



Type 1 Diabetes & Exercise: Highlights from the Performance in Exercise and Knowledge (PEAK) Program (and some other cutting edge research on exercise and T1D)

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- Understand the benefits and risks of regular physical activity in type I diabetes
- List the main determinants of glucose responses to acute exercise
- Introduce a new decision support algorithm for evidence-based adjustments of nutrition and insulin for exercise
- Highlight some recent studies on improving exercise management











National Institute of **Diabetes and Digestive** and Kidney Diseases

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Insulin Management System

## Until a cure is found......

- I. Insulin
- 2. Exercise
- 3. A Healthy Diet





In spite of all the challenges, type 1 diabetes can be a disease that focuses you on the things in life that can help keep you healthy...

- Energy balance
- Good nutrition
- Exercise and fitness



## Higher physical activity levels are associated with lower HbA1c levels in young people with type 1 diabetes



N= 4655 Swedish patients

PAO, none, PAI, less than once a week, PA2, I-2 times per week, PA3, 3-5 times per week, and PA4, every day.

#### Beraki et al., Diabetes Res Clin Pract., 2014

## Exercise can cause dysglycemia in T1D...



Exercise has long been know to act like insulin to lower blood glucose levels



#### THE EFFECT OF EXERCISE ON INSULIN ACTION IN DIABETES.\*

BY

R. D. LAWRENCE, M.D., CHEMICAL PATHOLOGIST, KING'S COLLEGE HOSPITAL.



The British Medical Journal 1926

Exercise can transiently cause hyperglycemia..... Then late-onset hypoglycemia....





Glucose uptake increases dramatically with exercise and is elevated for up to 48 hours after exercise- this promotes hypoglycemia in T1D



## A fear of hypoglycemia in T1D is a barrier to exercise

- Adolescents with TID were shown to spend more time lying down and resting than non diabetic peers (2.0 vs. 1.3 h/day)
- In the global TEENS study, about <sup>2</sup>/<sub>3</sub>rds of youth with TID were not participating in 30 min of exercise daily





Hanas et al., ISPAD Meeting, Toronto, abstract #217; Lobelo et al., Pediatrics 2010; Mohammed et al., Can J Diabetes 2014.



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JDRF Performance in Exercise and Knowledge (PEAK) Program



#### Exercising Safely with Type 1 Diabetes

Do you have type 1 diabetes (T1D) or care for someone who does? Are you a healthcare provider who treats people with T1D? JDRF PEAK's one-day events offer the information you need to manage physical activity and T1D.





#### WHERE DOYOUR PATIENTS TAKE THEIR ADVICE FROM?



#### THETID KETOGENIC DIET FIGHT....





A → Share



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So that's 3 days of fasting in the bag... BG stable at 4.5 and ketones still at 5.1... have lost some weight - fat mass, lean mass unchanged and feel fine. Energy levels normal, drinking a bit more water than usual, but that can only be a good thing and am on total insulin per day of 6u.

 $\checkmark$ 



<u>Key Problem:</u> many individual sources of information on exercise and TID exist (mostly personal and individual); no central body at the national or global scale

JDRF-PEAK:

- A unique outreach initiative to increase education on the management of physical activity for individuals with TID
- Break new ground in supporting safe, informed exercise within the TID community
- Addressing the need for additional education for patients, parents, and caregivers on how to participate in physical activity while managing TID
- Education focuses on the physiological, dietary, and environmental elements that impact physical activity with TID





## Program Faculty

#### Founding Expert Panel

- Peter Adolfsson, Sweden
- Francesca Annan, UK
- Bruce Bode, US
- Paul Fournier, Australia
- Pietro Galassetti, US
- Ian Gallen, UK
- Claudia Graham, US
- Tim Heise, Germany
- Carin Hume, UK

- Tim Jones, Australia
- Aaron Kowalski, US
- Lori Laffel, US
- Alistair Lumb, UK
- Rory J. McCrimmon, UK
- Anne Peters, US
- Andreas Petz, Denmark
- Remi Rabasa-Lhoret, Canada
- Michael Riddell, Canada
- Iñigo San Millán, US
- Carmel Smart, Australia













