Physical Activity and Inactivity in Individuals with Pre-Diabetes

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Effect of Westernization on Health; Falling Out of Balance

The Activity Spectrum

Two people with similar amounts of moderate/vigorous activity but vary by time spent in light and sedentary

Person A
Person B

The BURDEN of not being physically active is extensive:

- Coronary heart disease (CVD)
- Certain types of cancer
- Gallbladder disease
- Bone health
- Mental health
- Osteoarthritis
- Quality of life
- Weight management
- Type 2 diabetes
**CLINIC PROCEDURES:**
- Oral Glucose Tolerance Test
- Weight and Height (BMI)
- Waist-to-Thigh Ratio
- Physical Activity Questionnaire

**Diabetes Incidence Rates by Total Physical Activity Levels**
(Follow-up of 1,728 Pima Indians, without Diabetes at Baseline)

![Graph showing incidence rates by physical activity levels and age groups](image)

**Diabetes Prevention Program**
The Evidence Behind the Translation Efforts

- **Diverse**
  - Age
  - Ethnic/Racial
  - Geographic

- 3,234 individuals at unhealthy higher weights and with pre-diabetes from across 27 US sites
- Randomly assigned to one of 3 arms: lifestyle, drug (metformin), or placebo.
**Program Goals**
- Lose 7% of body weight
- Do 150 minutes (2½ hours) of moderate intensity physical activity per week
  (These were minimum goals)

**Physical Activity Recommendations**

“Every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week.”

*JAMA, 1995*

A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine

**Diabetes Prevention Program Results: Mean Change in Leisure Physical Activity**

- 58% decrease in diabetes incidence in the lifestyle vs. placebo groups
- Worked across all subgroups, including age, sex, baseline BMI and ethnicity/race

**Diabetes Incidence Rates by Ethnicity**

**Diabetes Incidence Rates by Age**

The DPP Research Group, NEJM 346:395-405, 2002
**Diabetes Incidence Rates by Sex**

![Graph showing Diabetes Incidence Rates by Sex](image)

The DPP Research Group, NEJM 346:393-403, 2002

**Reduced Cumulative Incidence of the Metabolic Syndrome**

![Graph showing Reduced Cumulative Incidence of the Metabolic Syndrome](image)

*Orchard, et al., JAMA 233:1439-1441, 2002

**DPP to DPPOS**

- January - June 2002: all participants were offered a group version of the DPP Lifestyle Intervention Program
- September 2002-present: the DPPOS study began (N = 3251; 88% of all original DPP groups)
- June 2010 - July 2012: the DPPOS Accelerometer Ancillary Study was conducted

**Metabolic Syndrome**

**National Cholesterol Education Program (NCEP) Adult Treatment Panel III:**

- Clustering of abdominal obesity, atherogenic dyslipidemia, hypertension, and insulin resistance
- Defined as any 3 of the following risk factors:
  - Waist circumference >40" (men) or >35" (women)
  - TG ≥150 mg/dL
  - HDL-C <40 mg/dL (men); <50 mg/dL (women)
  - BP ≥130/85 mm Hg
  - FPG ≥100 mg/dL


**DPP Outcomes Study (DPPOS)**

- 2766 DPP participants joined DPPOS (88% of all original DPP groups)
- DPPOS Goals:
  - Diabetes delay or prevention
  - Prevention of diabetes complications such as kidney, eye and nerve problems, and heart disease

In the DPP, an investigation was done to examine the impact of change in weight and activity on risk of developing diabetes among lifestyle participants.*

- Weight change significantly predicted the reduction in diabetes incidence (for every kg of weight, there was a 16% reduction in risk).
- Achieving the PA goal but not weight loss goal resulted in a 46% reduction in diabetes. PA was also important for weight loss.

