Moving your Way to a Good Night’s Rest

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Exercise Science & Health Promotion

ASU Retirees Association, January 27, 2016
Validation of commercially-available sensors for 24-hour assessment of behaviors.

Smartphone ‘apps’ for behavior change across the 24-hour spectrum for cardiometabolic health.

“…understanding the dynamic interplay of sleep, sedentary, and more active behaviors, and how collectively these behaviors may be harnessed for health promotion and disease prevention.”

Workplace interventions to reduce sitting time and increase light-intensity physical activity.

Validation of commercially-available sensors for 24-hour assessment of behaviors.
Background

- Sleep complaints highly prevalent
- Chronic insomnia - 10% of US population
- Long-term pharmacological treatments are not recommended
- Behavioral sleep treatments are more effective but expensive to deliver
Exercise and Sleep: Summary Findings from RCT’s

- Modest improvements in sleep
  - Subjective (sleep quality, sleep-onset latency)
  - Objective (Stage 1, Stage 2, # awakenings)

- National guidelines are sufficient for improvement (more is better!)
- 4 months or longer is better
- Acute vs. chronic effects debate
How much exercise is needed?

• Meeting physical activity guidelines appears sufficient
  – 150 min/wk of moderate PA or 75 min/wk of vigorous PA (or some equivalent)
  – Stretching, strength training, and balance exercise (for older adults) are also recommended
How much is too much?

• Some limited evidence that prolonged exercise (>2hrs) leads to sleep disruptions
• Some may be more sensitive than others
Time of Day Effects

- Standard sleep hygiene suggests avoiding exercise 4 hrs prior to sleep
- Little evidence
- Exercise 4-8 hrs prior to sleep is optimal
- Evening exercise is not discouraged
Resistance Training

- Limited evidence suggests equal benefits to aerobic activity
- Muscle pain following resistance training not thought to interfere with sleep
Yoga and Tai Chi

- Yoga appears effective, but more controlled studies are needed
- Evidence stronger for Tai Chi
How does exercise improve sleep?

• Reduced depression and anxiety
  – Exercise → depression → sleep

• Restorative effects
  – Body is restored during sleep

• Body temperature changes
  – Greater efficiency in temperature down regulation
How does exercise improve sleep?

- Circadian phase-shifting
  - Exercise as a re-syncronizer
- Inflammatory effects
  - Modest increases in IL-1, IL-6, and TNF-α
- Indirect effects
  - Reduce medications
  - Control weight
  - Improve functional capacity
What about sleep apnea?

Didgeridoo playing as alternative treatment for obstructive sleep apnoea syndrome: randomised controlled trial

Milo A Puhan, Alex Suarez, Christian Lo Cascio, Alfred Zahn, Markus Heitz, Otto Braendli
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Is sitting the new smoking?
Sitting as a novel risk factor

**How Sitting Wrecks Your Body**

- **As Soon As You Sit:**
  - Electrical activity in the leg muscles **shuts off**
  - Calorie burning drops to 1 per minute
  - Enzymes that help break down fat drop 90%

- **After 2 Hours:**
  - Good cholesterol drops 20%

- **After 24 Hours:**
  - Insulin effectiveness drops 24% and risk of diabetes rises

People with **sitting jobs** have twice the rate of cardiovascular disease as people with standing jobs.
2013 NSF Annual Poll

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<thead>
<tr>
<th>Total sitting</th>
<th>OR (95% CI)</th>
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<tr>
<td>Short sleep duration (&lt;7 h)</td>
<td>1.02 (0.98,1.06)</td>
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<td>Long sleep duration (&gt;8.5 h)</td>
<td>0.96 (0.88,1.05)</td>
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<td>Long sleep onset latency (≥30 m)</td>
<td>0.97 (0.92,1.03)</td>
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<td>Waking up during the night</td>
<td>1.02 (0.97,1.06)</td>
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<tr>
<td>Waking up too early in morning</td>
<td>0.99 (0.95,1.04)</td>
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<tr>
<td>Poor sleep quality rating</td>
<td>1.06 (1.01,1.11)</td>
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<td>‘High risk’ for OSA</td>
<td>1.01 (0.96,1.06)</td>
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<td>Excessive daytime sleepiness</td>
<td>1.00 (0.93,1.06)</td>
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<th>Sitting while watching television</th>
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<td>Short sleep duration (&lt;7 h)</td>
<td>1.04 (0.96,1.14)</td>
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<tr>
<td>Long sleep duration (&gt;8.5 h)</td>
<td>1.10 (0.93,1.30)</td>
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<td>Long sleep onset latency (≥30 m)</td>
<td>1.15 (1.04,1.27)</td>
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<td>1.08 (0.98,1.18)</td>
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Buman et al., CHEST, in press
Exercise protects against sitting

Buman et al., CHEST, in press
Considering the full 24h spectrum
Isotemporal Substitution Method