#### **Program Faculty Expanded Faculty**

- **Richard Bracken, UK**
- Anne-Sophie Brazeau, Canada Jacqui Moran, UK
- Pratik Choudhary, UK
- Matthew Corcoran, US
- Liz Davis, Australia
- Katherine Desjardins, Canada Jeremy Pettus, US
- **Rob Andrews, UK**
- Kady Helme, US

- Clare MacArthur, UK
- - Parth Narendran, UK
  - **Charles O'Connell, US**
  - Sarah Oliver, US

- **Becky Sulik, US**
- Craig Taplin, US
- Eric Tozer, US
- **Stephen Twigg, Australia**
- Adrie van Diemen, **Netherlands**
- Dan West, UK
- Per Winterdijk, Netherlands





#### JDRF Peak Strategy and Program Implementation

#### **3-year educational initiative:**



Pilot program to test validity
U.S. > 9/26/15
U.K. > 10/24/15
Australia > 3/5/2016

Analysis of the pilot data and refinement of HCP curriculum Adaptation and development of curriculum for patients and their families/ caregivers Training of faculty to support global program roll-out

Global program roll-out





## JDRF PEAK Program Overview

Audience: Patients, their families, and HCPs

• Aims:

- To increase education and provide tools on the management of physical activity for individuals with TID
- To support safe, informed exercise within the TID community
- Format:
  - Core educational sessions and tools to illustrate the normal and abnormal metabolic responses to different forms of exercise and glycemic management strategies
  - Specialized electives on topics ranging from physiology and nutrition to insulin management strategies for pumps and MDI for kids to older adults (athlete, non athlete)
  - Curriculum geared to HCPs (I-day programme)
  - Curriculum geared to patients with TID and their families/caregivers (1/2 day program)





# Exercise management in type 1 diabetes: a consensus statement

Michael C Riddell, Ian W Gallen, Carmel E Smart, Craig E Taplin, Peter Adolfsson, Alistair N Lumb, Aaron Kowalski, Remi Rabasa-Lhoret, Rory J McCrimmon, Carin Hume, Francesca Annan, Paul A Fournier, Claudia Graham, Bruce Bode, Pietro Galassetti, Timothy W Jones, Iñigo San Millán, Tim Heise, Anne L Peters, Andreas Petz, Lori M Laffel

Type 1 diabetes is a challenging condition to manage for various physiological and behavioural reasons. Regular exercise is important, but management of different forms of physical activity is particularly difficult for both the individual with type 1 diabetes and the health-care provider. People with type 1 diabetes tend to be at least as inactive as the general population, with a large percentage of individuals not maintaining a healthy body mass nor achieving the minimum amount of moderate to vigorous aerobic activity per week. Regular exercise can improve health and wellbeing, and can help individuals to achieve their target lipid profile, body composition, and fitness and glycaemic goals. However, several additional barriers to exercise can exist for a person with diabetes, including fear of hypoglycaemia, loss of glycaemic control, and inadequate knowledge around exercise management. This Review provides an up-to-date consensus on exercise management for individuals with type 1 diabetes who exercise regularly, including glucose targets for safe and effective exercise, and nutritional and insulin dose adjustments to protect against exercise-related glucose excursions.



Lancet Diabetes Endocrinol 2017 Published Online January 23, 2017 http://dx.doi.org/10.1016/ S2213-8587(17)30014-1

Muscle Health Research Centre, York University, Toronto, ON, Canada (Prof M C Riddell PhD); Royal Berkshire NHS Foundation Trust Centre for Diabetes and Endocrinology, Royal Berkshire Hospital, Reading, UK (I W Gallen FRCP); Hunter Medical Research

## Identifying general trends and reasons for patient variability in blood glucose responses to exercise in T1D



#### NEW (CONSENSUS) EXERCISE DECISION TREE FOR TID



Figure 2: Decision tree for aerobic exercise and mixed aerobic and anaerobic activities lasting 30 min or longer in people with type 1 diabetes





Riddell MC et al., Lancet Diabetes Endocrinol. 2017



#### JDRF PEAK Pilot Program Overview







US Pilot Chicago, IL, USA September 26, 2015 UK Pilot Birmingham, UK October 24, 2015 Australia Pilot Sydney, Australia March 5, 2016

#### 220 ATTENDEES FROM 16 STATES & 7 COUNTRIES





## PEAK Symposia Highlights

- International Diabetes Federation (IDF)
  - December 2015
  - Vancouver, Canada
  - 100 attendees each at two symposia
- European Association for the Study of Diabetes (EASD)
  - September 2016
  - Munich, Germany
  - > 25 attendees at one symposium
- International Society for Pediatric & Adolescent Diabetes (ISPAD)
  - October 2016
  - Valencia, Spain
  - 350 attendees at one symposium





#### PEAK Symposia Highlights - IDF











PILOT PROGRAM FEEDBACK FROM HEALTH CARE PROVIDERS (NURSES, DOCTORS, NUTRITIONISTS, EXERCISE PHYSIOLOGISTS, ETC.)

