Movement = Medicine:
A Critical Role for Physical Activity in Treating Diabetes.
Natural Selection – beneficial traits that are heritable increase in frequency over time.

1) Physical activity/fitness/strength obligatory for survival?
2) Thrifty Genes – highly efficient – store and conserve energy

<table>
<thead>
<tr>
<th>Group</th>
<th>Steps/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paleolithic Stone Agers(^1)</td>
<td>24,000</td>
</tr>
<tr>
<td>\textit{how we evolved}</td>
<td></td>
</tr>
<tr>
<td>Amish(^2)</td>
<td>18,000 (men)</td>
</tr>
<tr>
<td>\textit{agriculture lifestyle}</td>
<td>14,000 (women)</td>
</tr>
<tr>
<td>Modern USA (^3)</td>
<td>5,117</td>
</tr>
</tbody>
</table>

3. Bassett and Hill et al. MSSE 2010
Post-Meal glucose disposal

- Liver
- Pancreas
- Meal
- Muscle (sink – important disposal site)
- Activity

Insulin sensitivity = insulin’s ability to drive Glucose into muscle and peripheral tissues

Type 1 vs. Type 2 Diabetes?
Glucose and Insulin Responses Across Groups

Normal Weight Active
Overweight Sedentary
Impaired Glucose Tolerant
Type 2 Diabetes

Glucose mmol/L

Insulin pmol/L

Postmeal Glucose Excursion

Hyperglycemia

GENETIC COMPONENT RESIDES IN PANCREAS
Pathology of T2D

- NGT – normal glucose tolerance
- IGT – Impaired glucose tolerance
- DIA – Diabetes/T2D

Adapted from Kahn, S. E. J Clin Endocrinol Metab 2001;86:4047-4058
Physical activity and prevention of T2D

Adjusted for age and gender:

- Relative risk of diabetes (107 cases out of 487)

- Minutes walked per day

- >3,500 steps/day confers protection

Frets et al. Diabetes Care 2012

Laaksonen Diabetes 54:158-165, 2005
Treatment: short term exercise and glucose levels in free living patients with T2D

- 7 Days of Exercise
- 1 hour each day
- Walking on treadmill
- <5,000 to >10,000 steps/day

Oberlin et al. MSSE 2013
Mikus et al. Diabetologia 2012
Proven mechanisms for exercise/activity to treat T2D

Meal Consumption

↓ Glycemic Variability
The Physical Activity Spectrum

‘Real Life’

Sed only

Sed/End

Active/
No Vigorous

Full range
Activity/exercise

‘Exercising’
Benefits for Type 2 Diabetes of Interrupting Prolonged Sitting With Brief Bouts of Light Walking or Simple Resistance Activities

Every 30 min:
- A light 3 min walk
  - Or
- Standing and doing light exercise

Figure 3—Fasting and postprandial plasma glucose (A), serum insulin (B), serum C-peptide (C), and plasma triglyceride (D) concentrations measured during SIT (○) and sitting interrupted with 3-min LW (□) or SRA (●) bouts. Vertical dashed lines indicate timing of the breakfast (0 h) and lunch (3.5 h) meals. Data are presented as mean ± SEM.

Dempsey and Dunstan et al Diabetes Care 2016