- 24h day is distributed between sleep, sedentary, and active behaviors
- Time in finite; increasing one behavior means decreasing another

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<th>Target Behavior</th>
<th>Replace with…</th>
<th>Health Outcome</th>
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<td>↓ Television viewing</td>
<td>↑Brisk walking, ↑Desk work, ↑Sleep</td>
<td>???</td>
</tr>
<tr>
<td></td>
<td>↑Household chores</td>
<td>???</td>
</tr>
<tr>
<td>↓Sleep</td>
<td>↑Running, ↑Sitting</td>
<td>???</td>
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Objective Light-Intensity Physical Activity Associations With Rated Health in Older Adults


* Correspondence to Dr. Matthew P. Buman, Department of Medicine, Stanford University School of Medicine, Medical School Office Building, 251 Campus Drive, MC 5411, Stanford, CA 94305-5411 (e-mail: mbuman@stanford.edu).
Nutritional and Health Examination Survey (NHANES) (N=2185 adults ≥20 years of age)

Outcomes: Cardiometabolic risk factors

- **Sleep**: Self-reported
- **Sedentary**: <100 cts/min
- **Light**: 100-1,951 cts/min
- **MVPA**: ≥1,952 cts/min

Total Activity
Research Questions

• What is the impact of re-allocating time spent in sleep, sedentary, and active behaviors on cardiometabolic risk biomarkers?

• Are decreased sedentary time or increased active time protective or synergistic in the relationship between sleep duration and cardiometabolic risk?
Results (per 30min re-allocation)

- 2.4% to 2.6% reduction
- 4.3% to 4.4% increase
- 7.4% to 9.3% reduction
- 10.7% to 14.4% reduction
- No re-allocation differences between sleep and light intensity (LIPA)
- 2.2% reduction (HOMA-B also)
Optimal sleep enhances MVPA effects

P for interaction = 0.04

Fasting Triglycerides (mmol/L) vs Quartiles of MVPA

- ≤ 5 hrs: p = 0.09
- 6 hrs: p = 0.01
- 7 hrs (ref)
- ≥ 8 hrs: p = 0.01
Light Intensity “protection” from short sleep

Quartiles of LITE

HDL-C (mmol/L)

P for interaction = 0.03

\[ P \text{ for interaction } = 0.03 \]
Light Intensity “protection” from short sleep

Quartiles of LITE

- ≤ 5 hrs: p=0.03
- 6 hrs: p=0.53
- 7 hrs (ref)
- ≥8 hrs: p=0.08

\[ P \text{ for interaction } = 0.09 \]
What does this all mean?

- MVPA may be the most health-enhancing (time dependent) behavior
- Light activity and sleep are also beneficial
- Activities should be re-allocated from sedentary time (but doesn’t have to be replaced with MVPA for benefit)

What to do with an extra 30 minutes...

- Yes
- No
BeWell24

Smartphone “app” that uses evidence-based behavioral strategies to target the full 24h spectrum of health behaviors

Funded by pilot grant from Virginia G. Piper Charitable Trust
Returning Veterans are at greater risk

- Often suffer from PTSD, traumatic brain injury
- May struggle with re-integration into civilian life
- At disproportionate risk for metabolic syndrome
Activity Monitoring

• Users self-report behaviors across the 24h

• Able to report context of behaviors
  – Sleep quality metrics
  – Domains of sitting (e.g., work, TV, transport)
  – Types of exercise

• Ideally 5min in morning and 5min in evening
Sleep

- Evidence-based treatment to re-associate bed with restful sleep
- Personalized wake time calculator with feedback
- Basic sleep hygiene tips
Sedentary

- Focus on reducing time spent sitting by swapping sitting with other activities
- Gives context-specific (i.e., work, TV) feedback and tips
Physical activity

- Based on Fit-Minded strategies
- Provides automated goal suggestions based on previous behavior
- Provides user-generated tips for motivation
BeWell24 Pilot study

Timeline
- Run-in (3 weeks)
- Week 0
- Intervention period
- Week 8

Behavioral self-monitoring

MOST design

- Goal setting for physical activity with personalized and adaptive feedback
- Behavioral replacement for context-specific sitting behaviors with personalized and adaptive feedback
- Stimulus control therapy for sleep with personalized and adaptive feedback

Continuous sleep, sedentary, and activity via accelerometry

Assess

- Week 0
  - Behavioral outcomes: Physical activity and dietary recalls, Postural allocation

- Week 4
  - Cardiometabolic outcomes: Waist circumference, blood pressure, lipids, leptin, IL-6, glucose/insulin, proteomics

- Week 8

ASU School of Nutrition & Health Promotion
Arizona State University
Preliminary results

- 7% increase in sleep efficiency
- 12% of 47 min/day in sitting
- 105% or 11 min/day of moderate-vigorous physical activity
- 12.3% reduction in fasting glucose
Thank you!

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