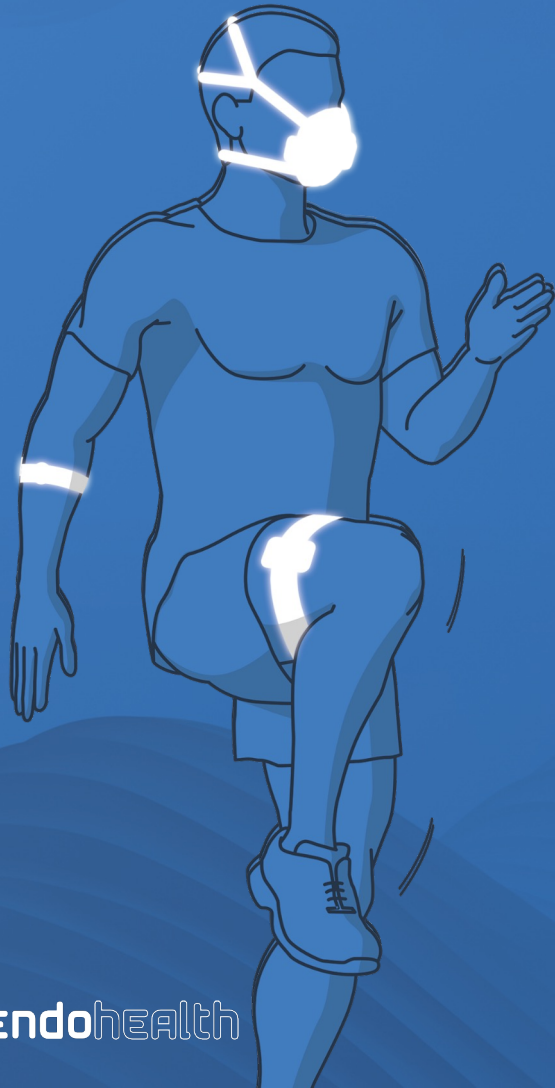


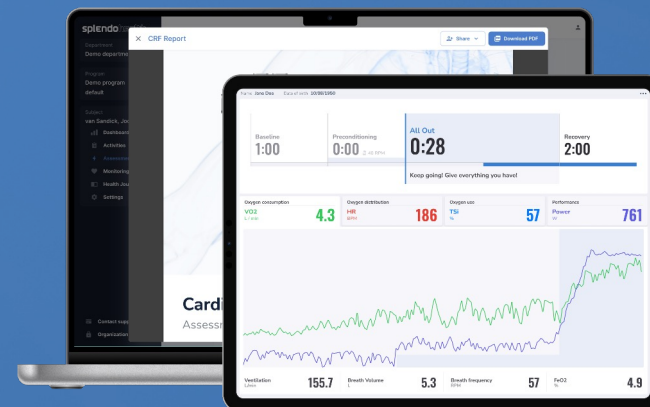
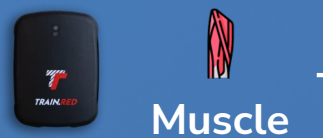
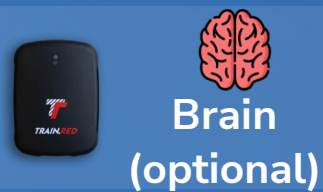
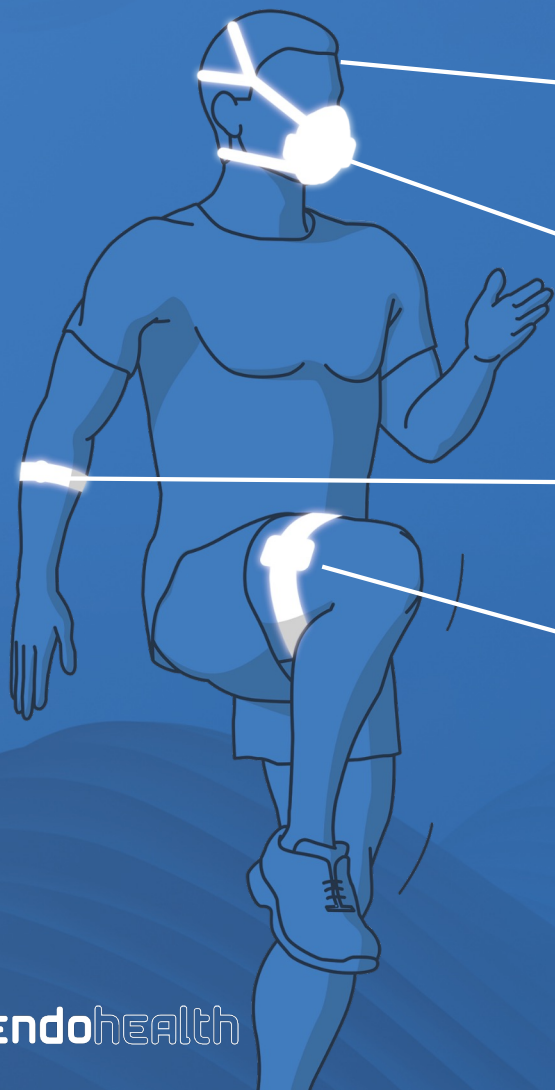


