EXERCISE AND DIABETES

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DEFINITION AND IMPORTANCE

- Exercise – planned, structured physical activity with aim of increasing fitness
- Improves glycemic control via acute responses and chronic adaptations in local muscles and systemic responses (adaptations in liver, neural, immune, endocrine, and metabolic factors.
- It is central to help achieve and maintain target glucose control and improve quality of life.

EXERCISE PRESCRIPTION

- **American College of Sports Medicine and American Diabetes associations guidelines:**
- Initial instruction and periodic supervision by a qualified exercise trainer is recommended for most people with T2 Diabetes, especially for resistance training to ensure optimal benefits for BP control, glucose, lipids, and CVD risk, and to minimize injuries

Diabetes Care 2010; 33: 2692–96

ESSENTIAL TERMINOLOGY

Leisure Time Physical Activity

Activities during free time: walking, hiking, gardening, sport, dance, formal exercise training

One Metabolic equivalent

Is the rate at which adults burn kilocalories at rest

~ 1kCal/kg/hour

Walking at ground level with moderate pace ~ 3.3 kCal/kg/hour

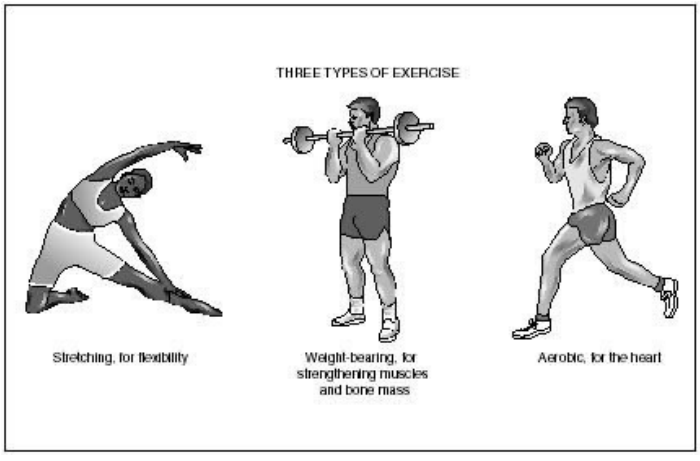
- **Exercise Training** – sub-category of Leisure time physical activity
- planned, structured and repetitive bodily movements are performed
- To improve or maintain one or more components of physical fitness (i.e. cardiorespiratory, strength and flexibility)

- **Resistance exercise**
- anaerobic training designed specifically to increase muscular strength, power and endurance by varying the resistance

OCCUPATIONAL PHYSICAL ACTIVITY

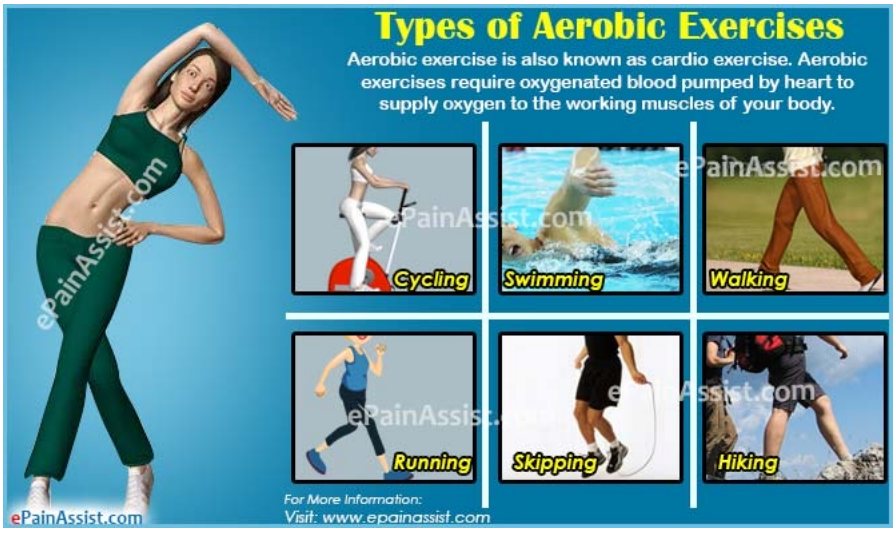
- activity associated with an occupation or job
- Usually over 8 hours

