Exercise and Type 1 diabetes (EXTOD)

Rob Andrews & Parth Narendran

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EXTOD overview 1 – Support

Yearly patient conference

Yearly HCP conference

extod Buddies

DTN UK

collaborate · evolve · support

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EXTOD overview 2 – research studies

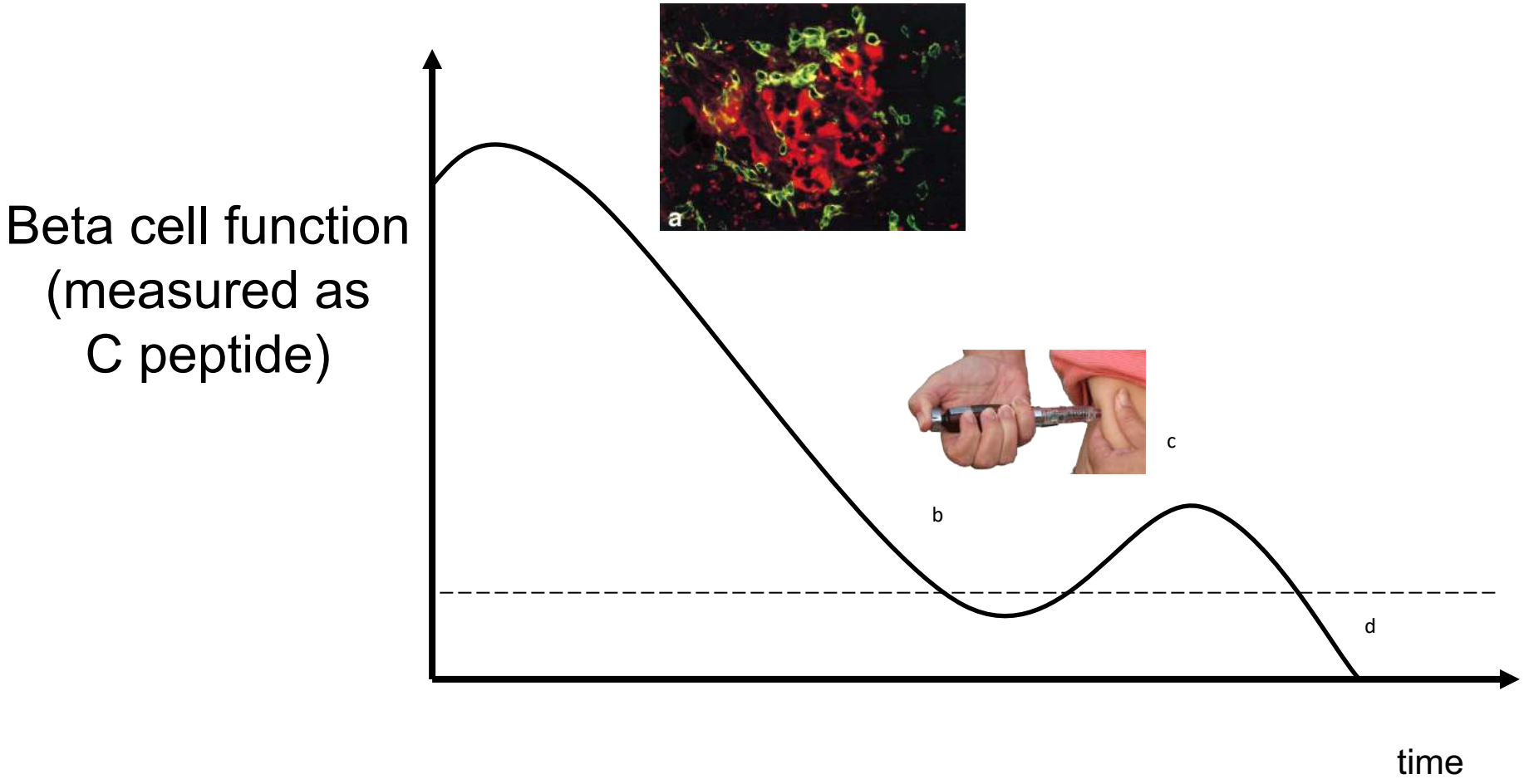
Does exercise preserve C-peptide in Type 1 diabetes?

How does exercise effect the immune process in Type 1 diabetes?

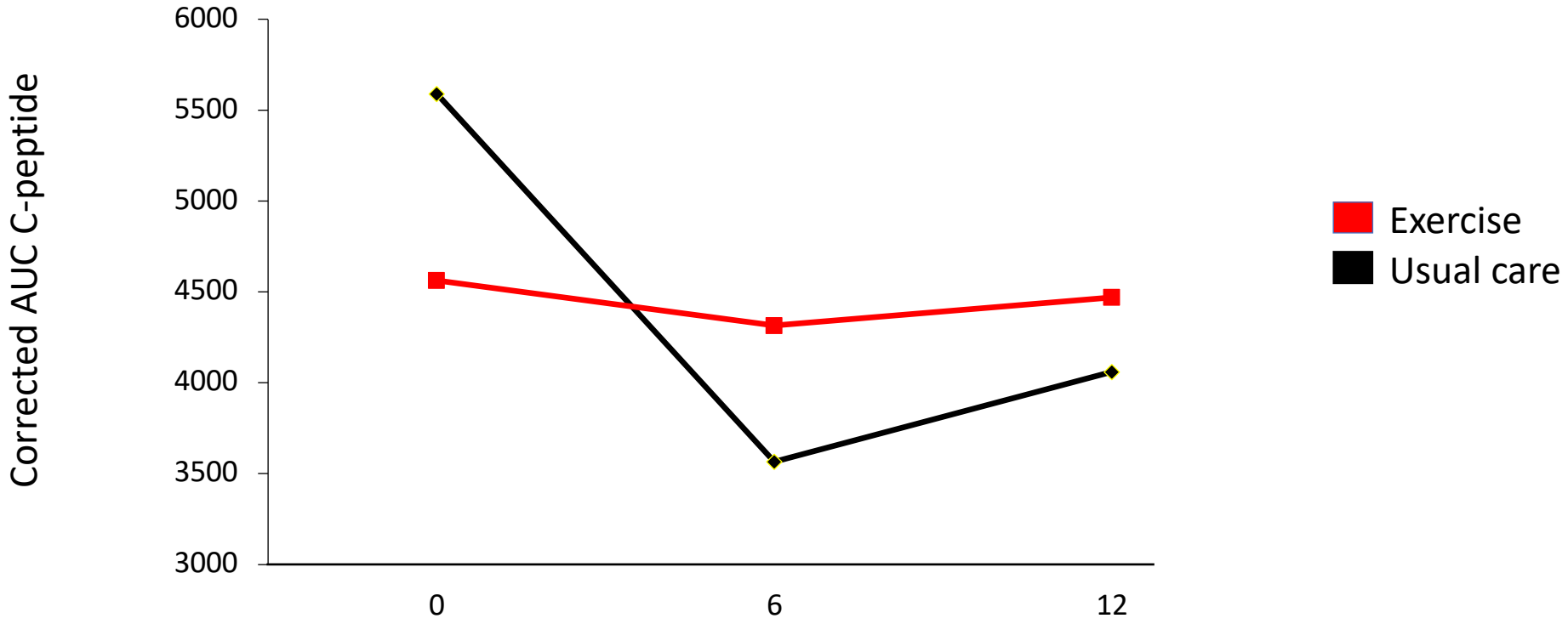
Real world study of people with Type 1 diabetes training for and running half marathon.

Development of an education programme to help people with Type 1 manage glucose around exercise.

Natural history of T1D



C-peptide corrected for Insulin sensitivity
The Disposition Index



Narendran et al, Diabetic Medicine 2017

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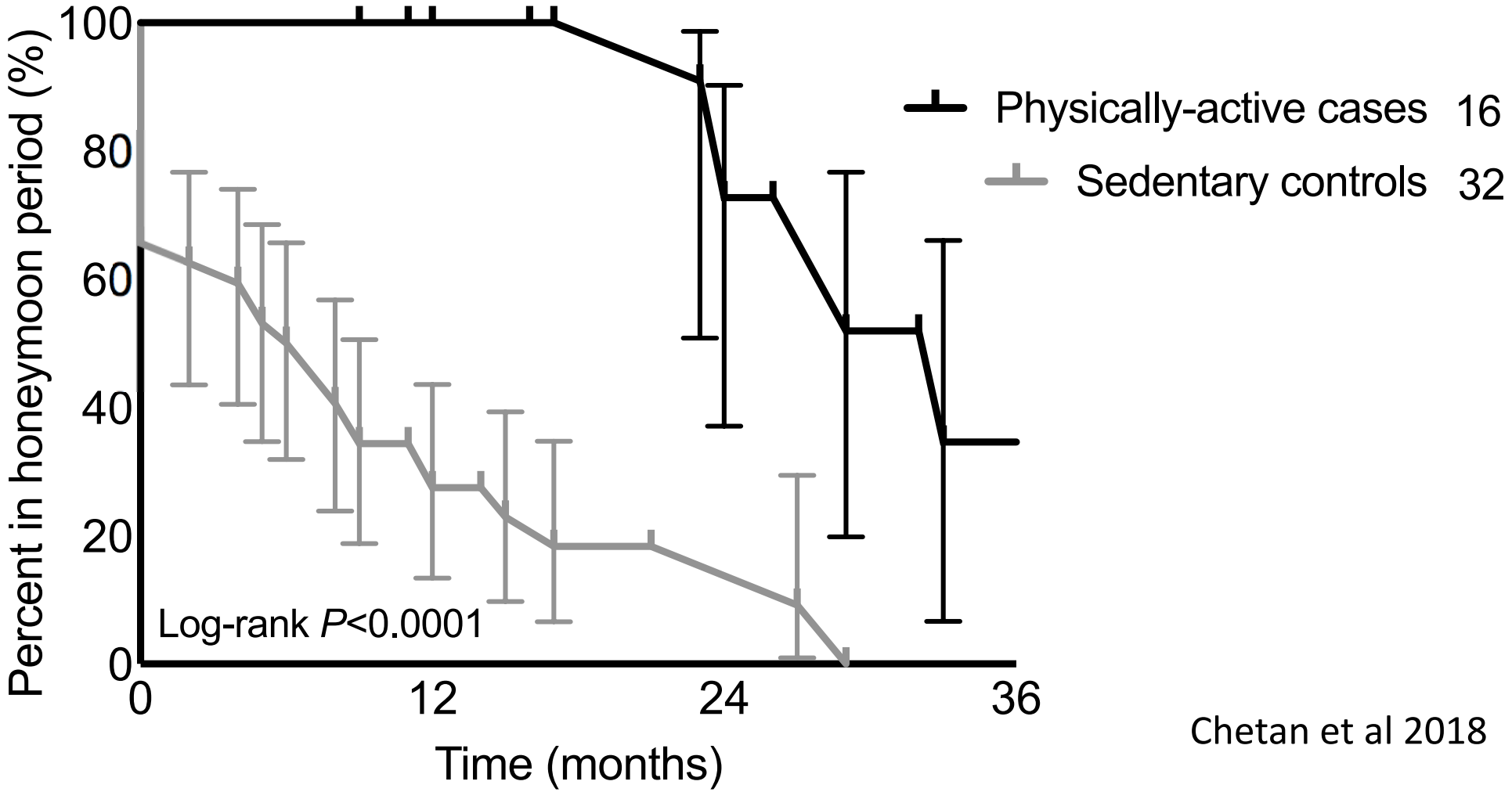
Duration of honeymoon in T1D patients who exercise



Chetan et al 2018

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What are the recommendations?

150 minutes per week of

moderate to vigorous aerobic activity

Resistance training three times a week

Reduce sitting time – try to get up three times per hour

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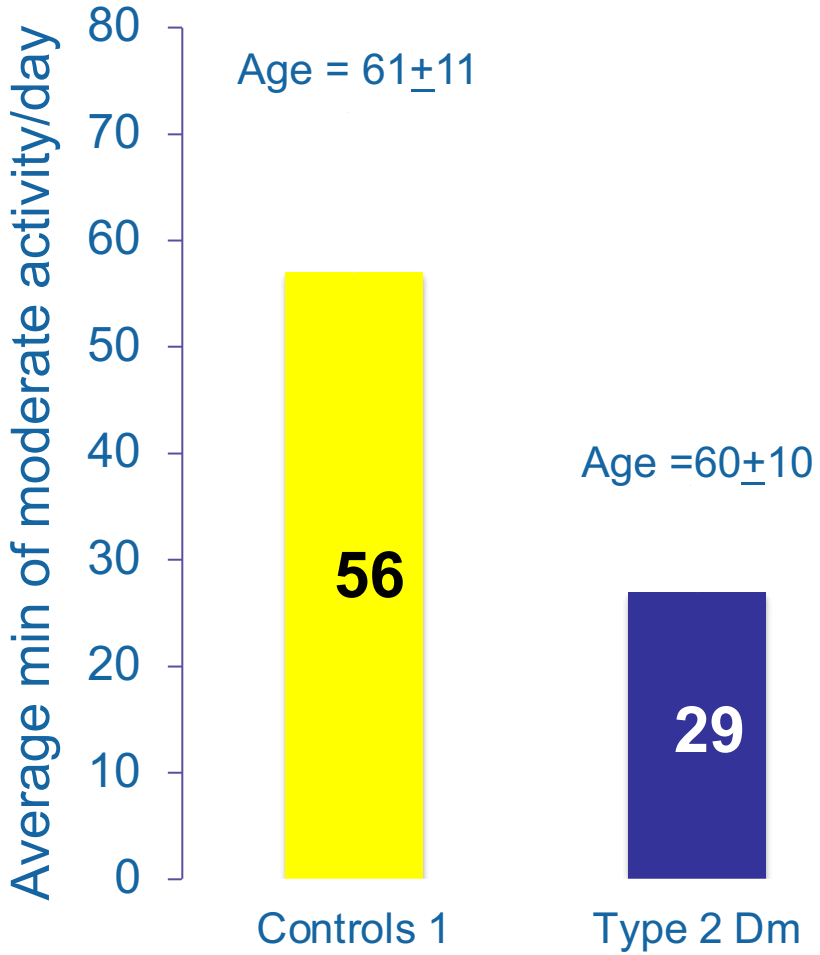
Activity of Patients with diabetes

Rhys Matson et al 2019



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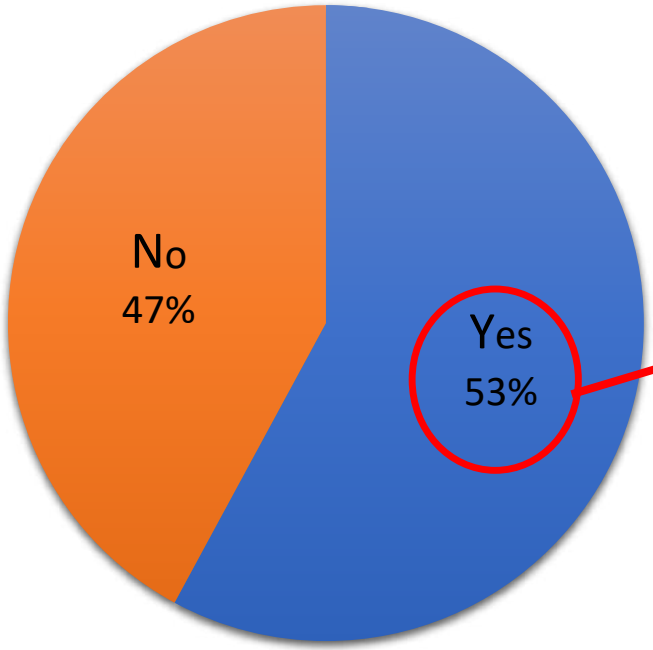
Diabetes specific barriers in adults with new-onset and established T1D

New onset T1D	Established T1D
• Hypoglycaemia (both actual and fear of) • **Lack of knowledge/confidence in managing diabetes** • Advice from healthcare professionals to stop exercising • Planning (e.g. checking blood glucose) • Feeling overwhelmed by diagnosis.	• Loss of control of diabetes • **Lack of knowledge on the management of diabetes for exercise**

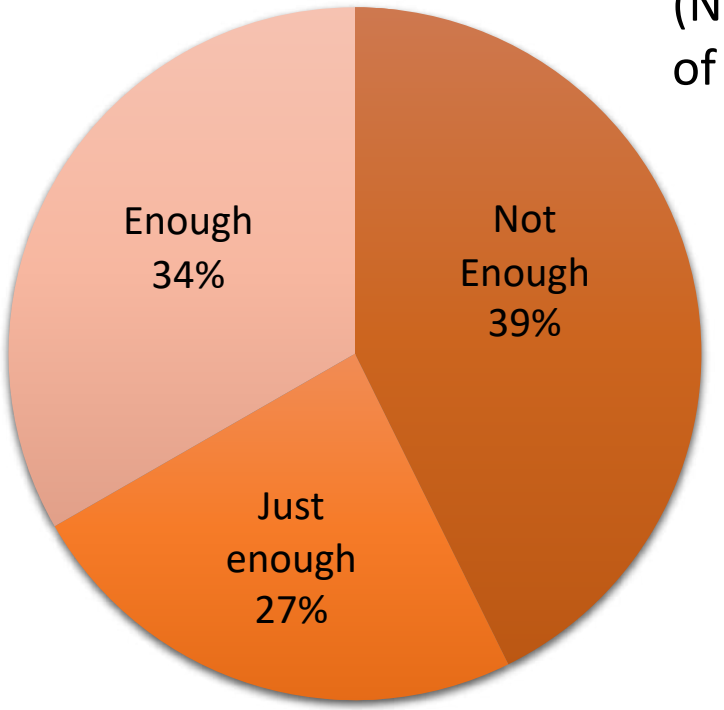
Kennedy 2018, Lascar 2014

T1D patient questionnaire around support for exercise

Did you receive information on exercise from your healthcare professional at the time of diagnosis?



If so, was this information enough?



