 ±8.4458

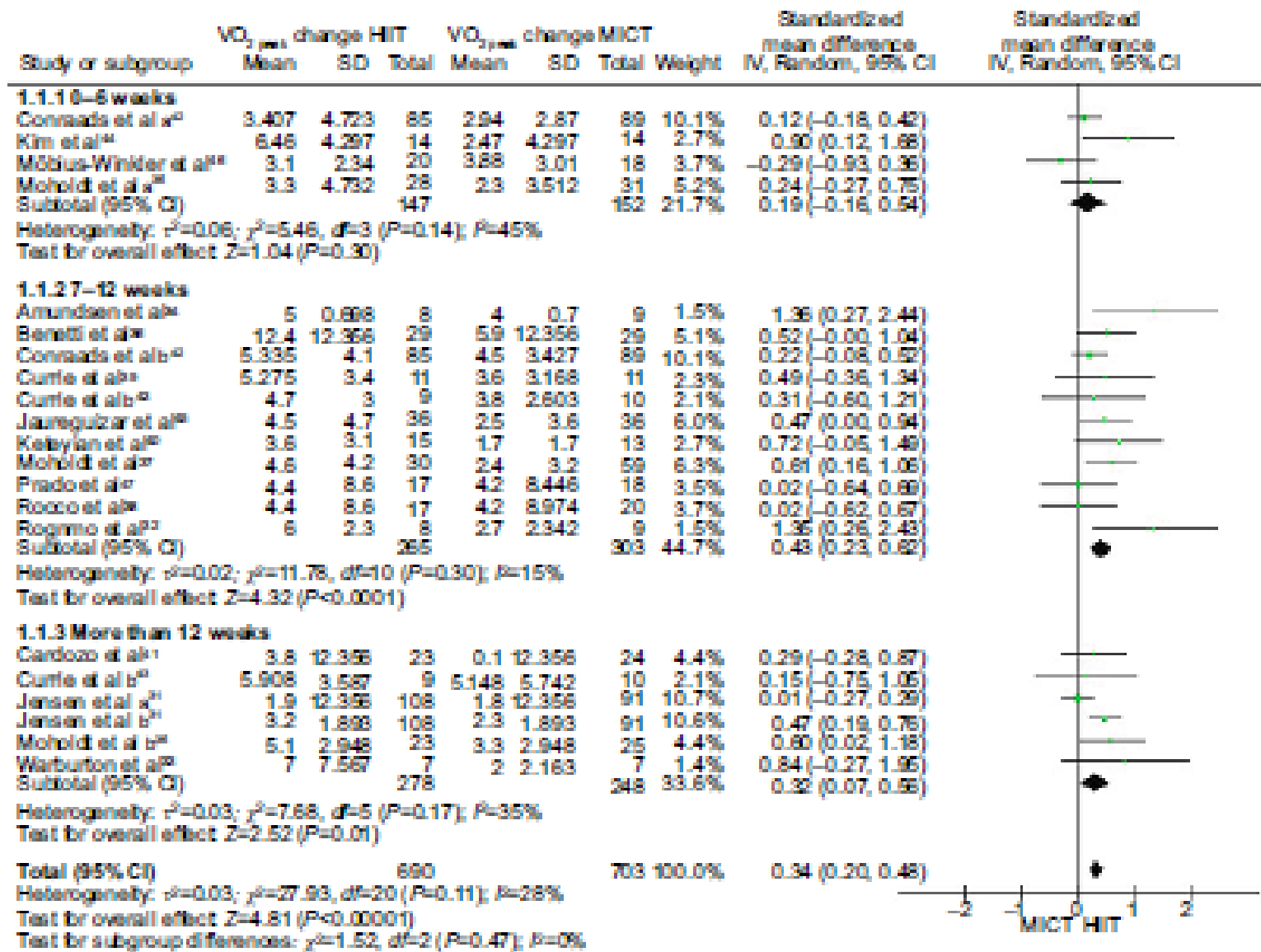


Figure 2 Forest plots depicting aerobic capacity changes as a result of HIT versus MICT (standard mean difference in mL/kg/min).

Abbreviations: HIT, high-intensity interval training; MICT, moderate-intensity continuous training; IV, inverse variance; CI, confidence interval; SD, standard deviation.