TYPES OF EXERCISE



RECOMMENDATIONS FOR EXERCISE

- *Bohn et al, Diab Care 2015*
- Less than 20% exercise more than 2 times per week
  - 60% have no structured exercise
    - Types of exercise:
  - *Aerobic* – rely on aerobic energy producing systems
  - *Anaerobic/Resistance/Strength* – on anaerobic energy producing systems
  - *High Intensity Interval Training* – brief periods of vigorous exercise and recovery at low to moderate intensity, both aerobic and anaerobic



ACSM AND ADA RECOMMENDATIONS FOR AEROBIC EXERCISE

- At least 3 days per week with no more than 2 consecutive days between bouts of activity
- At least moderate intensity
- For most people with T2 DM – brisk walking is a moderate intensity exercise
- Minimum of 150 min/week to achieve optimal coronary heart disease risk reduction
- Any form of exercise that uses large muscle groups and causes sustained increase in heart rate

- Gradual progression of both is advisable to minimize the risk of injury, particularly if health complications are present, and to enhance compliance

RESISTANCE EXERCISE

Resistance Training

- Purpose
  - Build muscle mass
    - Increases metabolism!
  - Develop and maintain muscle strength, muscle power, and muscle endurance
- Benefits for prevention of chronic diseases
- Maximizes and maintains bone mass
- Improves posture & reduces risk of back injury

RESISTANCE EXERCISE

- At least twice a week on non-consecutive days
- Ideally 3 times per week as a part of physical activity program for individuals with T2 DM along with regular aerobic activity
- Intensity – moderate or vigorous
- Duration – each training session at minimum of 5-10 exercises involving major muscle groups (upper body, lower body, and core)

involve completion of 10–15 repetitions to near fatigue per set early in training, progressing over time to heavier weights (or resistance) that can be lifted only 8–10 times.

INTENSITY OF EXERCISE

- Expressed in relation to the capacity of the person performing the activity
- Key factor in the responsiveness to exercise for achieving health outcomes
- Exercise stimulus to a specific tissue is greater than usually experienced
- In T2 DM importance of intensity is debatable
- Similar non-significant improvement in clinical outcomes (cholesterol, cardiovascular fittness

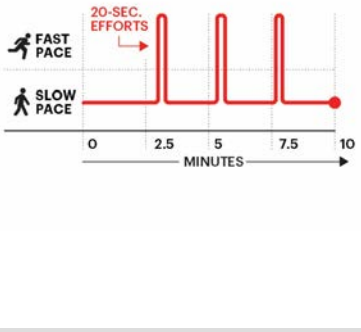
Activities to Achieve 2008 Exercise Guideline Recommendations

Moderate-Intensity Aerobic Activities >150 min/week	Vigorous-Intensity Aerobic Activities >75 min/week
Brisk walking (>3 miles/h)	Uphill walking or race walking
Bicycling (<10 miles/h)	Bicycling (>10 miles/h)
Water aerobics	Running or jogging
Tennis (doubles)	Tennis (singles)
Ballroom dancing	Aerobic dancing
General gardening	Heavy gardening (digging/hoeing)

From the Centers for Disease Control and Prevention guidelines (12).

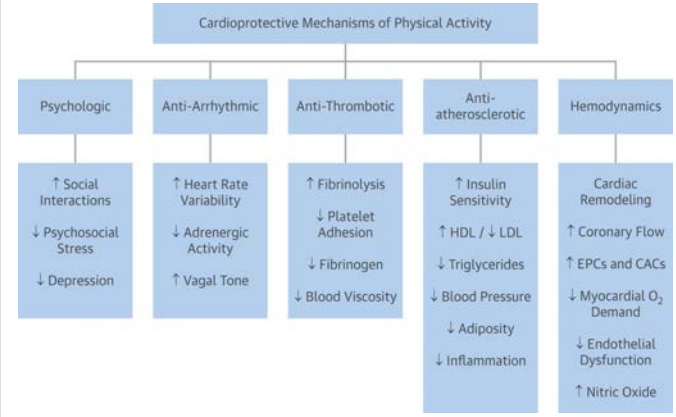
HIGH INTENSITY INTERVAL TRAINING

- Bouts of high intensity exercise (15 s to 4 min with >90% of max O2 uptake) followed by a recover period (40-50% of max O2 uptake) of equal or longer duration than work interval
- Possible that it may provide greater changes in metabolic pathways and benefit



