Physical Activity as Part of DPP-Based Community Lifestyle Intervention Efforts

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Diabetes Prevention Program

The Evidence Behind the Translation Efforts

The Landmark Study that Demonstrated Lifestyle Intervention Prevented Type 2 Diabetes
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)
Lifestyle participants had a significantly greater increase in physical activity levels than the other two randomized arms and.....

Lifestyle participants also had a relatively and significantly greater weight loss by the end of the DPP (At year #1; 7.1-8.4% wt loss in all race-sex groups except black women who lost 4.5%*).

* West; Obesity, 2008
Prevention

- 58% decrease in diabetes incidence in the lifestyle vs. placebo groups

- Worked across all subgroups, including age, sex, baseline BMI and ethnic/race

- 41% decrease in incidence of metabolic syndrome in the lifestyle vs. placebo groups
Diabetes Incidence Rates by Ethnicity

Cases/100 person-yr

- Caucasian (n=1768)
- African American (n=645)
- Hispanic (n=508)
- American Indian (n=171)
- Asian (n=142)

The DPP Research Group, *NEJM* 346:393-403, 2002
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 reduced diabetes incidence (for every kg of weight, there was a 16% reduction in risk).
- Change in physical activity levels was not related to diabetes incidence.
- In contrast, achieving the PA goal did result in a 46% reduction in diabetes.

*Hamman et al; Diabetes Care, 2006
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.
DPPOS Incidence of Diabetes

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)

Worn on a belt around the waist
### Median (interquartile range) values of physical activity and time spent sedentary by treatment arm in years 9/10 of DPPOS

<table>
<thead>
<tr>
<th>Activity related variables (minutes/day)</th>
<th>Lifestyle N=536</th>
<th>Metformin N=543</th>
<th>Placebo N = 543</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MV intensity PA</strong></td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>MV intensity PA</td>
<td>20.7 (10.0-41.8)</td>
<td>19.6 (8.6-36.6)</td>
<td>19.6 (8.5-40.2)</td>
</tr>
<tr>
<td><strong>Light intensity PA</strong></td>
<td>363 (297-436)</td>
<td>353 (286-417)</td>
<td>353† (282-425)</td>
</tr>
<tr>
<td><strong>Total (MV + Light) PA</strong></td>
<td>389 (320-469)</td>
<td>376 (308-451)</td>
<td>377* (307-461)</td>
</tr>
<tr>
<td><strong>Time spent Sedentary</strong></td>
<td>470 (403-532)</td>
<td>483 (406-547)</td>
<td>471 (400-547)</td>
</tr>
</tbody>
</table>

Note: Total counts/day and steps/day followed a similar trend.

*Kruskal Wallis p-value <.05* was used to determine significant differences between treatment groups.

† p< 0.10

Adapted from Kriska et al., Diabetes. 2014; 63 (suppl 1): A68-A69.
Median values of accelerometer counts/minute (*total counts/wear time*) for those without diabetes vs. those with confirmed diabetes at the time of accelerometer monitoring.

**No diabetes n=739**  **Confirmed diabetes n=883**

<table>
<thead>
<tr>
<th>Group</th>
<th>Median Accelerometer Counts/Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lifestyle</strong></td>
<td><img src="#" alt="Bar Graph" /></td>
</tr>
<tr>
<td><strong>Metformin</strong></td>
<td><img src="#" alt="Bar Graph" /></td>
</tr>
<tr>
<td><strong>Placebo</strong></td>
<td><img src="#" alt="Bar Graph" /></td>
</tr>
</tbody>
</table>

*diff. between groups p<0.05

Kriska et al., ADA presentation 2014
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
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?
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
- Approved by CDC Diabetes Prevention Recognition Program
- Delivered in a group setting
- 12 core, 4 core transition, and 6 post-core monthly sessions
- 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

- Purpose: To formally evaluate delivery of the GLB lifestyle intervention research program in three very different community settings:
  - Community Senior Centers of varying SES
  - Worksite
  - Military
DPP-GLB Program Evaluation
Participant Eligibility

• ≥18 years of age
• No reported history of diabetes
• BMI ≥24kg/m² (≥22kg/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
Baseline Characteristics of Participants in the DPP-GLB Intervention (N=287*)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean (sd)</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<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 (5.9)</td>
</tr>
<tr>
<td>Physical Activity (MET-hours/week); Median (IQR)</td>
<td>10.5 (3.75-21.50)</td>
</tr>
</tbody>
</table>

*Participants who attended baseline and 6 month assessment visits
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
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)

Eaglehouse et. al., 2015 (under review)
What Impact Does Season/Weather Have on Physical Activity
Past Week MAQ at Baseline Clinic Visit (n=500)