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Defining Fitness

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 **Duke** University
School of Medicine



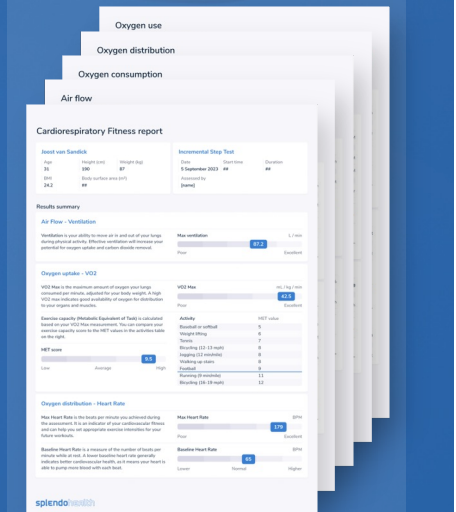
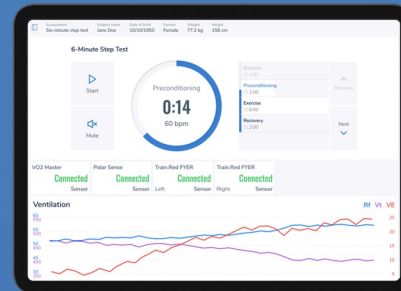
How it works



One-Minute All Out
Airbike Test (1MAO)



Six-Minute Incremental
Step Test (6MIST)



Actionable reporting is
instantly available

Validation study:

Molinger, et al. (2024), 'Feasibility of a Novel Augmented 6-Minute Incremental Step Test: a Simplified Cardiorespiratory Fitness Assessment Tool', *JACC: Advances*

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 **Duke University**
School of Medicine

Test-Protocols

RMR

Protocol



- RMR, REE, (Kcal/day)
- Substrate (FATox, CHOox)

RMR Report

Resting Metabolic Rate

Resting Energy Expenditure at rest is the per minute metric for Resting Metabolic Rate.



Fat Oxidisation amount of fat being used. A high percentage shows a good metabolic flexibility and optimal fuel use for the activity level. Fat being 'burned' is not being stored in the body.



Carb Oxidisation at rest. While at rest, carbohydrates are not the optimal fuel, so use should be low. A high percentage of Carb oxidation indicates a poor metabolic flexibility.



2.834

Average caloric intake
based on form input

1.703

Resting Calorie burn per 24 hrs
based on Resting Energy Expenditure

1.131

Calories to offset with activity
or reduced intake

Average daily energy expenditure per lifestyle

Low

< 750 cal/day

Mostly sitting or lying down.
Desk work with car commute.

Moderate

750 - 1000 cal/day

Moderately active, conscious about
physical activity and extracurriculars.

Active

> 1000 cal/day

Always on the move, working on your feet,
athletic, outdoors.