(Nationwide survey of 622 patients)

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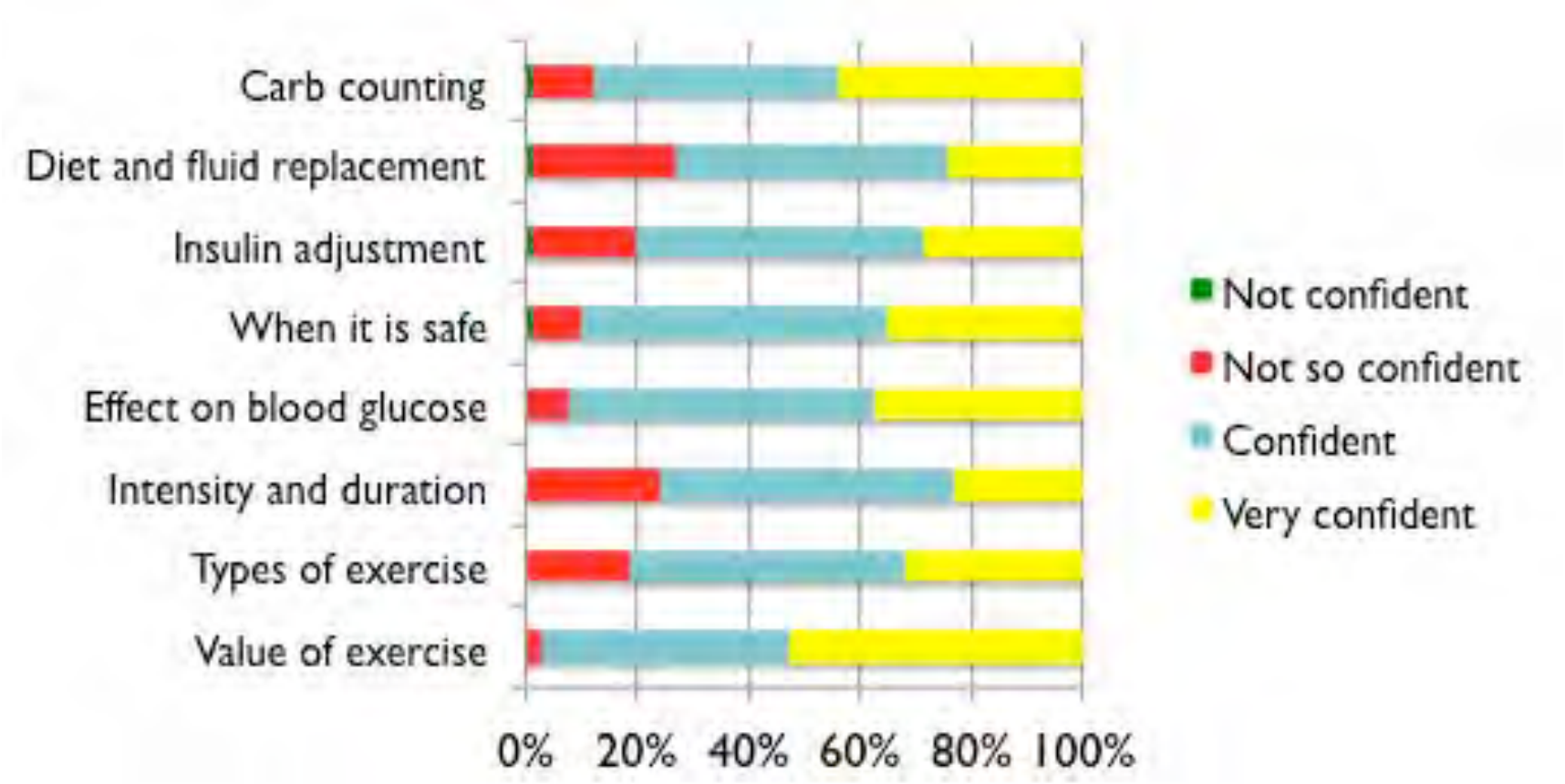
HCP confidence in giving advice

162 responses.
44% Dieticians,
30% Drs,
25% nurses



85% of HCPs reported they were very confident or confident at providing exercise education on all key topics

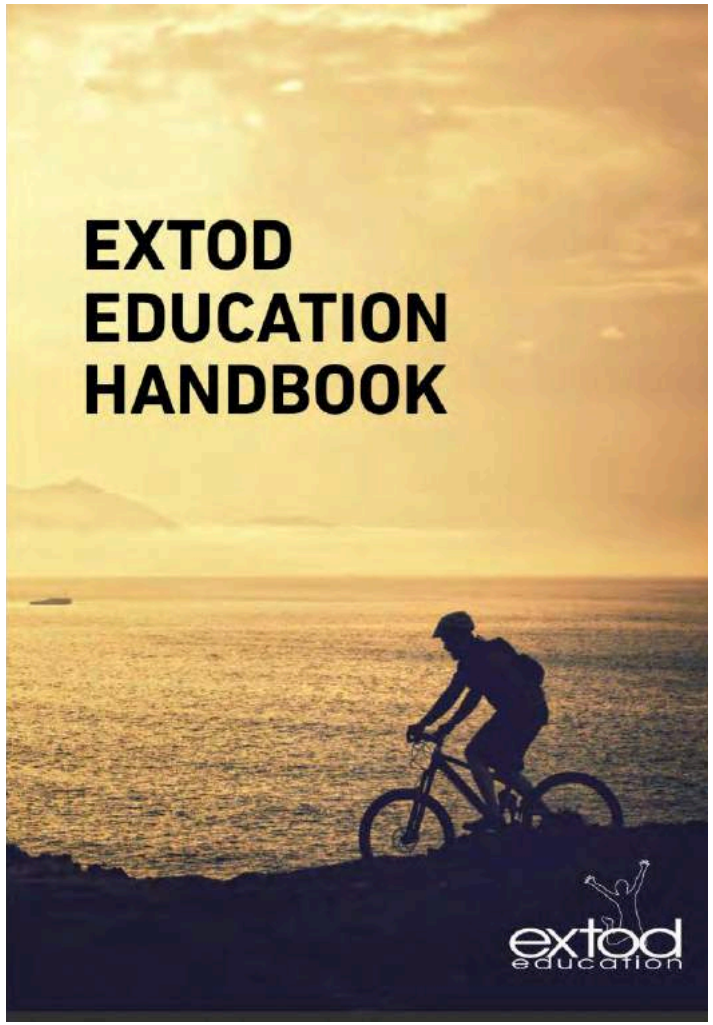
Knowledge levels of HCPs

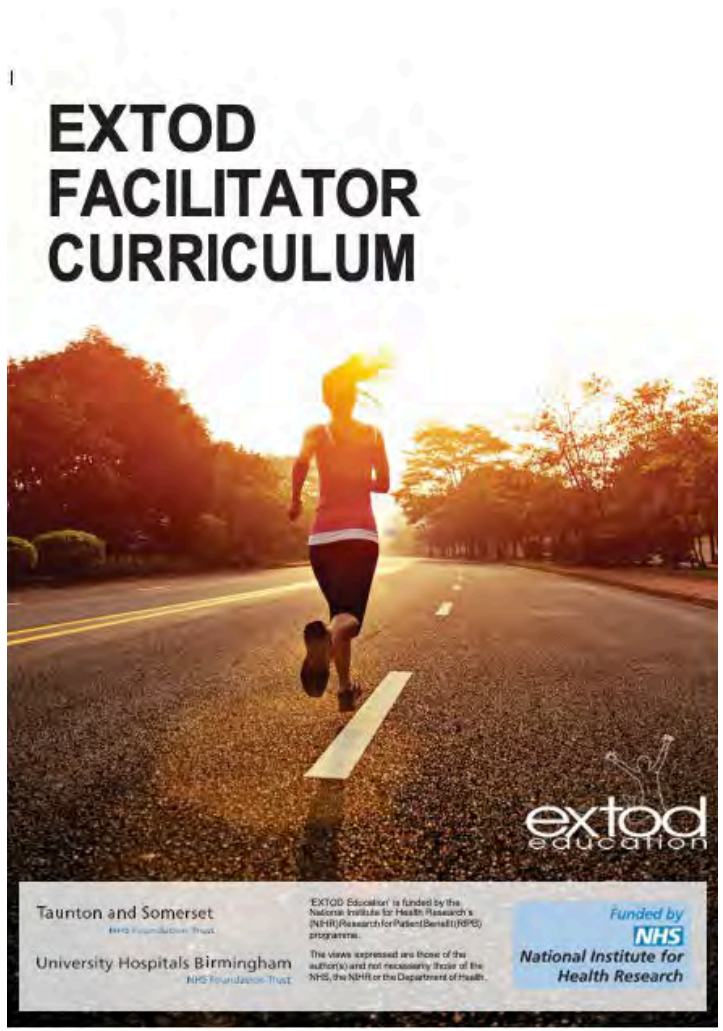
Average scores for each domain (the number of questions in each domain)	Correct responses	
	n (N)	%
General knowledge (4)	151 (648)	23
Action depending on blood glucose (8)	839 (1296)	65
Adjustment of rapid acting insulin (6)	459 (972)	47
Adjustment to basal insulin (6)	334 (972)	34
Risk of hypoglycaemia (2)	42 (324)	13
Insulin injection sites (2)	207 (324)	64
Food and drink consumption (3)	334 (486)	69
Treatment of hypoglycaemia (1)	98 (162)	60

Knowledge levels were poor

89% of respondents wanted more formal education for managing T1D for exercise.

EXTOD education





Litchfield 2019
Narendran 2019

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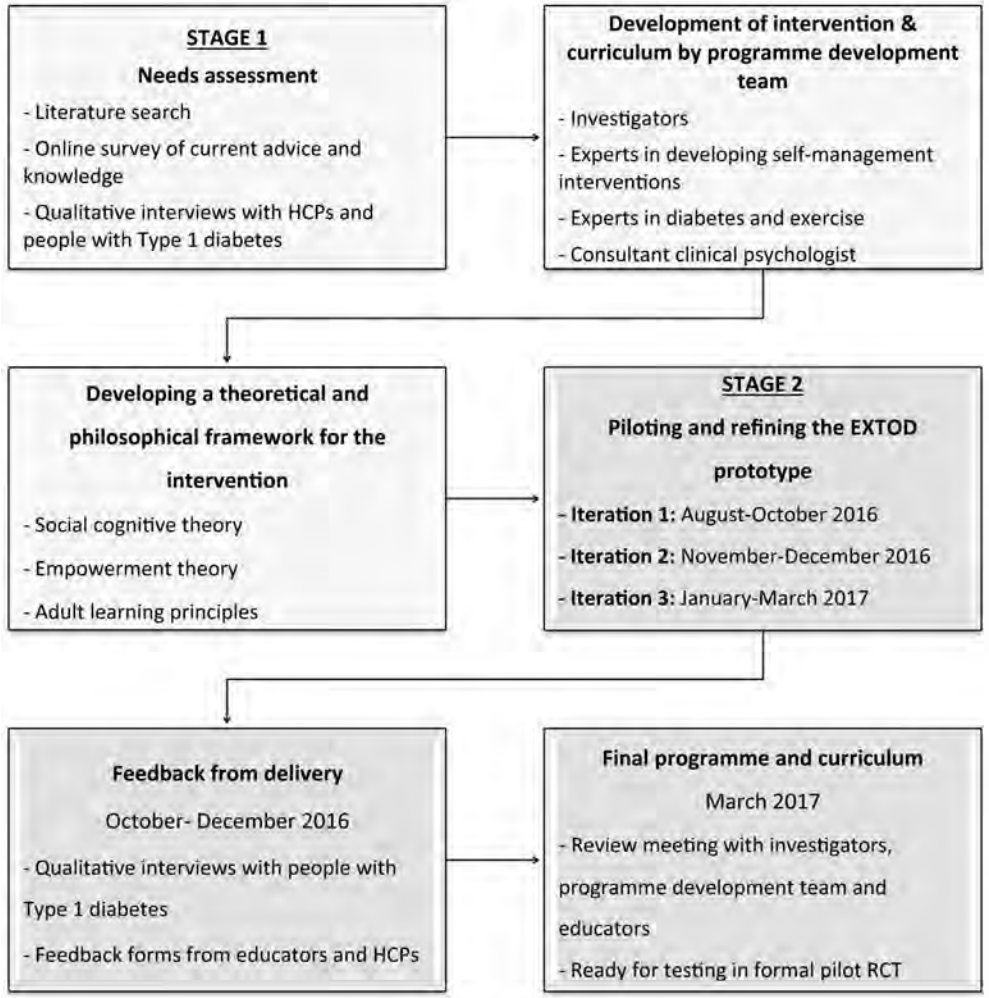
Developing the education programme



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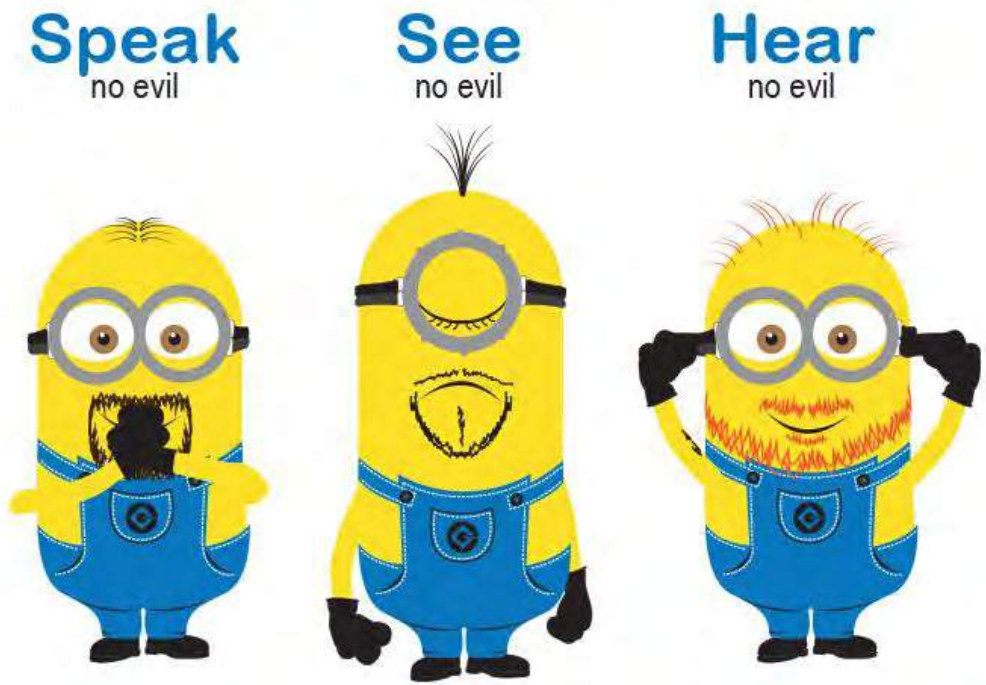
The rules of threes



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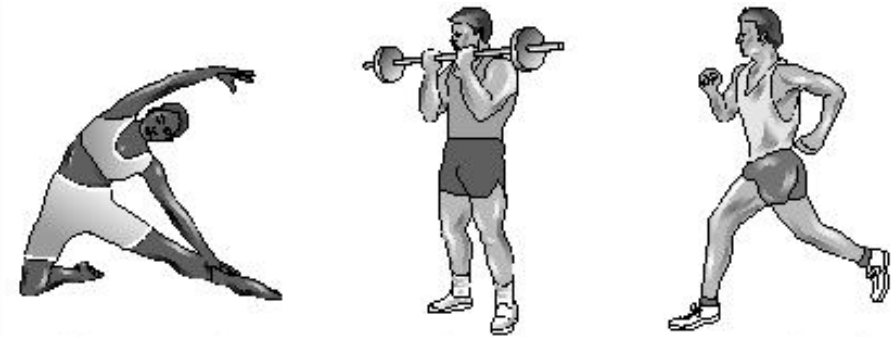
The exercise – three things you need to know

- What type of exercise are you going to do?
- What will the intensity of the exercise be?
- How long will you exercise for?



