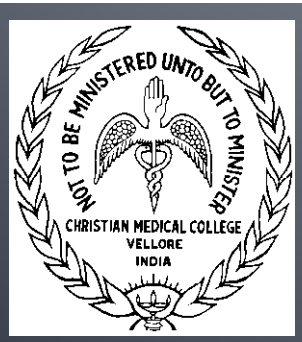
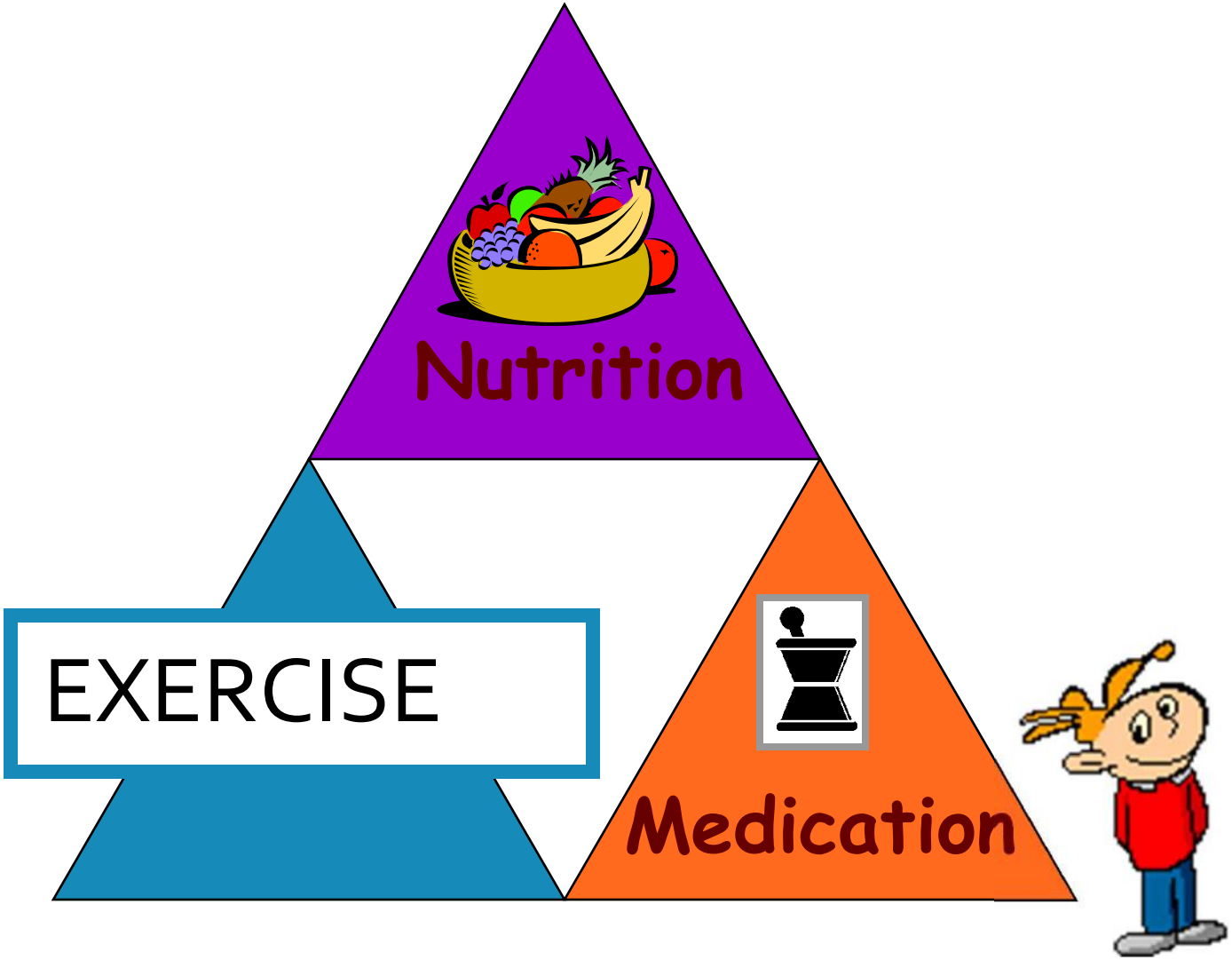
DIABETES & EXERCISE



Physiotherapist
Department of PMR,
CMC, Vellore

DIABETES "TRIAD"



"Exercise is the best insulin sensitizer on the market; better than any medication we currently have available"

Bartol

Physiology:

During the first few minutes of exercise:

Glycogen in the muscles is broken down anaerobically

Physiology:

After 5-10 minutes of activity:
Muscle glycogen breakdown decreases. Glucose broken down in the liver is released into the blood stream and is taken up by the muscles as fuel. This glucose becomes the major source of fuel (hepatic glycogenolysis).