Newman; MSSE 2009
Delayed Participants (N=71) PA Levels Prior to Intervention

Winter to Summer p-change < 0.0001; MAQ = Modifiable Activity Questionnaire
Positive Impact of Intervention on Diabetes and CVD Risk Factors

<table>
<thead>
<tr>
<th>Risk Factora</th>
<th>6 Month Change (N=286)</th>
<th>12 Month Change (N=190‡)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting Glucose</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Hemoglobin A1c (%) †</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>LDL Cholesterol</td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>HDL Cholesterol</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>✅</td>
<td>✅</td>
</tr>
</tbody>
</table>

aParticipants with relevant medication changes excluded from analysis; ‡12 month data collection from military participants in progress; †HbA1c not available for military participants
# Positive Impact of Intervention on Risk Factors: All Work Site Participants and Those at High-riska

<table>
<thead>
<tr>
<th>Risk Factorb</th>
<th>All Work Site Participants</th>
<th>Work Site High-riska</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>6 Month Change (mean) N</td>
</tr>
<tr>
<td>Fasting Glucose (mg/dL)</td>
<td>82</td>
<td>0</td>
</tr>
<tr>
<td>Hemoglobin A1c (%)</td>
<td>82</td>
<td>-0.07**</td>
</tr>
<tr>
<td>Systolic BP (mm/Hg)</td>
<td>77</td>
<td>-4.2**</td>
</tr>
<tr>
<td>LDL Cholesterol (mg/dL)</td>
<td>72</td>
<td>-2.1</td>
</tr>
<tr>
<td>HDL Cholesterol (mg/dL)</td>
<td>73</td>
<td>1.0</td>
</tr>
<tr>
<td>Triglycerides (mg/dL) (M, IQR)</td>
<td>73</td>
<td>-14.0**</td>
</tr>
</tbody>
</table>

a Meeting clinical cut-points for metabolic syndrome (NCEP-ATP III) or pre-diabetes for individual risk factors
b Participants with relevant medication changes excluded from analysis

**p<0.01, *p<0.05

Adapted from Kriska et al., Diabetes. 2014; 63 (suppl 1): A171.
How Does Intervention Impact Risk Factors For Those Who are High-Risk\textsuperscript{a}?

Baseline Value (regardless of pharmacological treatment):

- Fasting Glucose \( \geq 100 \text{ mg/dL} \)
- Hemoglobin A1c \( \geq 5.7\% \)
- Systolic Blood Pressure \( \geq 130 \text{ mmHg} \)
- LDL Cholesterol \( \geq 100 \text{ mg/dL} \)
- HDL Cholesterol \(<50 \text{ (f)} \text{ and } <40 \text{ (m)} \text{ mg/dL} \)
- Triglycerides \( \geq 150 \text{ mg/dL} \)

\textsuperscript{a}Meeting clinical cut-points for metabolic syndrome (NCEP-ATP III) or pre-diabetes for individual risk factors
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 provides evidence that this improvement in PA levels may have a significant impact on health outcome including the prevention of diabetes
Lessons Learned (Cont.)

When investigating the effect of community translation efforts…

• Consider the high risk approach when examining the intervention’s impact on participants health

• Pay attention to the potential influence of season in intervention and analysis
Sitting Too Much Could be Deadly
Research is preliminary, but several studies suggest people who spend most of their days sitting are more likely to be fat, have a heart attack or even die.
By: Maria Cheng
The Baltimore Sun

Those with a desk job, please stand up
By Michael S. Rosenwald
Washington Post

Are you sitting down? It's slowly killing you
Regular workouts don't decrease death risk if you're also a couch potato
LifeScience Staff

Sitting Too Much Could be Deadly
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Your Body's Biggest Enemy
The dangers of living a sedentary life: Learn how to ward off the nasty effects of a new epidemic called Sitting Disease
Selene Yeager
Women's Health Magazine

Are you sitting down? It's slowly killing you
Regular workouts don't decrease death risk if you're also a couch potato
LifeScience Staff

Stand Up While You Read This!
By OLIVIA JUDSON
NYTIMES
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

Also...Each hour per day of sitting watching TV was associated with a 3.4% increased risk of developing diabetes over the follow-up period (p <0.05). This risk was attenuated to 2.1% (ns.) when controlling for weight.

Adapted from Rockette-Wagner et al., Diabetologia, in press.
Gaps in Knowledge Leading to Next Steps

What about sedentary behavior?

Specifically, what if we (initially) 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?
DPP-GLB Translation Team

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Beth Venditti, PhD
Thank you for your kind attention!

And thanks again to the NIH for their kind funding!

DPPOS U01 DK048412, Healthy Lifestyle R18 DK081323
Accelerometer R01 DK091345, Sedentary R18 DK100933
Diabetes Incidence Rates by Age

The DPP Research Group, NEJM 346:393-403, 2002
Typical PA Intensity Break-down During a 24 Hour Time Period

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