Have you had your daily dosage of activity?

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Facts

- **The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014.**
- **The global prevalence of diabetes* among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014 (1).**
- **Diabetes prevalence has been rising more rapidly in middle- and low-income countries.**
- **Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation.**

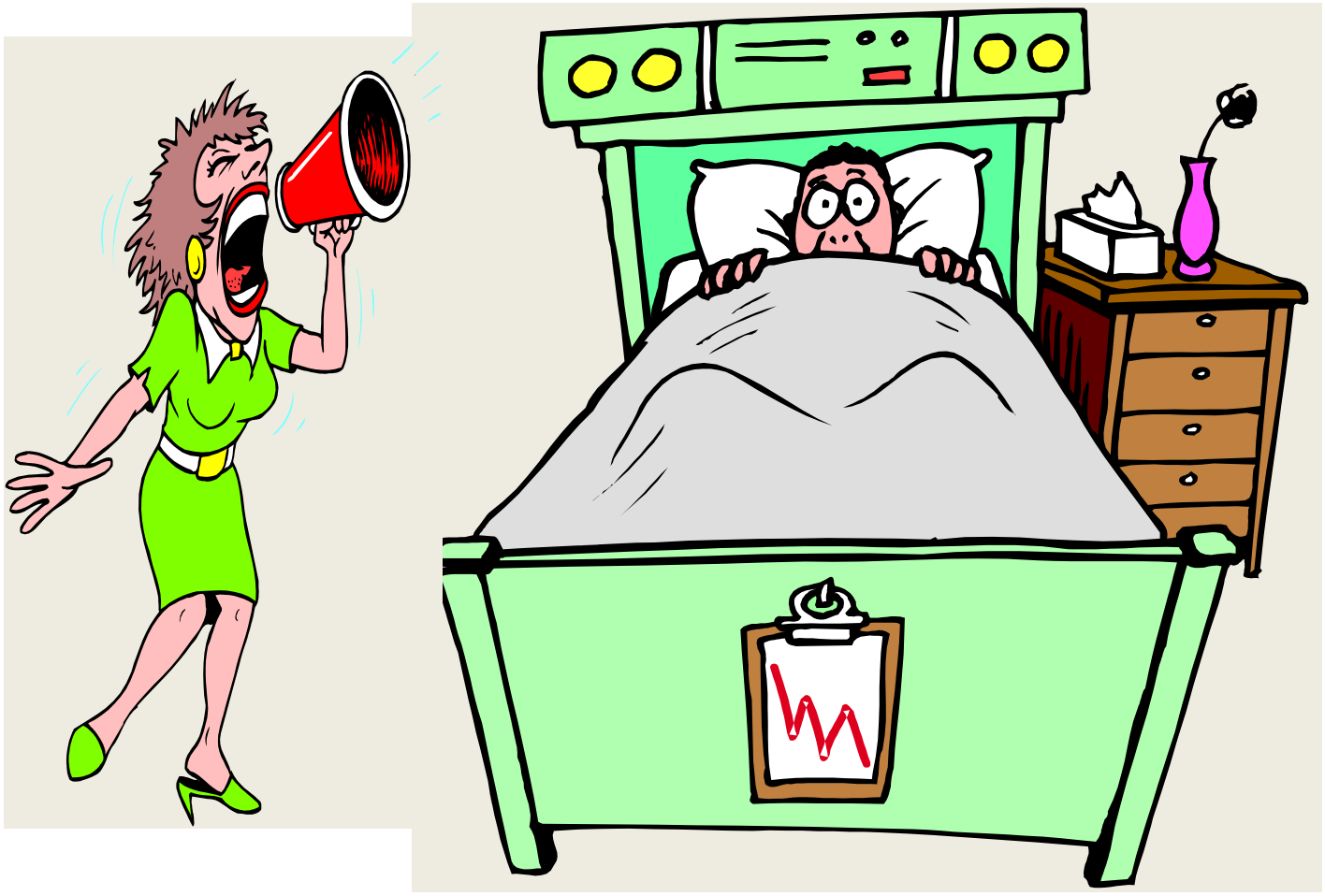
It's estimated that 2.3 million South African adults have diabetes.

