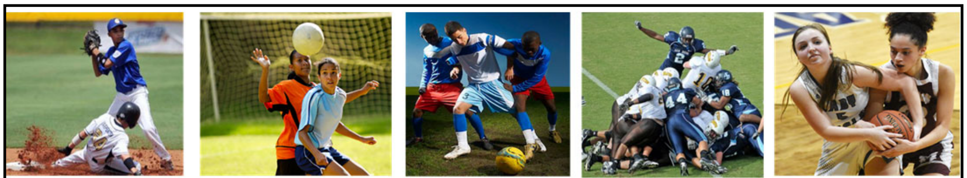

Diabetes in Athletes

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Disclosure

- I have no real or perceivable conflicts of interest in association with this presentation.

Learning Objectives

- Understand the insulin effect during exercise
- Identify the signs and symptoms of hyperglycemia and hypoglycemia and how to treat them
- Know the criteria for sports participation

Epidemiology

- Diabetes mellitus type 1 (DM1) is a group of diseases caused by an absolute or relative deficiency of insulin
- It affects 20-30 per 100,00 children in the United States younger than 20 years

Diabetes Types 1 & 2

- DM1 is the predominant form of diabetes affecting young children (<10). It is a disorder in which the insulin-producing islet cells of the pancreas are selectively destroyed by the body's immune system

- Type 2 diabetes mellitus (DM2), a disease of insulin resistance and relative insulin deficiency. Rise in prevalence in past 20 yrs. Currently affects 10-14/100,000 children in U.S.

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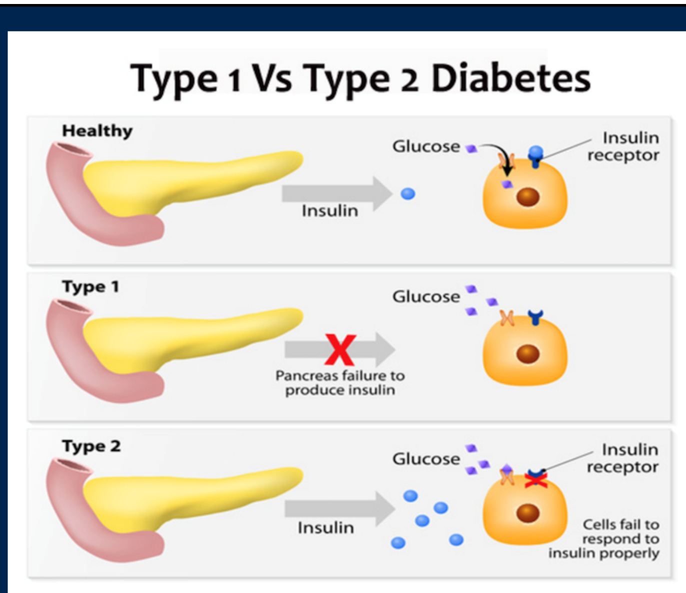

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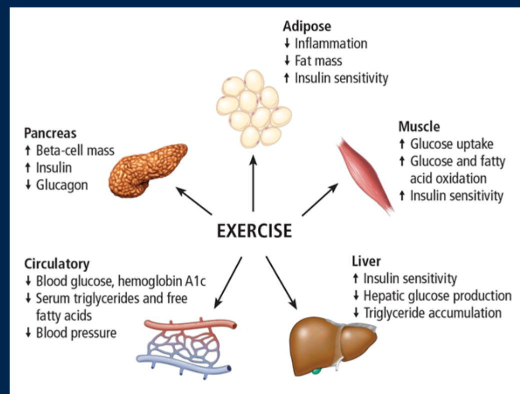
Diabetes & Athletics