1-Minute All-Out Protocol



Baseline
1 minute

Warm-up
1 minute

Exercise
1 minute

Recovery
2 minutes

- Fast; total 5 minutes (including WU/CD)
- Instant reporting after finishing the protocol
- Airbike has low injury risk
- No learning effect is involved
- Reproducible and valid

Test-Report 1-MAO

Results summary

Response, balance, and limitations

Breathing - Ventilation

Your recorded **peak ventilation** of 87 L/min is **poor**, limiting the air supply to your lungs and **significantly affecting your performance and potentially your overall well-being**. To improve this, engage in medium to high-intensity training and work on breathing through your nose and mouth simultaneously during exercise.



Oxygen uptake - VO_2 / kg

Your recorded VO_2 Max of 27.2 indicates **good cardiovascular fitness**, reflecting overall good health and energy levels. To enhance your fitness, incorporate a combination of steady-state cardio, moderate-intensity exercise, and high-intensity interval training into your weekly program.

Your VO_2 max is **less than 25th percentile (low)** for your age and sex.

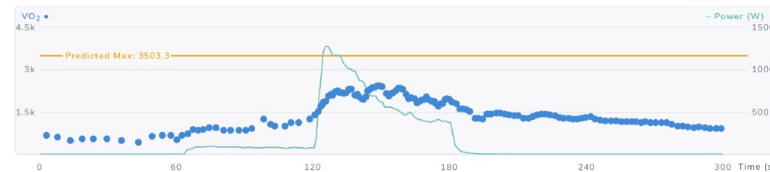


MET (Metabolic Equivalent of Task) shows the estimated VO_2 Max required for an activity. You can compare your exercise capacity score to the MET values in the activities table on the right.

Activity	VO_2 Max	MET value
Bicycling (10 -12 mph)	23.8	6.8
Tennis	24.5	7
Your assessment	27.2	7.8
Jogging (12 min/mile)	28	8
Bicycling (12-13 mph)	28	8

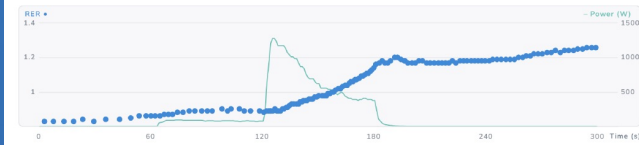
VO_2

Your recorded VO_2 peak of 2421.5 mL / min indicates **poor cardiorespiratory function**. Since this is an absolute measurement, it helps to compare cardiorespiratory function independent of changes in body weight (as opposed to VO_2 Max).



Respiratory Exchange Ratio

Respiratory Exchange Ratio (RER) is the ratio between the volume of CO_2 being produced by the body and the amount of O_2 being consumed. This value of this ratio gives us an indication as to whether the body is operating aerobically or anaerobically.

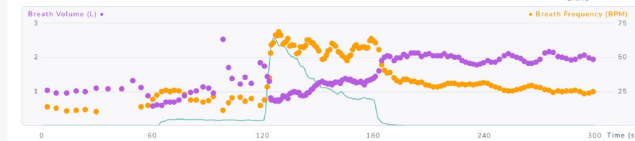


Breath volume and Breath frequency

Your recorded **peak breath volume** of 2.5 L is small, might lead to ineffective shallow breathing, which limits performance. Boost your lung capacity with **moderate exercise**.

Access this capacity with deep breathing techniques like diaphragmatic or pursed-lip breathing. Be attentive to your breathing technique during exercise.

Your recorded **peak breath frequency** of 68.8 BPM is **decent**, in combination with your breath volume it indicates a moderate level of respiratory efficiency and capacity. Work on your endurance and practice controlled breathing techniques during physical activities.



