

How to target aerobic exercise training in polio survivors

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Program

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- 1 **Aerobic exercise training in individuals with PPS**

 - 2 **Programming aerobic exercise training**

 - 3 **How to determine exercise intensity in aerobic training?**

 - 4 **Conclusion and recommendations**

 - 5 **Questions**

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1 Aerobic training in PPS

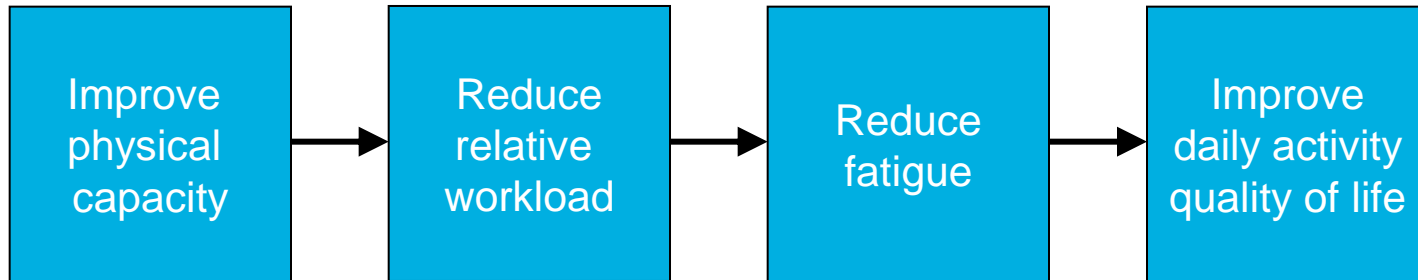
- Symptoms Postpoliomyelitis Syndrome (PPS)
 - New muscle weakness, fatigue and pain
 - Negative impact on daily activities and health related quality of life (HRQoL)

1 Aerobic training in PPS

- Treatment:
 - Pharmacological: insufficient evidence
 - Rehabilitation:
 - Aimed at reducing or compensating restrictions in activities to enable individuals to participate in society and to optimize HRQoL.
 - **Physical training**
 - Lifestyle changes
 - Orthoses and assistive devices

1 Aerobic training in PPS

- Physical training in individuals with PPS:
 - Muscle strengthening exercise
 - Aerobic exercise



1 Aerobic training in PPS

- Many individuals with PPS have a reduced aerobic capacity (Nollet et al., 2001; Stanghelle et al., 1993)
- Practitioners often have difficulty with programming aerobic exercise training
- No evidence on the effectiveness of aerobic exercise training in PPS (Cup et al., 2007; Koopman et al., 2011)

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2 Programming aerobic exercise

- Aerobic exercise prescription for **healthy subjects** according to the American College of Sports Medicine (ACSM, 1998):
 - Mode: use large muscle groups
 - Frequency: 3 to 5 times per week
 - Duration: 20 to 60 minutes per session
 - Intensity: 40% to 85% of HRR or VO_2R *depending on the initial level of fitness*

2 Programming aerobic exercise

- Aerobic exercise prescription for **individuals with PPS**

Clinical Exercise Physiology: *Application and Physiological Principles* (2004)

Chapter 18: Polio (Birk & Nieshoff)

Intensity
50–80% of MHHR if no history or full recovery from weakness
40–60% of MHHR if history of variable recovery from weakness and currently stable, but up to 40% of MHRR if recent new weakness

Duration

Frequency

Mode

BOX 18.4. Aerobic Exercise Prescription Summary

Intensity
50–80% of MHHR if no history or full recovery from weakness
40–60% of MHHR if history of variable recovery from weakness and currently stable, but up to 40% of MHRR if recent new weakness

Duration
30–40 continuous minutes, with intervals for the first few weeks if needed, if no history or full recovery from weakness
15–20 minutes divided into intervals of approximately 3 minutes if history of variable recovery from weakness, and up to 15 minutes if recent new weakness

Frequency
2–5 days per week, with only 3 nonconsecutive days if history of variable recovery from weakness and currently stable or especially if with recent weakness

Mode
Non-weight-bearing activities preferred (arm or leg cycling, or both; swimming and water walking/exercises)
Walking advised only if lower extremities are functional and capable of up to 2–3 minutes duration without symptoms