# Benefits: HIIT vs MICT

- Direct better cardiac function
  - Significantly improve VO<sub>2</sub> at ventilatory threshold,
  - left ventricular size and function,
  - contractile function,
  - left ventricular diastolic diameter,
  - diastolic volume,
  - posterior wall thickening fractional shortening and rate pressure product,
  - cardiorespiratory fitness,
  - ejection fraction,
  - endothelial function
- Indirect: improvement
  - mitochondrial biogenesis,
  - insulin sensitivity<sup>19</sup> and glucose regulation
  - HDL cholesterol,
  - blood pressure,
  - deep abdominal adiposity<sup>21</sup>

# Exercise Training in patients at established High Risk

- Safety
- Frequency
- Intensity



# Exercise parameters

Study	No. HIIT participants	No. MICT participants	Duration	Intensity HIIT	Intensity MICT
Jensen et al <sup>19</sup>	108	91	6–12 months 3 days/week	Progressed from 50–85% VO <sub>2</sub> peak	Not recorded
Rozzmo et al <sup>22</sup>	8	9	10 weeks 3 days/week	5 minutes warm up 50–60% VO <sub>2</sub> peak (65–75% HR peak) 4×4 minutes: 4 minutes @ 80–90% VO <sub>2</sub> peak (85–95% HR peak); 3 minutes @ 50–60% VO <sub>2</sub> peak 3 minutes cool down 50–60% VO <sub>2</sub> peak	50–60% VO <sub>2</sub> peak (65–75% HR peak)
Warburton et al <sup>23</sup>	7	7	16 weeks 2 days/week	2 minutes 85–95% HR/VO <sub>2</sub> reserve interpolated with 2 minutes recovery @ 35–45% HR/VO <sub>2</sub> reserve	60% HR/VO <sub>2</sub> reserve
Amundsen et al <sup>24</sup>	8	9	10 weeks	80–90% peak O <sub>2</sub> uptake	50–60% peak O <sub>2</sub> uptake
Moholdt et al <sup>25</sup>	23	25	4 weeks 5 days/week	HIT 90% max HR interspersed with 3 minutes @ 70% max HR	MICT: 70% max HR
Benetti et al <sup>26</sup>	29	29	12 weeks 5 days/week	85% max HR	75% max HR
Moholdt et al <sup>27</sup>	30	59	12 weeks 2 days/week plus 1 day/week home	Total 38 minutes 4 minutes >4; 85–95% MHR 3 minutes 70% MHR 8 minutes warm up 5 minutes cool down	Periodically encouraged to do vigorous exercises
Rocco et al <sup>28</sup>	17	20	12 weeks 3 days/week	Respiratory compensation point	VT
Currie et al <sup>29</sup>	11	10	12 weeks 2 days/week	89% peak power Range 80–104%	58% peak power Range 51–65%

# Protocol

Study	No. HIIT participants	No. MICT participants	Duration	Intensity HIIT	Intensity MICT
Katartan et al <sup>10</sup>	15	13	1–2 weeks MICT then 10-week trial 3 days/week	80–90% HRR	60–80% HRR
Cardozo et al <sup>11</sup>	23	24	16 weeks 3 days/week	60% max HR 90% max HR	70–75% max HR
Conrado et al <sup>12</sup>	85	89 non-exercise control	12 weeks 3 days/week	90–95% HR peak (prescribed) 88% HR peak (actual)	70–75% HR peak (prescribed) 80% HR peak (actual)
Currie et al <sup>13</sup>	9	10	12 weeks 2 days/week	75–95% peak power output 1 minute	51–65% peak power output
Kim et al <sup>14</sup>	14	14	6 weeks 3 days/ week	85–95% HRR and 50–70% HRR	70–85% HRR
Jurekutar et al <sup>15</sup>	36	36	8 weeks 3 days/week	Month 1 104.5±22.2% VO <sub>2</sub> peak Month 2 134.5±29.7% VO <sub>2</sub> peak	Month 1 64.2±8.5 VO <sub>2</sub> peak Month 2 69.5±8.7 VO <sub>2</sub> peak
Möbitus-Winkler et al <sup>16</sup>	20	20 (control group)	4 weeks 5x/week	95% anaerobic-free threshold Interspersed with 70% anaerobic-free threshold 1 hour recovery between sessions	60% anaerobic-free threshold
Prado et al <sup>17</sup>	17	18	12 weeks 3 days/week	7×3 minutes respiratory compensation point and 3 minutes VT anaerobic	VT anaerobic threshold



# Duration and frequency

- programs of <7 weeks or >12 weeks may be suboptimal when implementing HIIT
- conducted five times a week resulted in greater gains of cardiorespiratory fitness favoring HIIT, the analysis only included two studies and may not be practical to implement

