

Type 2 Diabetes and Exercise

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- Introduction – my story
- Defining type 2 diabetes
- Etiology
- Stats
- Exercise
 - Movement
 - Aerobic
 - Anaerobic
 - Resistance

Agenda



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My Story



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My Story by the Numbers

Date	HbA1C
August 2015	5.9
August 2016	6.3
November 2017	7.7

NO! NO!! NO!!! Not Yet!

Then something significant happened – I got the flu.

- Blurry eyes
- Craved water
- Peed a LOT
- Lost 25-30 lbs

March 15

Fasting Blood 350 / HbA1C 12.6

it
OM

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Criteria for Diagnosis

Normal	Below 5.7%
Prediabetes	5.7% to 6.4%
Diabetes	6.5% or above

A1C%	eAG mg/dL
7	154
8	183
9	212
10	240



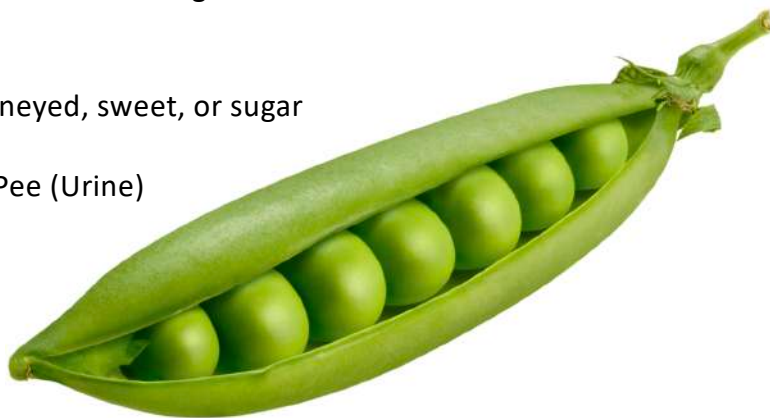
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Defining Diabetes Mellitus

Diabetes – Greek for siphon or flow through

Mellitus –Latin meaning honeyed, sweet, or sugar

Literal Translation – Sweet Pee (Urine)



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So... How Did They Know it was Sweet?

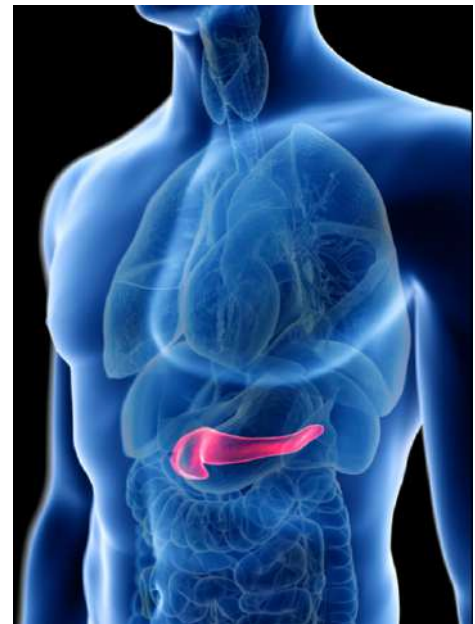
- Physicians as early as 600 BC recorded that ants were attracted to sugar in patients' urine.
- Thomas Willis, an English physician, described diabetic urine in a 1674 journal as "wonderfully sweet as if it were imbued with honey or sugar."



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Insulin Resistance

- Insulin is the key that allows glucose to leave the bloodstream and be stored in the muscles
- Over time the beta cells in the pancreas can stop producing insulin (similar to type 1)
- Our focus will be non-insulin mediated glucose uptake ... via exercise!



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Risk Factors

LIFESTYLE / ENVIRONMENTAL RISK FACTORS

- Sedentary behaviors
- Overconsumption of sugar
- Overconsumption of "unhealthy" fat
- Overconsumption of (red) meat
- Smoking

OTHER RISK FACTORS

- Family
- Age
- Fat distribution
- Obesity
- Race
- Stress
- Sleep apnea

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- Every 21 seconds someone in the US is diagnosed with diabetes (ADA)
- Type 2 diabetes is diagnosed in 1.5 million people in the US every year
- According to the [National Diabetes Statistics Report \(2020\)](#) put out by the Centers of Disease Control and Prevention (CDC) there are an estimated 34.2 million Americans with diabetes (approximately 1.5 in every 10) and 90-95% are type 2
- Those over the age of 18 the estimates are 34.1 million which shows why type 2 diabetes is commonly known as adult onset diabetes
- An estimated that 7.3 million of those are not aware they have diabetes
- From 2002-2012 the research illustrates the incidence of diabetes increasing in both type with type 1 showing a 1.8% increase and type 2 showing a 4.8% increase in young people.