Three types of exercise

AEROBIC

Hiking

Golf

Road cycling

Cycle tour

Mountain biking

Distance running

Distance swimming

ANAEROBIC

Weight lifting

Body Building

Dressage

Fencing

Track and field events

Sprinting

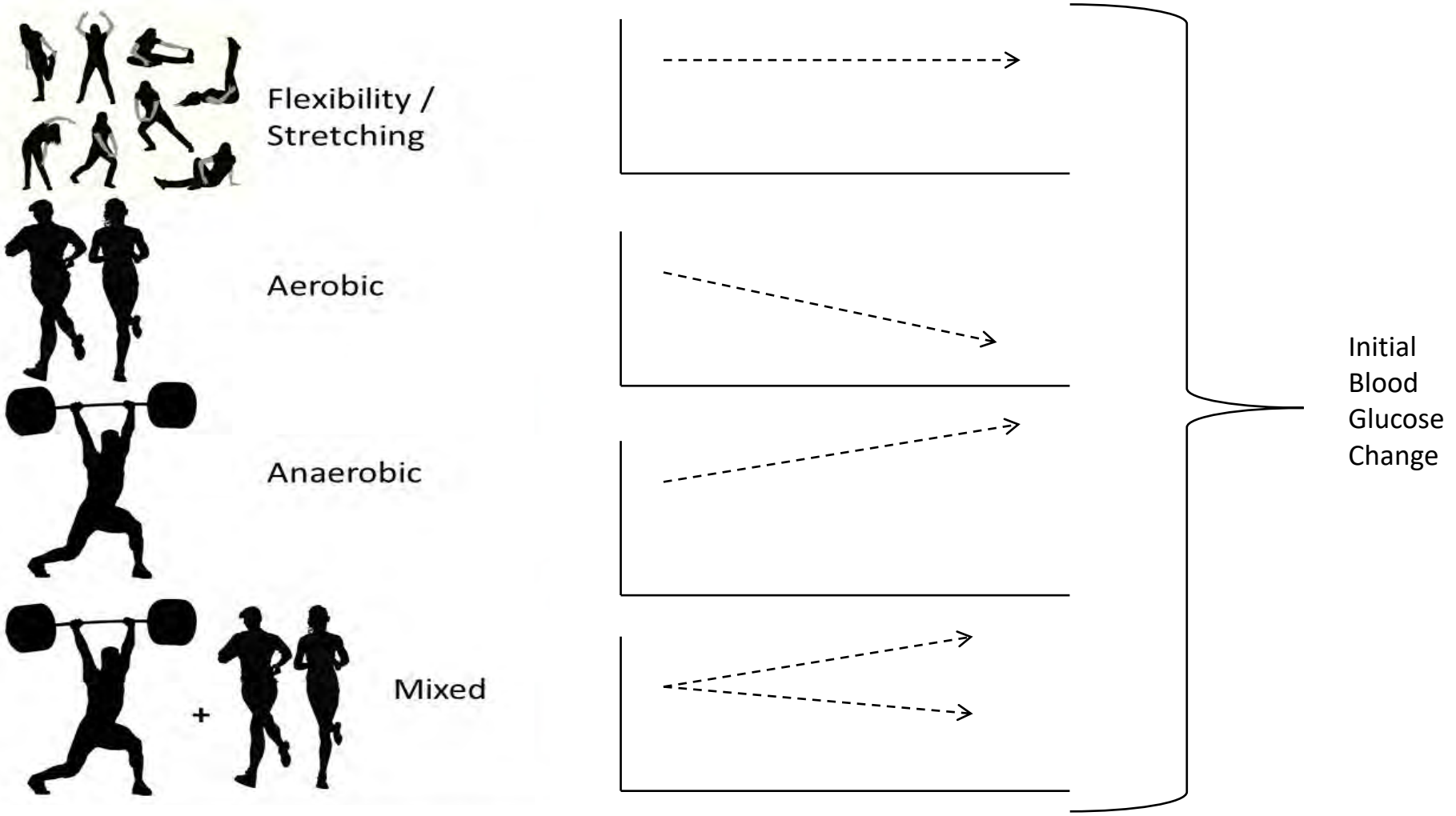
Archery

FLEXIBILITY

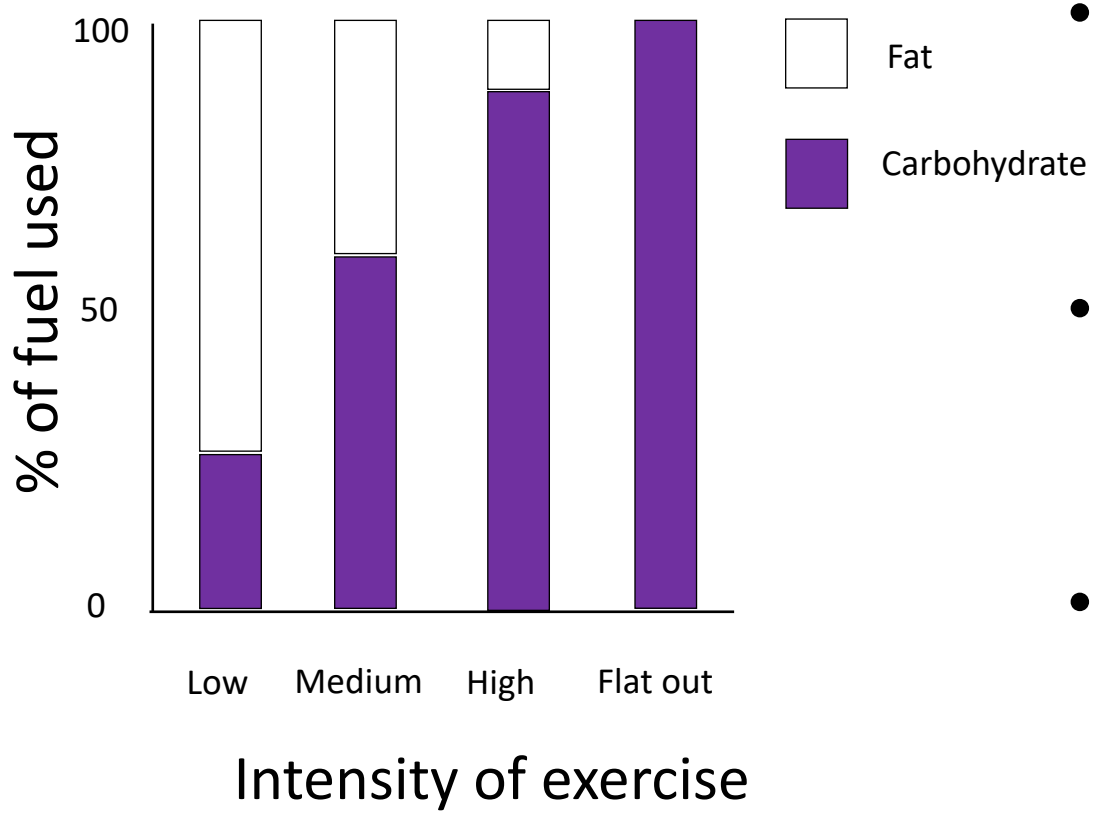
Stretching

Yoga

Glucose can go in three directions in T1D

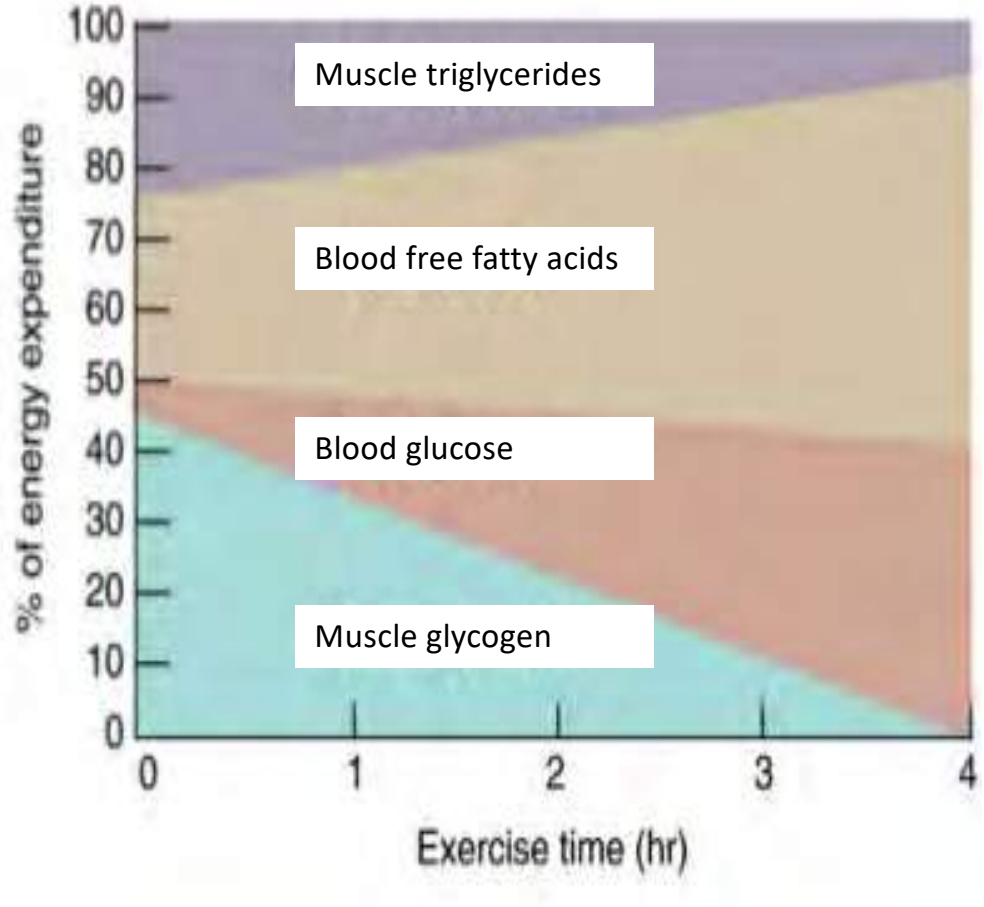


Intensity of exercise



- Glucose is used at all intensities of exercise
- At low intensity the main fuel used is fat
- At high intensity the main fuel used is glucose

Length of exercise

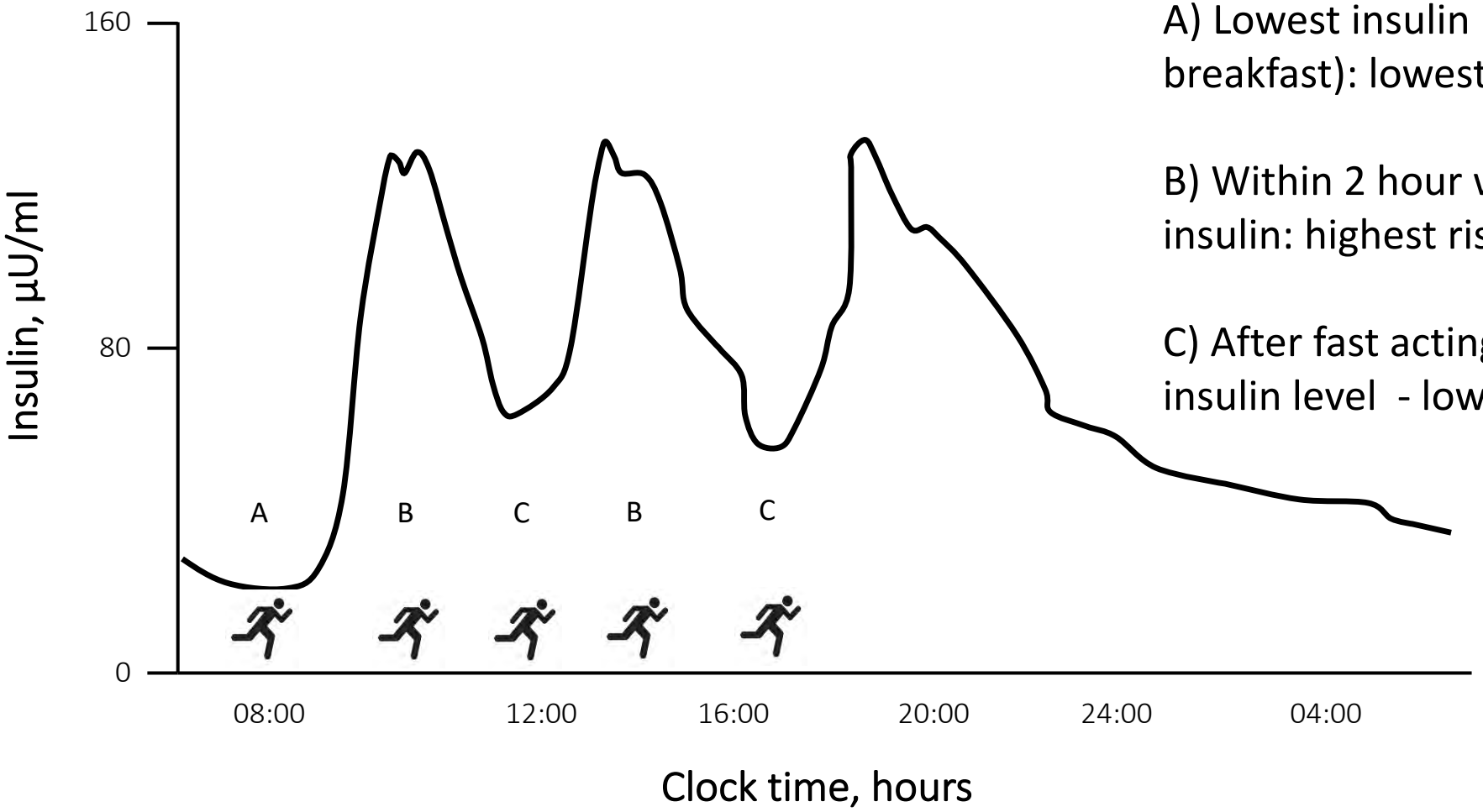


- Little blood glucose used during first 30mins of exercise
- More blood glucose used with longer duration exercise

Time of day – three things to think about

- How much insulin do you have on board?
- When did you last eat?
- Are you exercising in the morning or afternoon?

Prevailing insulin levels

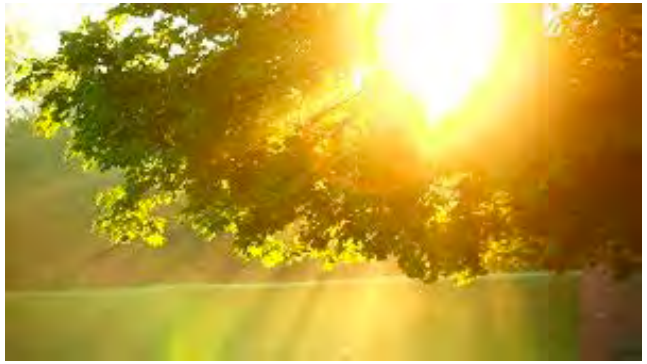


A) Lowest insulin level on waking (pre-breakfast): lowest risk of hypoglycaemia here

B) Within 2 hour window of fast acting insulin: highest risk of hypoglycaemia here

C) After fast acting insulin: second lowest insulin level - low risk of hypoglycamia

Morning or afternoon exercise?



Greater risk of hypo if exercise undertaken after 4pm

Insulin resistance

Wakefulness

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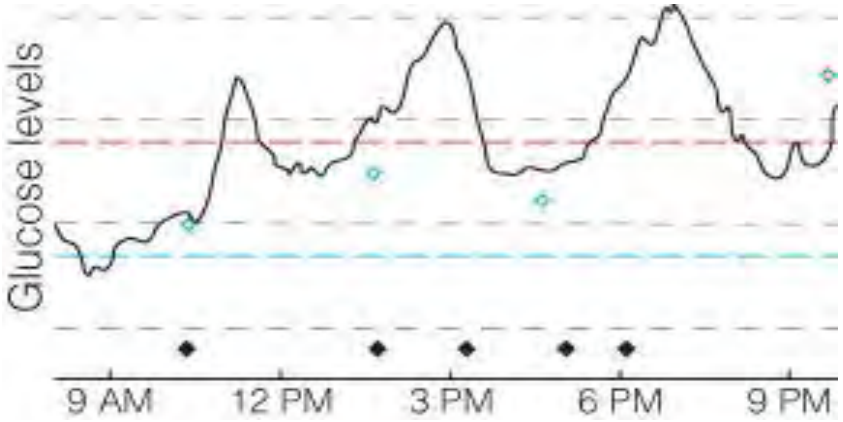
Glucose level– three things to think about

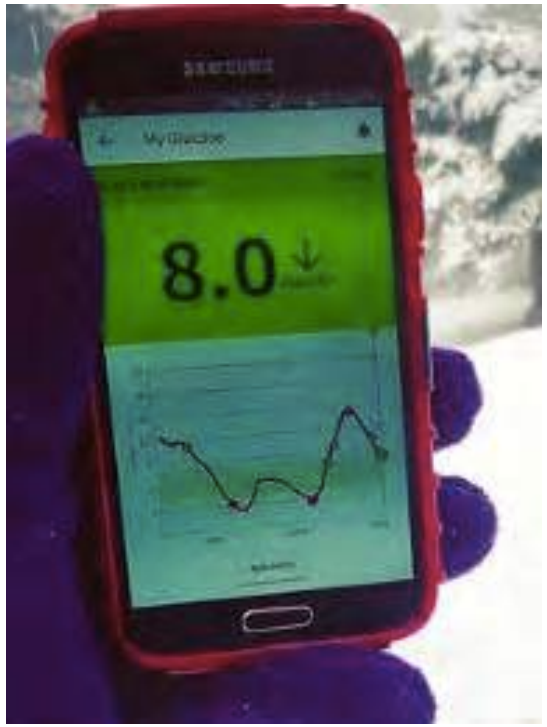
- Have you had a hypo in the last 24 hours?
- What has been happening to your glucose in last hour?
- What is your current blood glucose?



Hypoglycaemia and exercise

Type of hypo	Risk of hypo with exercise
Severe hypoglycaemic episode (needed help from someone else) in last 24 hours.	Risk of hypoglycaemia with exercise and after exercise is very high. **Advice is not to exercise on that day**
Hypoglycaemic episode self treated in last 24 hours.	Higher risk of hypoglycaemia with exercise and after exercise **Advice is to** **1. Not to do lone events/ training** **2. Monitor more frequently** **3. Check blood overnight**

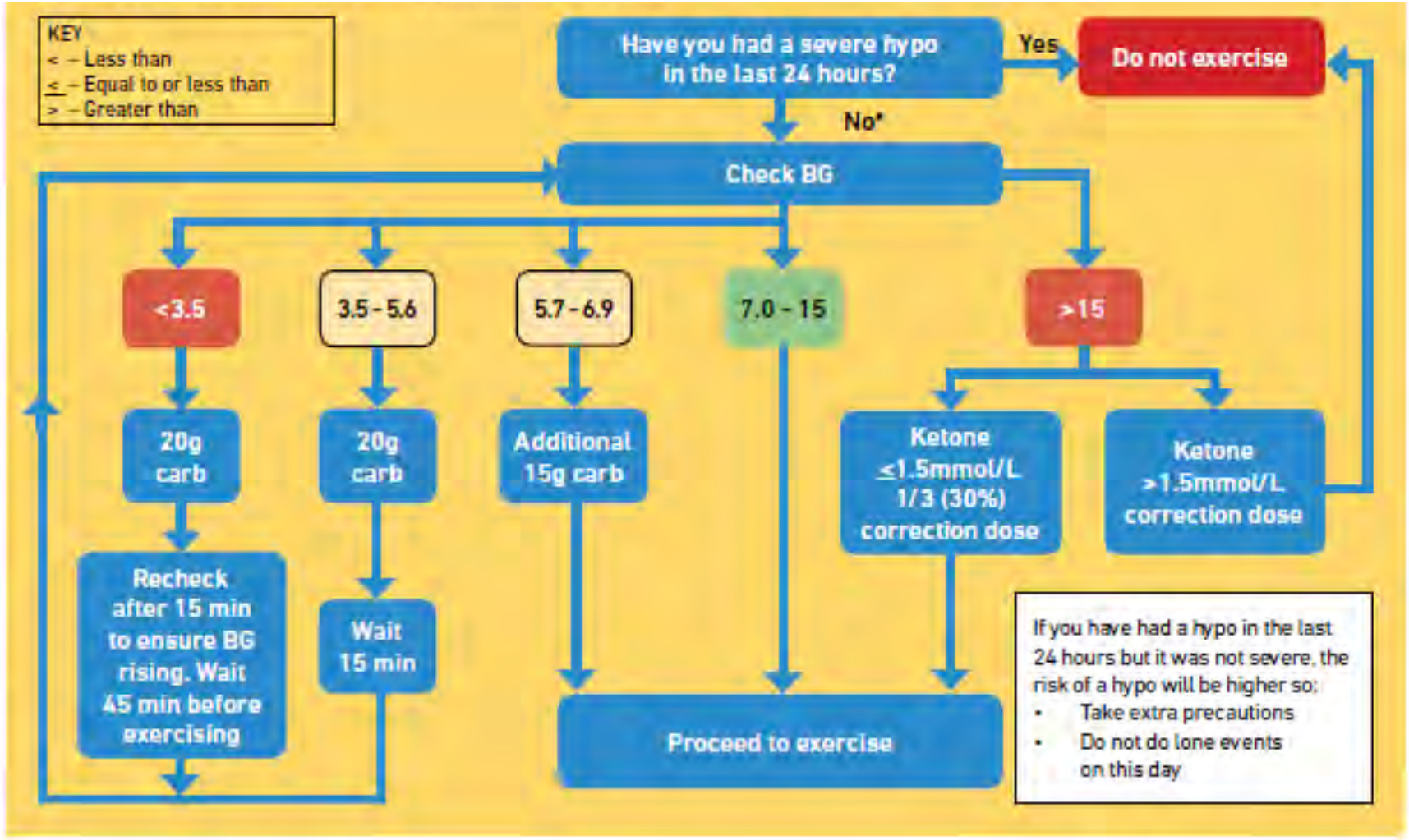
Direction of glucose



Although both have of these show glucoses in target range for exercise, response to exercise is likely to be different