Special Considerations
Must determine extent of limb function prior to prescribing aerobic exercise
Even if no history of weakness, some of the exercise session should consist of non-weight-bearing activities
The patient must not exercise beyond RPE of “hard” even if no history of weakness
The patient must stop and modify exercise amounts if increased fatigue, weakness, or pain results
Adequate hydration is encouraged, especially in warmer than usual temperatures

2 Programming aerobic exercise

- Aerobic exercise prescription for **individuals with PPS**

ACSM's Exercise Management for Person's with Chronic Diseases and Disabilities (2003)

Chapter 41: Polio and Post-Polio Syndrome (Birk)

An exercise intensity of 60 to 70% of peak oxygen consumption ($\dot{V}O_{2peak}$) or moderate-to-somewhat hard ratings of perceived exertion, is recommended if there is no new weakness or symptoms. An intensity of less than 50% of $\dot{V}O_{2peak}$ is recommended if there is recent weakness and/or symptoms. Clients with severe atrophic polio and who have recent weakness should not exercise.

Recommendations for Exercise Programming

The primary purpose of an exercise program for individuals with PPS is similar to that for their asymptomatic counterparts: to prevent premature onset of hypokinetic diseases and maintain adequate muscle strength and endurance for occupational and leisure pursuits. However, individuals without PPS can usually perform a wider range of intensities and durations without long-lasting residual complications, whereas the person with PPS usually has a narrower range of acceptable exercise intensities. If persons with PPS overestimate their maximum intensity, they may risk premature acceleration of motor unit loss. The following principles of aerobic exercise prescription are based on symptoms and history. Recent symptoms of pain and weakness warrant a preparticipation medical exam and neuromuscular evaluation (see the Polio and

Post-Polio Syndrome: Exercise Programming table on page 276 for specific programming suggestions).

Exercise should involve as much stable musculature as possible. This should include four-limb ergometry, therapeutic aquatics, and other non-weight-bearing activities. Conventional weight-bearing activities such as walking and running may be appropriate for some individuals less involved and without a history of muscle atrophy.

An exercise intensity of 60 to 70% of peak oxygen consumption ($\dot{V}O_{2peak}$) or moderate-to-somewhat hard ratings of perceived exertion, is recommended if there is no new weakness or symptoms. An intensity of less than 50% of $\dot{V}O_{2peak}$ is recommended if there is recent weakness and/or symptoms. Clients with severe atrophic polio and who have recent weakness should not exercise.

A frequency of 3 sessions/wk is recommended. An alternate-day basis would be optimal to attain beneficial physiological changes without overtaxing the reduced number of motor units.

2 Programming aerobic exercise

- Aerobic exercise prescription for **individuals with PPS**
 - Mode: use large muscle groups
 - Frequency: 3 to 5 times per week
 - Duration: 15 to 40 minutes per session
 - Intensity: **up to 80% of HRR or VO_2R depending on the (recent) history of weakness and symptoms**

2 Programming aerobic exercise

- Aerobic exercise prescription for **individuals with PPS**
 - Intensity:

	Clinical Exercise Physiology	ACSM's Exercise Management
Full recovery	50 to 80% of HRR	60 to 70% of VO_{2max}
Currently stable	40 to 60% of HRR	
Recent weakness	up to 40% of HRR	up to 50% of VO_{2max}
Severe atrophy and recent weakness		no exercise

2 Programming aerobic exercise

Conclusions:

- Difficulties for practitioners in determining the exercise intensity for aerobic training in individuals with PPS
 - Wide range of recommended exercise intensities
 - Overuse and disuse should both be avoided
- Methods are needed to enable practitioners to better individualize aerobic exercise intensity prescription in persons with PPS

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3 Determining exercise intensity

Intensity is measured as percent of maximal capacity

- Usually assessed through graded maximal exercise testing
 - Heart Rate Reserve (HRR)
 - Oxygen Uptake Reserve (VO_2R)

- Alternatives
 - Ratings of perceived exertion
 - Estimating maximal capacity
 - Determining the Lactate Threshold (LT)