*Hazzan et al, Diabetes Care, 2008
DPPOS Incidence of Diabetes

DPPOS Accelerometer Ancillary Study
- Designed to incorporate an objective measure of physical activity and sedentary time as part of the Diabetes Prevention Program Outcomes Study (DPPOS)
- Conducted at 23 of 26 DPP sites
- Open to all DPPOS participants who were not confined to a wheelchair, able to walk, and without significant cognitive impairment (per clinic staff)

Grant: NIDDK 5R01DK081345-03

Accelerometer
- Measures all intensities of movement throughout the day:
  - Inactivity - Sitting time
  - Light Activity
  - Moderate Activity
  - Vigorous Activity
- Best at capturing activities that resemble walking (and running)

Physical Activity Spectrum

So what do we know….
- We can prevent diabetes with lifestyle intervention
- Physical activity is a critical component of this intervention effort

So how about translation?
- Can we take this behavioral lifestyle intervention into the community and get successful results?
Percent of women from the DPP and from NHANES III reporting being physically inactive over the past month

<table>
<thead>
<tr>
<th>Age Group</th>
<th>NHANES III</th>
<th>DPP</th>
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<tbody>
<tr>
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Percent of men from the DPP and from NHANES III reporting being physically inactive over the past month

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Who is the group we are most interested in targeting?

Low Moderate High

Change in Activity from Baseline

The Diabetes Prevention Support Center
University of Pittsburgh

The DPSC guides community translation efforts thru facilitating all aspects of delivery of a modified DPP lifestyle intervention program, the Group Lifestyle Balance™.

- Up-to-date one-year curriculum
- Curriculum approved by CDC Diabetes Prevention Recognition Program
- DVD version of core curriculum available
- Training and ongoing support for lifestyle coaches

Group Lifestyle Balance Translation Research Project

- University of Pittsburgh translational research study funded by NIH (Kriska, PI)
- Purpose: To formally evaluate delivery of the GLB lifestyle intervention research program in three very different community settings:
  - Community Senior Centers
  - Worksite
  - Military

DPP-GLB Program Evaluation Participant Eligibility

- ≥18 years of age
- No reported history of diabetes
- BMI ≥24 kg/m² (≥22 kg/m² for Asians)
- Pre-diabetes and/or the metabolic syndrome
  - Pre-diabetes:
    - Fasting glucose 100 mg/dL - 125 mg/dL and/or
    - Hemoglobin A1c 5.7% - 6.4%
  - Metabolic Syndrome (at least 3 of the following):
    - Waist ≥35 (F) / ≥40 (M) inches
    - Blood Pressure ≥130 and/or ≥85 mm Hg (or on treatment)
    - HDL Cholesterol <50 (F) / <40 (M) mg/dL
    - Triglycerides ≥ 150 mg/dL)
DPSC Translation Efforts:
Group Lifestyle Balance Program

• One-year group program adapted and updated from the DPP Lifestyle Balance curriculum
• 12 core, 4 core transition, and 6 monthly sessions
• Program delivery by trained health professionals

Baseline Characteristics of Participants in the DPP-GLB Intervention (N=287*)

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<th>Characteristic</th>
<th>Mean (sd)</th>
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<tr>
<td>Age (years)</td>
<td>58.4 (11.3)</td>
</tr>
<tr>
<td>Sex: % (n) Female</td>
<td>62.7 (180)</td>
</tr>
<tr>
<td>Education: % (n) Bachelor’s Degree</td>
<td>64.1 (184)</td>
</tr>
<tr>
<td>Race/Ethnicity: % (n)</td>
<td></td>
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<tr>
<td>Non-Hispanic White</td>
<td>86.1 (247)</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>7.0 (20)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>3.1 (9)</td>
</tr>
<tr>
<td>Other</td>
<td>3.8 (11)</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>208.0 (43.0)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>33.7 (9.9)</td>
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<tr>
<td>Physical Activity (MET-hours/week); Median (IQR)</td>
<td>10.5 (3.75-21.50)</td>
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GLB-DVD

• Developed in collaboration with the USAF Center of Excellence for Medical Multimedia
• 12 initial sessions with actors portraying the lifestyle coach and participants
• Participants from diverse ethnic backgrounds