Physiology:

At 20 minutes or more:

The muscles' glycogen stores are now depleted. Blood glucose is now maintained by hepatic glycogenolysis and triglycerides that are broken down from adipose tissue. As exercise continues fat breaks down to free fatty acids (FFA) and is used as a source of fuel for the muscles, through the process of hepatic gluconeogenesis rather than hepatic glycogenolysis.

Physiology:

Longer duration of exercise:

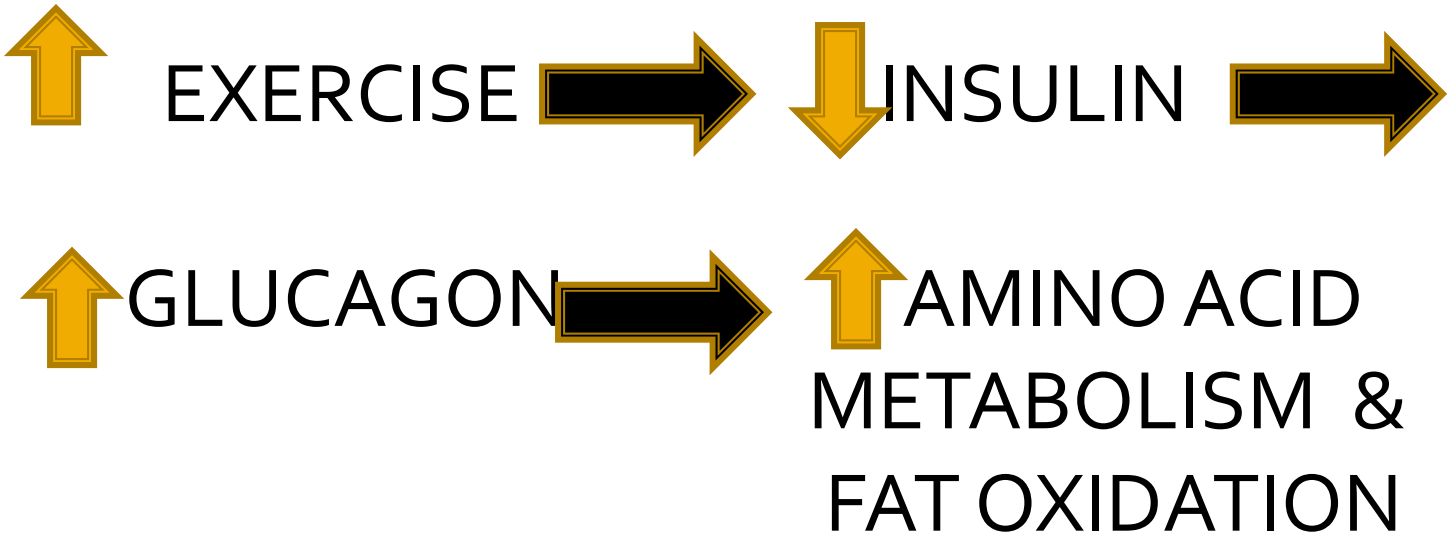
- Should low-to-moderately intensive exercise continue for a long period of time, the muscles will continue to use the glucose derived from hepatic gluconeogenesis.
- FFA cannot completely replace the use of glucose and if carbohydrates are limited, then ketone bodies may form.
- Increase the risk of DKA in a person who is insulin deficient; such as Type I with elevated blood glucose.
- If carbohydrate is consumed during exercise, the decrease in blood glucose can be delayed and the exercise can be sustained for a longer period. This is often done by people with diabetes who are marathon runners or engage in moderate to intensive exercise for long periods of time.