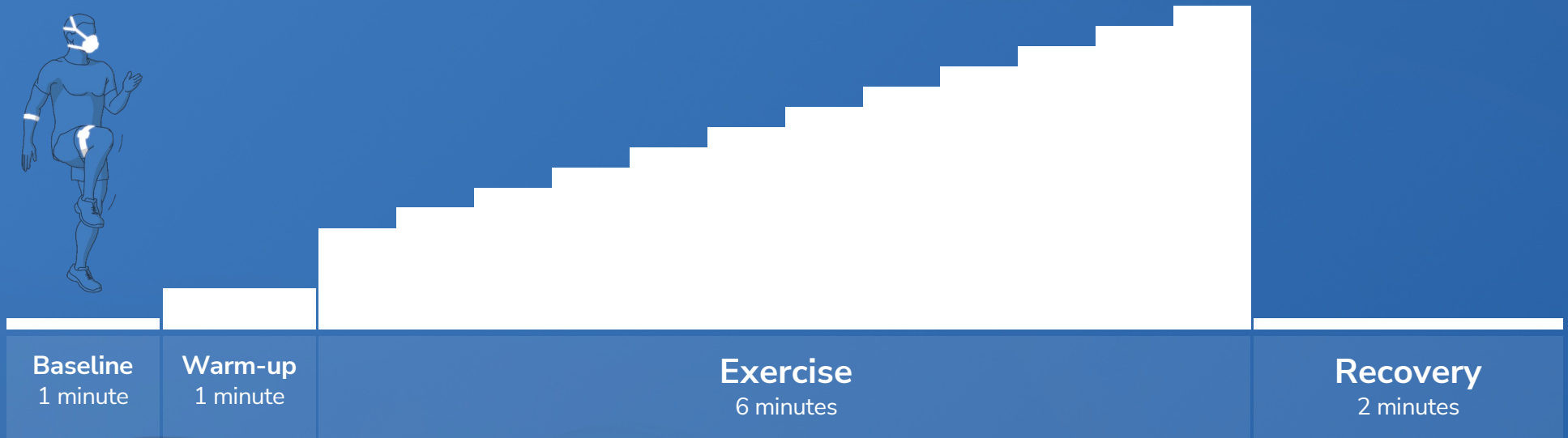
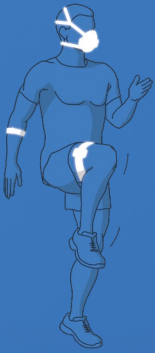
Oxygen delivery and utilization

Critical Metabolic Rate (%) - Right quadriceps



6-Minute Incremental Step Test

Protocol



- Low impact
- No exercise equipment required
- Instant reporting after finishing the protocol
- No learning effect is involved
- Reproducible and valid



JACC: Advances

Volume 3, Issue 8, August 2024, 101079



Original Research

Feasibility of a Novel Augmented 6-Minute Incremental Step Test: A Simplified Cardiorespiratory Fitness Assessment Tool

Jeroen Molinger MS^{a b c}, Veraprapas Kittipibul MD^{a d}, J. Matthew Gray MS^a,
Vishal N. Rao MD, MPH^{a d}, Stratton Barth BS^b, Ashley Swavely MS^a, Brian Coyne MEd^a,
Aubrie Coburn MS^a, Jan Bakker MD^{e f}, Paul E. Wischmeyer MD^c, Cynthia L. Green PhD^{d g},
David MacLeod MD^{b c}, Manesh Patel MD^{a d}, Marat Fudim MD, MHS^{a d}  

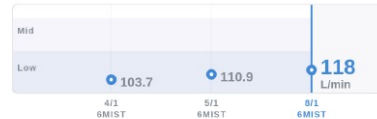
Test-Report 6MIST

Results summary

Response, balance, and limitations

Breathing - Ventilation

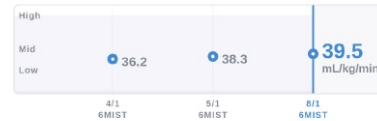
Ventilation is your ability to move air in and out of your lungs during physical activity. Effective ventilation will increase your potential for oxygen uptake and carbon dioxide removal.



Oxygen uptake - VO_2 / kg

VO_2 Max is the maximum amount of oxygen your lungs consumed per minute, adjusted for your body weight. A high VO_2 max indicates good availability of oxygen for distribution to your organs and muscles.

Your VO_2 max is in the 50th - 74th percentile (above average) for your age and sex.

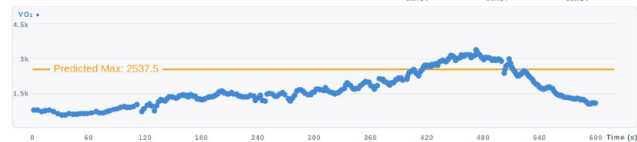
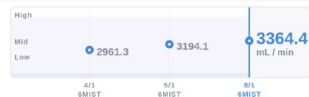


MET (Metabolic Equivalent of Task) shows the estimated VO_2 Max required for an activity. You can compare your exercise capacity score to the MET values in the activities table on the right.