Attendance at 6 Months

During the first 6 months there were 16 possible sessions

• Median attendance: 14 out of 16 sessions
• 75% of study participants attended 12 or more sessions

Eaglehouse et al., Preventive Medicine, 2015

Do 150 minutes (2½ hours) of moderate intensive physical activity per week

♦ Aerobic activity (similar to a brisk walk) is the foundation activity
♦ Intensity should be similar to a brisk walk
♦ Do for at least 10 minutes at a time
♦ Try to spread out over at least 3 days a week

Reporting of Physical Activity in DPP Community Translation Efforts

• Systematic Review of 71 articles representing 57 DPP Translation Studies
• **100%** include PA as a primary intervention goal
• **82%** report how PA was assessed (predominantly self-report, subjective measures)
• **60%** report PA-related outcomes (most often percent of participants meeting goal)
What Impact Does Season/Weather Have on Physical Activity

Past Week MAQ at Baseline Clinic Visit (n=500)

Delayed Participants (N=71) PA Levels Prior to Intervention

Lessons Learned

- Both efficacy trials, including the DPP, and effectiveness trials (like our GLB efforts in the community) suggest that we can increase participants' PA levels.
- DPP and GLB provide evidence that this improvement in PA levels may have a significant impact on health outcomes.

US Physical Activity Guidelines for Adults

US Physical Activity Guidelines for Adults (cont.)
Strength is clinically important...

- Biological aging: lose strength and lean body mass
- Strategies to maintain muscular strength enhance mobility and functional independence further into old age are important

Slides: Marni Armstrong

RCT evidence

- In a systematic review (n=7) all but one study reported strength improvements of at least 50% after completing resistance training in people with type 2 diabetes. Gordon, Diab Res Clin Pract. 2009;83(2):157-17
- Meta-analysis (n=4) reported 0.57% reduction in HbA1c in studies where resistance training alone was compared against a control. Umpierre, JAMA, 2011; 305, (17): 1790-99

A COMBINATION OF BOTH AEROBIC AND RESISTANCE APPEARS TO BE THE MOST BENEFICIAL...

DARE trial: The Diabetes Aerobic and Resistance Exercise Trial (n=251)

HART-D: Health Benefits of Aerobic & Resistance Training in Individuals with Diabetes

Sedentary behavior and health outcomes

Sitting Too Much Could be Deadly

Research is preliminary, but several studies suggest people who spend most of their day sitting are more likely to be fat, have a heart attack or even die. By: Maria Cheng

Church T, JAMA. Nov 24 2010;304(20):2253-2262

Are you sitting down? It’s slowly killing you. Regular workouts don’t decrease death risk if you’re also a couch potato.
Typical PA Intensity Break-down During a 24 Hour Time Period

- Moderate-vigorous intensity PA
- Sleep
- Sedentary behavior
- Light intensity PA

Sedentary behavior in the population- U.S. Objectively Measured

As populations become more sedentary, are we approaching the point where we should focus our intervention efforts on decreasing sedentary time in addition to increasing moderate/vigorous physical activity.

DPP: TV watching assessed by MAQ (n=3035)

Mean change from baseline in minutes/day of TV watching over follow-up (average 3.2 yrs.) by study arm

DPP: TV watching assessed by MAQ (n=3035)

- The risk of developing diabetes increased 3.4% with each hour per day of reported TV watching; controlling for sex, age, and reported leisure activity (p <0.05)
- This risk was attenuated to 2.1% (ns.) when also controlling for weight.

Females
Males

Rockette-Wagner et al., Diabetes 2013

Rockette-Wagner et al., Diabetes 2013
Gaps in Knowledge Leading to Next Steps

What about sedentary behavior?

Specifically, what if we replaced the goal of increasing moderate PA levels with sitting less in community lifestyle intervention programs in diverse settings?

Would we still see significant changes in weight loss and diabetes and cardiovascular disease risk factors?

Thank you for your kind attention!