PHYSIOLOGY

SHIFT IN FUEL USAGE

N E F A 'S
Muscle Glycogen

REGULATION OF FUEL



INTENSE AEROBIC EXERCISES

NOREPINEPHRINE & EPINEPHRINE LEVELS

15 FOLD PRODUCTION

GLUCOSE

RISES 7 FOLD

Role of Physical Activity

- Improves overall blood glucose control and HBA1c levels in type 2 diabetes.
- Improves insulin sensitivity and lowered insulin requirements often leading to a reduced dosage of insulin and or oral hypoglycaemic agents especially in people with Type 2 diabetes.
- Attainment and maintenance of ideal body weight.
- Reduction of coronary risk factors
- Favorable changes in body composition (decreased body fat and weight, increase in muscle mass).
- Lowers cardiovascular and overall mortality.

Effects of Exercises

- In the acute phase, exercise results in translocation of glucose transporters to the plasma membrane and increased glucose uptake
- With prolonged exercise there is up regulation of glucose transporter numbers, changes in capillary density which overall causes an improvement in insulin sensitivity.

Clinical Implications

- Even short-term (2-week), regular aerobic exercise in type 2 diabetic patients results in significant improvement in both aerobic capacity and whole-body insulin sensitivity.
- Long-term endurance training in diabetic patients markedly improves whole-body insulin sensitivity and the expression of key muscle enzymes regulated by insulin. However, the maintenance of this effect seems to require dedication to a regular and uninterrupted exercise regimen.

Clinical Implications

- Intramyocellular lipid accumulation, which is associated with insulin resistance in muscle, can be acutely decreased by even a single bout of sustained endurance exercise.
- Exercise is beneficial for both glucose uptake mechanisms and the anti-lipolytic effects of insulin.

Potential adverse effect of exercise

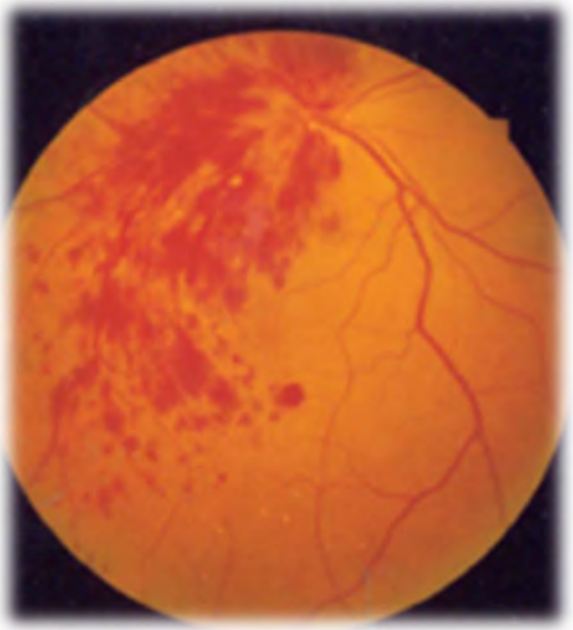
- Cardiovascular
- Microvascular
- Metabolic
- Musculoskeletal and traumatic

Cardiovascular

- Cardiac Dysfunction and Arrythmias due to silent IHD
- Excessive increments in Blood pressure
- Post Exercise Orthostatic hypotension

Microvascular

- Retinal Haemorrhage
- Increased proteinuria
- Acceleration of other microvascular lesions



Metabolic

- Worsening of Hyperglycemia and ketosis
- Hypoglycemia

Musculoskeletal and traumatic

- Foot ulcers
- Accelerated degeneration of joints

EVALUATION OF A PATIENT BEFORE EXERCISES

EVALUATION…

- Exercise ECG
- Borg's Rate of Perceived Exertion
- Karvonyn's Formula

Karvonyn's Formula

$$MHR = 220\text{-}AGE$$

$$HRR = MHR\text{-}RHR$$

$$EHR = \frac{50\text{-}60}{100} \times HRR + RHR$$

Preparing For Exercise

- Proper warm-up consisting of 5–10 min of aerobic activity
- Activity session 15- 30 mins
- cool-down should be structured similarly to the warm-up and should last about 5–10 min

Types of Physical Activity

The Mnemonic: **"SAFE"** exercises are recommended:

- **S**trengthening exercises
- **A**erobic exercises
- **F**lexibility exercises
- **E**ndurance exercises

Aerobic exercise

- With Oxygen
- Aerobic exercise is the type that moves large muscle groups and causes you to breathe more deeply and your heart to work harder to pump blood. It's also called cardiovascular exercise. It improves the health of your heart and lungs.