Alternatively,
Check BG twice in the previous half hour

Simple flowchart for glucose and exercise



Addition information for Libre

Confirm with BG reading if

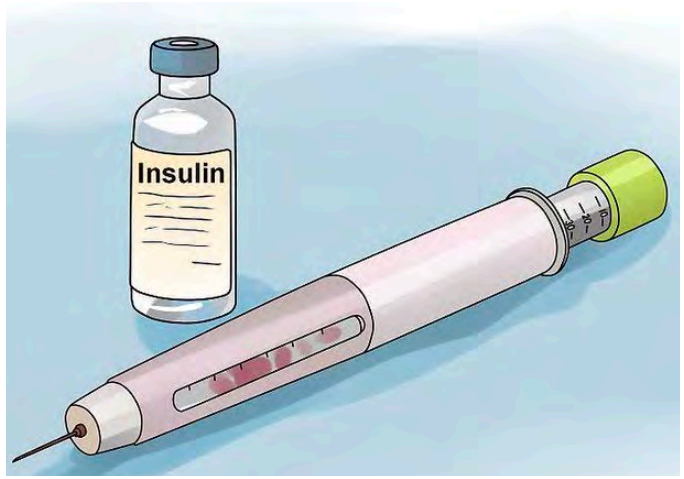
- Glucose <6.0
- Glucose >15

If ↑ and glucose 5.7-6.9: no need for extra carbs, proceed to exercise. Stick to advice if in any other range

If ↓ and glucose 5.7-6.9: take twice as much carbs at 20 and 40 minutes into exercise

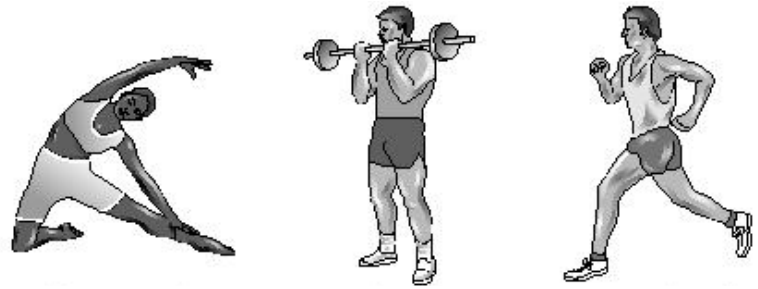
If ↓ and glucose 7.0-9.0: take 15 grams of carbs at start of exercise

Three ways to manage glucose during exercise -ICE



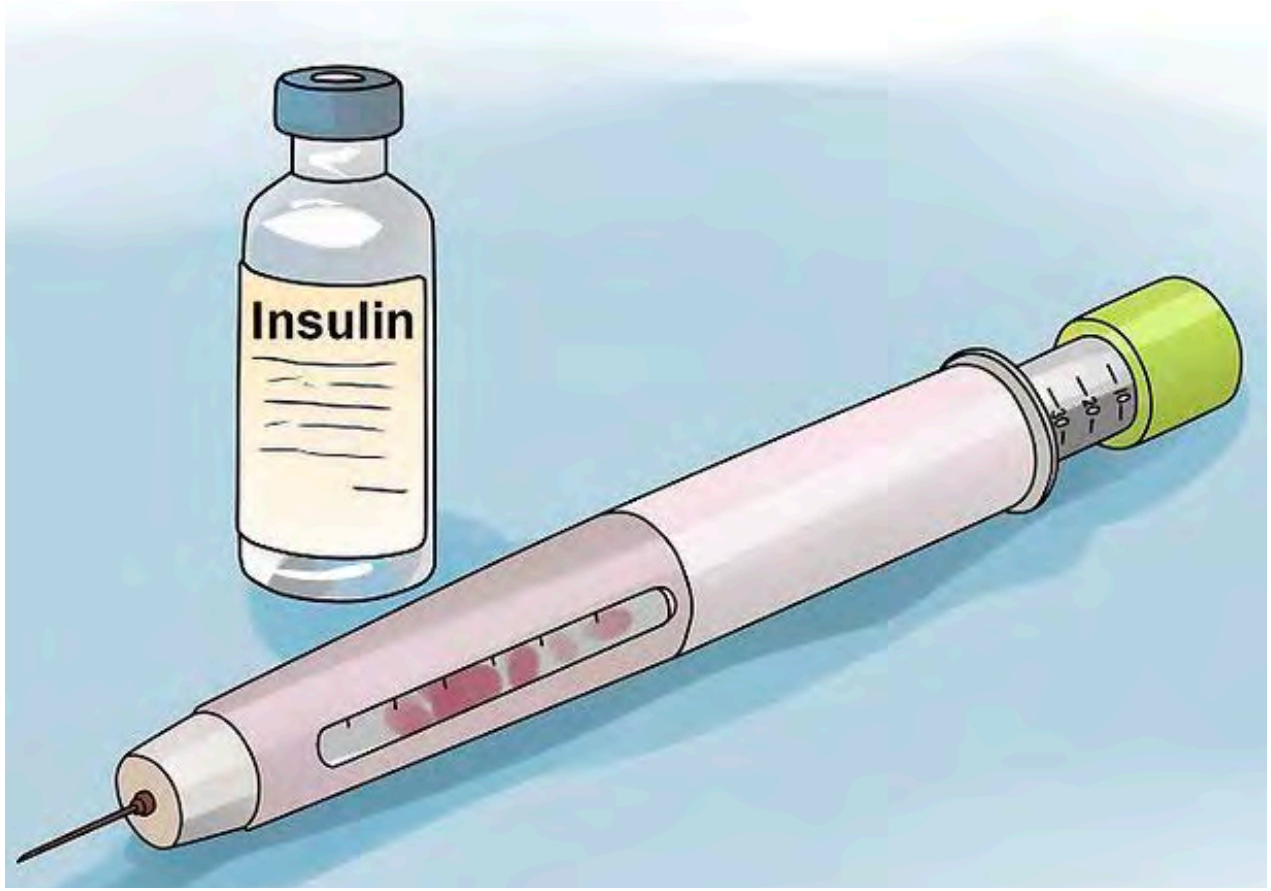
Insulin

Carbohydrate



Exercise

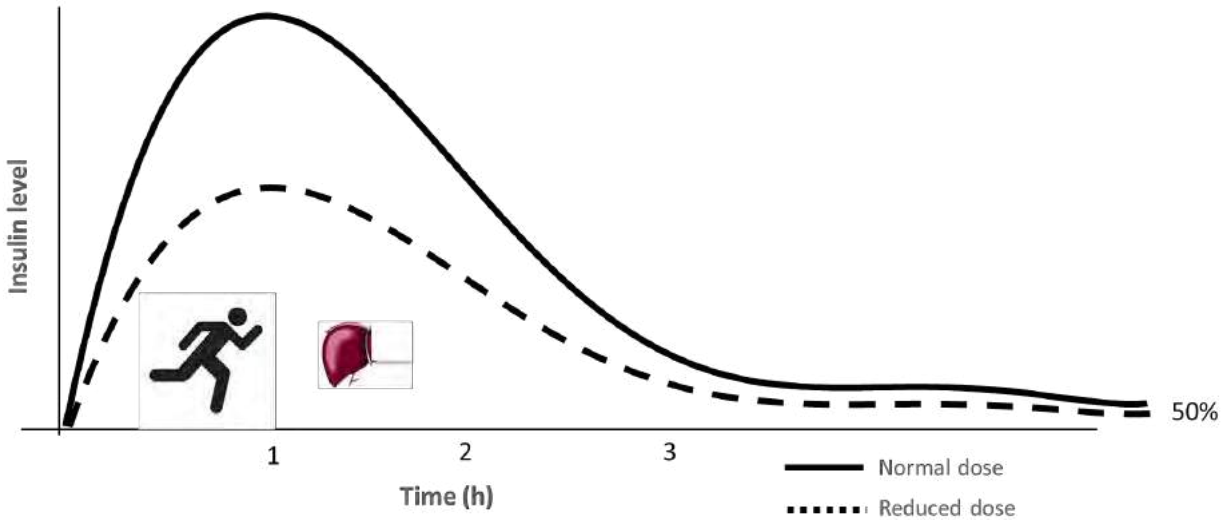
Using insulin to manage glucose during exercise



Simple strategy for meal-insulin

If exercising within 2 hours of quick acting (bolus) insulin

- Reduce pre-exercise fast acting (bolus) insulin by 50%



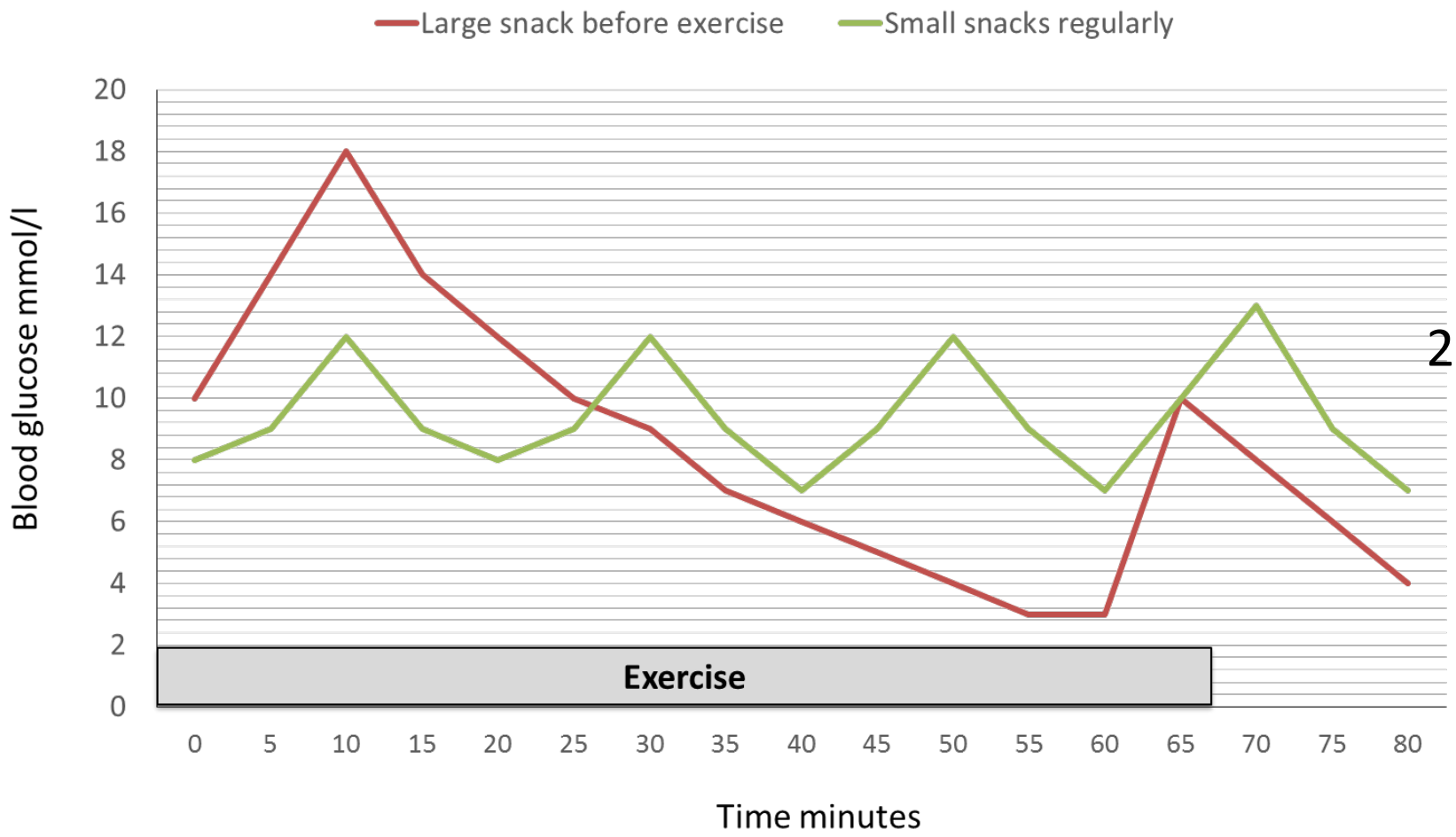
Simple strategy for basal insulin on pumps

- Reduce basal insulin by 50% one hour before starting exercise
- Return to usual basal rate at the end of exercise

Using carbohydrate to manage glucose during exercise

Simple carbohydrate regime

Start with 60g/hour, move onto to 30g/hour or to other strategies



Taking something every 20 minutes will keep blood glucose stable

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Carbohydrate intake during exercise

CGM Glucose level	Trend arrow(s)	Action	Comments
<5.0 mmol/L	None or downward trending	15-20g CHO 	Stop exercise if blood glucose ≤ 3.9 mmol/L
5.0-6.1 mmol/L	↘ Libre	15g CHO 	
5.0-6.1 mmol/L	↓ Libre	20g CHO 	
6.1-6.9 mmol/L	↘ or ↓ Libre	8g CHO 	
>7.0 mmol/l		No action	

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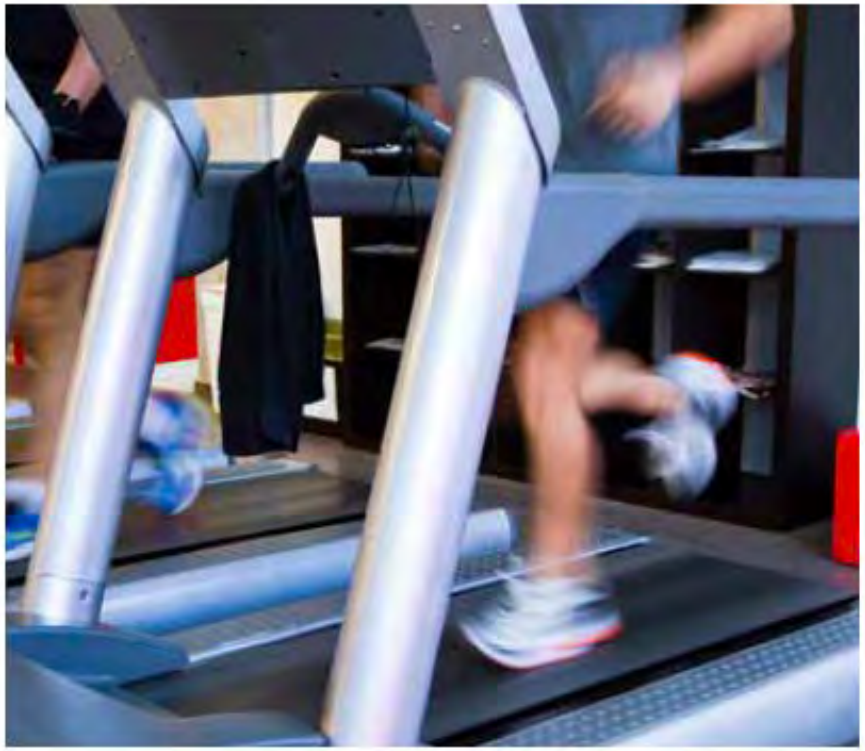
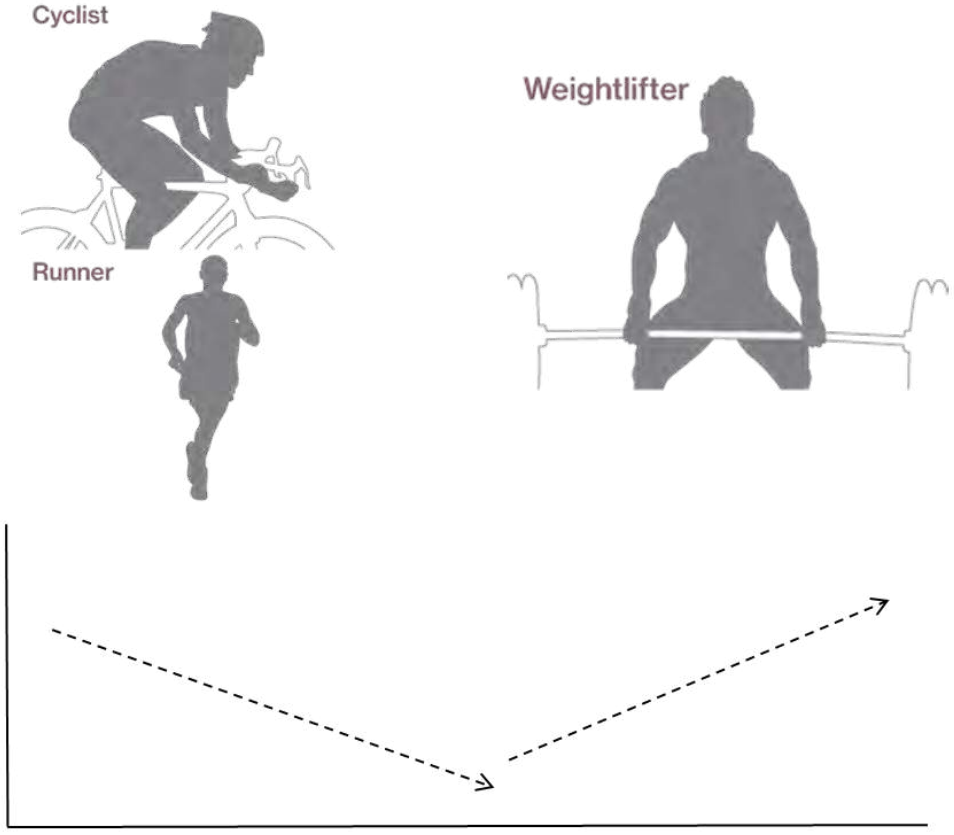
Using exercise to manage glucose during exercise