**Overall Educational Quality of the Program** 







#### 9-MONTH POST PILOT ASSESSMENT- HCPs

Relative to your knowledge prior to participating in this program, how comfortable do you feel advising patients about T1D and exercise?







#### 9-MONTH POST PILOT ASSESSMENT-HCPs

What proportion of your patients have you talked to about how to manage their diabetes care around exercise since your participation in the PEAK program?



## PROGRAM ROLLOUT





#### Learn about the benefits and challenges of exercise while managing diet and blood glucose.

JDRF PEAK participants choose one of two tracks: people with T1D and caregivers or Healthcare Providers. Each track explores the environmental, dietary, physiological and psychosocial elements that impact physical activity in people with T1D. You'll come away understanding how to plan for and manage different types of activity safely and successfully with T1D. For CEU/CE Information Please Click Here

#### Program Rollout – U.S.







## Program Rollout – International



City, Country	2017 Date
Copenhagen, Denmark	May 22
Utrecht, Holland	May 16
Canberra, Australia	July 31
Birmingham, England	October 13
Toronto, Canada	November 17/18
Montreal, Canada	November 24/25







#### **Carbohydrate (CHO) Intake for Aerobic Exercise**





Riddell MC et al., Lancet Diabetes Endocrinol. 2017

# Adjusting the timing of exercise or manipulating bolus insulin dose to limit hypo risk



Exercise and Knowledge

## Exercise Hypoglycemia insulin management strategies

- 1. Reduce the pre exercise mealtime bolus by ~50%
- 2. Suspend/reduce basal insulin by 30-100%, ~60 minutes BEFORE the start of exercise until the end of the activity
  - Disconnection/suspension should be no more than 2 hours

ADJUSTING BOLUS INSULIN FOR AEROBIC EXERCISE



ADJUSTING BASAL INSULIN FOR SAMPLE AEROBIC EXERCISE (90 minutes, between 4:00 p.m. and 5:30 p.m.)





### Recent Technical Advances in T1D



Dexcom



In the very near future, we will be using "exercise smart" artificial pancreases!





Jacobs et al., Diabetes Obes Metab. 2016 Nov;18(11):1110-1119.

In the very near future, we will take minidose glucagon by special prefilled needles before exercise to prevent hypoglycemia!







In the very near future, we will know more about managing post exercise highs!





• CSII and CGS

- MOTIVATION!
- Regular predictable physical activity
- Moderate carb diet (nuts, seeds, fruits, vegetables, protein, milk...)
- An SGLT2 antagonist





#### **DIABETES SUMMER SPORT CAMP**

Summer Camps

Email to a Friend | Print

**CLICK HERE TO REGISTER!** 



The Diabetes Sports Camp, run through Professor and Researcher Dr. Michael Riddell, provides young people with Type 1 diabetes a necessary hand-on learning experieteres independent understanding and management of diabetes. This unique program is seamlessly integrated with the sport camps during the weeks of July 7-11 and 1 Or on the onhance the quality of life for young persons with diabetes through sport, physical activity and physical fitness in a unique camp experience with their peers.

#110



Hockey - Diabetes - Dskate - Dskate U - Events - About -



#### Dskate

The only "Hockey + Diabetes" sports-education Program in the world. For players living with Diabetes and their families. Helping young athletes living with diabetes achieve a greater quality-of-life while discovering their limitless potential to succeed.







## Relative change in glucose levels with pump "off" during moderate walking vs. circuit training exercise



▲ Continuous (Suspended Basal)



Zaharieva et al., Diabetes Tech Ther in press

#### Modified Clarke Error Grid & Bland Altman Plots: Measured vs. Perceived BG Concentrations

