Not All Exercise is Created Equal:

Exercise and Glycemic Control in Type 1 Diabetes

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Outline

- Types of exercise
- Insulin and nutrition adjustments
- Post exercise hypoglycemia
- Role of the RD

Objectives

- Describe the difference in glucose utilization in aerobic versus anaerobic exercise
- Evaluate appropriate insulin and glucose adjustments based on blood glucose values and planned exercise
- Select and justify at least two strategies to prevent post-exercise or nocturnal hypoglycemia

Exercise with Type 1 Diabetes

Barriers

- Fear of hypoglycemia
- Lack of knowledge
- Poor motivation
- Body image
- Time constraints

Benefits

- Improved HbA1c
- Improved body composition
- Cardiorespiratory fitness
- Reduced risk of CVD
- Improved blood markers

Influences of glycemic response

1. Location of insulin delivery
2. Amount of insulin in circulation
3. Blood glucose (BG) concentration before exercise
4. Composition of last meal or snack
5. Intensity and duration of activity

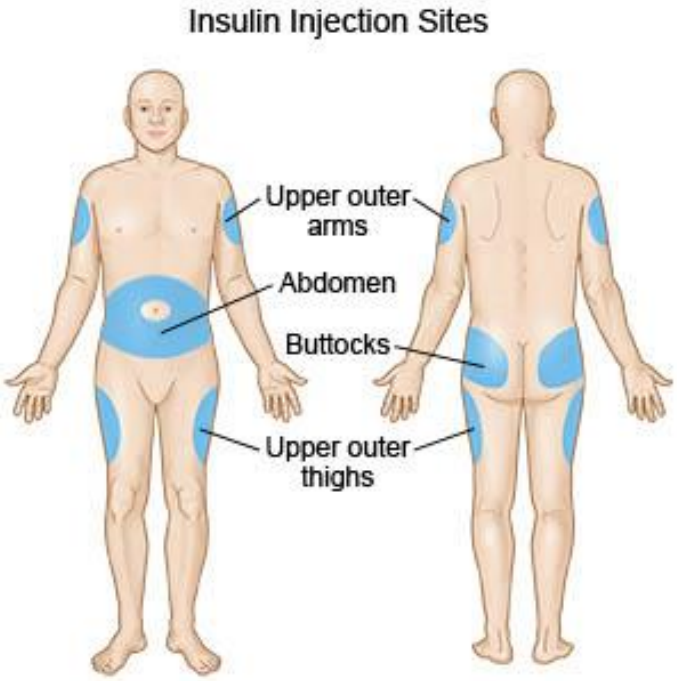


Image courtesy of: https://www.drugs.com/cg/images/en3010152.jpg

Types of Exercise

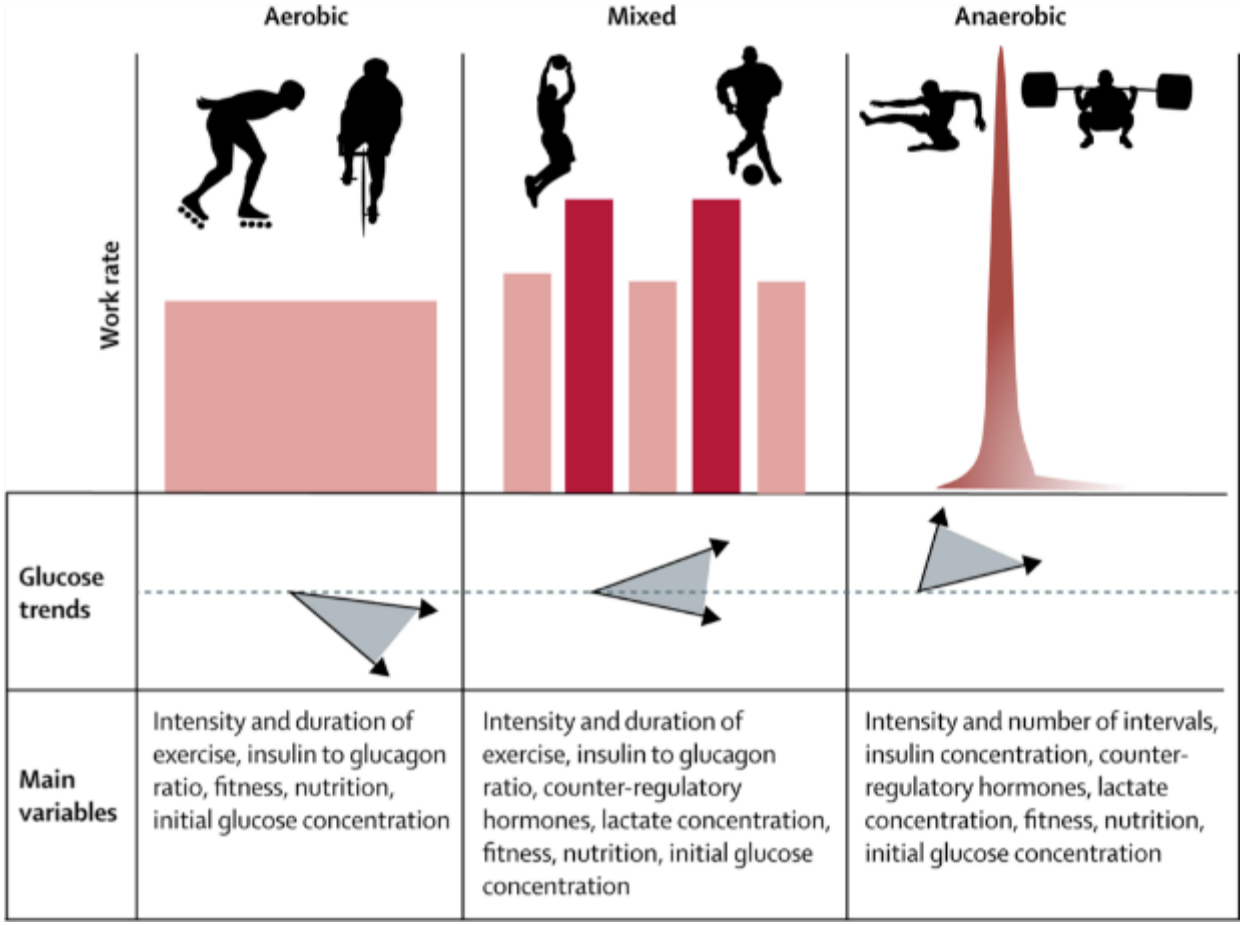
Aerobic

- Repeated and continuous movement of large muscle groups
- Oxygen requiring

Anaerobic

- Short duration, high intensity exercise
- Oxygen not required for energy production

Figure 1: Glucose Utilization



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Preparation for Exercise

- Time of day
- Maximize glycogen stores in liver and muscle (~4 hr. prior)
- Initial BG goal
  - Aerobic: 126-180 mg/dL
  - Anaerobic or mixed: 90-126 mg/dL

Nutritional Adjustments

Carbohydrates	Fat	Protein
45-65%	20-35%	10-35%

- Carbohydrate and fat fuel performance
- Low glycemic index (GI) food prior to exercise
- High GI food during exercise
  - 30-60 g/hour or higher
- Mixed GI following exercise

Insulin Adjustments

Bolus

- Timing prior to exercise, intensity, carb content
- Reduce meal dose 25-75%

Basal

- Hyperglycemia risk
- Greater than usual activity
- Continuous subcutaneous infusion vs. multiple injections
  - Suspension, 2 hr. limit
  - 20-80% rate reduction 60-90 min prior to exercise

Late Onset Hypoglycemia

- Carbohydrates post exercise, mix high and low GI foods
- Bolus reduced (50%) post-exercise meal, low GI food before bed
- Basal reduce (20-50%) and carbohydrate before bed

Role of the RD

- Educate the client: risks and benefits
- Individualize: each person will be different
- Formulate plan with the clients individual needs:
  - Exercise frequency, intensity, time, and type
  - Meal and snack timing and composition
  - Insulin routine
  - Blood glucose values

Is there anything further you would like to know?

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Table 2: Adjustments for prolonged or brief exercise

	Prolonged endurance exercise (predominantly aerobic)	Brief intense exercise (aerobic and anaerobic)