Anaerobic (Resistance) Exercise

- Anaerobic exercise uses large muscles that do not require oxygen for short periods of exercise. It helps build strong muscles; lowers blood glucose makes the action of insulin more effective.

Flexibility (Stretching) Exercise

- Flexibility exercises are aimed at increasing or maintaining range of motion at joints, also improve tone in muscles and keep it supple. They develop better muscular and body control.

Endurance Exercises

- Low Resistance, High Repetition Exercises
- Examples:
  Walking, cycling, swimming, or upper extremity ergometry that involve the use of the large muscle of the body.

How much exercise?

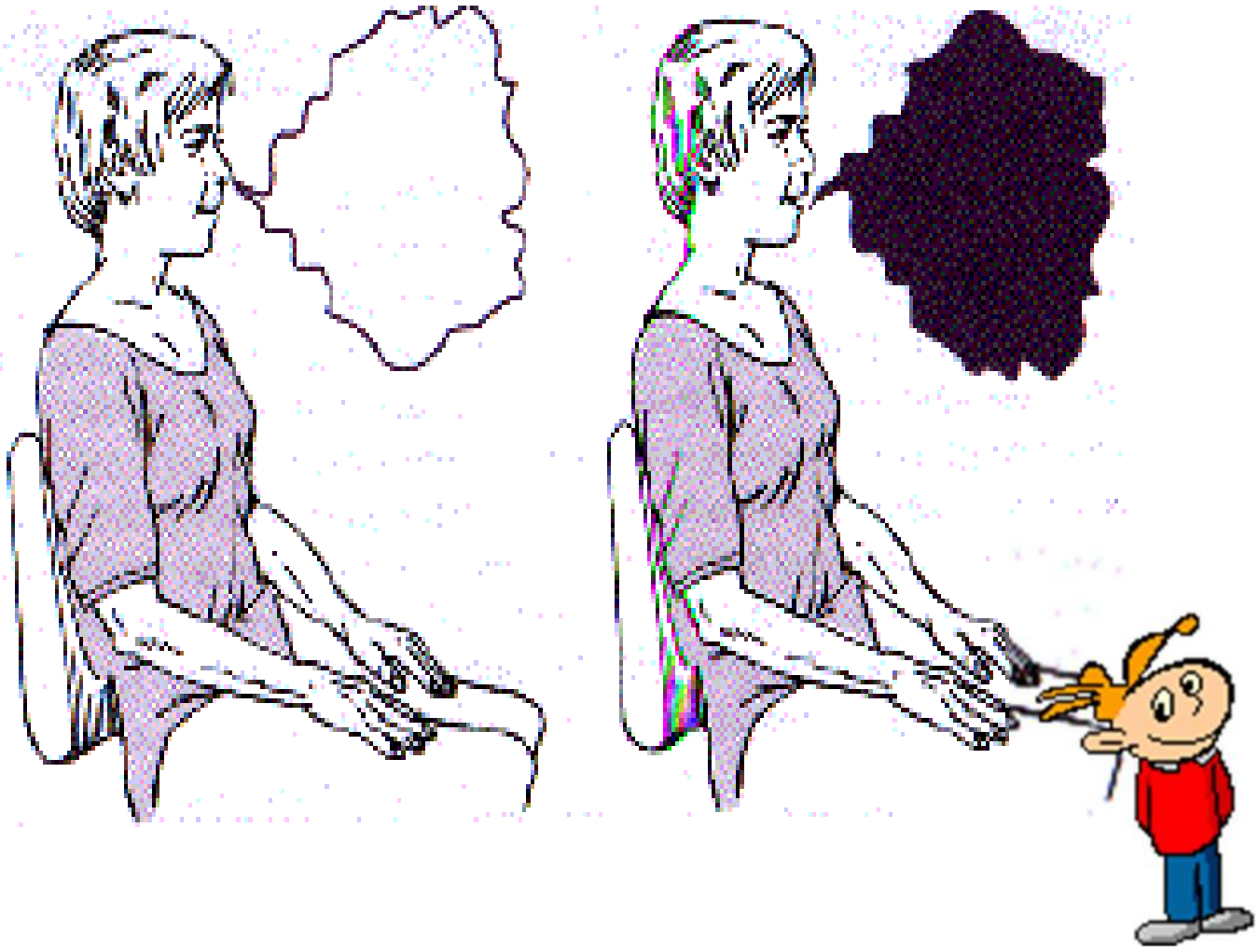
Exercises should be done according to FITT principle.

