Functional phenotypes: Frailty as an example

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Introduction
Functional Phenotypes

- At the heart of well-being in aging
  - Integrative
  - Older adult-centered: Preservation of well-being, independence
  - Mark risk of downstream adverse outcomes
  - “Raison d’être of geriatric medicine”


- Such as…
  - Physical and cognitive function
  - Multimorbidity
  - Sarcopenia
  - Frailty
Frailty

- Consensus definition
  - "A medical syndrome with multiple causes and contributors that is characterized by diminished strength, endurance, and reduced physiologic function that increases an individual’s vulnerability for developing increased dependency and/or death."


- Many measures; substantial disagreement

- Why we should especially care about racial disparities: Double jeopardy
Frailty Measurement

- Frailty is a construct; measurement inherently is imprecise

- Potential for disparities in measurement (algorithmic unfairness)

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\[\begin{align*}
\text{Frailty} & \rightarrow \\
\rightarrow \text{Weight loss} & \quad \text{ex} \quad 1 \\
\rightarrow \text{Exhaustion} & \quad \text{ex} \quad 2 \\
\rightarrow \text{Slowness} & \quad \text{ex} \quad 3 \\
\rightarrow \text{Weakness} & \quad \text{ex} \quad 4 \\
\rightarrow \text{Low physical activity} & \quad \text{ex} \quad 5
\end{align*}\]
```

“manifest”
State of the Art
Literature Review

frailty (race OR racial OR ethnic OR ethnicity) (disparity OR OR disparities)

After filtering for “demographic frailty” and some liberality on definitions but focusing on race/ethnicity in the US…

(All the rest did involve older adults…)
Literature Review

frailty (race OR racial OR ethnic OR ethnicity) (disparity OR disparities)

25 articles

7 – Racial/ethnic disparities in frailty
4 – Algorithmic fairness
3 – Effect modification of frailty effect on outcomes by race / ethnicity
3 – Frailty implications for health in URM groups
3 – Health disparities among frail individuals
3 – Mediation of health / health care / cost disparities by frailty
2 – Health / health care / cost disparities after controlling for frailty
## Frailty Disparities in the National Health and Aging Trends Study

*Bandeen-Roche et al., J Gerontol Biol Sci Med Sci, 70:1427-34*

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>Overall Frailty Status$^2$</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Robust</td>
<td>Pre-frail</td>
<td>Frail</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (43.6%)</td>
<td>43.8</td>
<td>43.3</td>
<td>12.9</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Female (56.4%)</td>
<td>35.6</td>
<td>47.2</td>
<td>17.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>White non-Hispanic (81.7%)</td>
<td>40.8</td>
<td>45.3</td>
<td>13.8</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Black non-Hispanic (8.3%)</td>
<td>30.1</td>
<td>46.0</td>
<td>22.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic (6.7%)</td>
<td>28.8</td>
<td>46.5</td>
<td>24.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (3.4%)</td>
<td>40.5</td>
<td>45.8</td>
<td>13.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community (94.6%)</td>
<td>40.3</td>
<td>45.2</td>
<td>14.5</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Residential Care (5.4%)</td>
<td>19.8</td>
<td>50.7</td>
<td>29.5</td>
<td></td>
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</tbody>
</table>
Differential Measurement in Black vs. Non-Hispanic White Individuals in NHATS

<table>
<thead>
<tr>
<th></th>
<th>Black vs White Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Associations with criteria controlling for latent frailty (LCA regression with DIF)</td>
</tr>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td>Weight loss</td>
<td>1.296</td>
</tr>
<tr>
<td>Exhaustion</td>
<td>0.601</td>
</tr>
<tr>
<td>Slowness</td>
<td>1.759</td>
</tr>
<tr>
<td>Weakness</td>
<td>0.795</td>
</tr>
<tr>
<td>Low Phys. Act.</td>
<td>1.023</td>
</tr>
</tbody>
</table>

* Fit using Mplus

Prediction of subsequent outcomes: Does DIF by race matter?

NHATS baseline
n=6791 black, white
Mortality by frailty criterion count

Black Americans

Kaplan-Meier survival estimates

White Americans

Kaplan-Meier survival estimates
Gaps in the Field
Research gaps / priorities - Measurement

- **Less racially sensitive assessments needed?**
  - Mixed methods work (qualitative, quantitative)
  - Tailored performance norms?

- **Better understand measurement disparity implications**
  - Over- or under-targeting for care
  - Impaired care management
**Research gaps / priorities – Addressing Health**

- **There remain gaps in the literature on disparities**
  - Pathways leading to disparities
    - … phenotypes, downstream health, health care, costs
    - Synergistic implications of under-represented status, functional deficits

- **Moving beyond disparity identification to cause identification**
  - Pathways: Disadvantages
  - Racism: Individual, Institutional, Structural

- **Interventions to heighten equity**
  - Multifaceted (e.g. medical and social: ex/ CAPABLE)
  - Multilevel (e.g. individual, institutional, policies)