Order of exercise types

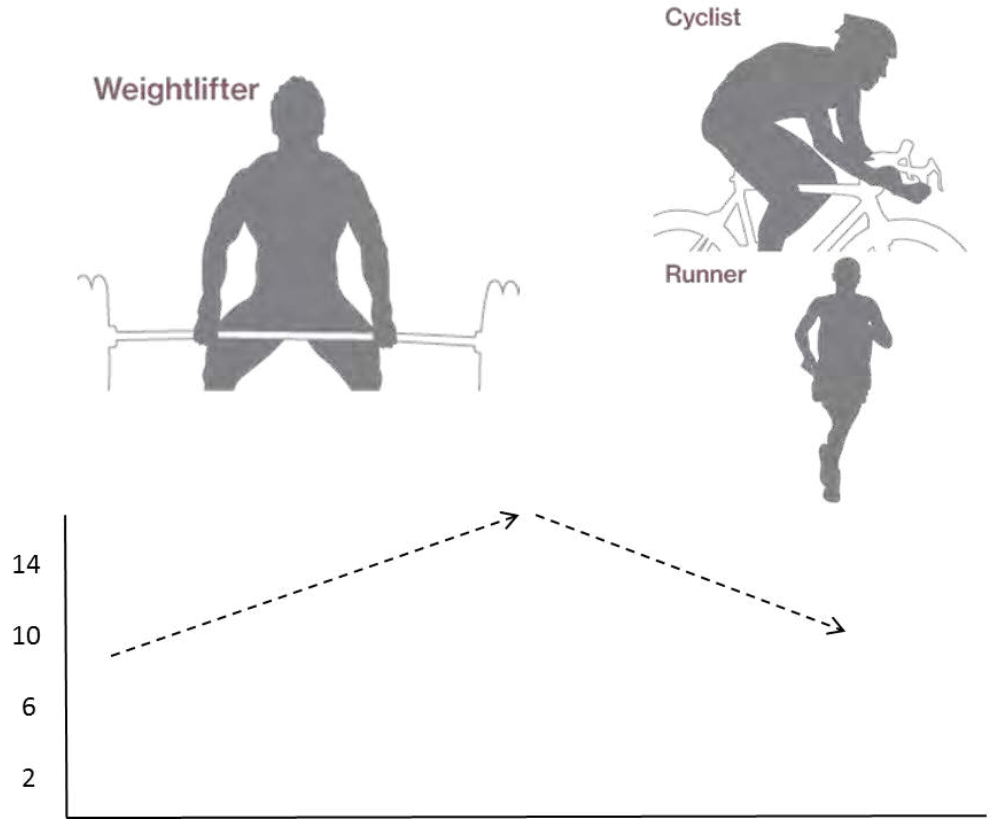
Order 1

Aerobic then Anaerobic



Order 2

Anaerobic then Aerobic



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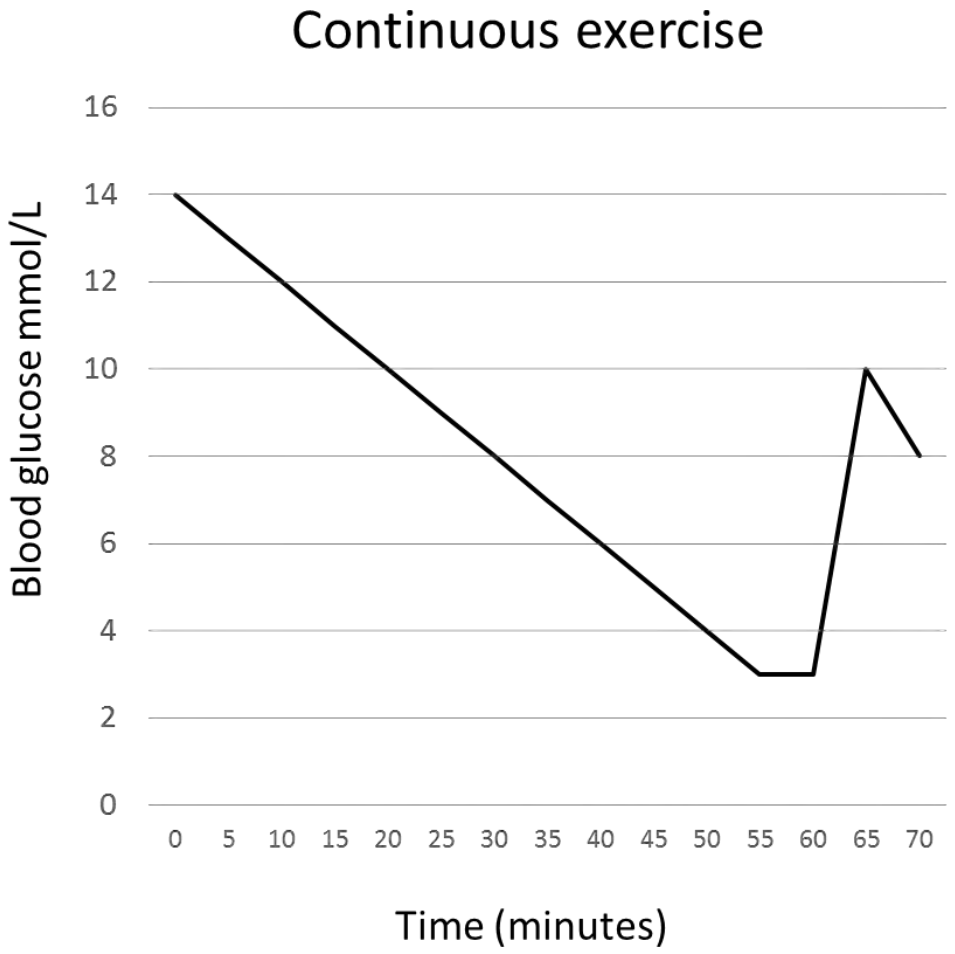
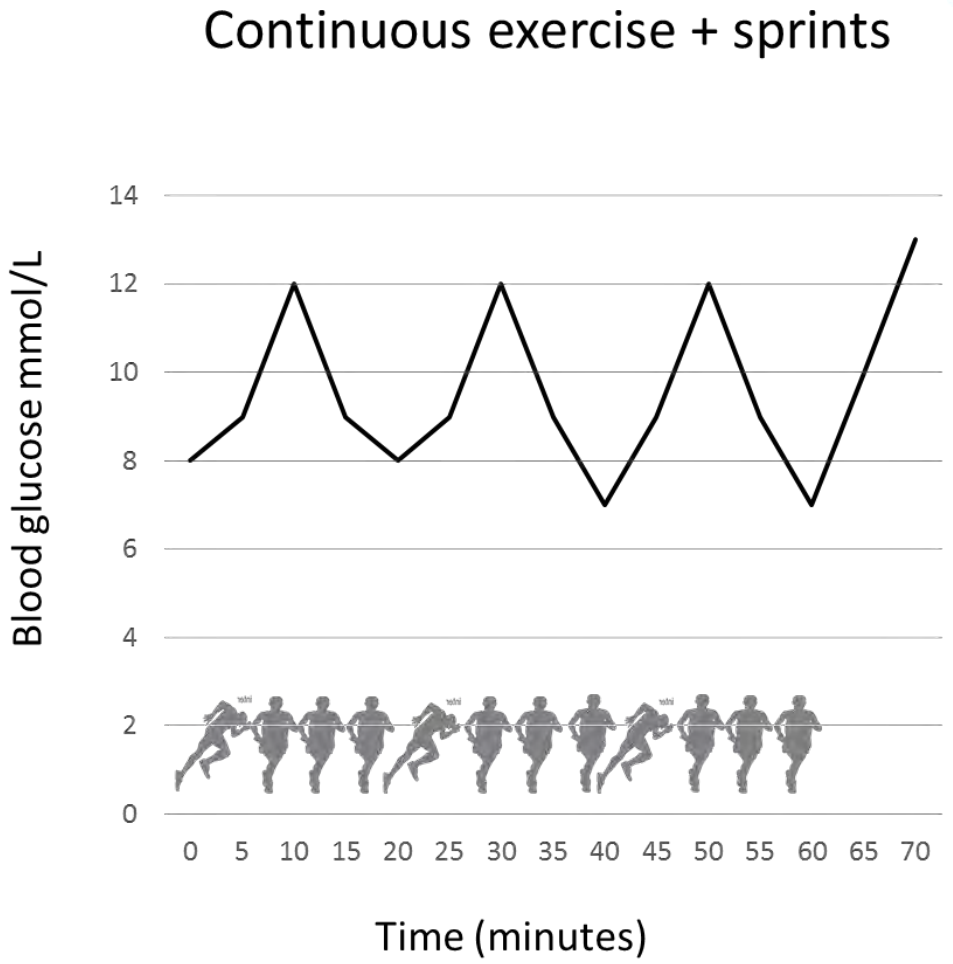
Sprinting increases your glucose





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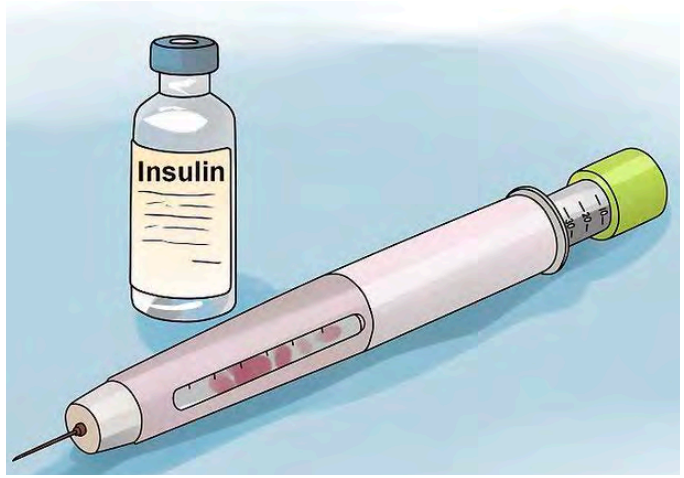
Three ways to manage glucose after exercise - ICE

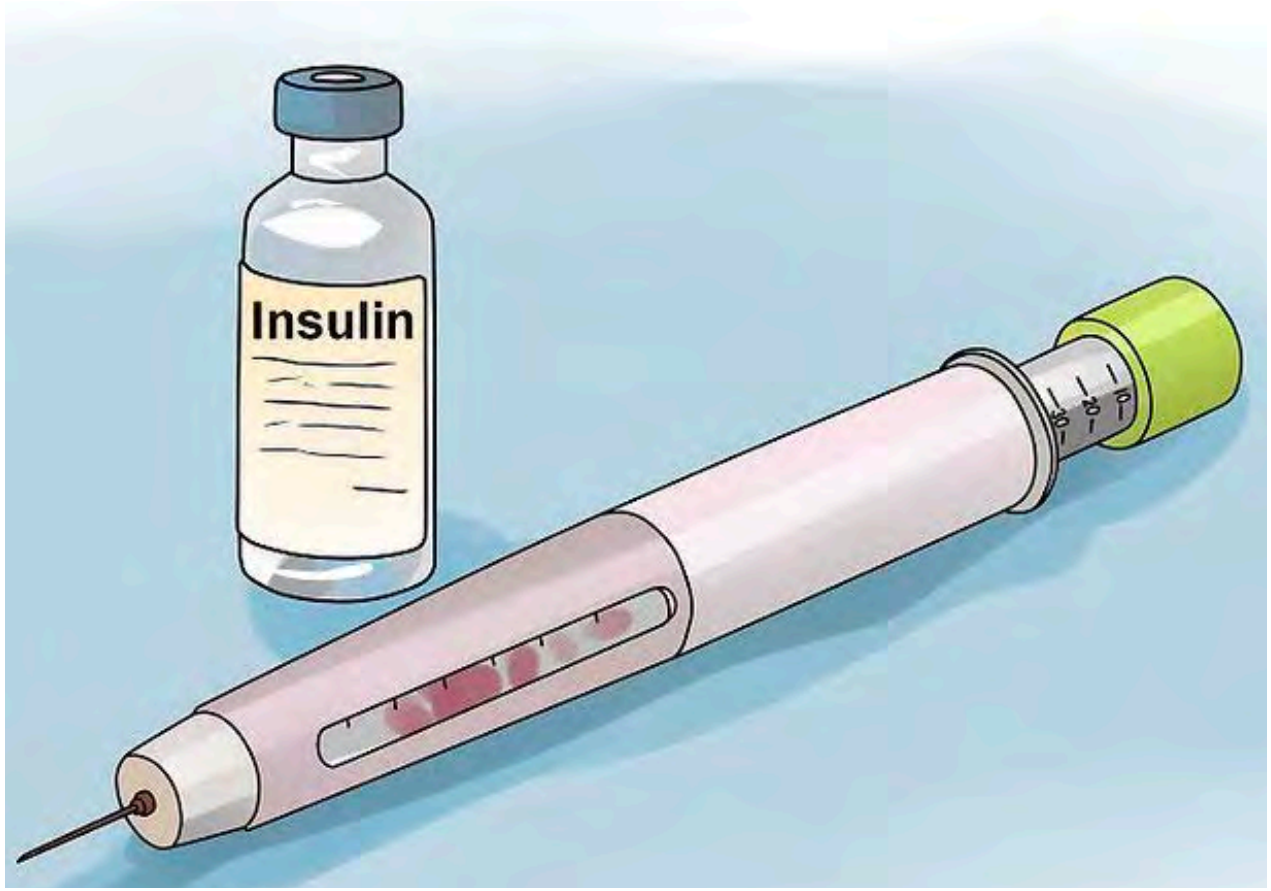


Insulin

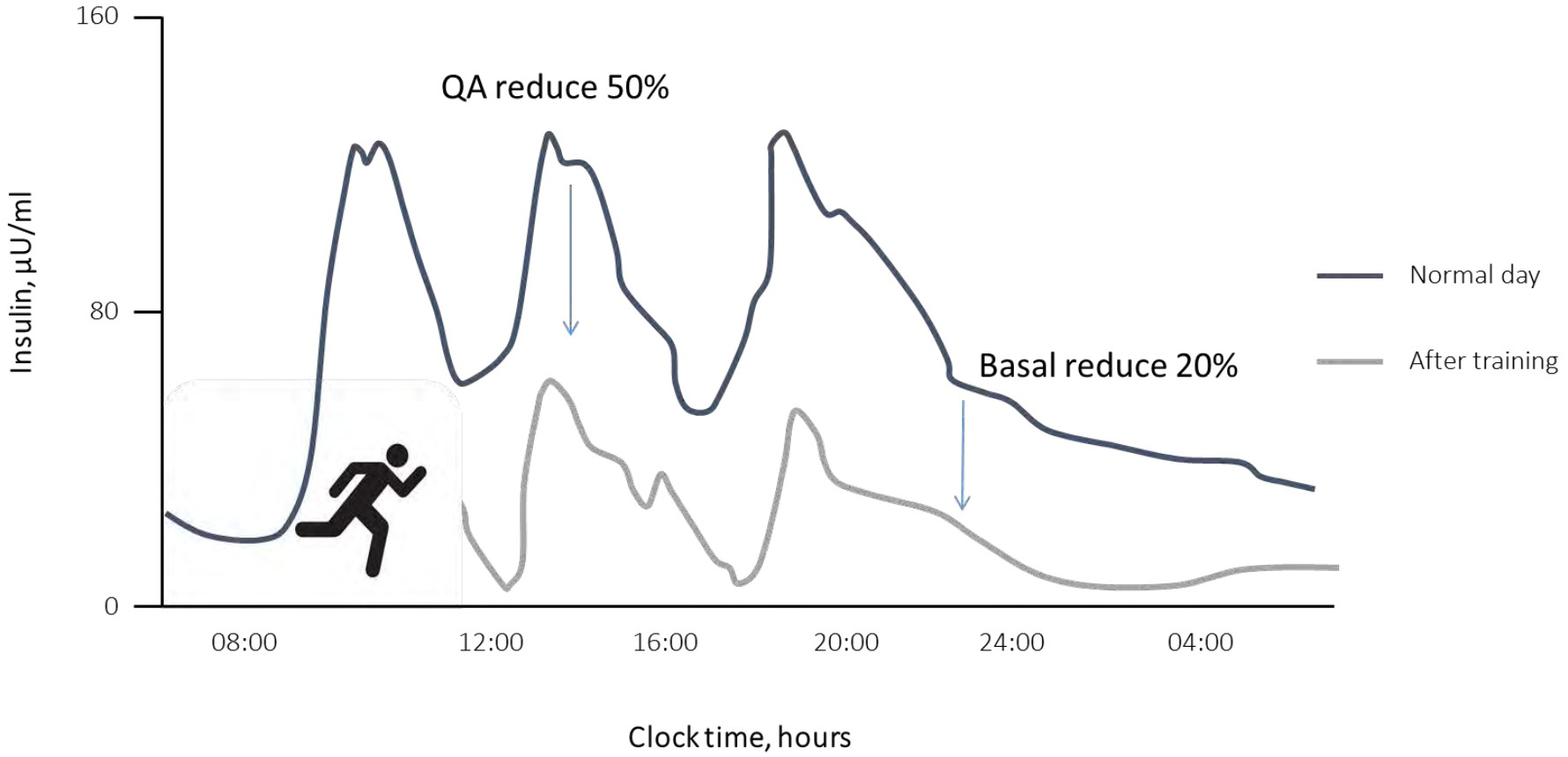
Carbohydrate

Exercise

Using insulin to manage glucose post exercise



Effect of exercise on Insulin sensitivity



The 50-50-20 rule

- 50% reduction of normal bolus for next 2 meals
- 50% reduction of normal correction for the next 12 hours
- 20% reduction of normal evening background if:
  - after 4pm
  - over 2 hours of exercise
  - HIT at any time of the day

  - MDI - only applies to glargine / determir / intermediate acting insulin
  - Pump - 20% reduction background for 6 hours from when gone to bed

Using carbohydrate to manage glucose post exercise

Three things to think about

- Is your daily carbohydrate correct?
- Are you taking a recovery meal after exercise?
- Do you need to have something before bed

Using carbohydrate to manage glucose post exercise

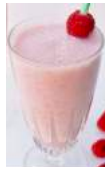
Did you do more than 60 minutes moderate intensity exercise or more than 30 high intensity exercise?

No → No recovery food needed

Yes → Have food with carbohydrate and protein in Ratio 4:1. For example

Ham sandwich.