- **FREQUENCY:** Exercising 4 to 6 times a week.
- **INTENSITY:** 30-40 min of exercise at 50- 60 % of target heart rate.
- **TYPE:** SAFE exercises are recommended.
- **TIME:** Morning is ideal

A SAMPLE WALKING PROGRAM				
	Warm Up	Target Zone Exercising *	Cool Down Time	Total
Week 1				
Session A	Walk normally 5 min.	Then walk briskly 5 min.	Then walk normally 5 min.	15 min.
Session B	--Repeat above pattern--			
Session C	--Repeat above pattern--			
Continue with at least three exercise sessions during each week of the program. If you find a particular week's pattern tiring, repeat it before going on to the next pattern. You do not have to complete the walking program in 12 weeks.				
Week 2	Walk 5 min.	Walk briskly 7 min.	Walk 5 min.	17 min.
Week 3	Walk 5 min.	Walk briskly 9 min.	Walk 5 min.	19 min.
Week 4	Walk 5 min.	Walk briskly 11 min.	Walk 5 min.	21 min.
Week 5	Walk 5 min.	Walk briskly 13 min.	Walk 5 min.	23 min.
Week 6	Walk 5 min.	Walk briskly 15 min.	Walk 5 min.	25 min.
Week 7	Walk 5 min.	Walk briskly 18 min.	Walk 5 min.	28 min.
Week 8	Walk 5 min.	Walk briskly 20 min.	Walk 5 min.	30 min.
Week 9	Walk 5 min.	Walk briskly 23 min.	Walk 5 min.	33 min.
Week 10	Walk 5 min.	Walk briskly 26 min.	Walk 5 min.	36 min.
Week 11	Walk 5 min.	Walk briskly 28 min.	Walk 5 min.	38 min.
Week 12	Walk 5 min.	Walk briskly 30 min.	Walk 5 min.	40 min.

Week 13 and thereafter:
Check your pulse periodically to see if you are exercising within your target zone. As you get more in shape, try exercising within the upper range of your target zone. Gradually increase your brisk walking time to 30 to 60 minutes, three or four times a week.

Breathing Exercises



Neck Exercises

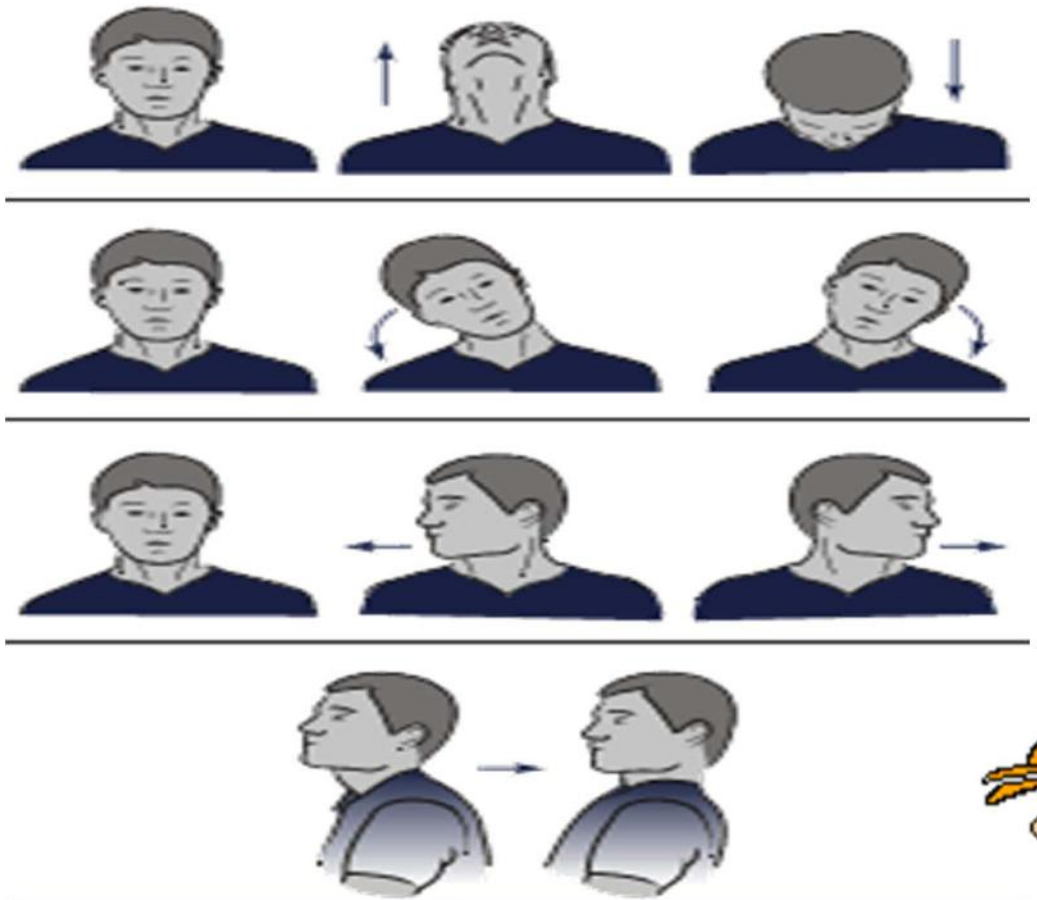
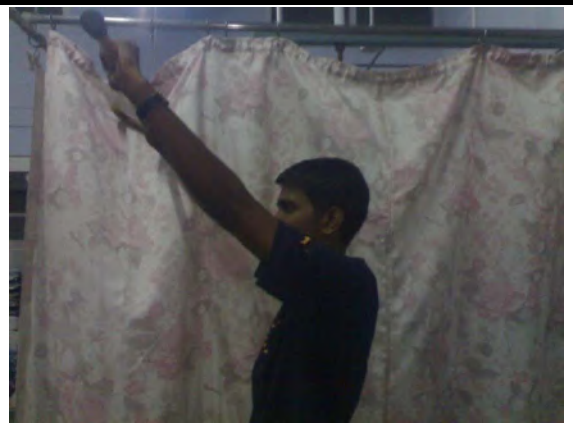