Type1 DM and **Type 2 DM**

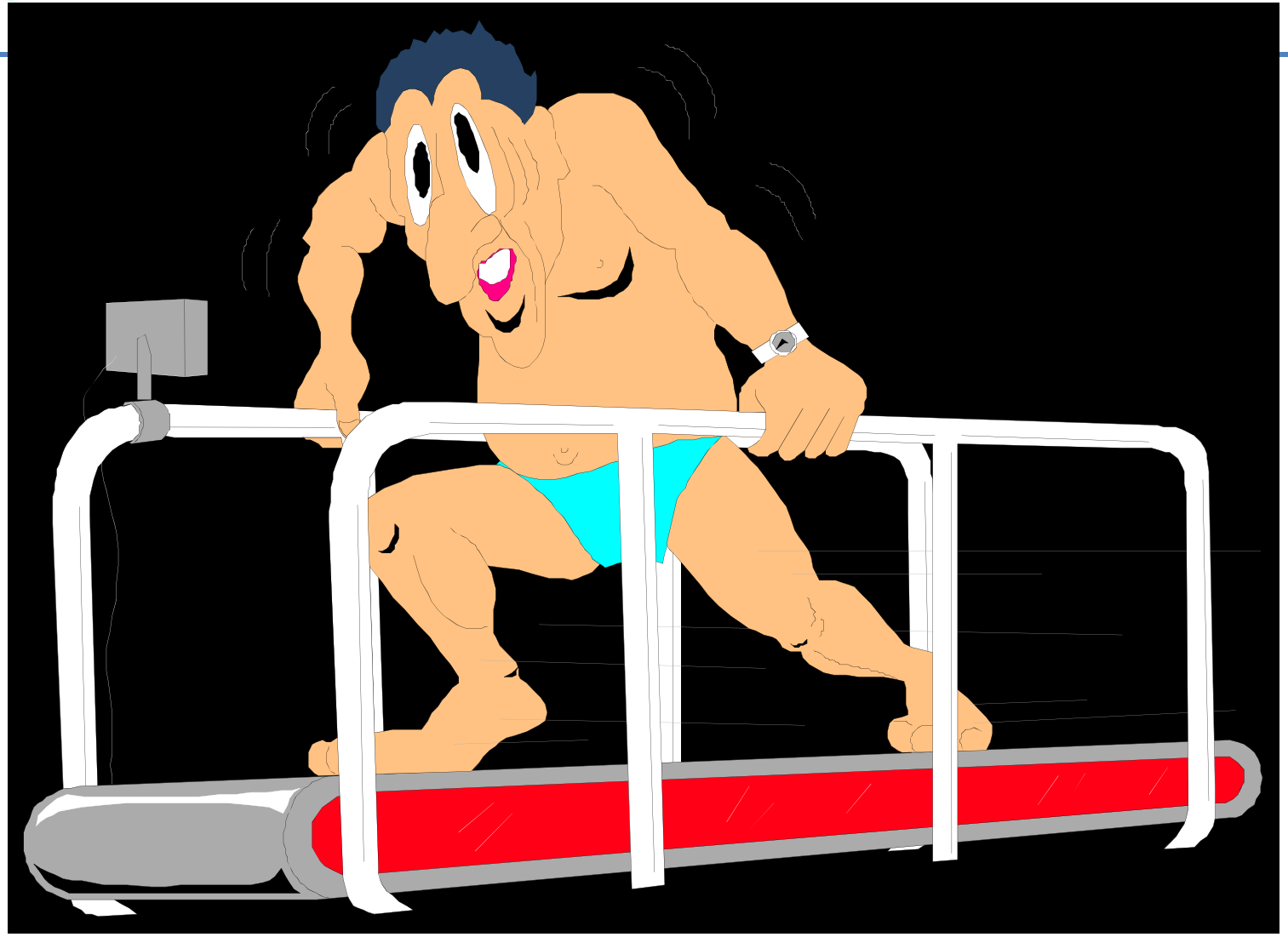
Warning signs of diabetes

Why is inactivity detrimental to ones health?

A lack of physical activity and excess abdominal fat are two of the major causes of type 2 diabetes. Most people do not get enough physical activity to improve their health and wellbeing in today's demanding times.



Don’t over exercise!!!!!



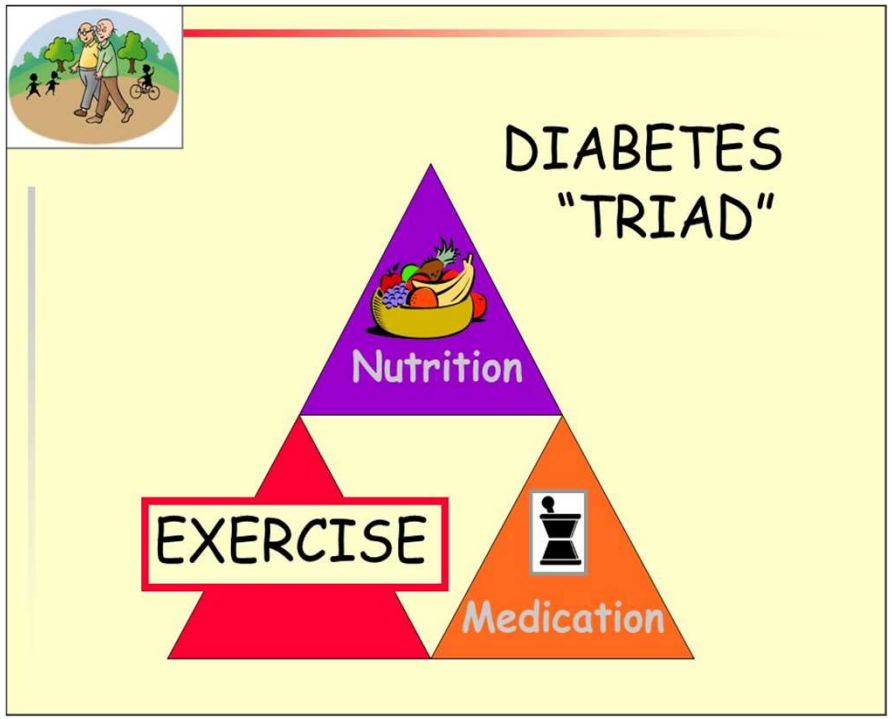
1970's

- **Drugs**
- Diet
- Exercise

1990's

- **Exercise**
- Meal Plan
- Drugs

SEMDSA & ADA Guidelines 2012 – T2DM



- **Exercise**
- **Balanced Meal Plan**
- **Metformin**

All interventions to be started <u>together</u> at diagnosis

Exercise

- Metabolic effects
- How to prescribe exercise
- What kind of exercise should be recommended for people with diabetes?

Endurance Type Activities
Metabolic effects

First ten minutes:

- muscle glycogen
- glucose

After 10 minutes

- Fat becomes the primary energy source

Resistance Training
Metabolic effects

Wanlass P . Strength and Sports nutrition for men, 2014: 12-14

- Intermittent / Interval exercise

- Blood glucose and Muscle glycogen are the primary energy sources

HbA_{1c} Results

Sigal RJ et al, 2004; Eves ND ,2006

	Baseline	6 months
Endurance	7.5 %	6.9 %
Resistance	7.8 %	7.7 %
Endurance and Resistance.	8.0 %	6.7 %
Control	7.9 %	7.7 %