Milkshake



Cereal and milk

Consider bedtime snack with protein and complex carbohydrate if:

- exercised after 4 pm
- exercised more than 2 hours

1 hour after

Many hours after

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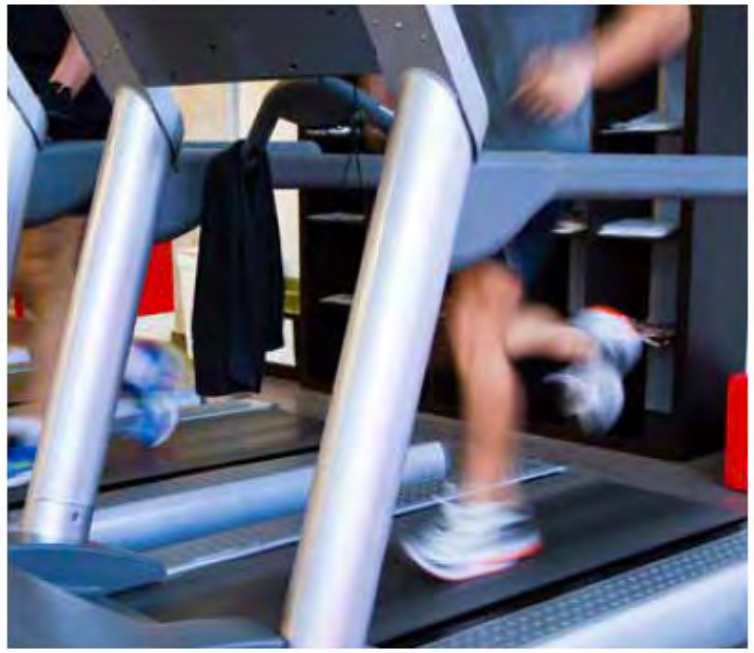
Using exercise to manage glucose post exercise



Exercise can help manage glucose post exercise in two ways

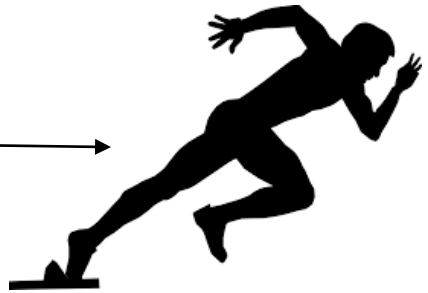
- Help to lower high glucose
- The more you do the easier the control

Using exercise to manage glucose post exercise

Glucose >10

warm down
10 minutes warm
Down lowers by 1-2 mmol

Glucose <4



10 sec sprint
Raises by 2-4 mmol
Protects from hypo for
30-40 minutes

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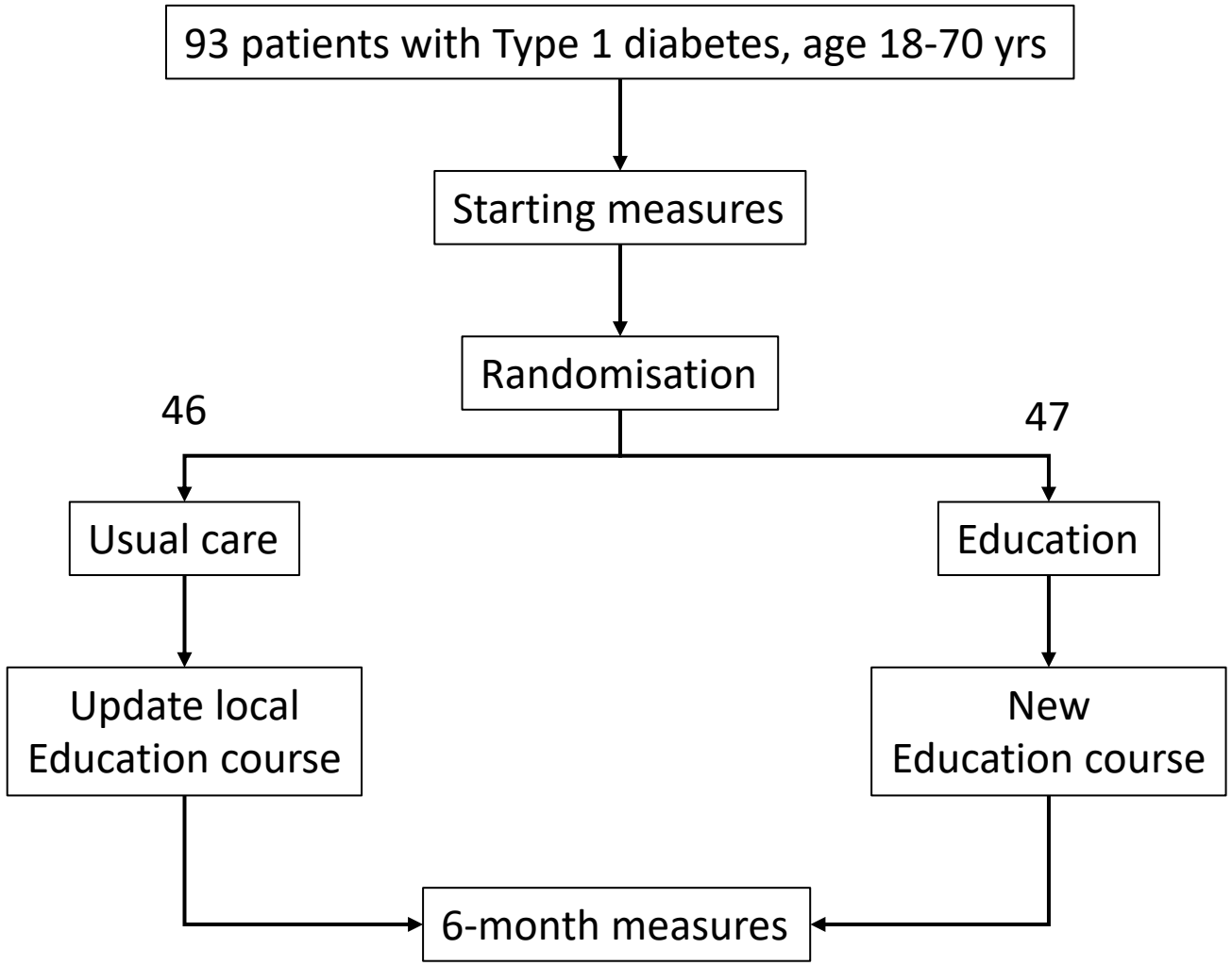
“I have not failed. I’ve just found 10,000 ways that won’t work”

Thomas Edison (1847-1931)

EXTOD education study

Dr Stephen' understanding of randomisation wasn't very good !

Study design



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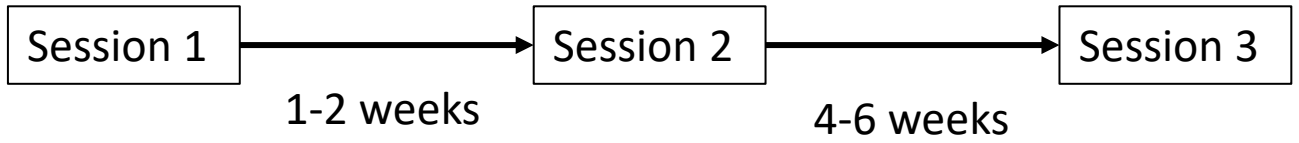
Session 1 Total time 4 hours	Session 2 Total time 3 hours	Session 3 Total time 2.5 hours
Welcome (10 mins)	**Welcome Back (5 mins)**	**Welcome Back (5 mins)**
Where Are You Now? (40 mins) *Identifying personal experiences, expectations and goals when exercising with Type 1 diabetes*	**Sharing Stories (40 mins)** Participants feedback their experiences since session 1	**Sharing Stories (40 mins)** Participants feedback their experiences since session 2
	Understanding Your Mechanics 2 (30 mins) *Glucose regulation in the body after exercise*	
Understanding Your Mechanics 1 (80 mins) *Glucose regulation in the body at rest and during varying exercise types in someone with and without Type 1 diabetes*	**Fuel for Exercise (60 mins)** *Nutrition for effective exercise and glucose control*	
Staying Safe (30 mins) *Using an algorithm to determine safe limits for starting exercise how to treat or prevent hypoglycaemia (hypo).* *Exercise and complications of diabetes.* *Staying Safe Checklist*	**Strategies after exercise (30 mins)** *Discussion of application of ICE strategies to control glucose levels after exercise*	**Advanced Strategies (80 mins)** *Putting all the ICE strategies together and applying to complex scenarios using case studies*
Strategies before and after exercise (60 mins) *ICE Strategies to manage blood glucose levels before, during and after exercise.* *Insulin adjustments, Carbohydrate for exercise and adapting type or order of Exercise*	**Next Steps (15 mins)** *Identifying goals for the next month, completing a written action plan and sharing with the group*	
Next Steps (20 mins) *Making a personal action plan and sharing it with the group*		**Future Planning (25 mins)** *Making an action plan for next steps, building on what has been learnt from the course.*



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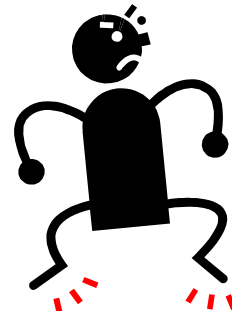
Measures 1- questionnaires

Heath status

Problem areas in diabetes

Barriers to exercise



Diabetes Distress

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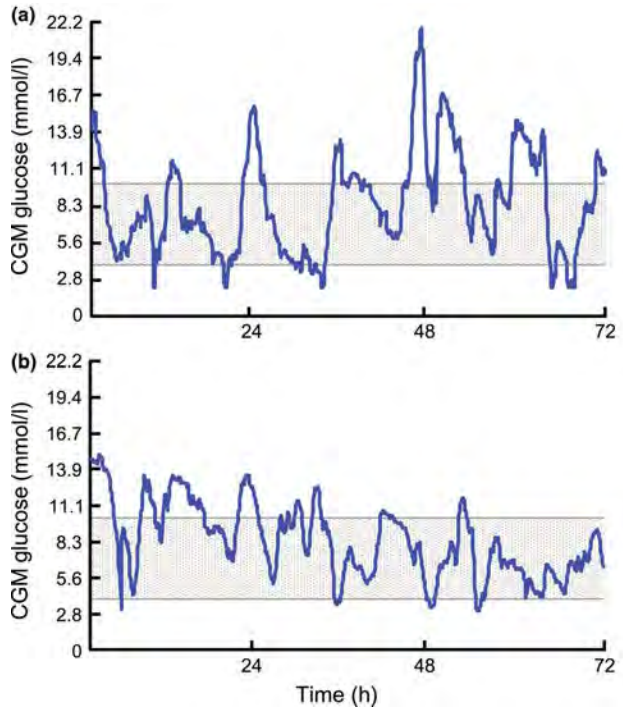
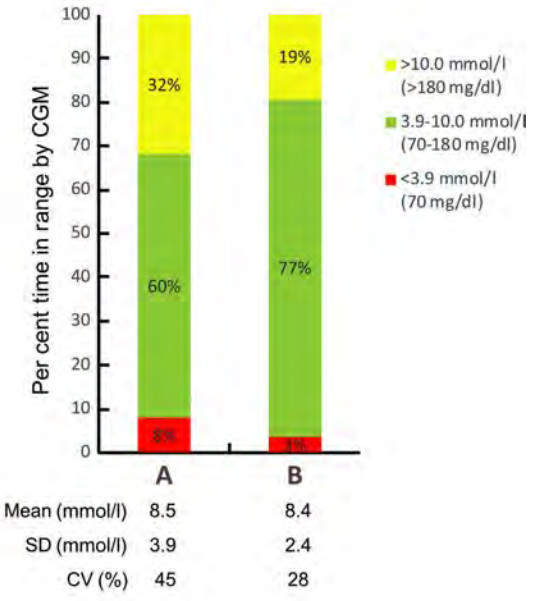
Measures -2 – Glucose control and hypos





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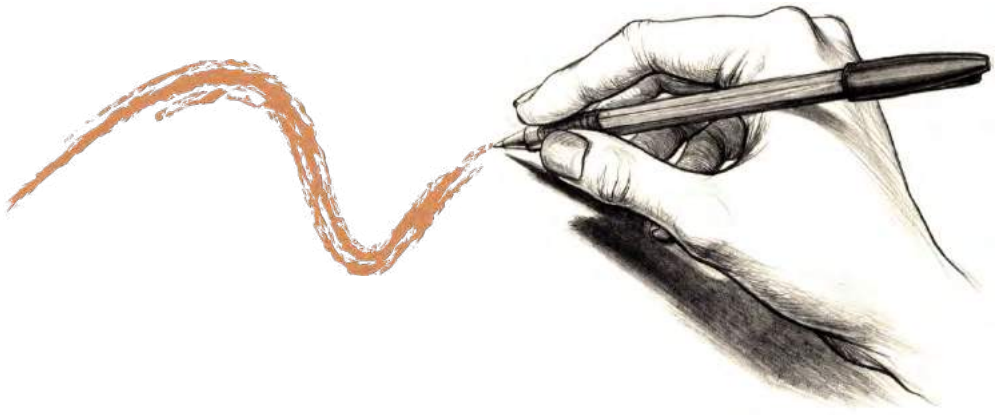
Participant characteristics

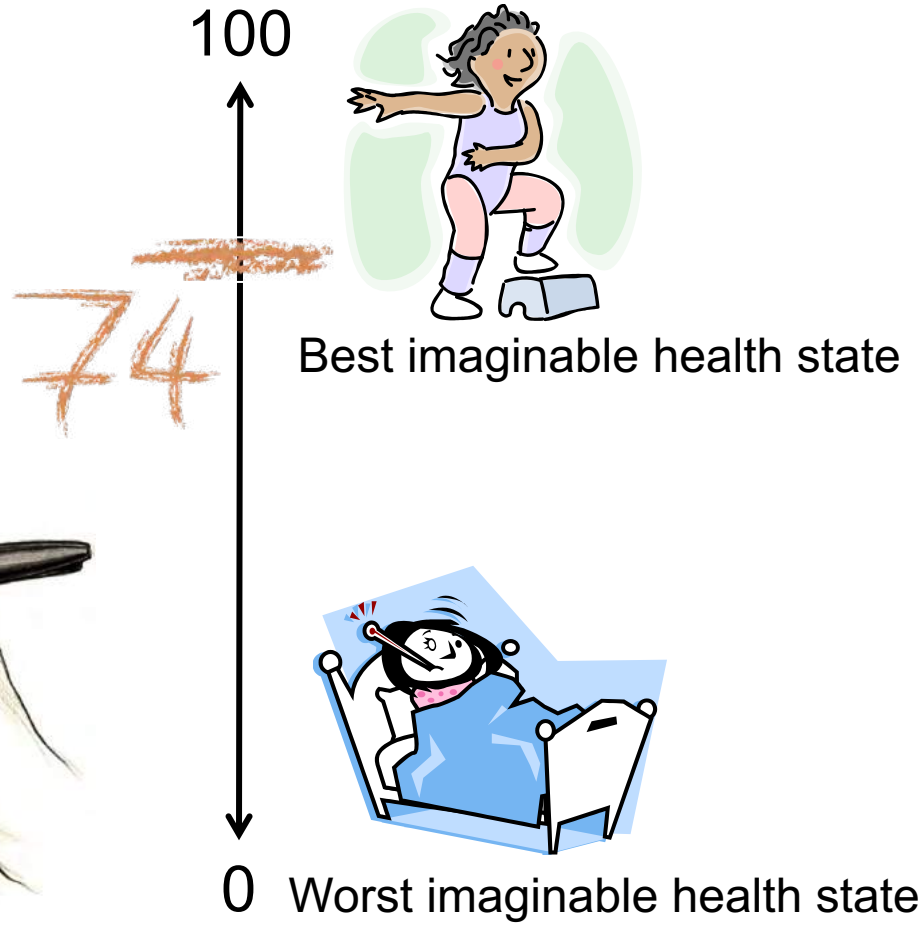
	Usual Care (n=46)	Intervention (n=47)	Overall (n=93)
Age (years)	47 ± 12	46 ± 14	46 ± 13
Gender (M:F)	27:19	29:18	56:37
Height (cm)	172 ± 9	174 ± 9	173 ± 9
Weight (kg)	80.0 ± 14.3	76.1 ± 13.6	78.1 ± 14.0
Waist circumference (cm)	93 ± 13	89 ± 13	91 ± 13
Body Fat content (BPM)	24.3 ± 13.5	23.2 ± 11.3	23.8 ± 12.4
Systolic BP (mmhg)	127 ± 15	126 ± 15	126 ± 14
Diastolic BP (mmhg)	78 ± 8	77 ± 7	77 ± 8
Heart rate (bpm)	71 ± 11	70 ± 9	70 ± 10
HbA1c (mmol/mol)	63 ± 12	61 ± 11	62 ± 11

Self reported health status

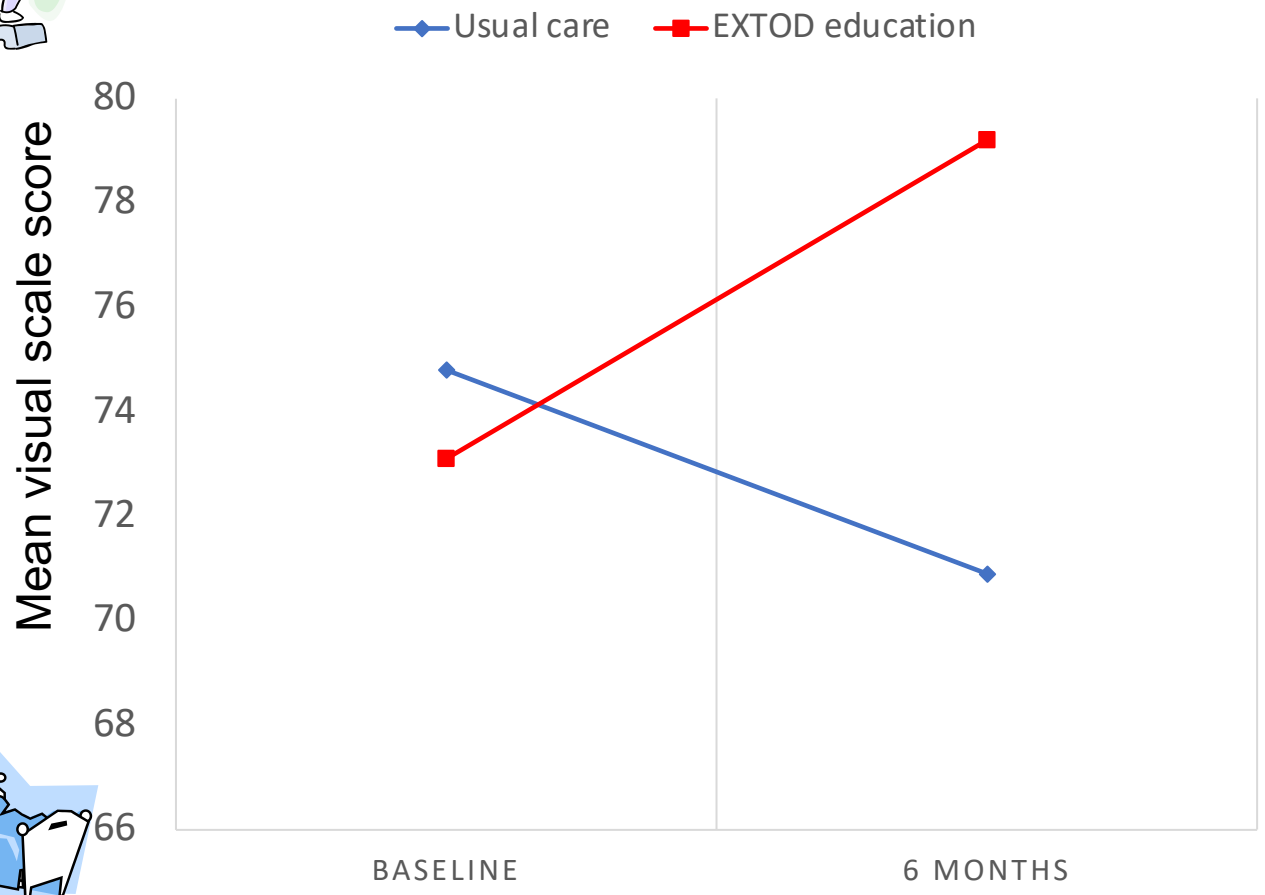
Linear Component of EQ-5D

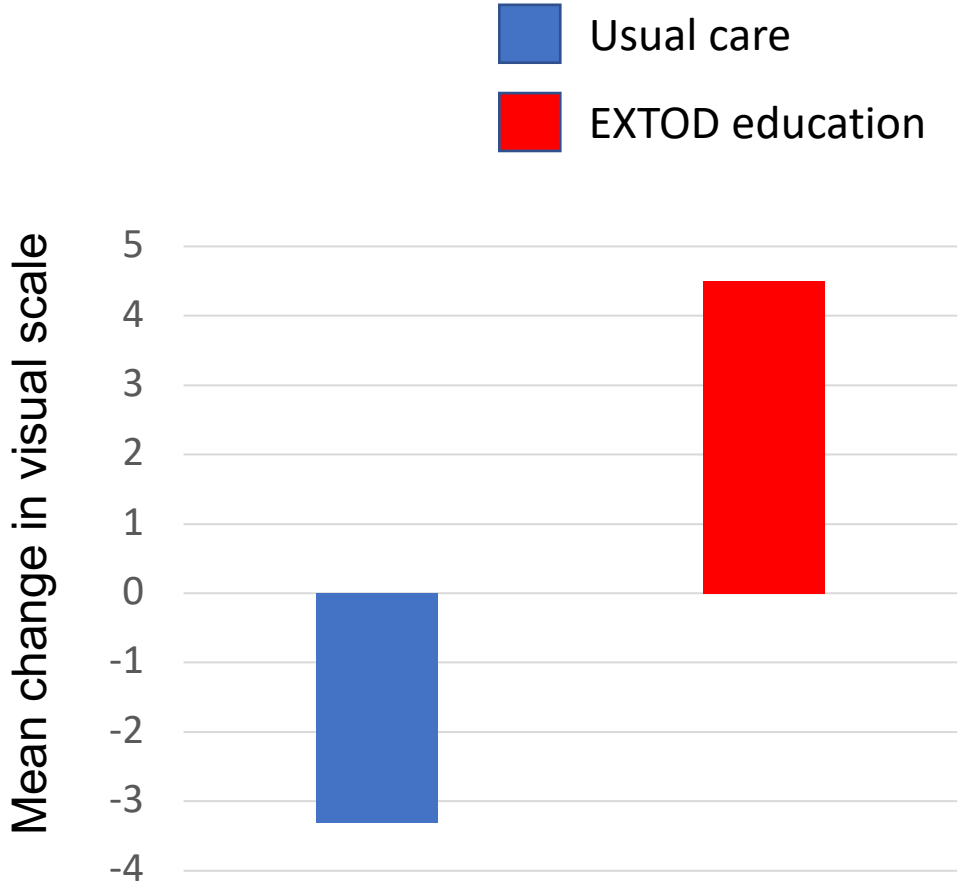
Please draw a line on the scale to indicate how good or bad your health state is today