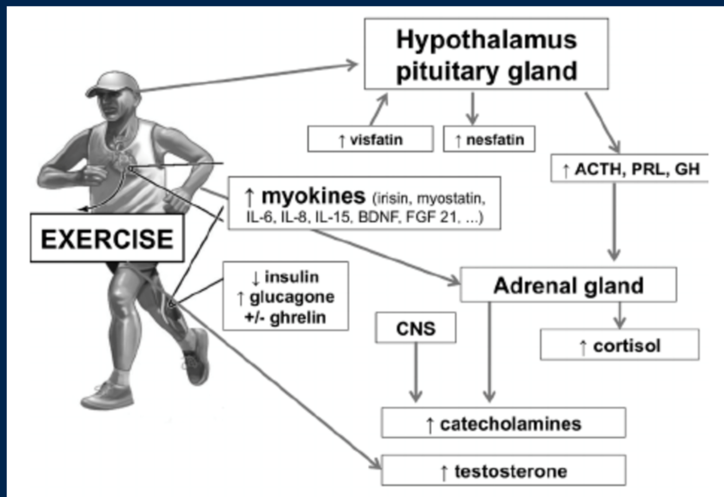
- Physical exercise is one of the mainstays of treatment of diabetes mellitus.
- There are many benefits of exercise in patients with diabetes



Diabetes & Exercise

Benefits	Risks
• Potentially lower Hgb A1C in children • Reduced risk of CVD, hypertension, • Increased CV endurance, muscle fitness and flexibility • Increased whole-body insulin sensitivity • Enhanced self-esteem and sense of well-being	• Hyperglycemia • Hypoglycemia • Musculoskeletal injury • CV accident (angina, myocardial infarction, dysrhythmia, sudden death)

Hormone Responses to Exercise



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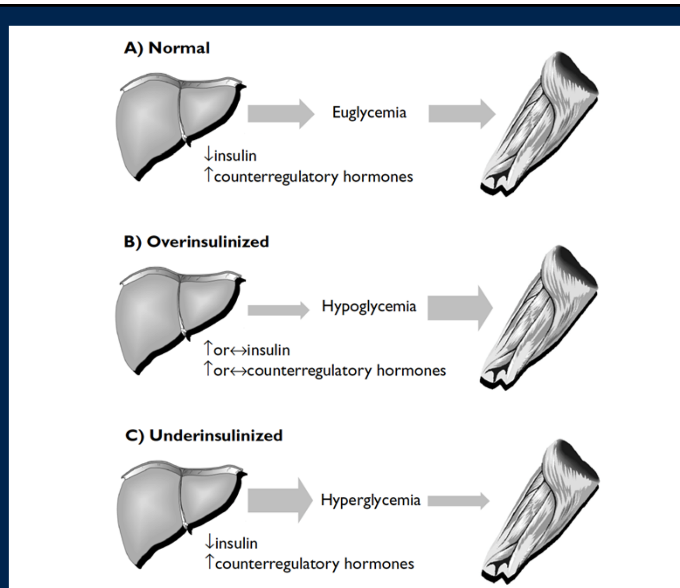
Normal & Abnormal (DM1) Insulin Responses to Exercise



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Underinsulinization & Hyperglycemia

- Individuals with poor control most vulnerable
- Especially with high intensity exercise
- Increased FFA, ketones impair glucose utilization by muscle
- Continued exercise leads to further impairment of peripheral glucose uptake and subsequent hyperglycemia, ketosis, and acidosis

Clinical Picture of Hyperglycemia (BG >180 mg/dL, or 10mmol/lit)

- Symptoms
  - Increased thirst
  - Headaches
  - Difficulty concentrating
  - Blurred vision
  - Fatigue
- Signs
  - Frequent urination
  - Dehydration

Acute Management of Hyperglycemia

- Treatment
  - -Verify elevated BG
  - -Water or IVF
  - -Additional insulin

https://diabetesvoice.org/en/caring-for-diabetes/lipohypertrophy-causes-unexplained-highs-and-lows/

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Protein & Glycemic Control

Muntis FR, et al. Nutrients, 2023

- 112 adolescents with DM1 using CGM to follow time in range (TIR) and time above range (TAR)

- Daily protein intakes of ≥1.2 g/kg/day were associated with 6.9% ($p = 0.03$) greater TIR and −8.0% ($p = 0.02$) less TAR following exercise

- No association between post-exercise protein intake and post-exercise glycemia

https://cleanhealthymeals.com/high-protein-grocery-list/

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Overinsulinization & Hypoglycemia