<https://care.diabetesjournals.org/content/early/2018/03/20/dci18-0007>

CLASSROOM

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\$327 billion – annual cost of diagnosed diabetes in America

\$237 billion in direct medical costs

\$90 billion in reduced productivity

\$3.3 billion in absenteeism

\$26.9 billion in reduced productivity at work (for those employed)

\$2.3 billion in reduced productivity for unemployed

\$37.5 billion incapable of working due to diabetes-related disability

\$19.9 billion in lost productivity due to mortality

From the previous 2012 study to this 2018 study, total diagnosed cost for diabetes rose \$82 billion dollars per year

\$1 in \$7 healthcare dollars is spent treating diabetes and its complications

\$16,752 - the average healthcare cost per diabetic patient per year

\$9,601 of that is directly attributed to diabetes



<https://care.diabetesjournals.org/content/early/2018/03/20/dci18-0007>



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Complications for Type 2 Diabetes

- Heart disease
- Stroke
- Arthrosclerosis
- High blood pressure
- Nerve damage
- Eye damage
- Kidney damage
- Slow healing
- Hearing issues
- Skin conditions
- Sleep apnea
- Alzheimer's disease
- Foot complications
- Ketoacidosis (rare in T2D)



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First Intervention – Diet and Exercise

Dietary guidance provided by:

- Certified diabetes educator
- Registered dietician
- Physician's assistant
- Sometimes physicians

Exercise guidance provided by:

- Tips
- Tricks
- Very little programming or real support.

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Exercise and Type 2 Diabetes



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WALKING



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Walking

Author: Motahari-Tabari et al.

Method: RCT

Subjects: 53 T2D women

Control: n=26

Intervention:

- n=27
- 10 min warm-up with stretches
- 30 min walking at 60% of est. MHR
- 10 min cool-down with stretches

Duration: 50 mins 3x/week for 8 weeks

Results:

- significant differences in
- weight ($p=0.01$)
- waist circumference ($p=0.004$)
- hip circumference ($p=0.000$)
- BMI ($p=0.01$)
- plasma insulin ($p=0.002$)
- insulin sensitivity ($p=0.004$)

There was no meaningful difference in insulin resistance between the groups at the beginning of the study and after the first and second month, but it was significantly lower in the exercise group after 2 months.



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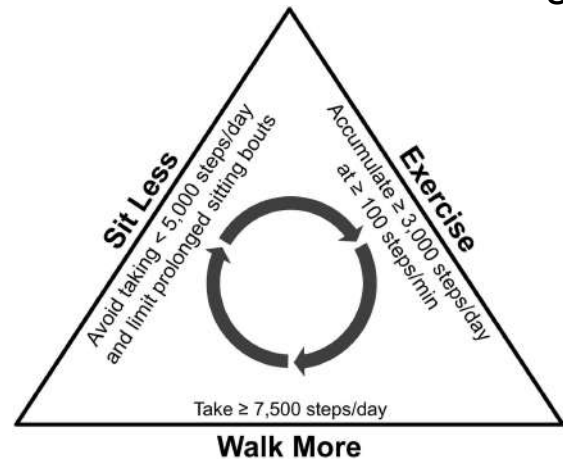
Walking – Tudor-Lock & Schuna (2012)

“Walk more, sit less,
and exercise.”

- Avoid \leq 5k steps per day
- Strive for \geq 7.5k steps per day
- 3k of steps \geq 100 steps/min pace
- Interrupt sitting with movement

Non-Exercise Physical Activity

- 150+ mins/wk brisk walking



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Walking - Weinstein et al., 2004

Women’s Health Study found that self-reported walking for 2–3 h/week was associated with a 34% reduction in the incidence of Type 2 diabetes over almost 7 years of follow- up.

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Honorable Mention – Watch This...