- n=250

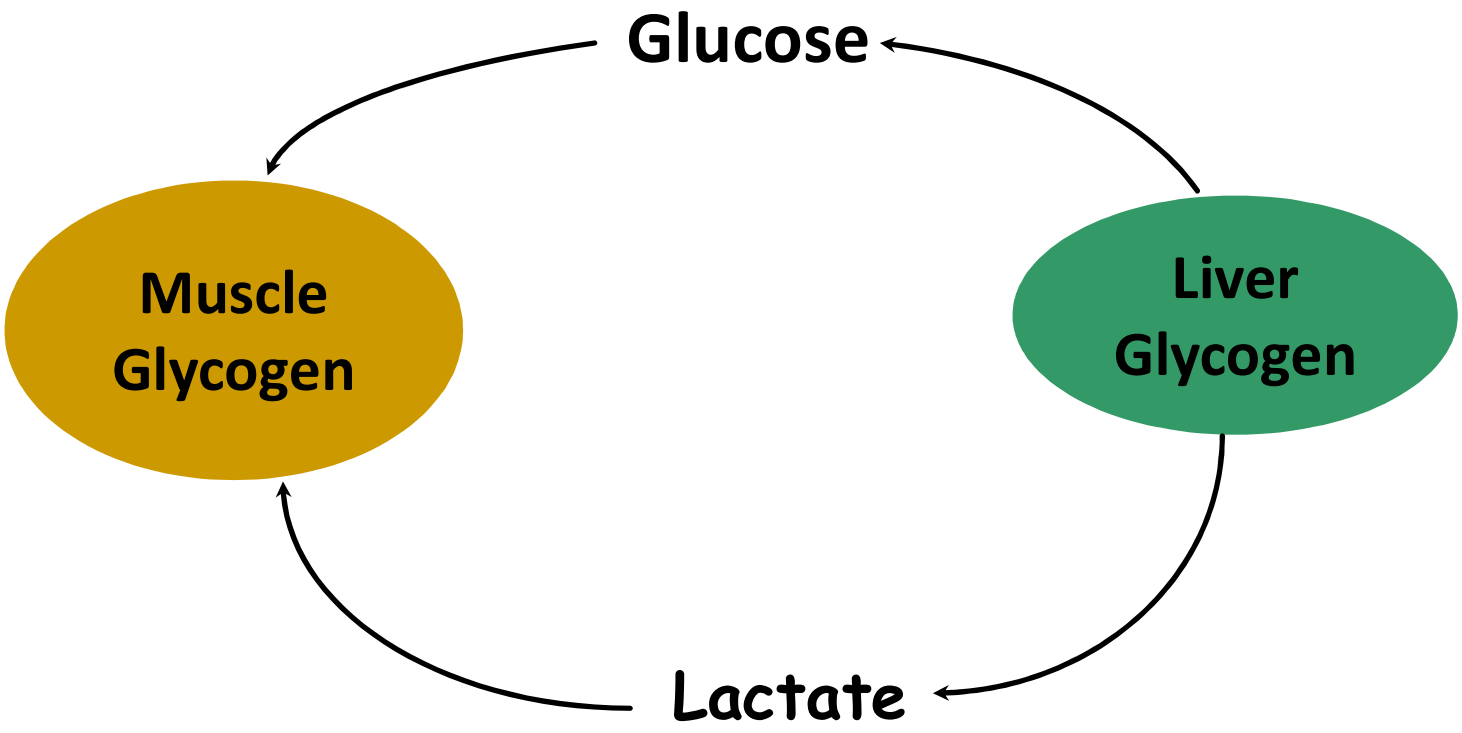
Activities of daily living

- Individuals with diabetes should be encouraged to increase the amount of activities of daily living, such as housework, gardening and walking around shopping centres and the office at regular intervals

Mechanism For Enhanced Insulin Sensitivity

- ? Increased insulin binding by muscle receptors
- ? Increased Insulin Regulating glucose transporters
- ? Increased muscle blood flow

Post Exercise



Persists for 24-48 hours

The Importance Of Exercise In Type 2 Diabetes

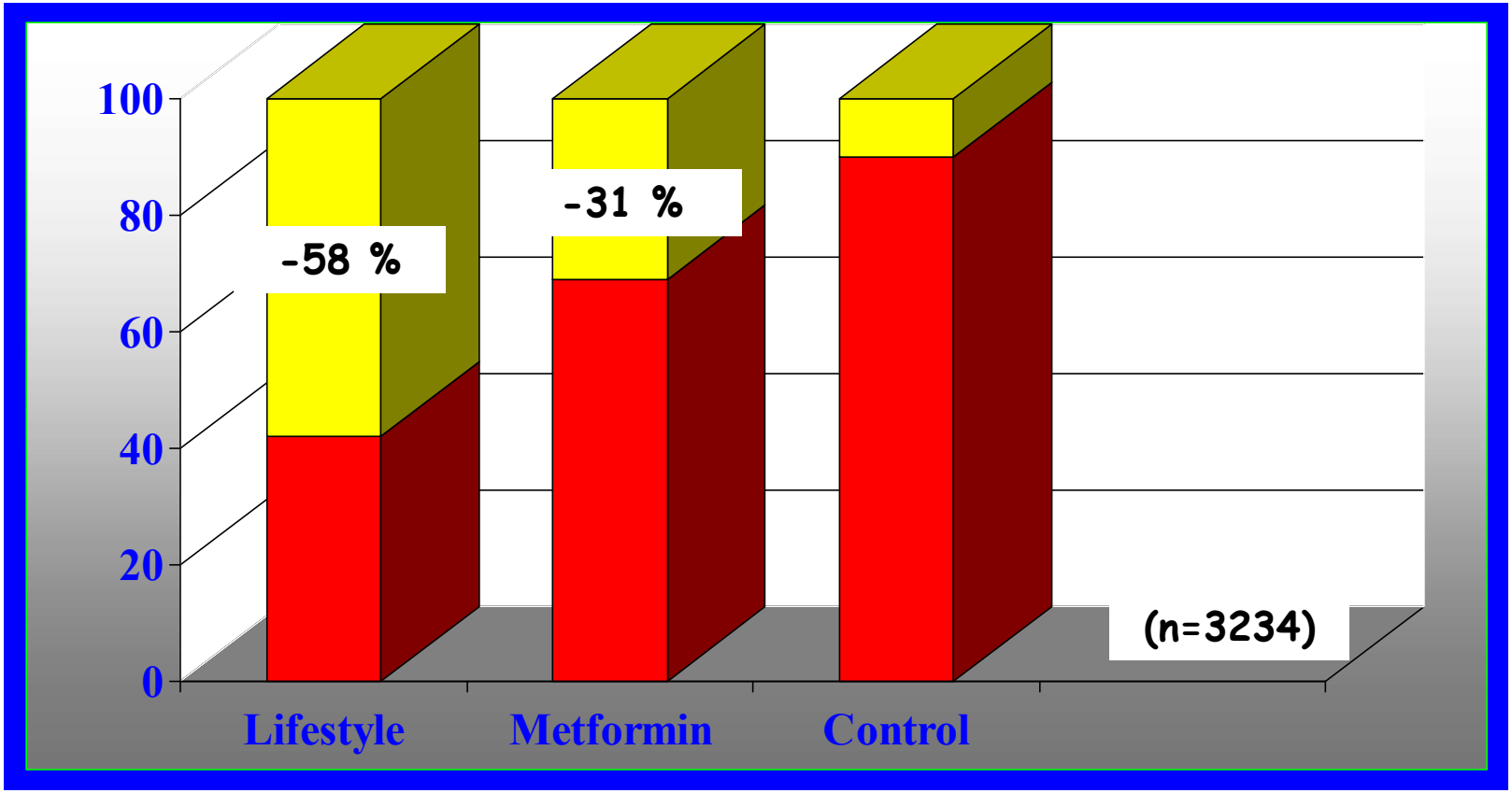
Can exercise prevent the occurrence of Type 2 diabetes?