EXERCISE BENEFITS IN INDIVIDUALS WITH UNDERLYING CHRONIC CONDITIONS

- Improvement in cholesterol
- Decrease in insulin resistance
- Reduction in blood pressure
- Increase in coronary blood flow and decrease in myocardial O2 demand



BALANCING BENEFITS AND RISKS

- Double edge sword
- Greater risk of musculoskeletal injuries
- Cardiovascular complications in individuals with underlying heart disease
- Establishing risk profile for various exercise regimens in different populations
- Providing benefits at minimal risk at high-risk populations

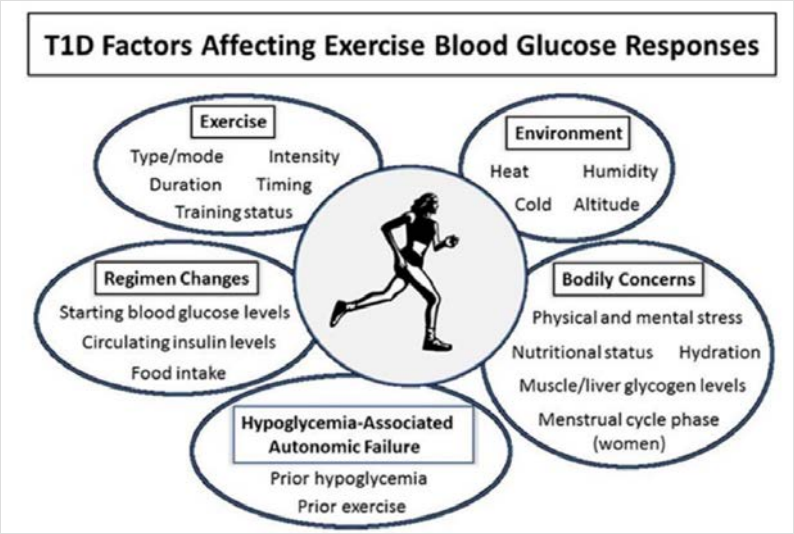
Risks associated with Exercise

- Hypoglycaemia
- Cardiac implications
- Retinal bleeding
- Protein excreted in the urine
- Changes to BP
- Increased risk of foot ulcers
- Possible problems with thermo-regulation

CAUTIONS WITH PRE-EXISTING COMPLICATIONS

- Autonomic neuropathy or long-standing uncontrolled DM → choose low intensity exercise
- In case of unstable proliferative retinopathy, severe AN, RF → avoid vigorous exercise, heavy lifting, competitive endurance sports
- Pre-existing heart disease or at high risk for heart disease – consult with HCP

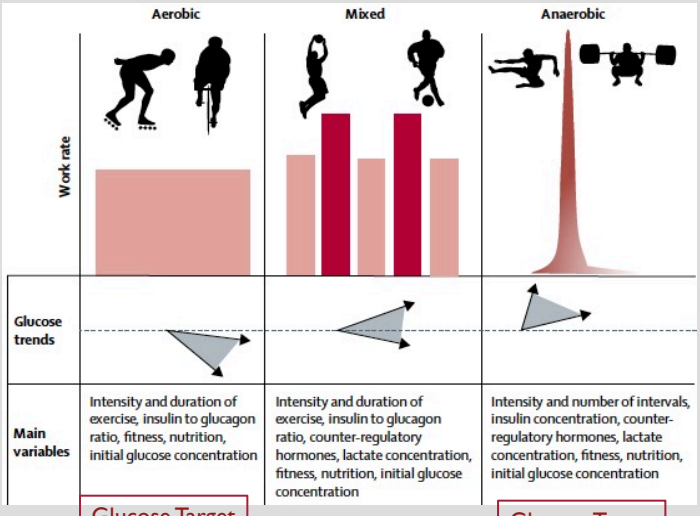
INSULIN TREATED T2 DM AND TYPE 1 DM



Colberg et al, J of Diab Science and Technol 2015

VARIABILITY OF BG RESPONSES DEPENDING ON THE TYPE OF EXERCISE

- Hypoglycemia develops within 45 min of starting aerobic exercise
- Trained individuals – greater reduction in BG
- Significant lowering of insulin before exercise → hyperglycemia before and during exercise → ketosis



