Biological Fitness Metrics - Metabolic

Table 1 — *Level 1* Markers, Purpose, Data Source & Fasting Requirement

Category	Measure / Marker	Type	Purpose	Raw Data Needed	Fasting Required?
Glucose Handling	TyG Index	Calculated Measure	Early insulin resistance, metabolic strain	Fasting glucose, Fasting triglycerides	✅ Yes
Glucose Handling	Adiponectin	Lab Test	Cellular insulin sensitivity, anti-inflammatory balance	Blood sample	Not strictly required but preferred
Lipid Metabolism	AIP	Calculated Measure	Small dense LDL risk, lipid misalignment	Fasting triglycerides, Fasting HDL	✅ Yes
Oxidative Stress	GGT	Lab Test	Oxidative stress, mitochondrial load, fatty liver risk	Blood sample	Not strictly required but preferred
Inflammation	hs-CRP	Lab Test	Systemic inflammation, metabolic stress	Blood sample	❌ No
Mitochondrial Fitness	VO_2 Max	Physical Test	Mitochondrial capacity, metabolic flexibility	Exercise test or estimation	❌ No

Mitochondrial Fitness	Resting HR	Physical Measure	Autonomic function, recovery, baseline stress	Simple measurement	❌ No
Anthropometrics	Waist-to-Height Ratio	Calculated Measure	Visceral fat proportion, metabolic risk	Waist circumference, Height	❌ No

✅ Additional Notes (Restated for Clarity)

- **Fasting Lipids:** Triglycerides and HDL are best measured fasting to avoid postprandial variation, crucial for accurate TyG Index and AIP calculations.
- **Adiponectin:** While not strictly fasting-dependent, readings are slightly more consistent when drawn in a fasting state.
- **GGT:** Not a fasting-dependent enzyme per se, but fasting minimizes variability from recent meals or alcohol consumption.
- **hs-CRP:** Not impacted by fasting state, suitable for any time of day.
- **VO_2 Max, Resting HR, WHtR:** Physical measures, not affected by fasting.

Table 2 — *Level 1* Markers & Proper Ranges for Biological Function

Marker / Measure	Proper Range for Biological Function	Scientific Rationale & References
TyG Index	< 4.5	Values above ~4.5 strongly correlate with insulin resistance and elevated metabolic risk (Simental-Mendía et al., 2008; Unger et al., 2020).
Adiponectin	> 10 µg/mL	Higher adiponectin correlates with proper insulin sensitivity, low inflammation, and reduced fatty liver risk (Kadowaki et al., 2006; Lara-Castro et al., 2006).
AIP	≤ 0.11	Lower AIP predicts larger, buoyant LDL particles and low atherogenic risk (Dobiasova et al., 2004; Niroumand et al., 2015).
GGT	Men ≤ 20 U/L; Women ≤ 16 U/L	Values above these levels correlate with oxidative stress and higher cardiometabolic risk (Lee et al., 2004; Emdin et al., 2005).
hs-CRP	< 0.5 mg/L	Chronic inflammation likely absent below this threshold; hunter-gatherer populations average <0.3 mg/L (Ridker et al., 1997; Kaplan et al., 2003).
VO_2 Max	≥ age/sex-adjusted 75th percentile	High VO_2 max is linked to lower mortality and greater metabolic flexibility (Blair et al., 1989; Kodama et al., 2009).
Resting Heart Rate	50–65 bpm	Indicates healthy autonomic balance and metabolic health (Lauer et al., 1999; Jensen et al., 2013).
Waist-to-Height Ratio (WHtR)	≤ 0.45	Consistently predicts low visceral fat burden and lower metabolic risk (Ashwell et al., 2012; Browning et al., 2010).