Age-Specific Probabilities of Transitioning between Ideal, Intermediate, and Poor Levels of Physical Activity in the United States. The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) and the National Health and Nutrition Examination Survey (NHANES).

Katelyn Holliday, MSPH
Disclosure Information

• No relevant financial relationships
Background

• AHA 2020 Impact Goals
  o By 2020, to improve the *cardiovascular health* of all Americans by 20% while reducing deaths from cardiovascular diseases and strokes by 20%

• Physical activity trends
  o Slight increase over time
  o Important racial/ethnic and sex differences

Study Purpose

• Evaluate age-specific transitions between AHA defined physical activity levels
  ○ By race/ethnic-sex groups
    ○ White
    ○ African American
    ○ Hispanic/Latino
Methods
Study Data

- **NHANES**
  - Nationally representative
  - Whites and African Americans aged 16+

- **HCHS/SOL**
  - Population-based cohort sample
  - San Diego, CA; Chicago, IL; Bronx, NY; Miami, FL
  - Hispanic/Latinos aged 18+
  - Enrolled 2008-2011
# Cardiovascular Health Definition: Physical Activity

<table>
<thead>
<tr>
<th></th>
<th>Adults ≥ 20 years old</th>
<th>Children &lt;20 years old</th>
</tr>
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<tbody>
<tr>
<td><strong>Ideal</strong></td>
<td>≥150 min/wk moderate or ≥75 min/wk vigorous intensity aerobic activity (or equivalent combination)</td>
<td>≥60 min/day moderate or vigorous intensity activity</td>
</tr>
<tr>
<td>2008 Physical Activity Guidelines</td>
<td><strong>Intermediate</strong> 1-149 min/wk moderate or 1-74 min/wk vigorous intensity aerobic activity (or equivalent combination)</td>
<td>1-59 min/day moderate or vigorous intensity activity</td>
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<tr>
<td><strong>Poor</strong></td>
<td>0 min moderate and vigorous intensity aerobic activity</td>
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Physical Activity Assessment

• Physical Activity Questionnaire
  o Moderate and vigorous activity
  o Work, leisure, transportation
  o Days per week and minutes per day

• Calculated total minutes of PA per week weighted by intensity (for adults)
  o Adults 20+: minutes_moderate + 2 (minutes_vigorous)=total
  o Teens 16-19: minutes_moderate + minutes_vigorous=total
**Statistical Methods**

- **Net transition probability**

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|                |        |            |       |       |
| **(b) Net transitions from (a)** |        |            |       |       |
| Normal         | 52     | 7          | 0     | 59    |
| Overweight     | 0      | 29         | 3     | 32    |
| Obese          | 0      | 0          | 9     | 9     |
| Total          | 52     | 36         | 12    | 100   |

### Statistical Methods

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### Statistical Methods

#### Net transition probability

For $i \neq j$ (e.g. normal to overweight)

\[
\tau'_{ij}(a) = \begin{cases} 
\tau_{ij}(a) - \tau_{ji}(a) & \text{if } \tau_{ij} > \tau_{ji} \\
0 & \text{otherwise}
\end{cases}
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(b) Net transitions from (a)

For \(i=j\) (e.g. normal to normal)

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\tau'_{ij}(a) = \pi_i(a - 1) - \sum_{j \neq i}^k \tau'_{ij}(a)
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\tau_{ij}'(a) = \pi_i(a - 1) - \sum_{j \neq i}^k \tau_{ij}'(a)
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\pi'_{ij}(a) = \pi_i(a - 1) - \sum_{j \neq i}^k \pi'_{ij}(a)
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\[
52 = 59 - (7 + 0)
\]

Statistical Methods

1. Estimate smoothed age-, sex-, and race-specific prevalence proportions of each level of cardiovascular health

2. Estimate net transition probabilities between levels
   - Operations research
     - \( \min J = \sum_{i=1}^{k} \sum_{j=1}^{k} c_{ij} \tau'_{ij}(a) \)

3. Estimate confidence intervals with bootstrapping
Statistical Methods

• Key assumption
  ○ Transitions remain stable over time
    ○ Prevalence at age 21 in our cross-sectional survey stands in for the expected prevalence of 20 year olds one year later.
Results
## Cross-sectional Characteristics of n=26,922 NHANES and HCHS/SOL Participants

* Not including 10.5% excluded as first degree relatives

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<td>% Missing</td>
<td>0.2</td>
<td>0.2</td>
<td>2.7</td>
</tr>
</tbody>
</table>

* Not including 10.5% excluded as first degree relatives
5 Year Net Transition Probabilities for African American Females

A. Ideal to Ideal PA
B. Ideal to Int PA
C. Ideal to Poor PA
D. Int to Ideal PA
E. Int to Int PA
F. Int to Poor PA
G. Poor to Ideal PA
H. Poor to Int PA
I. Poor to Poor PA

Five year net transition probability (95% CI)

*Int=Intermediate
5 Year Net Transition Probabilities for African American Females