- Absorption of subcutaneous insulin may increase during exercise as a result of
  - -Increased body temp
  - -increased cutaneous BF
- Exercise increases insulin sensitivity
- Increase in non-insulin mediated glucose uptake

Impaired Counterregulatory Response

- Inappropriately low output of catecholamines, glucagon, cortisol in response to hypoglycemia
  - -Previous episode of hypoglycemia
  - -Neuropathic changes blunt endocrine response (decrease in counterregulatory hormone)

Clinical Picture of Hypoglycemia
(BG < 70 mg/dL, 4 mmol/lit)

•Symptoms
- Shakiness
- Hunger
- Irritability

•Signs
- Sweating
- Tachycardia

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Acute Management of Hypoglycemia

•Mild reaction – check BG, give15 gm of fast-acting sugar immediately

•Important! – it takes 10-15 min for BG to rise after consumption of quick-acting carbohydrate

•Fast-acting sugar should followed by food containing complex carbohydrate and protein, produces a more sustained glycemic response

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High Glycemic Index Simple Sugars

Instant glucose (31 g tube): 1 tube

Cake gel (small tube = 12 g): 1 tube

Orange juice (1/2 cup = 15 g): 1 cup

Sugar (tsp = 4 g): 4 tsp

Gatorade (8 oz = 14 g): 8 oz

Glucose tabs (4-5 g each): 3-4

Regular soda (1 oz = 3 g): 5 oz

Lifesavers (2.5 g each): 6

Skittles (1 g each): 15

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Management of Acute Hypoglycemia

Untreated hypoglycemia - may lead to confusion, headache, behavioral change, and may progress to syncope, seizure, loss of consciousness

Unconscious athlete

- Do not give oral preparations
- Give parenteral glucagon (1 mg given intramuscularly) by properly instructed personnel

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Post-exercise Late-onset Hypoglycemia

- Occurs 6-10 hr after unusually strenuous or prolonged activity (frequently nocturnal)
- Frequently severe (stupor, coma, and/or seizure) with few warning signs
- Unrelated to age of patient or duration of diabetes
- Unrelated to strict metabolic control

Avoiding Post-exercise Late-onset Hypoglycemia

- Consume carbohydrate w/in 30 min of exercise to allow for more efficient glycogen repletion
- Reduce post-exercise, pre-meal insulin bolus
- After prolonged or intense exercise, BG should be measured before sleep and extra carbs taken to ensure adequate glucose to replenish depleted muscle and liver glycogen

Insulin Pump, Continuous BG Monitoring (Continuous subQ insulin infusion - CSII)

- May reduce risk of hypoglycemia
- Candidates:
  - Active
  - Diligent about BG checks, counting carbs
  - Responsible
  - Need to be prepared to give short-acting insulin

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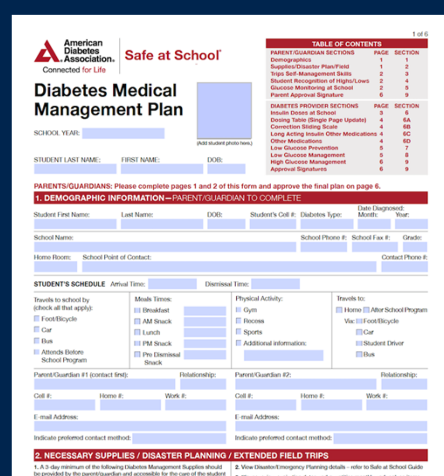
Criteria for Sports Participation

- Preparticipation Evaluation
- Should be done in athlete's medical home, not at the school mass PPE
- Managing health care provider should provide a diabetes medical management plan



1 of 6

American Diabetes Association. Connected for Life | Safe at School

Diabetes Medical Management Plan

SCHOOL YEAR:

(Add student photo here.)