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AEROBIC EXERCISE



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Aerobic (Khashaba, 2016)

Intervention Group

- N=15
- Diet, meds + aerobic exercise
- 3 days/wk. 40 mins
- 50-85% of VO₂max 12 weeks
- HbA1C – 12% decrease ... significant
- VO₂max – 25% increase ...significant

Control Group

- N=15
- Diet and medication
- 12 weeks
- HbA1C – not significant
- VO₂max – not significant
- VO₂max – significantly lower than the intervention group post study



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Aerobic v Aerobic Interval

(Santiago et al. 2018)

Aerobic – 35 mins 85-90% of anaerobic threshold

Aerobic Interval – 45 mins. 9 x 5mins. 4 mins @ 85-90% of AT. 1 min ≤ 85% AT (*benefits those that may need breaks*)

Pre-Training: RPE Borg Scale 11-13

Training: RPE Borg Scale 13-15

- Both significantly lowered blood glucose
- Both significantly lowered blood pressure
- Stable decrease over 30 mins post-exercise



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ANAEROBIC EXERCISE



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Quote – Bird & Hawley, 2012

“There is an urgent need for innovations in exercise prescription that can be incorporated into daily living and induce clinically beneficial health outcomes. Here we focus attention on a novel form of exercise prescription, high-intensity interval training (HIT), and provide evidence that HIT is a time-efficient and well-tolerated therapeutic intervention to improve cardio-metabolic health in a number of pre-clinical and clinical populations.”



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Anaerobic

Boule et al. meta-analysis of seven studies, with nine comparisons and a total of 266 subjects with type 2 diabetes:

- Mean frequency was 3.4 sessions/week
- Mean duration of 20 weeks
- Mean session duration of 49 min
- Mean intensity of 55% VO₂max

Exercise intensity was a better predictor than exercise volume of the difference in HbA1c and VO₂max between the exercise and the control group.



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HIIT (Wormgoor et al. 2017 narrative review on 14 HIIT studies)

- **HIIT** interventions demonstrated beneficial effects on various cardiometabolic risk factors in adults with type 2 diabetes.
- **vs MICT** : In the 5 studies that included a comparison to MICT, there was no evidence of HIIT's being significantly superior for GC, BP, lipidemia and body composition improvements, except for 1 study that reported a greater reduction in body mass



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HIT and SIT - Jiménez-Maldonado, 2020

- No time – No problem...
- Improve GC similar to aerobic in T2D
- Reductions in long-term HbA1C
- Adherence similar to MICT



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RESISTANCE TRAINING



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Resistance - Codella et al., 2018

Major benefits documented w RT in subjects with T2D :

- (i) increase of insulin sensitivity and glycemic control;
- (ii) improvement of blood cholesterol profiles;
- (iii) blood pressure decrease;
- (iv) improvement of cardiac performance;
- (v) increase in strength and muscular power;
- (vi) increase of lean body mass;
- (vii) increase in bone mineral density (with preventive effect on sarcopenia and osteoporosis);
- (viii) increase of daily energy expenditure
- (ix) quality of life.



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Resistance - Codella et al., 2018

- Aerobic training may be painful for those with comorbidities such as obesity, osteoarthritis, peripheral vascular disorders, and other physical disabilities.
- Exercise intensity can be difficult to control
- Resistance training with small weights and anaerobic stimulation is a valid alternative to manage T2D
- Insulin sensitivity is directly proportional to lean body mass. The increase of lean mass remains, therefore, a reasonable goal for T2D subjects performing RT



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Conclusion

- Diabetes – managed, but not cured
- Exercise helps
- Type of exercise is important to understand and track
- Combination of exercises TBA in future work
- Stay tuned for the “Type 2 Diabetes Exercise Specialist Course”



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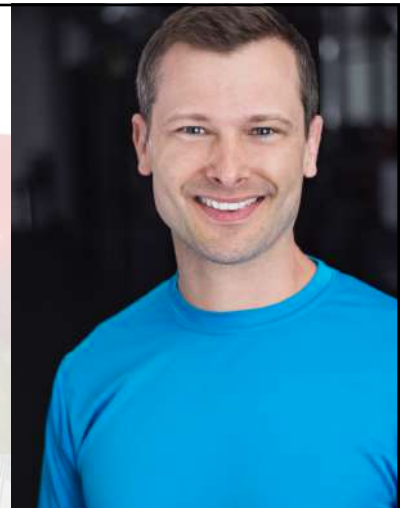
Thank You

Q&A?

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