Self reported health status





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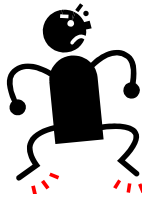
Diabetes distress



		Not a problem	A slight problem	A moderate problem	A somewhat serious problem	A serious problem	A very serious problem
1	Feeling that I am not as skilled at managing diabetes as I should be.	1	2	3	4	5	6
2	Feeling that I don't eat as carefully as I probably should.	1	2	3	4	5	6
3	Feeling that I don't notice the warning signs of hypoglycemia as well as I used to.	1	2	3	4	5	6
4	Feeling that people treat me differently when they find out I have diabetes.	1	2	3	4	5	6
5	Feeling discouraged when I see high blood glucose numbers that I can't explain.	1	2	3	4	5	6
6	Feeling that my family and friends make a bigger deal out of diabetes than they should.	1	2	3	4	5	6

28 questions
Score from all questions added to give total

Lower the score the less distress

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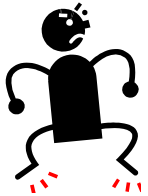
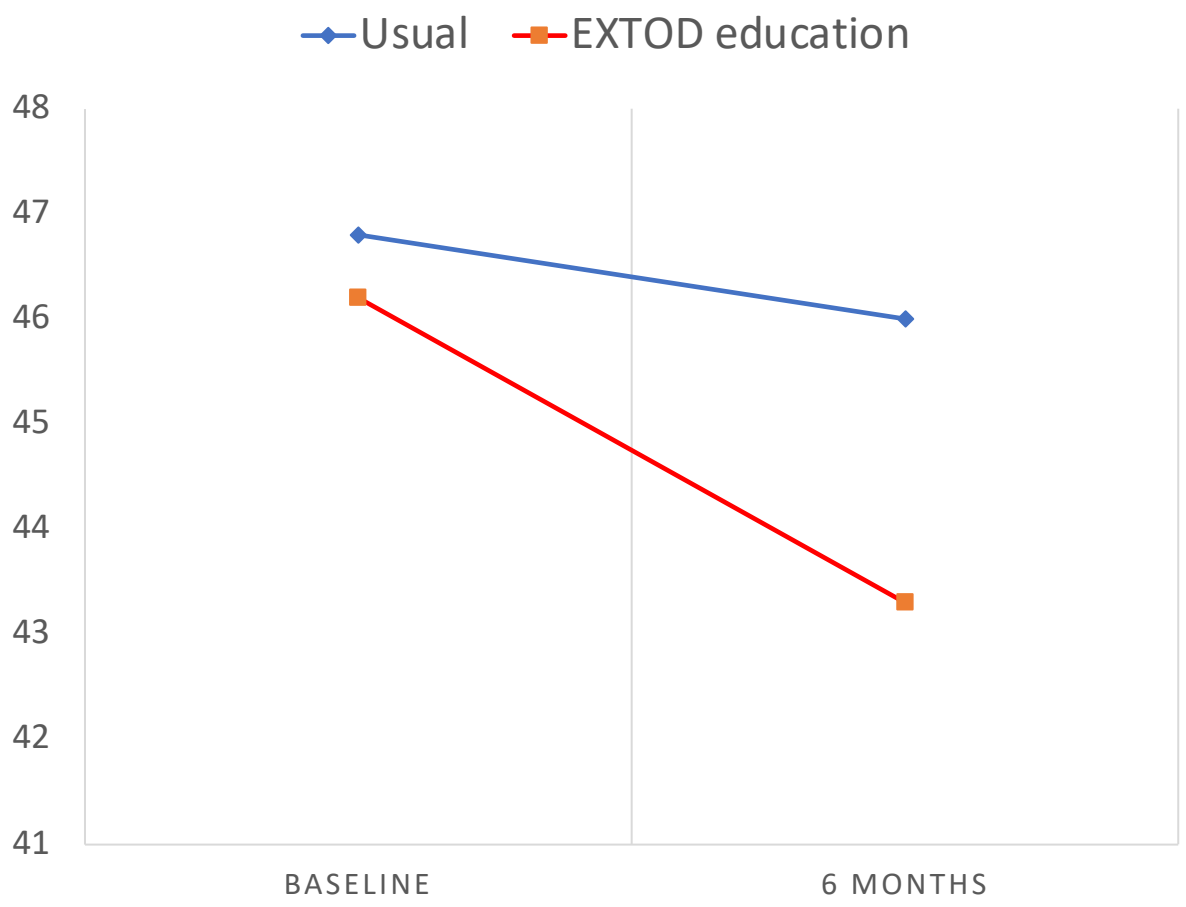
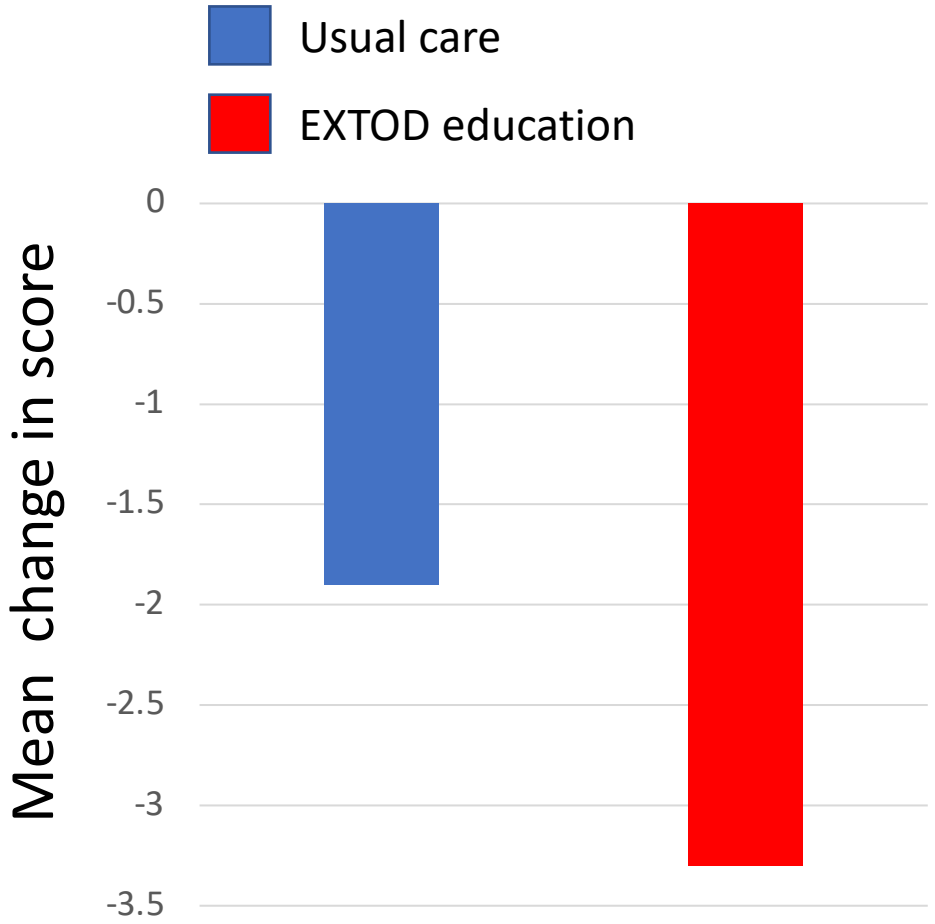
Diabetes distress







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Problems areas in diabetes

	Not a Problem	*Minor Problem*	*Moderate Problem*	*Somewhat Serious Problem*	*Serious Problem*
Not having clear and concrete goals for your diabetes care?	**0**	**1**	**2**	**3**	**4**
Feeling discouraged with your diabetes treatment plan?	**0**	**1**	**2**	**3**	**4**
Feeling scared when you think about living with diabetes?	**0**	**1**	**2**	**3**	**4**
Uncomfortable social situations related to your diabetes care (e.g. people telling you what to eat)?	**0**	**1**	**2**	**3**	**4**
Feelings of deprivation regarding food and meals?	**0**	**1**	**2**	**3**	**4**
Feeling depressed when you think about living with diabetes?	**0**	**1**	**2**	**3**	**4**
Not knowing if your mood or feelings are related to your diabetes?	**0**	**1**	**2**	**3**	**4**

20questions

Score from all questions added to give total

Lower the score the less problems

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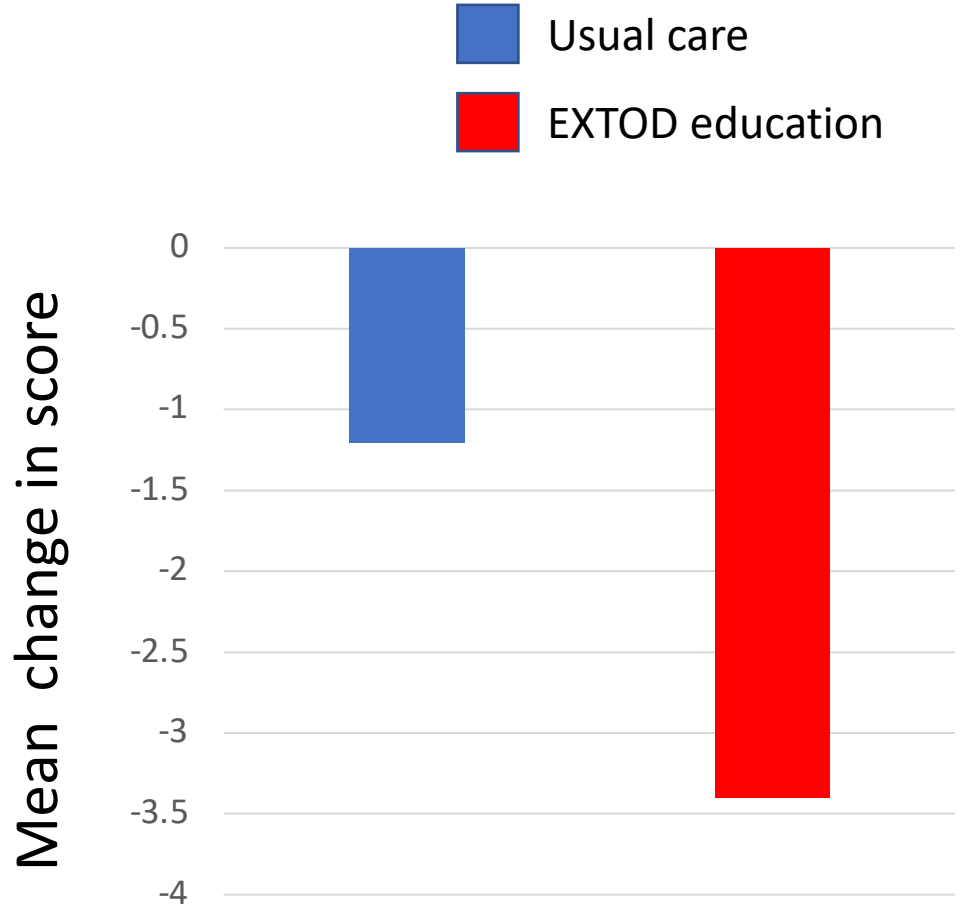
Problems areas in diabetes



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Barriers to exercise

Indicate the likelihood that each of these items would keep you from practicing regular physical activity during the next 6 months (1, extremely unlikely to 7, extremely likely).

1. The loss of control over your diabetes

1 2 3 4 5 6 7

2. The risk of hypoglycemia

1 2 3 4 5 6 7

3. The fear of being tired

1 2 3 4 5 6 7

4. The fear of hurting yourself

1 2 3 4 5 6 7

5. The fear of suffering a heart attack

1 2 3 4 5 6 7

6. A low fitness level

1 2 3 4 5 6 7

11 questions

Score from all questions added to give total and then divided by 11 to give mean.

Lower the score barrier to exercise

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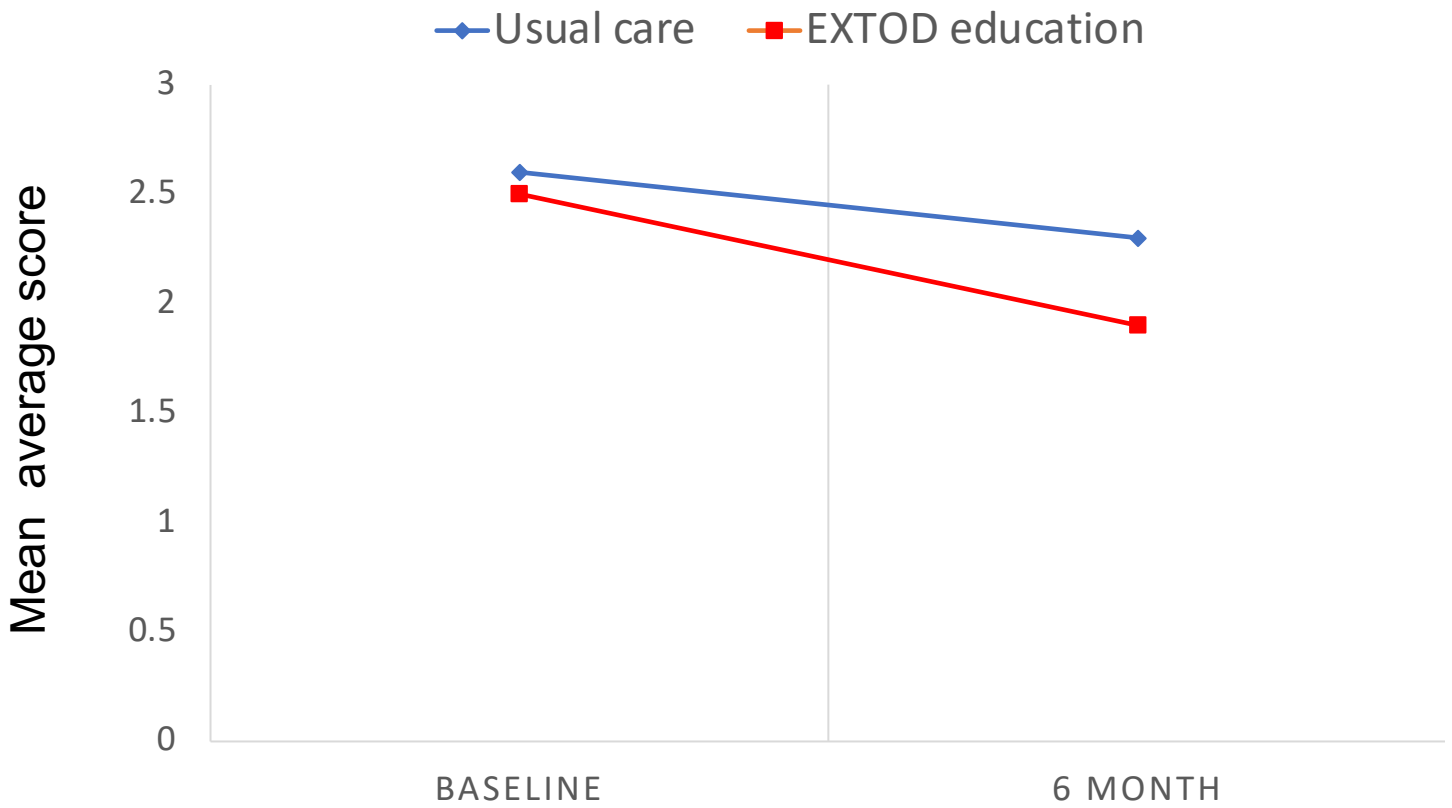
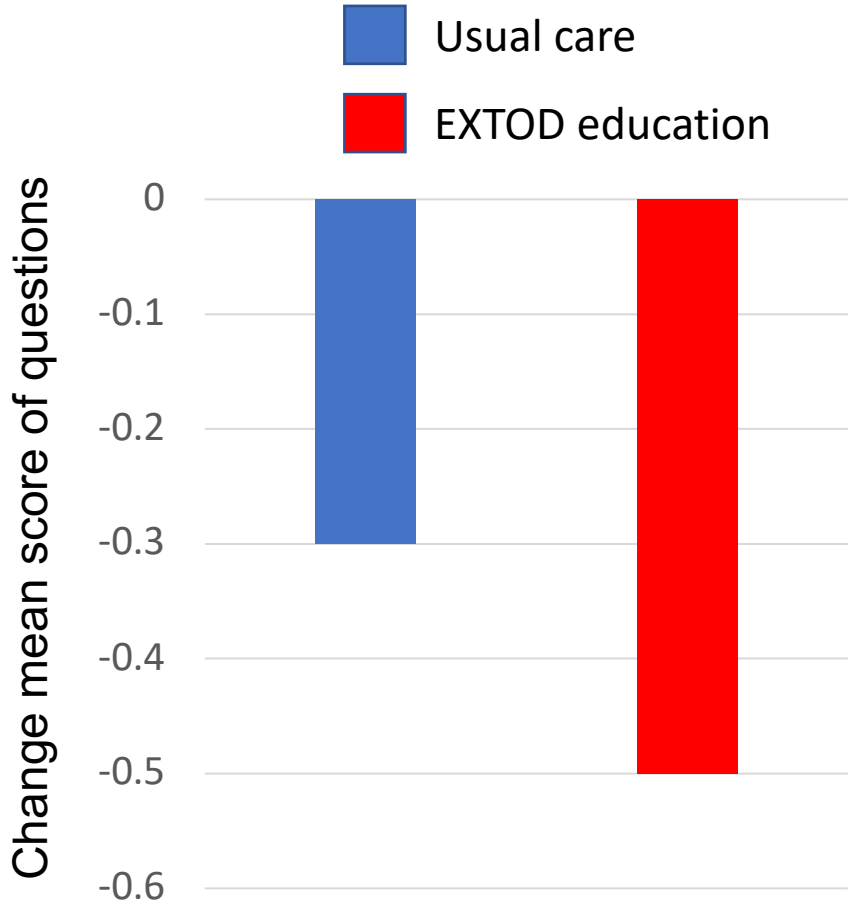
Barriers to exercise