Activity	VO_2 Max	MET value
Swimming (competitive)	36.1	10.3
Running (9 min/mile)	38.5	11
Your assessment	39.5	11.3
Bicycling (16-19 mph)	42	12
Running (7 min/mile)	43.1	12.3

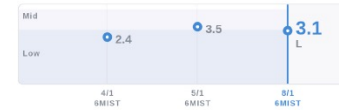
VO_2

VO_2 is the amount of oxygen your lungs consumed per minute. VO_2 Peak indicates your highest oxygen extraction at a single breath. VO_2 Max on page 1 shows your maximum sustained oxygen consumption over 30 seconds.

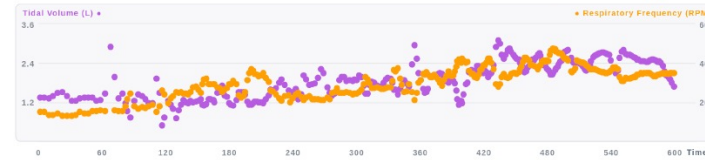
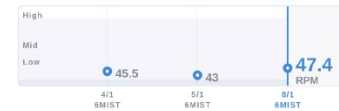


Tidal volume and Respiratory frequency

Tidal volume is the air volume inhaled and exhaled per breath. A large tidal volume provides a lot of potential to consume oxygen and expel carbon dioxide in each breath. A small tidal volume (shallow breaths) limits performance.

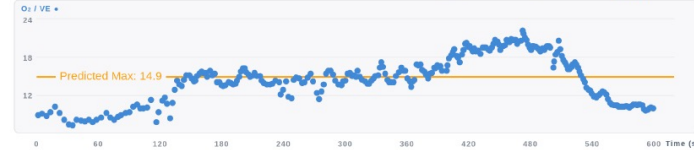
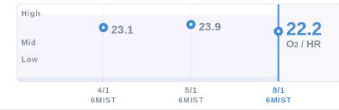


Respiratory frequency is the number of breaths per minute. A high respiratory frequency is effective breathing if the breaths are large as well. The graph below shows the relationship between tidal volume and respiratory frequency.



Oxygen intake per heart beat - O_2 Pulse

O_2 Pulse describes the volume of oxygen per heart beat. A high O_2 pulse means your heart is able to effectively supply the oxygen from the lungs to your organs and muscles.



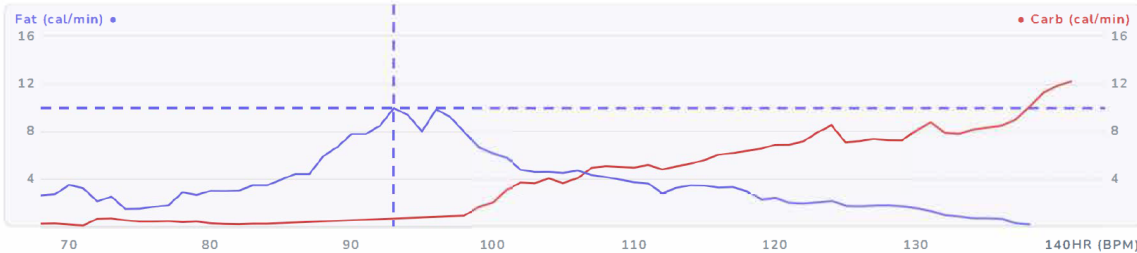
Modified YMCA test

90sec Submax protocol

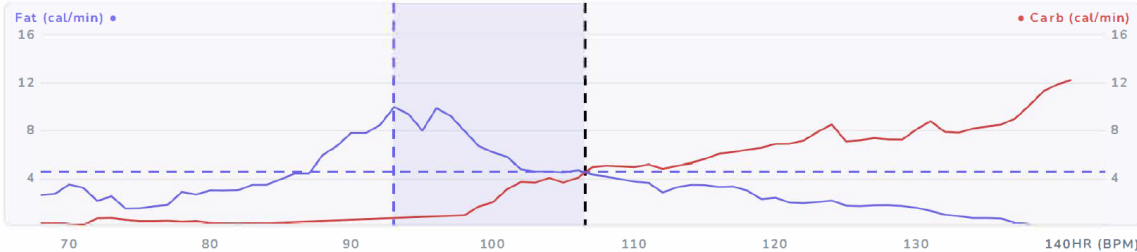


- Start 70watt / 100watt, increase with 20watt / 90sec
- Instant reporting after finishing the protocol
- Specific for metabolic profiling
- Stop the test after reaching 80% Hrmax (pred) or RER >1.0
- Reproducible and valid

