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Title: Lab #1: Aerobic Fitness Assessment

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Table 1. Classification of training zones as a function of lactate threshold and anaerobic threshold

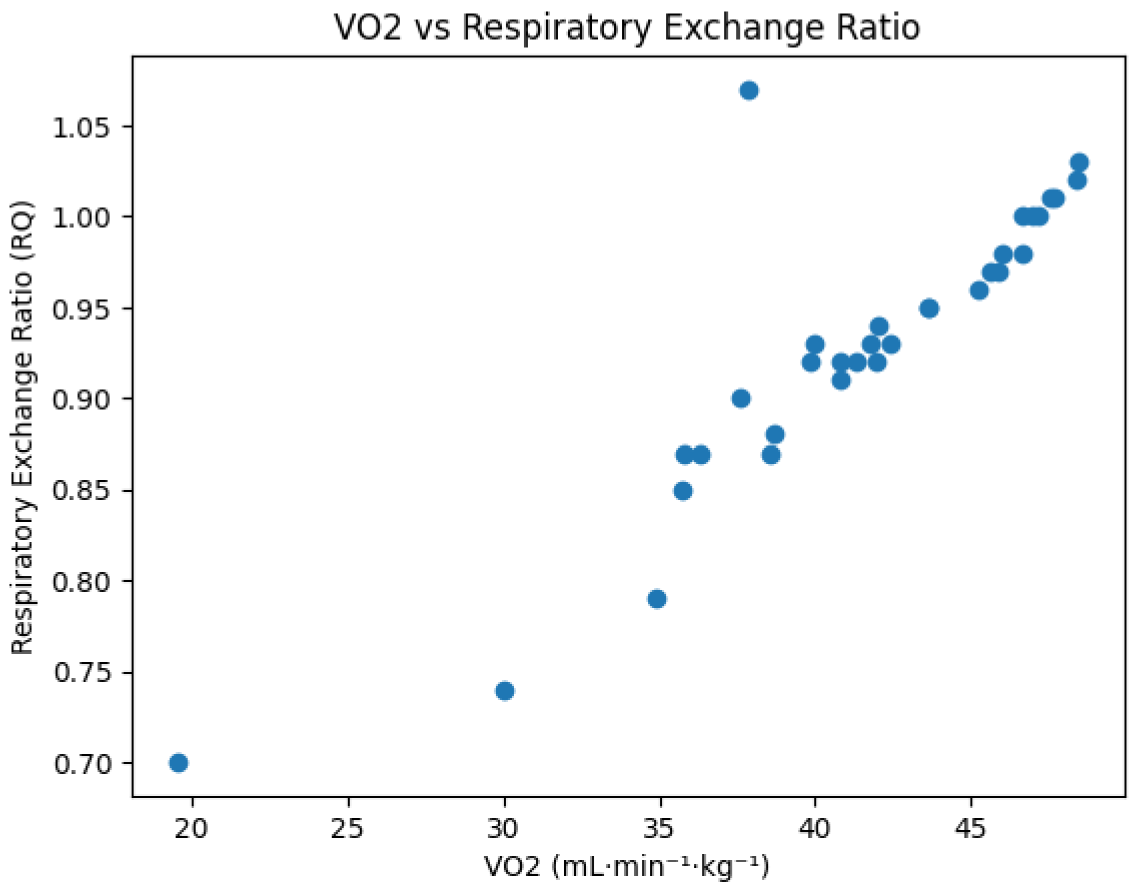
Description of Training Zone	Blood lactate relationship threshold	Blood lactate [$mmol \cdot L^{-1}$]	Workload (W)	Heart Rate (bpm)	Perceived Exertion	Critical Duration
Recovery (U3, E1)	<LT	<2	< 55	< 97	Easy	>3hrs
Extensive Aerobic (U2, E2a)	LT to LT + (AT−LT)/2	2–3	55-82.9	97-111	Comfortable	1–3hrs
Intensive Aerobic (U1, E2b)	AT to AT − (AT−LT)/2	3–4	82.9-119	111-129	Uncomfortable	30–90mins
Maximal Aerobic (Transport, E4)	>AT	>4	>119	>129	Very stressful	2–12mins

Blood lactate testing helps coaches plan training intensity for elite endurance athletes. By figuring out the two key thresholds (LT1 and LT2), training can be split into three zones: a low lactate zone (below ~2.0 mM), a middle zone where lactate is increased but stable (2.0–4.0 mM), and a high intensity zone where lactate builds up fast. (above 4.0 mM) (Seiler and Kjerland, 2006). These clear boundaries make it easier to target specific training adaptations.

Seiler and Kjerland (2006) found strong support for a polarised training model. Looking at 60 training sessions measured using blood lactate, 71% were done below 2.0 mM, only 7% fell in the middle zone, and 22% were above 4.0 mM. This roughly "75-5-20" split was also seen in elite rowers, cyclists and marathoners, suggesting this could be close to an optimal way of organising training for high level endurance athletes (Seiler and Kjerland, 2006).

Training too much in the middle lactate zone can cause excessive stress and increase the risk of overtraining, while keeping most sessions easy still provides a good training stimulus for well-trained athletes (Seiler and Kjerland, 2006). The harder sessions (at ≥90% VO_2 max) are then important for maintaining top fitness levels.

Seiler and Kjerland (2006) acknowledge the study was observational. This means that more experimental research is needed to confirm these findings and account for individual differences in how athletes respond to training.



The scatter graph shows a clear positive relationship between VO_2 and respiratory exchange ratio (RQ). As VO_2 increases, RQ generally rises from approximately 0.70 to above 1.0. At lower VO_2 values (~20–35 mL·min^{-1}·kg^{-1}), RQ values are around 0.70–0.87, indicating that fat oxidation is the primary fuel source, as an RQ close to 0.7 is characteristic of fat metabolism. As VO_2 increases with exercise intensity (~38–45 mL·min^{-1}·kg^{-1}), RQ values increase toward 0.90–1.00, showing a greater reliance on carbohydrate metabolism. Near the highest VO_2 values (~47–48 mL·min^{-1}·kg^{-1}), RQ exceeds 1.0, which typically occurs during high-intensity exercise when excess CO_2 is produced. Because protein use is assumed to be very small, the change mainly shows the body switching from using fat as the main fuel at lower intensities to using more carbohydrates as exercise intensity and oxygen consumption increase.

Calculation of Running Economy.

Running economy was calculated using:

Running Economy = (VO_2 ÷ Speed) × 60

Example calculation (10 km·h^{-1})

VO_2 (last 30 s) = 35.79 ml·kg^{-1}·min^{-1}

Running Economy = (35.79 ÷ 10) × 60

= 3.579 × 60

= 214.74 $\mathrm{ml \cdot kg^{-1} \cdot km^{-1}}$

Speed ($\mathrm{km \cdot h^{-1}}$)	**VO_2 ($\mathrm{ml \cdot kg^{-1} \cdot min^{-1}}$)**	**Running Economy ($\mathrm{ml \cdot kg^{-1} \cdot km^{-1}}$)**
10	35.79	214.74
11	39.95	217.91
12	42.39	211.95
13	45.60	210.46
14	47.54	203.74
15	37.84	151.36