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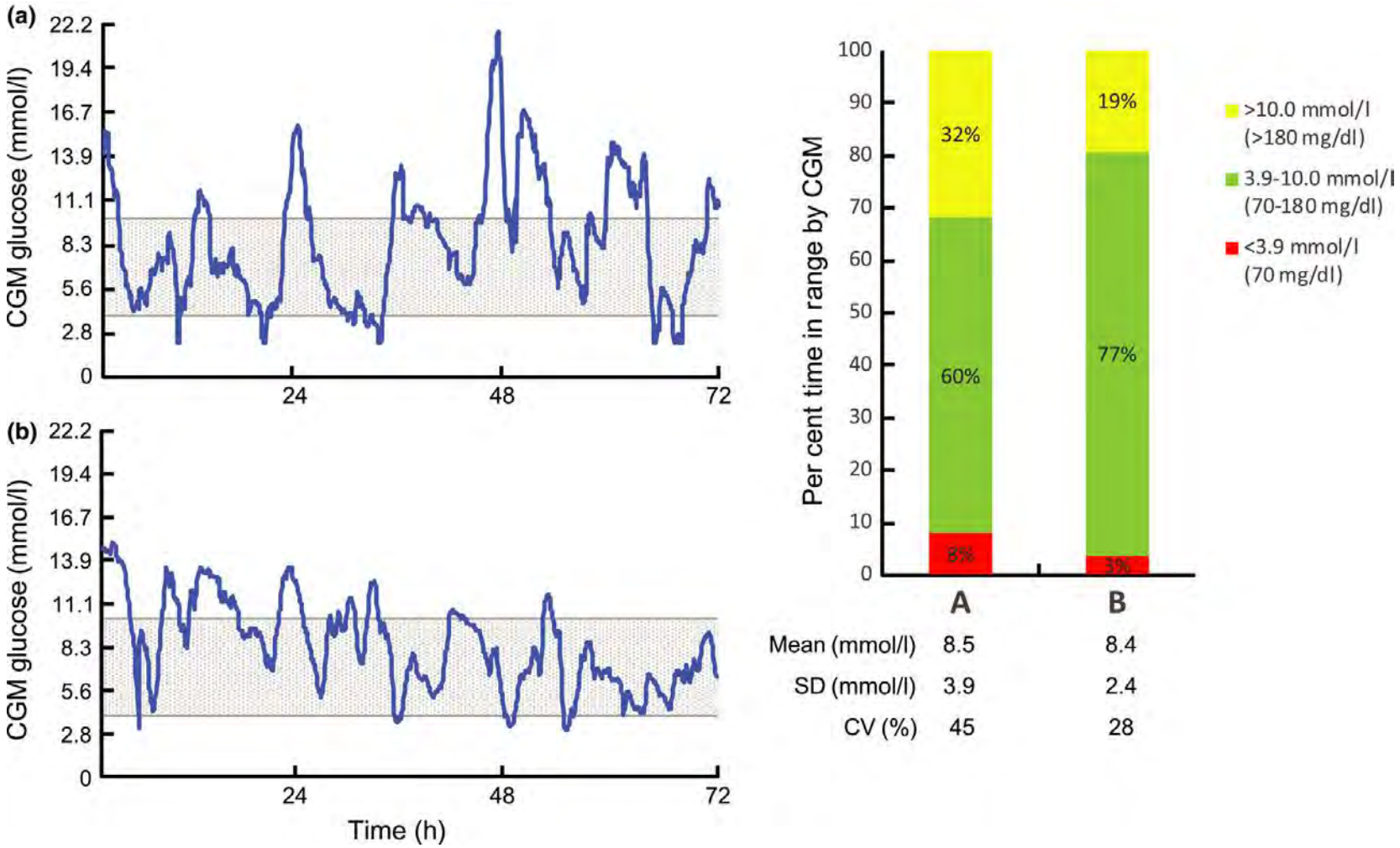
Glucose control and hypos results



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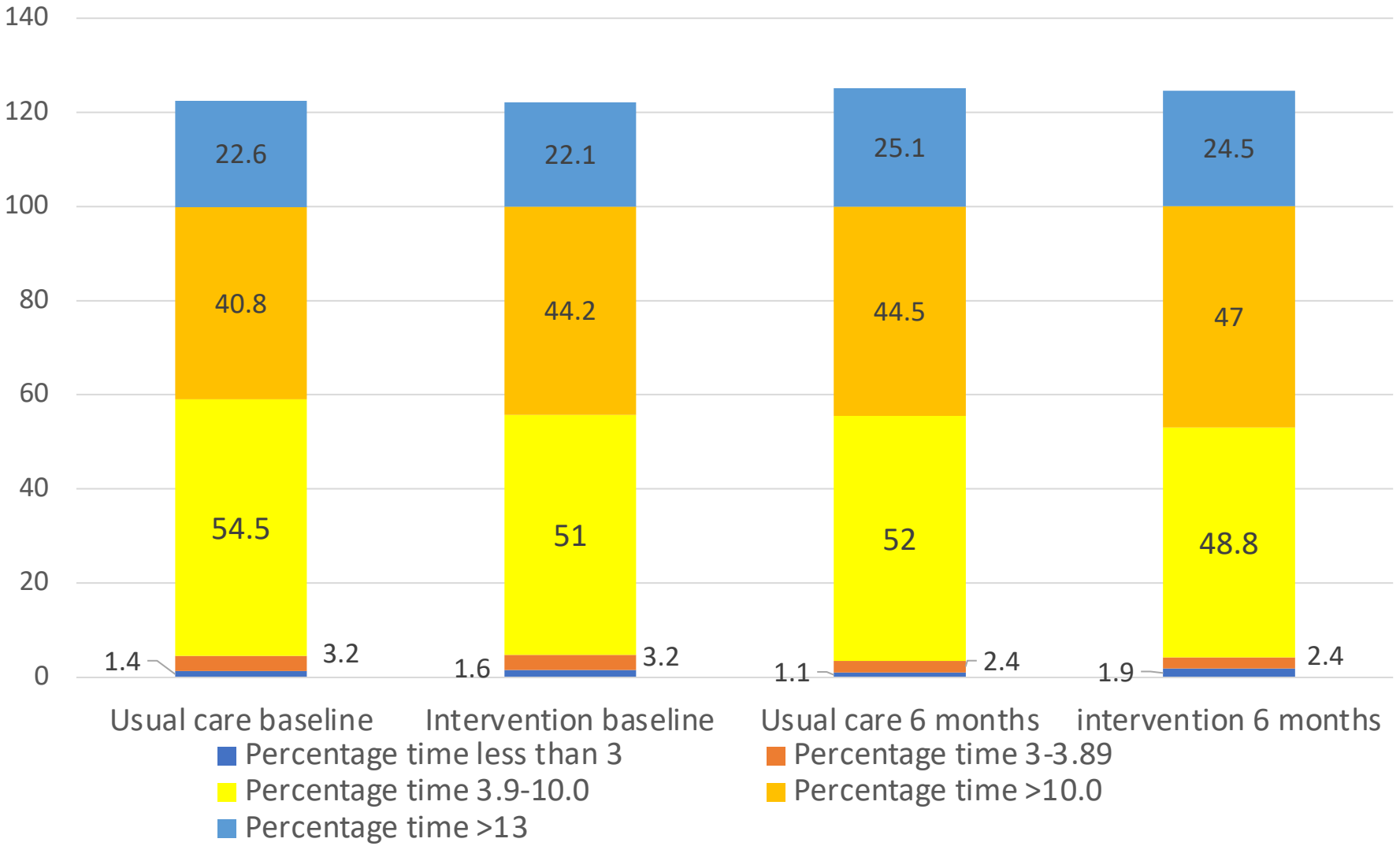
CGMs time in range at each time point



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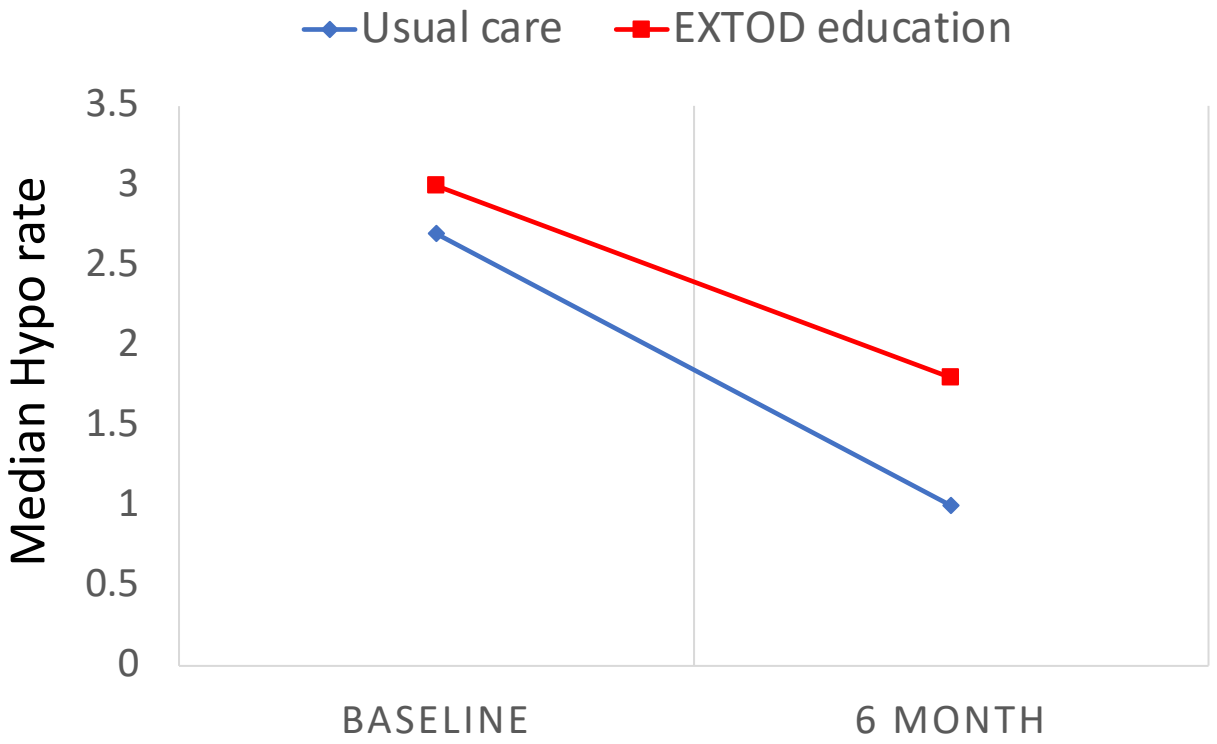
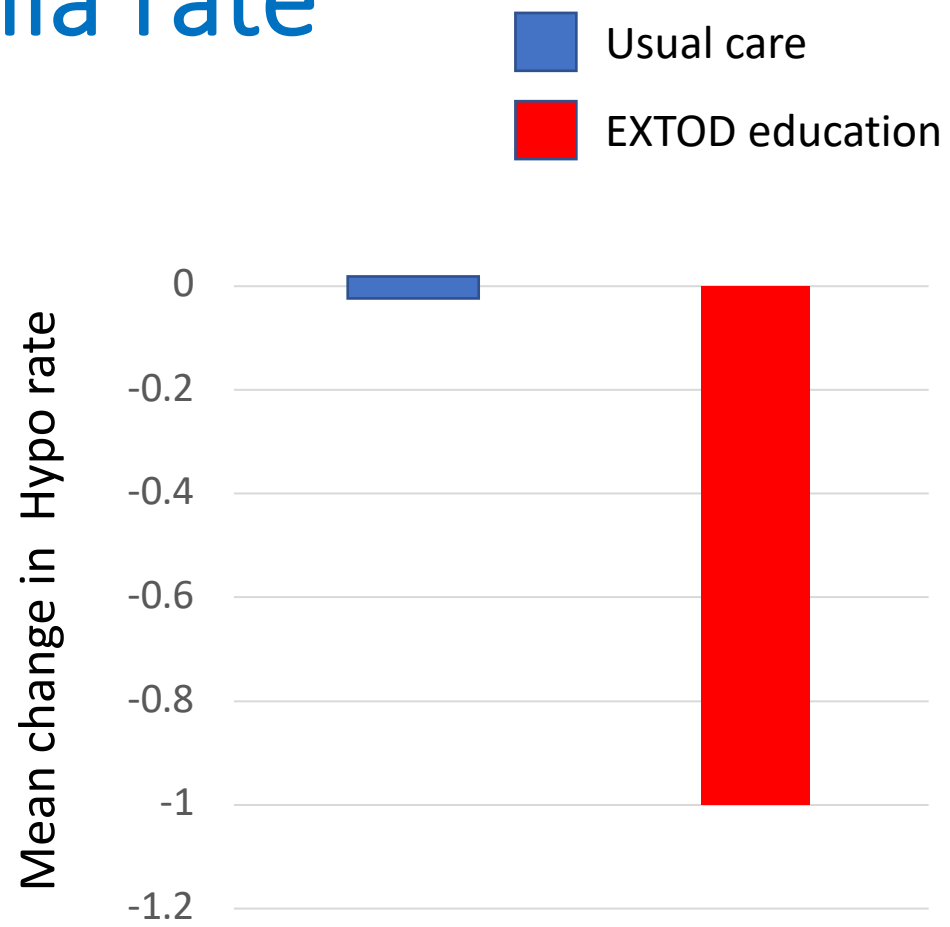
Hypoglycaemia rate





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Conclusions

I HAVE COME TO THE CONCLUSION THAT DRYER LINT IS THE CREMATED REMAINS OF ALL OF MY MISSING SOCKS.

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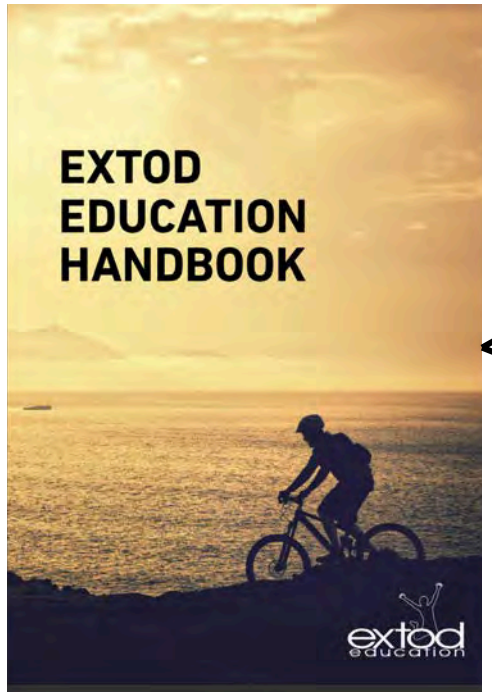
Conclusions EXTOD education study

- The education programme seems to be helpful improving many measures of hypoglycaemia and reducing hypo risk.



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extod education

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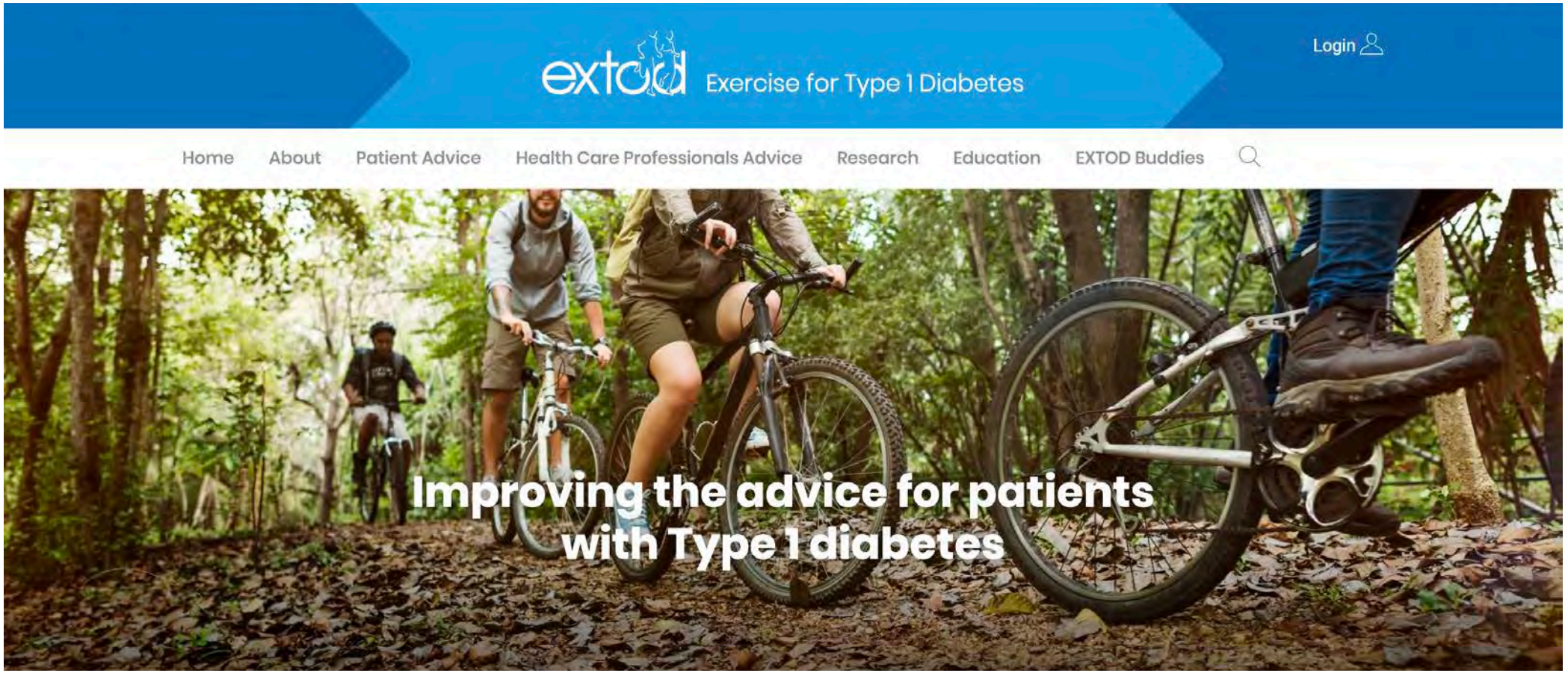
Further information – www.EXTOD.org



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