A. Ideal to Ideal PA

B. Ideal to Int PA

C. Ideal to Poor PA

D. Int to Ideal PA

E. Int to Int PA

F. Int to Poor PA

G. Poor to Ideal PA

H. Poor to Int PA

I. Poor to Poor PA

*Int=Intermediate
5 Year Net Transition Probabilities for Ideal to Ideal

Women

African American

White

Hispanic Latino

Men
5 Year Net Transition Probabilities for African American Females

A. Ideal to Ideal PA

B. Ideal to Int PA

C. Ideal to Poor PA

D. Int to Ideal PA

E. Int to Int PA

F. Int to Poor PA

G. Poor to Ideal PA

H. Poor to Int PA

I. Poor to Poor PA

*Int=Intermediate
5 Year Net Transition Probabilities for Intermediate to Ideal

African American

White

Hispanic Latino

Men

Age

Women

Age

Age
5 Year Net Transition Probabilities for Ideal to Intermediate

Women

African American

White

Hispanic Latino

Men

Age

Age

Age
5 Year Net Transition Probabilities for African American Females

A. Ideal to Ideal PA
B. Ideal to Int PA
C. Ideal to Poor PA
D. Int to Ideal PA
E. Int to Int PA
F. Int to Poor PA
G. Poor to Ideal PA
H. Poor to Int PA
I. Poor to Poor PA

*Int=Intermediate
5 Year Net Transition Probabilities for Intermediate to Poor

African American

White

Hispanic Latino

Women

Men

Age

Age

Age
5 Year Net Transition Probabilities for African American Females

- A. Ideal to Ideal PA
- B. Ideal to Int PA
- C. Ideal to Poor PA
- D. Int to Ideal PA
- E. Int to Int PA
- F. Int to Poor PA
- G. Poor to Ideal PA
- H. Poor to Int PA
- I. Poor to Poor PA

*Int = Intermediate
5 Year Net Transition Probabilities from Poor

**Poor to Ideal**

**Poor to Intermediate**
Results Summary

• Racial-ethnic differences in population’s ability to maintain prevalence of ideal physical activity

• Prevalence of ideal physical activity improved only at younger ages

• Hispanic/Latinos had most favorable intermediate to poor net transition probabilities

• Net change always favored increasing prevalence of poor physical activity over improving from poor to more ideal levels
Strengths and Limitations

• Strengths
  o Addresses an important public health question
  o Data from large nationally representative and population based studies
  o Data source more timely and cost-efficient than longitudinal data

• Limitations
  o Refining models
  o Interpretability of net transitions
  o Constancy assumption limits timeframe
Conclusions

• Target interventions before mid 30s-early 40s

• Focus on racial-ethnic and gender specific patterns

• Substantial and innovative efforts needed to reverse prevalence of poor physical activity
Thank you

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5 Year Net Transition Probabilities for African American Females

A. Ideal to Ideal PA

B. Ideal to Int PA

C. Ideal to Poor PA

D. Int to Ideal PA

E. Int to Int PA

F. Int to Poor PA

G. Poor to Ideal PA

H. Poor to Int PA

I. Poor to Poor PA

Five year net transition probability (95% CI)

Age

Shift age 40

*Int=Intermediate
5 Year Net Transition Probabilities for African American Males

A. Ideal to Ideal PA

B. Ideal to Int PA

C. Ideal to Poor PA

D. Int to Ideal PA

E. Int to Int PA

F. Int to Poor PA

G. Poor to Ideal PA

H. Poor to Int PA

I. Poor to Poor PA

Shift age 34

*Int=Intermediate
5 Year Physical Activity Net Transition Probabilities for White Females

- A. Ideal to Ideal PA
- B. Ideal to Int PA
- C. Ideal to Poor PA
- D. Int to Ideal PA
- E. Int to Int PA
- F. Int to Poor PA
- G. Poor to Ideal PA
- H. Poor to Int PA
- I. Poor to Poor PA

*Int=Intermediate

Shift age 41
5 Year Physical Activity Net Transition Probabilities for White Males

Shift age 36

Five year net transition probability (95% CI)

A. Ideal to Ideal PA

B. Ideal to Int PA

C. Ideal to Poor PA

D. Int to Ideal PA

E. Int to Int PA

F. Int to Poor PA

G. Poor to Ideal PA

H. Poor to Int PA

I. Poor to Poor PA

*Int=Intermediate
Five year physical activity net transition probabilities for Hispanic females.

- A. Ideal to Ideal PA
- B. Ideal to Int PA
- C. Ideal to Poor PA
- D. Int to Ideal PA
- E. Int to Int PA
- F. Int to Poor PA
- G. Poor to Ideal PA
- H. Poor to Int PA
- I. Poor to Poor PA

*Int=Intermediate

Shift age 36

Five year net transition probability (95% CI)
5 Year Physical Activity Net Transition Probabilities for Hispanic Males

A. Ideal to Ideal PA
B. Ideal to Int PA
C. Ideal to Poor PA
D. Int to Ideal PA
E. Int to Int PA
F. Int to Poor PA
G. Poor to Ideal PA
H. Poor to Int PA
I. Poor to Poor PA

Shift age 31

*Int=Intermediate
Age-Specific Smoothed Prevalence for African Americans and Whites in NHANES
Age-Specific Smoothed Prevalence for Hispanics in HCHS/SOL
Plot of Proportion of Individuals in PA Group 0 at the Third Timepoint for Overall Population
Plot of Proportion of Individuals in PA Group 1 at the Third Timepoint for Overall Population

- **Observed**
- **Expected**

Proportion

Age

20 30 40 50 60 70 80
Plot of Proportion of Individuals in PA Group 2 at the Third Timepoint for Overall Population

Proportion

Age

Observed
Expected