

AI-03508 Physiology of Insulin

Owner	© Rigel Arcayan
Tags	MD
Created time	@February 24, 2026 9:44 AM

What is insulin? How does it relate to metabolism, fitness, endurance, fatigue, well being. List 22 top insulin relationships in the human body. Just keep the list one-liner using medical notes methods. Then list 22 human actions to lower or raise insulin levels.

Then :

- explain insulin specifically for endurance cyclists,
- show how to manage insulin for long climbs & sustained power, or
- create a simple fueling strategy to avoid energy crashes.
- Show how to curate insulin levels for weight loss.

What is insulin?

Insulin is a peptide hormone produced by the **beta cells of the pancreas**. It acts as the body's primary **metabolic regulator**, directing how glucose, fat, and protein are stored and used.

Think of insulin as a **fuel traffic controller**:

- Moves glucose from blood → muscle & liver
- Promotes glycogen storage (energy reserve)
- Suppresses fat breakdown when energy is abundant
- Enables protein synthesis & tissue repair

Without insulin, blood glucose rises while cells starve for usable fuel.

Insulin & the Human System

Insulin directly influences:

- **Metabolism:** nutrient storage vs. mobilization
 - **Fitness & performance:** fuel delivery to muscles
 - **Endurance:** glycogen preservation & glucose uptake
 - **Fatigue:** blood sugar stability & mitochondrial efficiency
 - **Well-being:** mood, cognition, inflammation & energy stability
-

22 Key Insulin Relationships (Medical Note Style)

1. ↑ Insulin → ↑ cellular glucose uptake via GLUT4 transporters
2. ↑ Insulin → ↑ glycogen synthesis (liver & skeletal muscle)
3. ↑ Insulin → ↓ hepatic gluconeogenesis
4. ↑ Insulin → ↓ lipolysis (inhibits hormone-sensitive lipase)
5. ↑ Insulin → ↑ lipogenesis & triglyceride storage
6. ↑ Insulin → ↑ amino acid uptake & protein synthesis
7. ↑ Insulin → ↓ proteolysis (muscle preservation)
8. ↑ Insulin → ↑ potassium uptake into cells
9. ↑ Insulin resistance → hyperglycemia & hyperinsulinemia
10. Chronically ↑ insulin → metabolic syndrome risk
11. ↑ Insulin sensitivity → improved mitochondrial efficiency
12. Low insulin state → ↑ fatty acid oxidation
13. Insulin oscillations → appetite & satiety modulation
14. Postprandial insulin spikes → transient energy dip in some individuals
15. Exercise → ↑ insulin-independent glucose uptake
16. Training adaptations → ↑ insulin sensitivity
17. Sleep deprivation → ↓ insulin sensitivity
18. Visceral adiposity → ↑ insulin resistance

19. Cortisol excess → antagonizes insulin action
 20. Stable insulin → improved cognitive function & mood stability
 21. Hyperinsulinemia → systemic inflammation risk
 22. Optimal insulin signaling → vascular & endothelial health
-

22 Human Actions That Lower or Raise Insulin

Actions that LOWER insulin

1. Aerobic exercise
2. Resistance training
3. Fasted low-intensity training
4. Intermittent fasting
5. Low glycemic-load diet
6. High fiber intake
7. Weight loss & visceral fat reduction
8. Adequate sleep duration
9. Omega-3 intake
10. Vinegar before meals
11. Magnesium sufficiency
12. Stress reduction & breathwork
13. Cold exposure
14. Green tea consumption
15. Reduced ultra-processed foods
16. Time-restricted eating
17. Improved gut microbiome diversity
18. Sunlight & circadian rhythm alignment

19. Walking after meals
20. Low refined sugar intake
21. HIIT sessions (post-adaptation)
22. Reduced late-night eating

Actions that RAISE insulin

1. High glycemic carbohydrate intake
2. Refined sugar & sweetened beverages
3. Large mixed meals
4. Frequent snacking
5. Excess caloric intake
6. Highly processed foods
7. Sleep deprivation
8. Chronic stress (via cortisol)
9. Sedentary lifestyle
10. Alcohol with carbohydrates
11. Liquid calories
12. Ultra-palatable hypercaloric foods
13. Eating late at night
14. High fructose intake
15. Overtraining with inadequate recovery
16. Rapid carb intake post fasting
17. Certain medications (e.g., steroids)
18. Emotional stress eating
19. Artificially sweetened hyperpalatable foods (in some individuals)
20. Large post-workout carb loads

21. Chronic inflammation

22. Central obesity

Insulin for Endurance Cyclists

For endurance athletes, insulin is **fuel partitioning control**.

Key roles:

- Enables **muscle glucose uptake** during high intensity efforts
- Restores **glycogen stores post-ride**
- Prevents excessive muscle breakdown
- Helps regulate **blood sugar stability during long rides**

Endurance advantage: training increases insulin sensitivity → more fuel delivered with less insulin.

Managing Insulin for Long Climbs & Sustained Power

During climbs and threshold efforts:

Early climb (steady aerobic zone)

- rely more on fat oxidation
- insulin low → efficient fat use

As intensity rises

- muscles pull glucose independent of insulin
- small carb intake maintains blood glucose

Avoid:

- large sugar spike pre-climb → insulin surge → energy crash

Best practice

- ✓ small carb intake 10–15 min before climb
- ✓ steady intake every 20–30 min

- ✓ avoid massive gels at once
-

Fueling Strategy to Avoid Energy Crashes

Before ride (60–90 min)

- Low–moderate GI carbs + protein
e.g., oatmeal, yogurt, banana

During ride

<90 min: water + electrolytes

>90 min: 30–60g carbs/hr

>3 hours: 60–90g carbs/hr (mixed glucose/fructose)

Carb timing

- small frequent intake > large bolus
- sip, don't spike

Prevent bonking

- eat BEFORE hunger
 - steady fueling maintains stable insulin & glucose
-

Curating Insulin for Weight Loss

Weight loss requires **lower average insulin exposure** to allow fat mobilization.

Strategies

- ✓ prioritize protein & fiber
- ✓ reduce refined carbs & sugar
- ✓ strength training (improves insulin sensitivity)
- ✓ daily walking & NEAT activity
- ✓ eat carbs around workouts

- ✓ avoid constant snacking
- ✓ prioritize sleep
- ✓ manage stress hormones

Helpful pattern

Lower insulin most of the day → strategic elevation around exercise → enhanced fat utilization

If you want, I can next:

- ✓ Explain **insulin vs glycogen vs fat metabolism** for endurance
- ✓ Design a **ride fueling plan based on heart zones**
- ✓ Explain **why cyclists bonk despite eating**
- ✓ Show **insulin control for longevity & metabolic health**