Epidemiological studies show a decrease in the incidence of type 2 diabetes with regular exercise

Reduction in the incidence of T2DM with Lifestyle intervention or Metformin

DPP group update

Ratner R.E, 2007



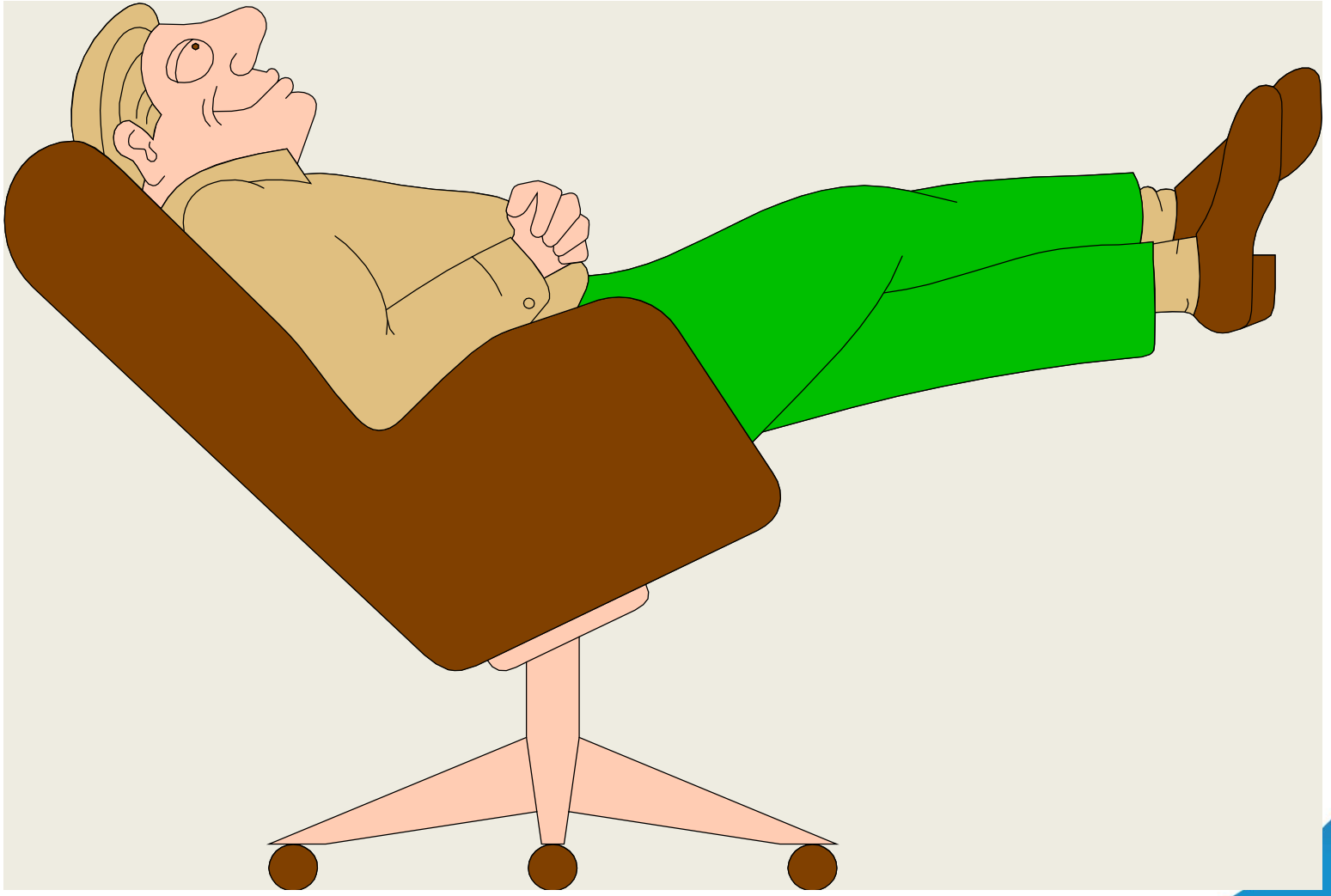
Meta analysis of 27 randomized controlled exercise training intervention studies in patients with T2DM & their effects on glycaemic control - Marwick T et al, 2009

- n = 6829
- Type 2 DM patients of different ethnicity, exercised for 3-12 months were compared
- Most studies specified = endurance or resistance training
  - 5 studies looked at a combination of endurance and resistance
- Subjects exercised 2-5 days per week for 30-60 minutes
- 88 % of the studies showed a significant improvement in glycaemic control
- 90 % of the studies revealed a significant improvement in BMI, lean mass and body fat %

Other benefits observed in these studies included

- Improved blood lipid profile
- Improved VO_2 Max
- Reduction in oxidative stress and improvement in endothelial function
- Increase in total body insulin sensitivity
- Reduction in:
  - insulin,
  - oral hypoglycaemic agents
  - blood pressure and blood lipid medications

Exercise through correspondence



Benefits of change

“He who has no time for exercise must create time for illness”

Edward Stanley, Earl of Derby

***The conduct of life*, address at Liverpool college,**

December 20 1873

Cardiovascular disease

- South Africa has one of the highest risks of coronary heart disease in the world. It is the 2nd highest cause of death in South Africa
- A South African will have a heart attack every 10 minutes
- A fatal heart attack occurs every 45 minutes
- The majority of males will have a heart attack in the prime their careers.