Figure 4. Stretching and strengthening exercises for the neck

Hand Exercises



Trunk Exercises

Trunk Exercises.....

Leg Exercises

Peripheral and autonomic neuropathy

Recommended

- non-weight-bearing activities
- swimming
- bicycling
- chair and arm exercises

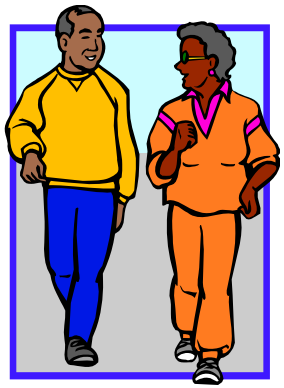
Contraindicated

- treadmill
- prolonged walking
- jogging
- step exercises

Nephropathy

Recommended

- Low to moderate intensity forms of exercise



Contraindicated

- High intensity forms of exercise

Diabetic retinopathy

Recommended

- Low-impact cardiovascular conditioning, such as swimming, walking, low-impact aerobics, stationary cycling, endurance exercises

Contraindicated

- Strenuous activities, pounding or jarring, such as weight lifting, jogging, high-impact aerobics, racquet sports.

Hypoglycemia Management

- The person should be instructed to stop exercising. People at risk for hypoglycaemia should always carry a source of glucose with them such as glucose tablets, candy or juice in order to treat hypoglycaemia.

Remember it is a medical emergency

Snacking to prevent hypoglycemia

Basic Rules:

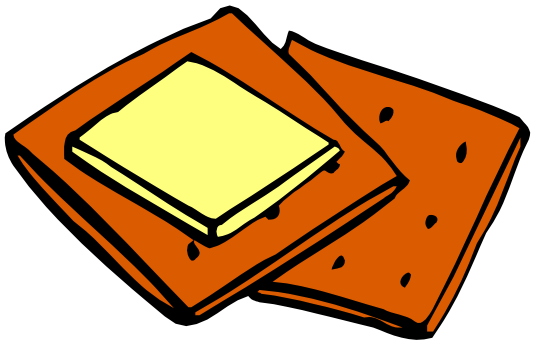
❶ **Snack *prior* to activity to *prevent* hypoglycemia**

❷ **Adjust quantity based on pre-activity BG or *direction* of BG**

- BG low or dropping: ⇧ usual carbs
- BG OK or stable: usual carbs
- BG High or rising: ⇩ usual carbs