Metabolic profile reporting



	Value	Unit	% Max HR
Max HR	141	BPM	100
HR at Max Fat	93	BPM	66
Max Fat usage	9.94	cal/min	-
VO ₂ at Max Fat	2.06	L/min	-
Fat usage at rest	1.13	cal/min	-
Carb usage at rest	0.59	cal/min	-

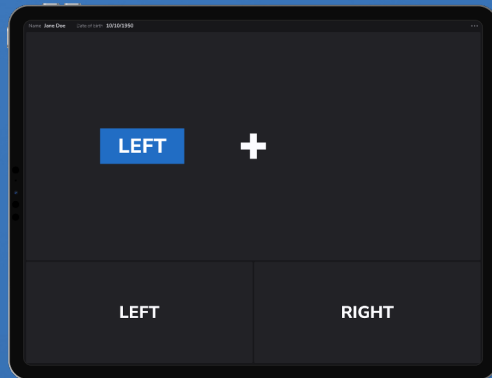


Fat burning zone

	Heart Rate (BPM)
MEP	107
Fat burning zone	93 - 107
No fat use above	139

Simon (Stroop) Test (optional)

Cognitive accuracy and response under stress



RESPONSE TIME (MS)	BASELINE	POST_ACTIVITY	POST_RECOVERY
Compatible	692	640	719
Incompatible	886	702	683
Simon effect	194	62 ↓-132	-36 ↓-230

RESPONSES	BASELINE	POST_ACTIVITY	POST_RECOVERY
Correct	20	20	20
Incorrect	0	1	0
% Incorrect	0%	4.8% ↑+4.8	0%