Norman R et al. Leading cause of death in South Africa survey 2000, revised 2016

The Potential Health Benefits Of Exercise Training

- Prevention Or Reduction Of Obesity
- Improved Blood Lipid Profile — Warburton, 2006
- Improved blood pressure — Warburton, 2006
- Psycho Social benefits — Griffiths, 2005
- Reduced Risk Of Coronary Heart Disease

Paffenbarger RS, et al; N ENGL J MED 1993; 328:538-545

Blair SN et al, *JAMA* 1996;276:205-10.

Harvard study

Ralph S. Paffenbarger, et al; N ENGL J MED 1993; 328:538-545

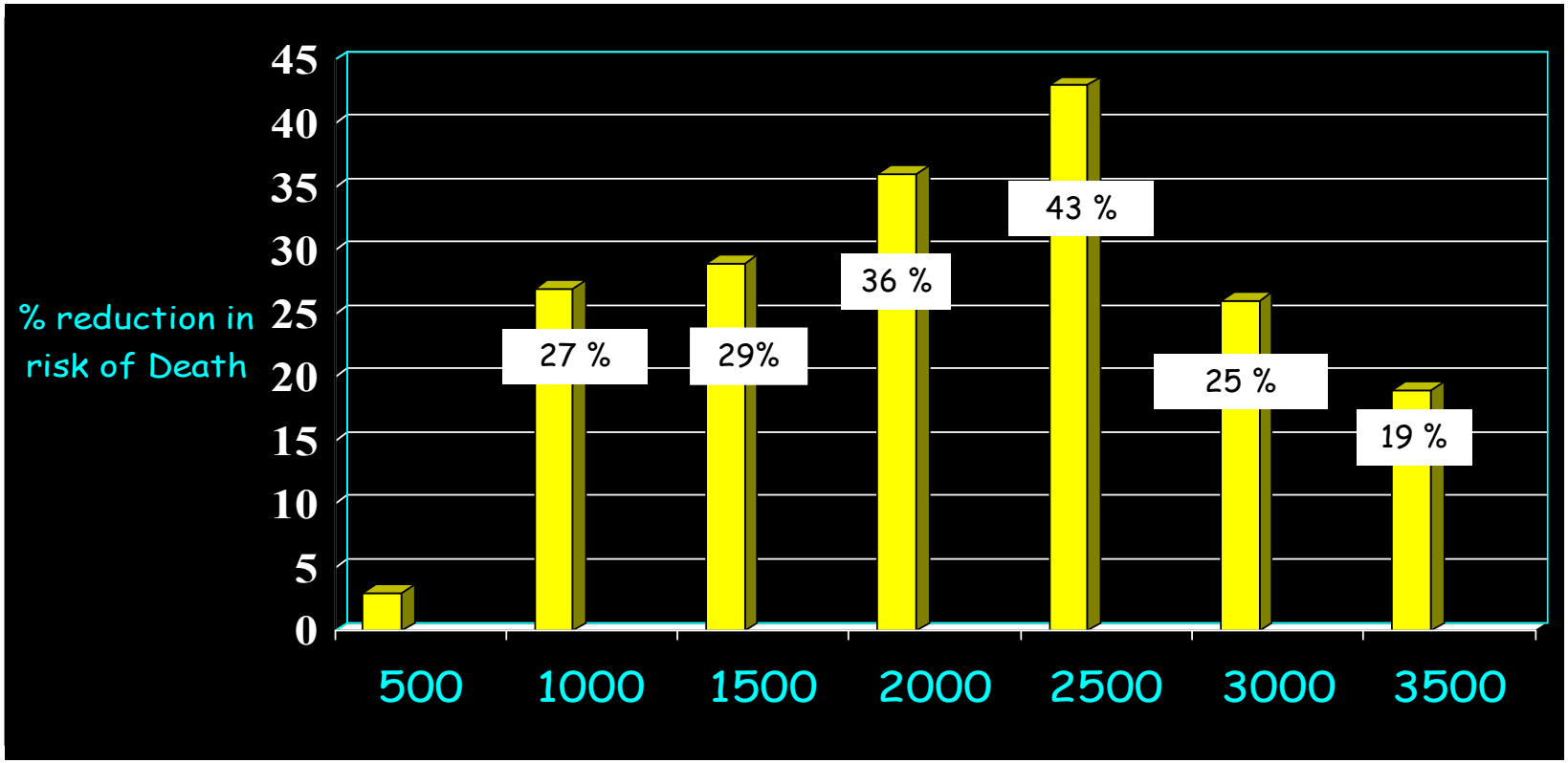
- 36 year follow-up study of more than 50,000 college alumni

- Relationship between Activity patterns and:
  - Longevity
  - CVD mortality
  - All cause mortality

Change In Physical Activity & CVD, diabetes, cancer & other life threatening diseases

"The Harvard Study"