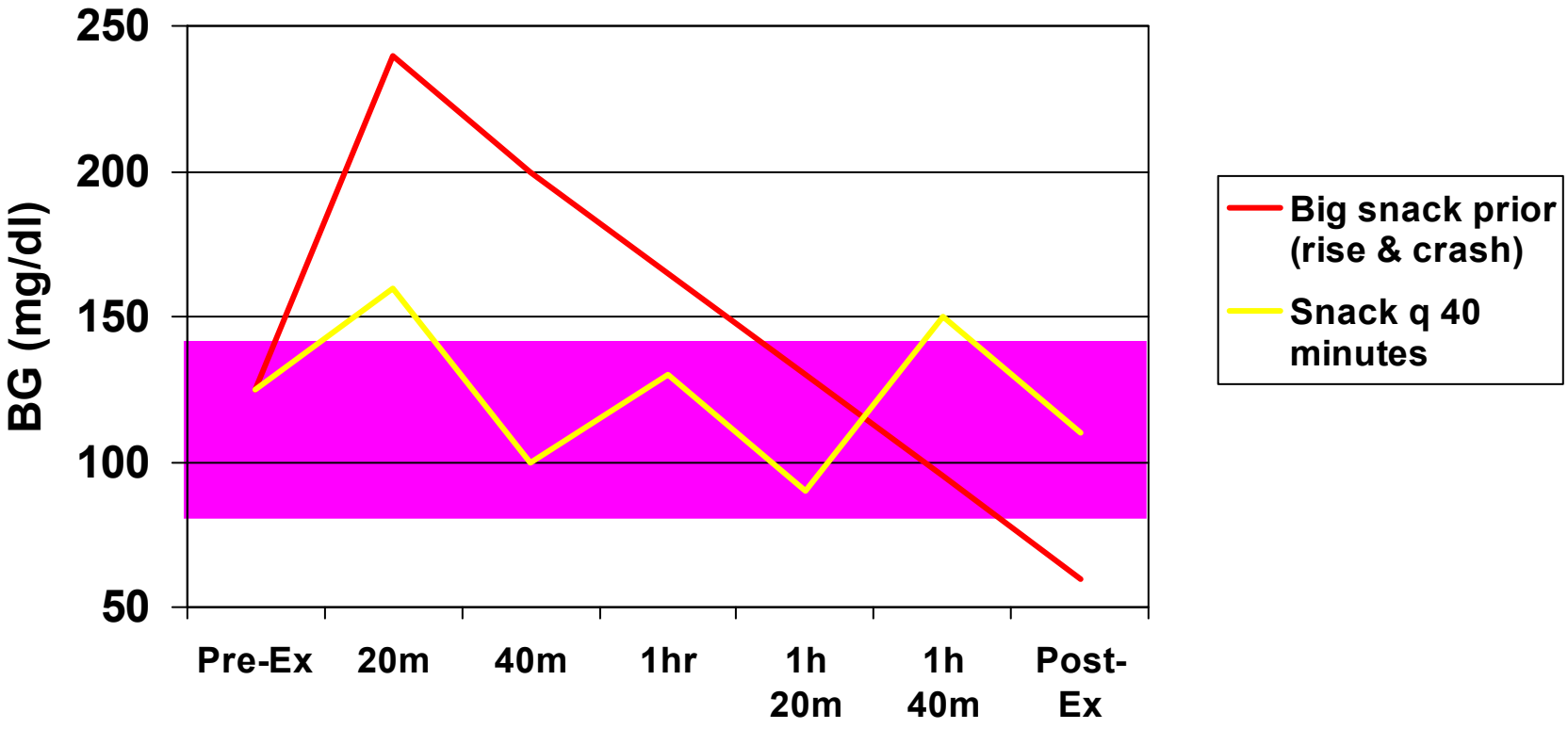
❸ **Snack at least once per hour during prolonged activity**

❹ **Choose high-glycemic forms of carbohydrate**



Source: Scheiner, Gary: Think Like A Pancreas, Marlowe Publishing, NY, 2005

Which approach keeps BG in range for the majority of the workout?



Source: Scheiner, Gary, MS CDE

Useful Tips For Exercise

- Always carry an identification card with you

- Check your feet before you walk

- Choose good footwear, light clothing

- Drink lots of water

- Don't exercise during hot seasons, and when not feeling well

Summary

- Physical activity should be encouraged in all people with diabetes
- People need to be educated about prevention and treatment of hypoglycaemia
- People should be taught to plan for periods of physical activity

Thank you