Glucose Target 126-180 mg/dl

Glucose Target 90-126 mg/dl

- High Intensity Exercise → incr oxidative capacity of skeletal muscle → sparing glycogen →
- decr risk of hypoglycemia

Riddell et al, Lancet Diabetes Endocrinol, 2017

PREVENTION ON HYPOGLYCEMIA

Risk of Hypoglycemia
for at least 24 hours after exercise
Nocturnal hypoglycemia if exercise in afternoon

Starting glycaemia below target (<5 mmol/L; <90 mg/dL)
- Ingest 10–20 g of glucose before starting exercise.
- Delay exercise until blood glucose is more than 5 mmol/L (>90 mg/dL) and monitor closely for hypoglycaemia.

Starting glycaemia near target (5–6·9 mmol/L; 90–124 mg/dL)
- Ingest 10 g of glucose before starting aerobic exercise.
- Anaerobic exercise and high intensity interval training sessions can be started.

Starting glycaemia slightly above target (10·1–15·0 mmol/L; 182–270 mg/dL)
- Aerobic exercise can be started.
- Anaerobic exercise can be started, but glucose concentrations could rise.

Recent Severe Hypoglycemia
< 50 mg/dl or requiring assistance
→ incr risk of more serious hypoglycemia

- Reducing meal bolus by 30-50% up to 90 min before exercise
- Major nutrients required for fuel performance: carbs and lipids
- During sports – 30-60 grams CHO/hour for aerobic high intensity exercise
- CHO replacement after anaerobic exercise

MORE ON HYPOGLYCEMIA PREVENTION

	Meal before exercise		Meal after exercise
	Activities lasting 30-45 minutes	Activities lasting >45 minutes	
Continuous, moderate to vigorous intensity aerobic activities (eg, jogging/running, moderate intensity swimming, bicycling, cross country, aerobic play)	25%-50% bolus reduction	50%-75% bolus reduction	Up to 50% bolus reduction
Mixed aerobic and anaerobic burst activities (eg, hopping, skipping, dance, gymnastics, tag, dodgeball, field and team sports, individual racquet sports, etc.)	~25% bolus reduction	~50% bolus reduction	Up to 50% bolus reduction

HEALTHY EXERCISE TIPS

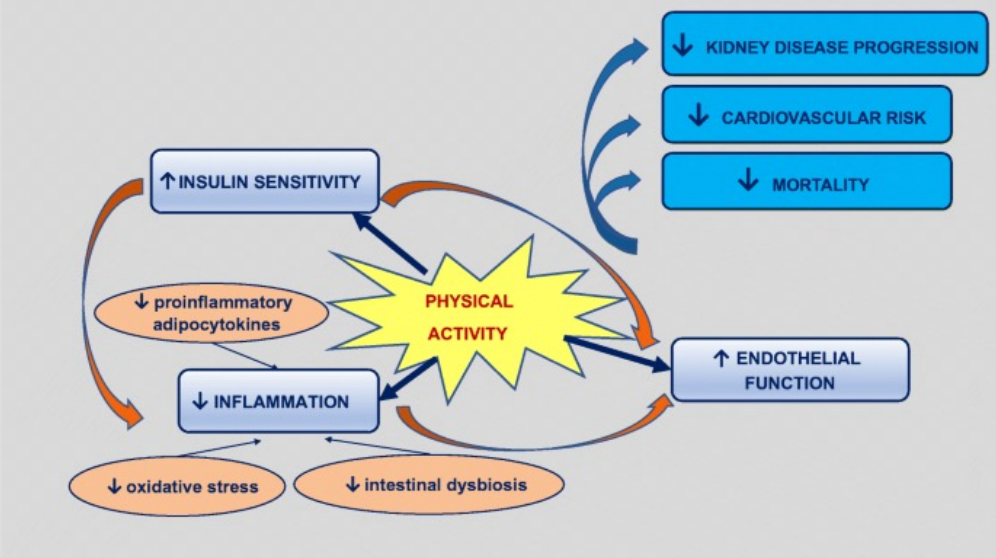
For insulin and meds with hypoglycemia potential:
Post-exercise Hypoglycemia prevention 1-1.5 gCHO/kg within 30 min after exercise, then at 2 hr intervals for up to 6 hours
20-30 grams of protein in addition to carbs – helps to restore muscle protein but not to restore glycogen