STUDENT LAST NAME: FIRST NAME: DOB:

TABLE OF CONTENTS		
PARENT/GUARDIAN SECTIONS	PAGE	SECTION
Demographics	1	1
Supplies/Disaster Plan/Field	1	2
Trips Self-Management Skills	2	3
Student Recognition of Highs/Lows	2	4
Glucose Monitoring at School	2	5
Parent Approval Signature	6	9
DIABETES PROVIDER SECTIONS	PAGE	SECTION
Insulin Doses at School	3	6
Dosing Table (Single Page Update)	4	6A
Correction Sliding Scale	4	6B
Long Acting Insulin Other Medications	4	6C
Other Medications	4	6D
Low Glucose Prevention	5	7
Low Glucose Management	5	8
High Glucose Management	6	9
Approval Signatures	6	9

PARENTS/GUARDIANS: Please complete pages 1 and 2 of this form and approve the final plan on page 6.

1. DEMOGRAPHIC INFORMATION—PARENT/GUARDIAN TO COMPLETE

Student First Name: Last Name: DOB: Student's Cell #: Diabetes Type: Date Diagnosed: Month: Year:

School Name: School Phone #: School Fax #: Grade:

Home Room: School Point of Contact: Contact Phone #:

STUDENT'S SCHEDULE Arrival Time: Dismissal Time:

Travels to school by (check all that apply): Foot/Bicycle; Car; Bus; Attends Before School Program

Meals Times: Breakfast; AM Snack; Lunch; PM Snack; Pre Dismissal Snack

Physical Activity: Gym; Recess; Sports; Additional information:

Travels to: Home; After School Program. Via: Foot/Bicycle; Car; Student Driver; Bus

Parent/Guardian #1 (contact first): Relationship: Parent/Guardian #2: Relationship:

Cell #: Home #: Work #: Cell #: Home #: Work #:

E-mail Address: E-mail Address:

Indicate preferred contact method: Indicate preferred contact method:

2. NECESSARY SUPPLIES / DISASTER PLANNING / EXTENDED FIELD TRIPS

1. A 3-day minimum of the following Diabetes Management Supplies should be provided by the parent/guardian and accessible for the care of the student at all times.

2. View Disaster/Emergency Planning details – refer to Safe at School Guide

3. Please review expiration dates and quantities monthly and replace items prior to expiration dates

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Criteria for Sports Participation

- •The individual should show knowledge, technical mastery, and consistent application of BG monitoring techniques
- •Should demonstrate good metabolic control
- •hemoglobin A1c
- •Knowledge of strategies to avoid hypoglycemia
- •BG < 250 mg/dL before exercise
- •Absence of ketonuria before exercise.
- •Medical ID card/bracelet

Athletic Trainer Preparedness

- •Glucometer w/supplies
- •Glucagon emergency kit
- •Ketone test strips
- •Insulin management emergency plan from doctor
- •Health insurance card
- •Pre-packaged snacks
- •Emergency glucose

The Glucagon Emergency Kit

Exercise & Type 2 DM

- Exercise is an important part of long-term management
- Can dramatically improve muscle insulin sensitivity (reduced insulin resistance)
- Not clear whether resistance, aerobic, or combo exercise is best for improving insulin resistance. Currently ADA recommends both.
- Rarely associated with profound either hyper- or hypoglycemia

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Major Points – DM1

Before exercise	Include at least 1.2 gm/kg/d protein Eat carbohydrate meal 1-3 hrs before exercise Assess metabolic control • If BG < 90 mg/dl and levels decreasing add carbs • If BG 90-250, extra carbs may not be needed depending on duration & intensity of exercise • If BG > 250, check ketones, give insulin as needed and delay exercise until levels are normal Prolonged or intense activity may require • Reduction in insulin up to 50% 1 hr before pre-activity meal • Increase carb intake up to 1gm/kg/hr
During exercise	Montior BG every 30 min Continue fluid intake (250ml/30min) If needed, consume carbs every 20-30 min
After exercise	Monitor BG, incl overnight, if amount of exercise not habitual Consider adjusting insulin to decr immediate & delayed action Consider ingesting slow acting (complex) carb

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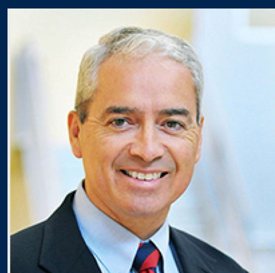
Thank you for your attention



jxgomez@texaschildrens.org

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