# Adverse Event

RCT study	Cardiac adverse events reported HIIT	Cardiac adverse events reported MICT	Other adverse events HIIT	Other adverse events MICT	Events recorded but not classified by intensity
Jensen et al <sup>11</sup>	Events not reported	Events not reported	Events not reported	Events not reported	Events not reported
Rozmo et al <sup>12</sup>	Nil events	Nil events	1 ankle fracture	1 knee injury	Nil events
Warburton et al <sup>13</sup>	Nil events	Nil events	Nil events	Nil events	Nil events
Amundsen et al <sup>14</sup>	Nil events	Nil events	Nil events	Nil events	Physical impairment not related to cardiovascular disease
Moholdt et al <sup>15</sup>	Nil events	Nil events	Leg pain, hip pain, bronchitis	Readmitted to hospital (reason not reported), pericardial effusion	Nil events
Benetti et al <sup>16</sup>	Nil events	Nil events	Nil events	Nil events	Unstable angina >2 Joint problems
Moholdt et al <sup>17</sup>	Angina caused drop out	Angina caused drop out	Gastroenteritis, pancreatitis, intermittent claudication	Gastrointestinal bleeds, bronchitis, knee surgery, low back pain, cardiac disease	Nil events
Rocco et al <sup>18</sup>	Events not reported	Events not reported	Events not reported	Events not reported	Events not reported
Currie et al <sup>19</sup>	Nil events	Nil events	Nil events	1x musculoskeletal injury unrelated to training caused inability to perform post-training test	Nil event
Keterian et al <sup>20</sup>	Nil events	Nil events	Knee pain 1x requiring 2-week rest	1x limiting leg pain	Nil events
Cardozo et al <sup>21</sup>	Nil events	Nil events	Nil events	Nil events	Nil events
Conrads et al <sup>22</sup>	Nil events	Nil events during training 1 acute MI requiring PCI greater than 24 hours post training. Two episodes of significant ST depression was seen on exercise testing 6 weeks post training. Both required PCI.	Nil events	Nil events	Nil events
Currie et al <sup>23</sup>	Events not reported	Events not reported	Events not reported	Events not reported	Events not reported
Kim et al <sup>24</sup>	Nil events	Nil events	Nil events	Nil events	Nil events
Jaurisvuar et al <sup>25</sup>	Nil events	Nil events	Nil events	Nil events	Nil events
Möblus-Winkler et al <sup>26</sup>	Nil events	Nil events	Nil events	Nil events	Progression of CAD 1x after 4 weeks training and increased angina requiring PCI
Prado et al <sup>27</sup>	Events not reported	Events not reported	Events not reported	Events not reported	Events not reported

# Adverse Events

- a retrospective analysis of 4,846 patients with cardiovascular disease, which analyzed 175,820 hours of CR exercise training for rates of adverse events.
  - one fatal event was reported per 129,456 hours of MICT and
  - two non-fatal events per 23,182 hours of HIIT

# Practical aspects

- HIIT protocol requires self-motivation at the start;
- HR monitoring device during each training session is effective in obtaining good adherence
  - close to the upper intensity border as possible
- speed and inclination of the treadmill was continuously adjusted as training was adapted to ensure that all training sessions were carried out at the desired HR throughout the training period

# Practical Aspects

- low-dose protocol for anxious or initially poor tolerance
- 4×1 minutes to start
  - shown to yield a similar improvement in the exercise aerobic capacity in healthy, overweight, middle-aged men,
  - starting with 4×1 minutes 3 times a week
  - increasing the number of bouts per session to 4x4
  - for who are not quite ready for high intensity
- frequency of high intensity sessions per week could be gradually increased from one to three times per week

# Ways to minimize risk

- Referral system
- Check any new / change of cardiac symptoms
- Emergency procedure
- Start slowly & progress slowly in particular for those who are physically unfit
- Pre-participation assessment: Stress Test and Echocardiogram
- Risk stratification
- Monitoring
- Individualized exercise program

# STRATIFY

## Risk Level

### Low

- Uncomplicated clinical course in hospital
- No evidence of myocardial ischemia
- Functional capacity  $\geq 7$  METs
- Normal LVEF ( $>50$ )
- Absence of significant ventricular ectopics

### Intermediate

- ST-segment depression  $\geq 2$  mm flat or down-sloping
- Reversible thallium defects
- Mod. to good LVEF ( 35 - 49 % )
- Prior myocardial infarction

### High

- Ventricular tachycardia or unexplained cardiac arrest
- EF  $< 35$  % at rest
- Changing pattern of or new development of angina pectoris
- Fall in exercise systolic BP to below resting value
- Persistent or recurrent ischemic pain 24 hours or more after hospital admission
- Functional capacity  $< 5$  METS with hypotensive BP response or  $\geq 1$ mm ST-segment depression
- Congestive heart failure requiring hospitalization
- $\geq 2$ mm ST-segment depression at peak heart rate  $\leq 135$ bpm

(AACPR 1991)

# MONITOR





# Summary

- HIIT is superior to MICT
- HIIT is safe as far as proper monitoring is provided
- Evidence suggesting the program of 7 -12 weeks would be optimal

Thank  
You  
謝謝