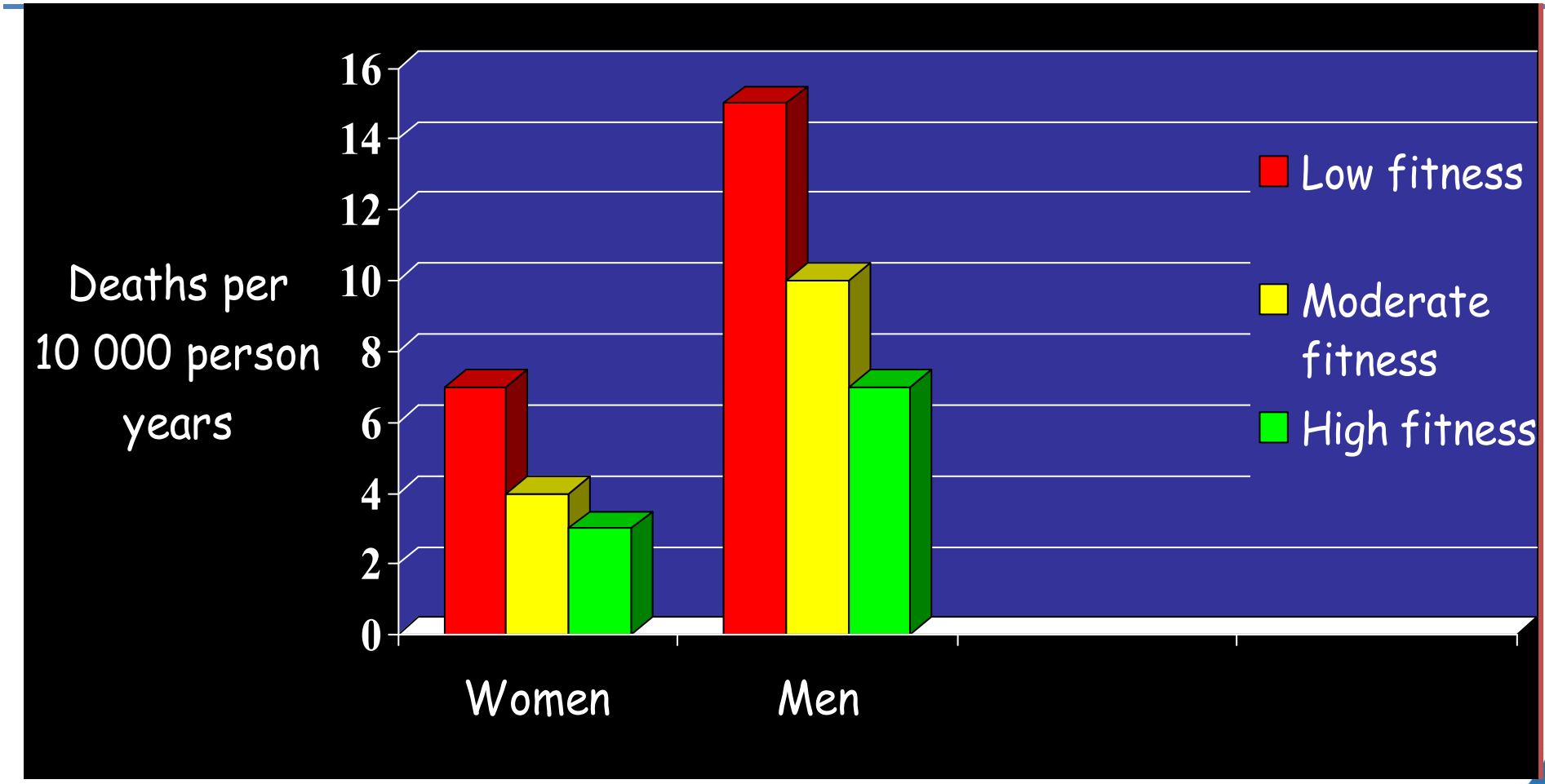
(Ralph S. Paffenbarger, et al; N ENGL J MED 1993; 328:538-545)



Energy expenditure, Kcal/week

Cardiovascular disease death rates

Blair SN et al, *JAMA* 1996;276:205-10



- The rates are adjusted for age, examination yr., smoking habit, systolic blood pressure, total cholesterol, BMI, FPG, history of CHD & health status

Which is a more important predictor of mortality?

Blair SN et al, *JAMA* 1996;276:205-10

overweight or inactivity?

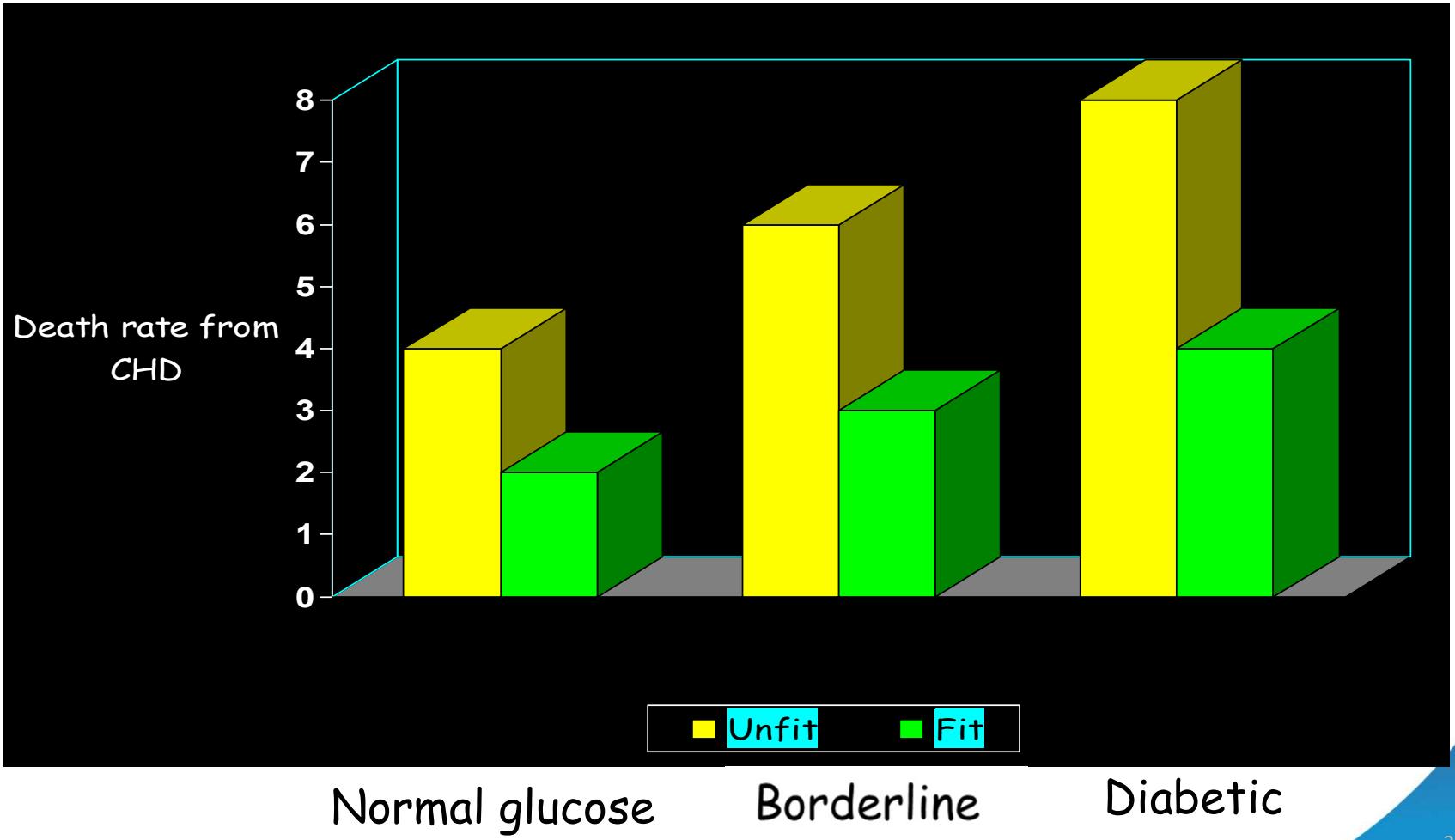
Cardiorespiratory fitness, BMI & mortality