3 Determining exercise intensity

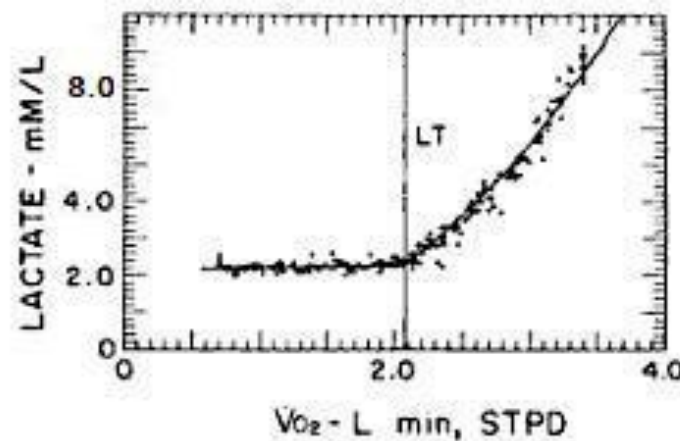
Lactate Threshold (LT):

- Upper limit of exercise intensity that can be sustained aerobically
- Strongly correlated with aerobic capacity (Wasserman et al., 2005)
- Training at or just below the LT (ACSM, 1998)
- Occurs at submaximal exercise intensities

3 Determining exercise intensity

Determining the LT:

- Assessed through incremental exercise testing
- Direct through blood lactate measurement



3 Determining exercise intensity

Determining the LT:

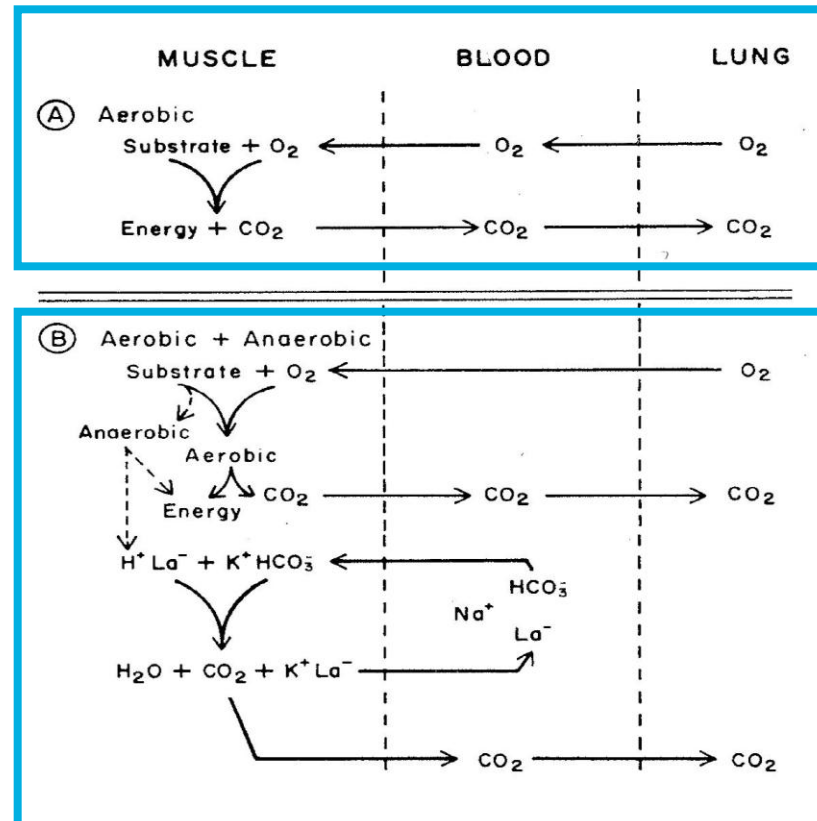
- Assessed through incremental exercise testing
- Indirect through measurement of gas exchange variables

Anaerobic Threshold (AT)



3 Determining exercise intensity

Determining the AT:



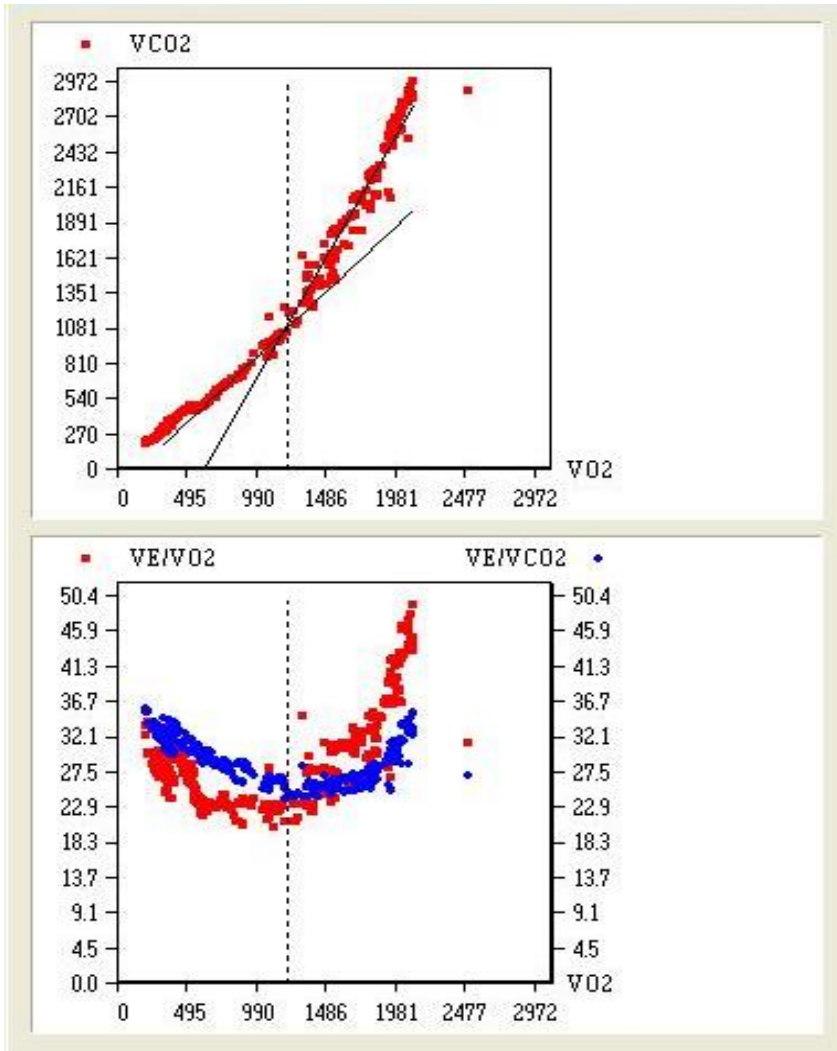
3 Determining exercise intensity

Determining the AT:

- V-Slope method:
 - VCO_2 accelerates relative to VO_2

- Ventilatory equivalent method:
 - Increase in V_E/VO_2 without an increase in V_E/VCO_2

3 Determining exercise intensity



V-Slope method

Ventilatory equivalent method

3 Determining exercise intensity

Determining the AT in individuals with PPS

	Willén et al. (1999) n = 32	
Exercise protocol	Graded <i>maximal</i> (cycle)	
AT determined	23 of the 32 subjects (~72%)	
AT intensity	Men: 34 ± 9 %VO _{2max} Women: 47 ± 15 %VO _{2max}	

3 Determining exercise intensity

Determining the AT in individuals with PPS

	Willén et al. (1999) n = 32	Unpublished data (2011) ¹ n = 60
Exercise protocol	Graded <i>maximal</i> (cycle)	Incremental <i>submaximal</i> (cycle)
AT determined	23 of the 32 subjects (~72%)	47 of the 60 subjects (~78%)
AT intensity	Men: 34 ± 9 %VO _{2max} Women: 47 ± 15 %VO _{2max}	Men: 38 ± 10 %HRR Women: 45 ± 14 %HRR

¹ Poster presentation 85: Ventilatory threshold in PPS patients. Anita Beelen

3 Determining exercise intensity

- Aerobic exercise prescription for individuals with PPS
 - Currently based on (recent) history of weakness and symptoms

	Clinical Exercise Physiology	ACSM's Exercise Management
Full recovery	50 to 80% of HRR	60 to 70% of VO_{2max}
Currently stable	40 to 60% of HRR	
Recent weakness	up to 40% of HRR	up to 50% of VO_{2max}
Severe atrophy and recent weakness		no exercise

maximal exercise prescription can be better

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4 Conclusions and recommendations

- Aerobic training is part of the rehabilitation management in individuals with PPS
- Clear guidelines to determine the exercise intensity for aerobic training in individual persons with PPS are lacking
- The AT assessed with submaximal exercise testing may be used to determine the individual aerobic exercise intensity
- Alternative methods should be developed for individuals with PPS for whom the AT cannot be determined

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