Baseline

Post-exercise

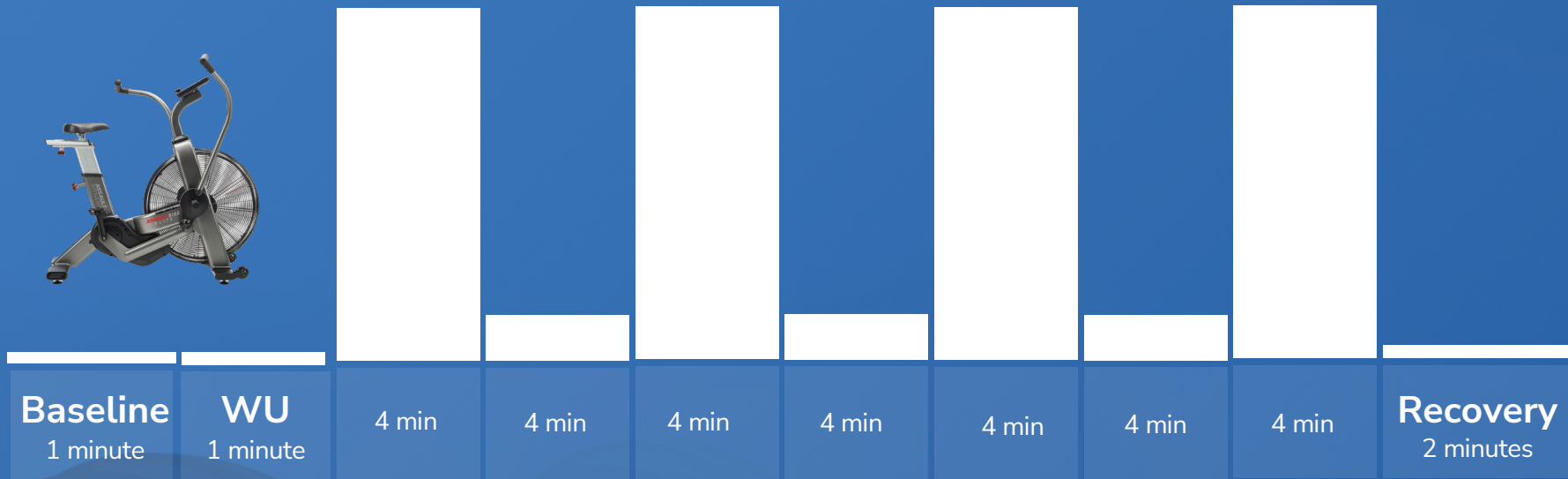
Post-recovery

- Response time and accuracy
- Delta between response to compatible and incompatible stimulus
- Differences in baseline, post-exercise, and post-recovery

Intervention-Protocols (examples)

4x4 HITT Airbike

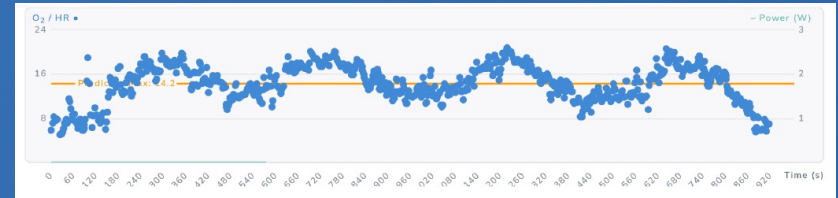
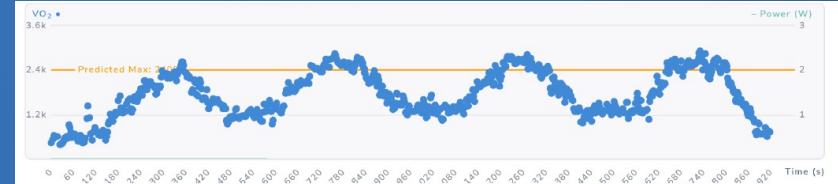
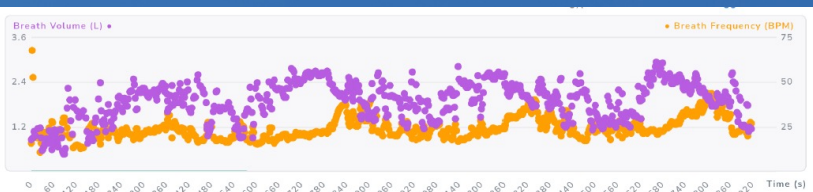
Protocol



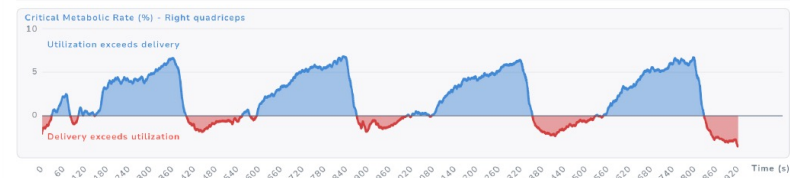
- 4x4 protocol; 4 min 80% VO₂max and 4 min active recovery

Intervention-Reports

Respiratory Exchange Ratio

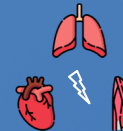


Oxygen delivery and utilization



Results

VO2 Max
VCO₂ / VO₂, EqCO₂, PECO₂



Integrative Biomarker
Operational Readiness
(Lung, Heart, and Muscle)

Ventilation
TV, RF, VE



Ventilatory Capacity

HR
HR, O₂ Pulse



Cardiac / Central Capacity

Metabolic Profiling
FAT_{ox}, CHO_{ox}, RER



HR / VO₂ Zones, FATmax,

%TSi
O₂Hb, HHb, Hb-Diff, THb



Muscle VO₂ Capacity

Results (Optional)

%TSi

O₂Hb, HHb, Hb-Diff, THb



Prefrontal cortex VO₂ Capacity

Cognitive ability

Response time, accuracy

	BASLINE	POST ACTIVITY	POST RECOVERY
Response time (ms)	548	587	596
Accuracy (%)	823	851	813
Correct	79	64	108
Incorrect	22	22	22



Simon Task Test



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