Blair SN et al, *JAMA* 1996;276:205-10

- Obese men (BMI $\geq$ 30 kg m^{-2}) who were at least moderately fit had an age adjusted all-cause death rate of 18.0 per 10,000 man years
- Obese unfit men had a death rate of 62.1 per 10,000 man years
- In fact the obese fit man had a far lower death rate than unfit men of normal weight
- This data suggests that cardiorespiratory fitness is more important than BMI as a predictor of all-cause mortality

Death Rate From Heart Disease in the normal vs. population with type 2 diabetes

Paffenbarger R ,1993; Blair SN, 1998; Eriksson J, 1998; Ming Wei, 2001



How much exercise is necessary to bring about weight loss & physiological adaptations to decrease mortality?

- Ralph Paffenbarger (75 minutes per day)
- Steven Blair (7 days per week) at 60-85% aerobic capacity (duration 30-60 min)
- ACSM (60 minutes per day of moderate intensity physical activity - A brisk walk)
- Weight loss (more then 60 minutes daily needed)
- The Centre for Diabetes, Houghton
- Moderate activities performed throughout the day are additive…

The Importance Of Exercise In Type 1 Diabetes

How Exercise Affects Blood Glucose Control In Patients with Type I Diabetes

Blood glucose response to exercise is not always predictable

Pharmacokinetics of Insulin

Toni S et al, ACTA BIOMED 2006; 77; Suppl. 1: 34-40

How exercise affects blood glucose control in patients with Type 1 diabetes

- Sufficient insulin levels ⇨ to reduction in blood glucose levels and insulin requirements for up to 24 hours
- If exercise is performed at peak effect of insulin ⇨ hypoglycaemia may occur
- If insulin levels are low ⇨ hyperglycaemia (possibly ketoacidosis)

Factors Influencing Insulin Action

Absorption

- Blood flow differences
  - Endurance > resistance

- Muscle mass / number of muscles
  - Weight bearing / non-weight bearing

- Ambient temperature (high/low)
  - Heat ↑ stress on cardiovascular system = ↑ energy expenditure
  - Cold ↑ glucose uptake to generate heat in the muscles

Hypoglycaemia

Remi-Rabasa Lhoret, Diabetes Care,2008:vol 31(11)

1. The biggest barrier to exercise was the fear of hypoglycaemia followed by

2. Lack of understanding of insulin metabolism

   - Those individuals who best understood how insulin works in their bodies were shown to be less fearful of physical activity
   - Individuals with the greatest fear of physical activity had the poorest control of their diabetes

How Exercise Affects Blood Glucose Control In Patients with Type 1 Diabetes

Riddel, MC et al. Physical activity, sport, and paediatric diabetes. Paediatric Diabetes 2006; 7: 60–70.

Hypoglycaemia!

Research and findings:

1. Exercise performed late in the day (i.e. after school or work) may lead to hypoglycaemia which may be unnoticed during sleep in the majority of individuals;

2. 26 % incidence of hypoglycaemia in children and adolescents on exercise nights.

Strategies to prevent hypoglycaemia

Riddell MC et al. Strategies to prevent hypoglycemia Med Sci Sports Exerc 2012; 44:1427.

- Increased CHO intake prior to, or during prolonged activity…, however the amount, type and timing of carbohydrate is debatable.
- The amount of CHO intake…
  - body mass and
  - energy expenditure of the activity.
- If no adjustment in insulin is made;
  (1.*0 g CHO/kg/hr)*…

Exercise and type 1 diabetes

Adapted from Grimm et al, Diabetes Metab.2004:30:465-470

As an alternative: reduce-exercise insulin by 30-50 % if exercise is performed at the peak insulin action.

Is it that simple?

High intensity exercise

What insulin adjustment should we make:

- Squash
- kick-boxing
- body building
- soccer etc.

Currently there are no guidelines

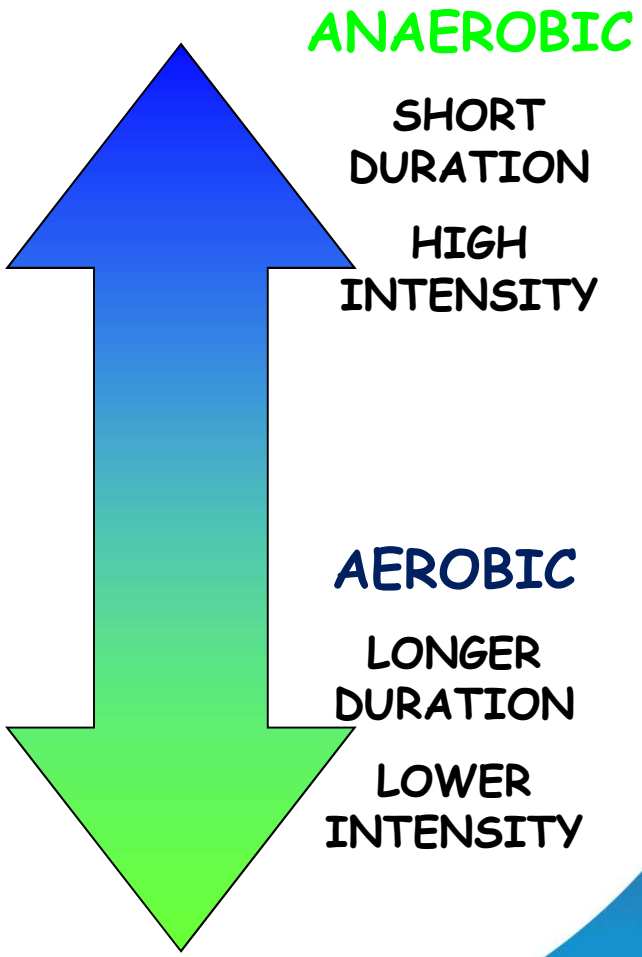
The effect of different exercises and intensities on blood glucose levels