Caffeine intake (5-6 mg/kg) before exercise reduces risk of hypoglycemia during exercise but may increase risk of late onset of hypoglycemia *(Zaharieva et al, Diab Med 2016)*

- Do not inject insulin at the site that will be heavier involved in muscular activity
- Increase in insulin sensitivity up to 24-48 hrs after exercise
- **Strategies for prevention:** meal dose reduction of ~ 50% after exercise, snack with low glycemic index at bedtime, 20% basal rate reduction for up to 6 hours at bedtime *(Campbell et al, Diab Care 2014)*, or 20% basal insulin dose reduction (for MDIs) on exercise day + free carb snack 0.4 g/kg (Campbell et all, BMJ Open Diab Res Care, 2015)
- Alcohol increases the risk of late hypoglycemia
- Use of CGM, suspend on low, suspend before low, PLGS (predictive low glucose suspend)

ADDITIONAL EXERCISE POINTS

- Time of exercise - Day versus Evening – no significant difference on glucose control
- For low intensity exercise - 15-20 g/hr for hypoglycemia prevention during exercise if > 30 min and on insulin. Water is the most effective fluid for hydration
- High intensity exercise - Up to 75 g/hr for activities longer than 2.5 hours. Fluids with 6-8% carbs and electrolytes, milk-based drinks provide carbs and protein



USEFUL RESOURCES

- **Free Online YouTube Channels with workouts ranging from 5 to 90 minutes:**
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- **Fitness Blender -** https://www.youtube.com/user/FitnessBlender
  - >500 at home workouts (HIIT, strength, pilates, stretching, etc.)
  - Bodyweight (no equipment) workouts
  - Low impact modifications
  - Modifications for small workout space
  - Heavily discounted workout plans during the pandemic if you don't want to think about what you should do each day
    - https://www.fitnessblender.com/workouts-programs

USEFUL RESOURCES

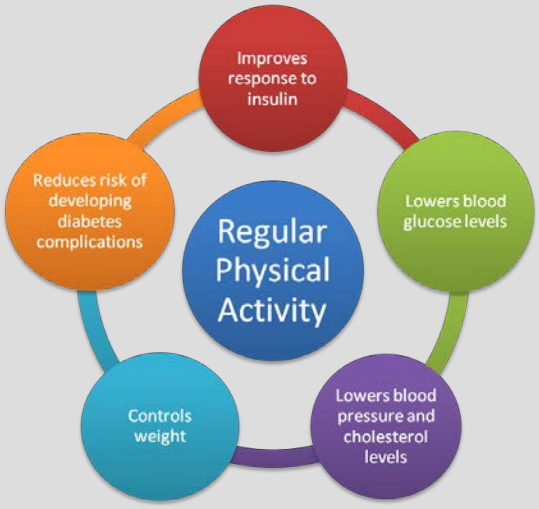
- **BodyProject**
  - Activities for everyone
  - High energy, motivating workouts to do from home
  - HIIT cardio, resistance training, pilates, and yoga
  - Can create a free account for other videos not on YouTube
  - https://www.youtube.com/channel/UCFjc9H89-RpWuIStDqhO7AQ/featured
- **PopSugar Fitness**
  - Hundreds of free workout videos
  - Dance routines, beginner exercises, full-body routines, no equipment
- https://www.youtube.com/user/popsugartvfit

USEFUL RESOURCES

- **ToneitUp App**
  - Free app, no credit card needed
  - No account needed to start
  - Programs with or without equipment
  - All programs run by women
- **7 Minute Workout App**
  - Especially helpful for people that "just don't have time"
  - Don't even need to create an account
  - You can even make your own custom workout

Creative at Home Lifting Using:

- Water bottles
- Text books
- Luggage
- Furniture
- Fill backpack up with water bottles
- Soup cans for dumb bells



"Welcome to the Diabetic Hotline! If you need a new excuse for cheating on your diet, press 1. If you need a new excuse for skipping your workout, press 2..."

THANK YOU!
QUESTIONS