Bolus insulin dose reduction at the meal before exercise	Advised when exercise occurs within ~120 min of bolus dose; the magnitude of reduction varies according to timing, type, duration, and intensity of exercise	Bolus reduction not advised; might require additional conservative bolus dose correction if hyperglycaemia develops
Before exercise, basal insulin dose reduction (of ~20%) in patients on multiple daily injections	Useful especially if exercise is done less than every 3 days or if the frequency of exercise is high throughout the day; might also be useful if patients are on twice daily intermediate insulin	Basal insulin dose reduction not advised
Basal nocturnal insulin dose reduction (of ~20%) after exercise in patients on multiple daily injections and continuous subcutaneous insulin infusion to reduce the risk of nocturnal hypoglycaemia	Particularly important if the exercise was done in the afternoon or early evening	Useful for helping to prevent hypoglycaemia after a high intensity interval training exercise session
Temporary basal rate change (continuous subcutaneous insulin infusion)	Basal rate can be reduced by up to 100% (ie, pump suspension) during exercise, however, keeping some basal insulin delivery is preferred; to take into account rapid acting insulin pharmacokinetics, a basal rate reduction should ideally occur well before exercise is started (up to 90 min); normal basal rates can be resumed either at the end of exercise, or later in recovery depending on glucose trends	Increased basal rate might be needed to help prevent or treat hyperglycaemia either during or immediately after exercise
Carbohydrate intake before exercise	See table 1 for details	Not usually needed
Carbohydrate intake during exercise	Typically up to 60 g/h if no insulin dose adjustments have been made (see table 1 for additional information)	Not usually needed
Carbohydrate intake after exercise	Useful to reduce the risk of hypoglycaemia and improve recovery; might need a specified bolus insulin dose depending on the length and intensity of exercise (eg, a reduced insulin to carbohydrate ratio)	Useful to reduce the risk of hypoglycaemia and enhance recovery but should be delayed if hyperglycaemia is initially observed; might need a specified bolus insulin strategy (eg, a reduced insulin to carbohydrate ratio)
Sprint before or after exercise (alternative or complementary approach not related to insulin or food intake)	Might help reduce the risk of hypoglycaemia	Might increase the risk of hyperglycaemia; consider a prolonged aerobic cool down

Table 3: Suggested bolus reduction prior to exercise

	Exercise duration	
	30 min	60 min
Mild aerobic exercise (~25% VO_2max)	–25%	–50%
Moderate aerobic exercise (~50% VO_2max)	–50%	–75%
Heavy aerobic exercise (70–75% VO_2max)	–75%	NA
Intense aerobic or anaerobic exercise (>80% VO_2max)	No reduction recommended	NA