More Hyperglycaemia

Weightlifting, Track cycling, Track (sprinting & field events), Diving (Platform and Springboard), Swimming (Sprints), Gymnastics, Fencing, Wrestling, Volleyball, Squash, Tree/ Rock Climbing

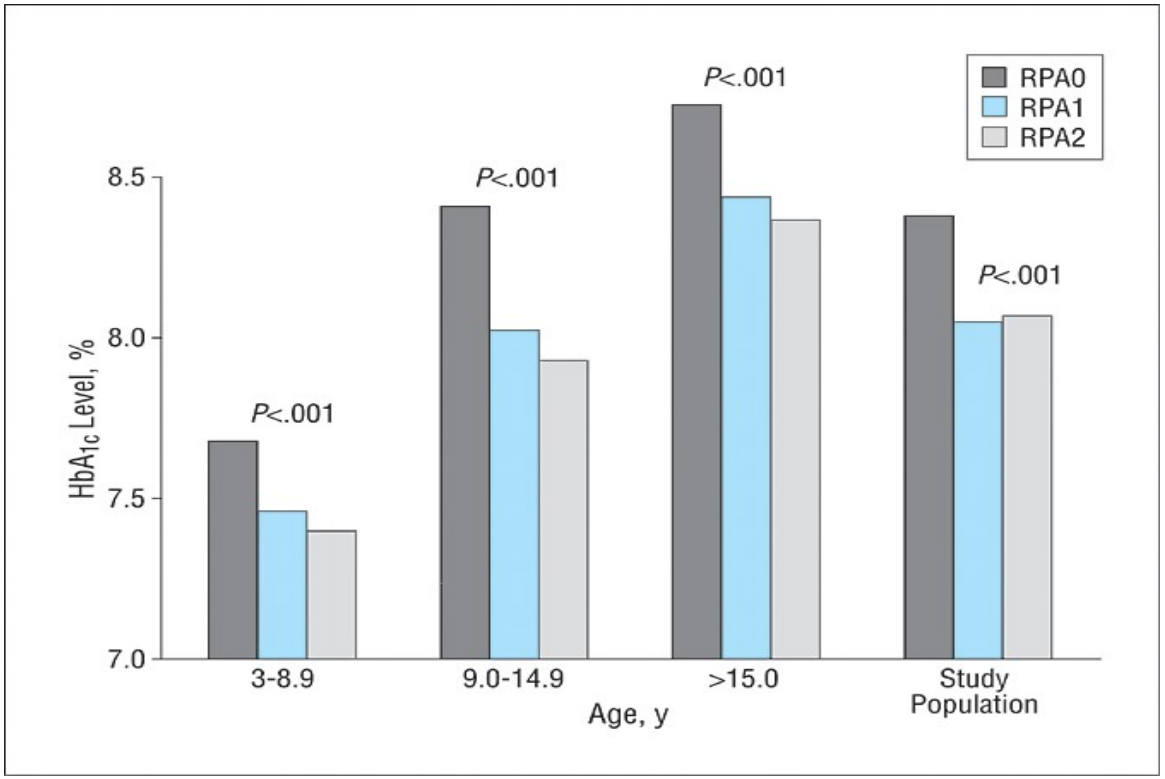
Basketball, Soccer, Racquet Sports, Skiing (slalom & downhill), Field Hockey, Jumping Rope, Rowing (Middle Distance), Martial Arts, Horseback Riding, Running (Middle Distance),

Road Cycling, Cross Country Skiing, Brisk Walking, Marathon Running, Triathlon



More Hypoglycaemia

Effect of regular Physical activity on control of glycaemia and rate of hypoglycaemia with frequency of activity in Pediatric patients with Type 1 DM



Glycated haemoglobin A1C (HbA_{1c}) level in age groups stratified by frequency of regular physical activity (RPA) per week. RPA0 indicates none; RPA1, 1 or 2 times per week; and RPA2, 3 or more times per week.

Herbst A et al, Arch Pediatr adolesc med 2006;160:573-577

Impact of Physical activity on Glycaemic Control and Prevalence of Cardiovascular Risk factors in Adults with Type 1 Diabetes

- Frequency of activity was a significant influence on glycaemic control without increasing the risk of severe hypoglycaemia. ($p < 0.0001$).
- Retinopathy and Microalbuminuria was more frequent in the inactive patients ($p < 0.0001$).
- BMI and Obesity was higher in the inactive group.
- Prevalence of hypertension was lowest in the most active group.
- Physically active patients had significantly lower serum lipid levels. ($p < 0.0001$)

($n= 18028$)

Bohn et al, Diabetes care 2015; 38:1536-1543

The Person with Type 1 Diabetes Should Pay Attention To The Following Important Factors

- The time of day that exercise is performed
- The blood glucose level prior to exercise
- The duration and intensity of exercise
- Fitness level, irrespective of Diabetes
- The type and dosage of insulin injected

Pre-Exercise Programme Evaluation

Full physical examination

Include specifically:

- Blood pressure
- Ischaemic / or other Heart Disease
- Peripheral Neuropathy
- Autonomic Neuropathy
- Peripheral Vascular disease

Pre-Exercise Programme Evaluation

- Body mass
- Waist circumference
- Body fat %

Ergological, orthopaedic evaluation

In Summary

- All people with diabetes and cardiovascular disease should exercise unless specific complications prevent this
- Patients should be fully evaluated before embarking on a programme
- A specific programme of exercise should be prescribed specifying:
  - Type … 50/50 split or 70/30 split
  - Duration… 60mins or longer
  - Intensity… Heart rate / RPE
  - Frequency…

The importance of exercise in Diabetes

- According to Dr. R. Butler in 2016, “If exercise could be packed in a pill, it would be the single most widely prescribed and beneficial medicine for the nation”

Your value driven partner in care

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