Associations between Behavior-Opportunity Gaps and Dementia Risk:

Leveraging Data from a Large Longitudinal Study of Aging

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Overview

- Background
- Research Aims
- Study 1: INRPHA Pilot Project
- Study 2: CFP-GEO
- Future Directions

Alzheimer's Disease and related dementias

6th

leading cause of death
in the U.S.

6 million

are currently affected by dementia
in the U.S.

~40%

of dementia cases
are due to *modifiable* lifestyle factors such as hypertension, obesity, physical inactivity, heavy alcohol use, and smoking

↓500K

fewer dementia cases
in the U.S. if we improve modifiable lifestyle factors by just 25%

Barnes et al., 2011; Kivipelto et al., 2018; Livingston et al., 2020; Mukadam et al., 2020; Norton et al., 20114; Rosenberg et al., 2018; Yaffe et al., 2018

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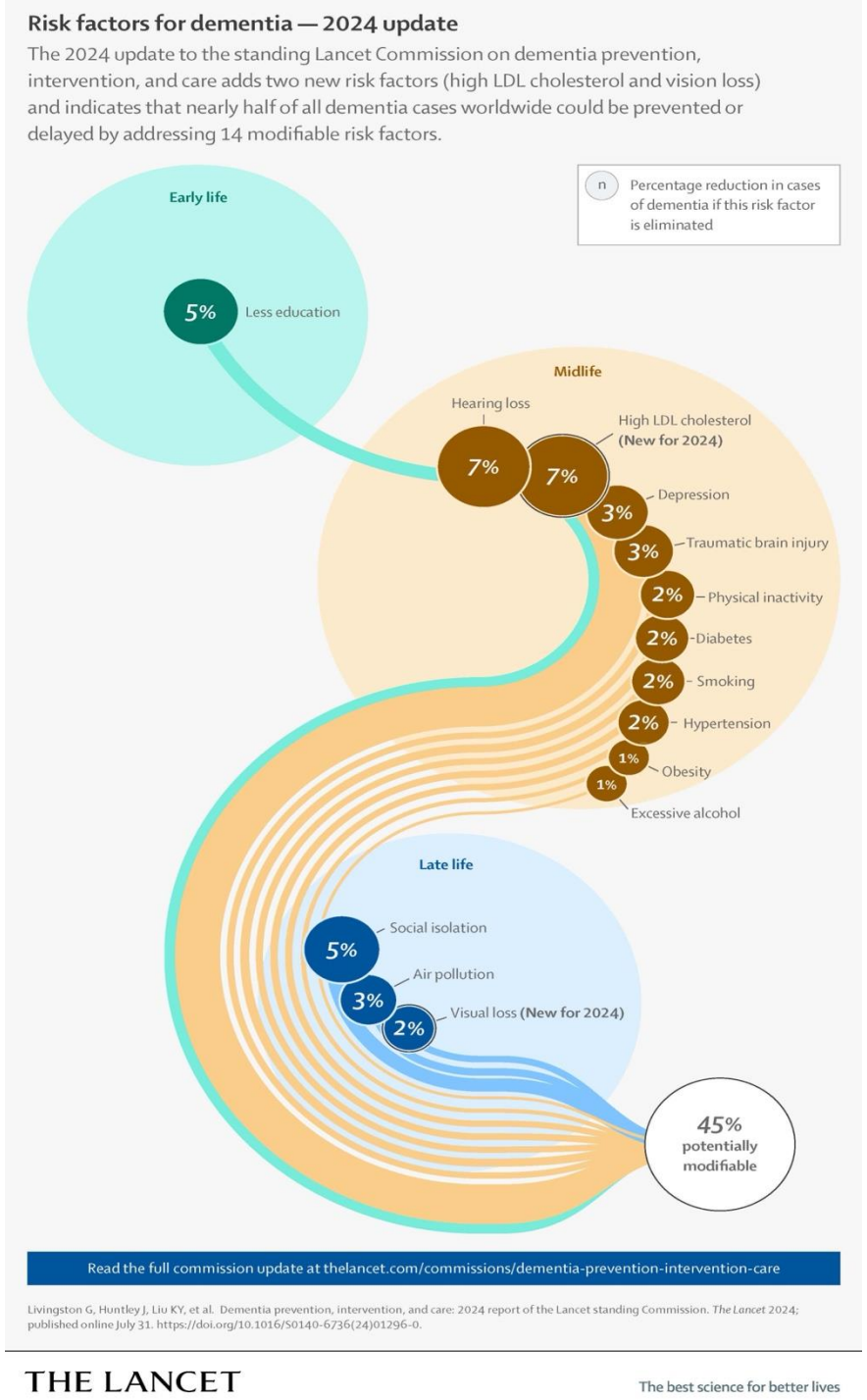

Modifiable lifestyle factors have a greater impact on ADRD cases in midlife compared to older adulthood.

Elder, 1998; Livingston et al., 2020

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How to improve modifiable lifestyle factors?

Modifiable Lifestyle Factors

Health Behaviors

People who engage in more physical activity, eat healthier meals, avoid substance use, and get preventative check-ups, tend to have <u>better</u> cognitive function and reduced dementia risk.

Environmental Opportunities

Living in proximity to environmental opportunities is associated with <u>better</u> cognitive function and reduced dementia risk.

Barnes et al., 2011; Bagheri et al., 2021; Besser, 2021; Chen et al., 2022; Fangfang et al., 2022; Finlay et al., 2021; 2022; Hyun et al., 2023; Kivipelto et al., 2018; Livingston et al., 2020; Luo et al., 2019; Mukadam et al., 2020; Mullins et al., 2021; Norton et al., 2011; Paul et al., 2020; Rosenberg et al., 2018; Tani et al., 2019; Wu et al., 2017; 2020; Yaffe et al., 2018; Zhang et al., 2023

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Behavior-Opportunity Gaps

Health Behaviors and Opportunities
MATCH (+)

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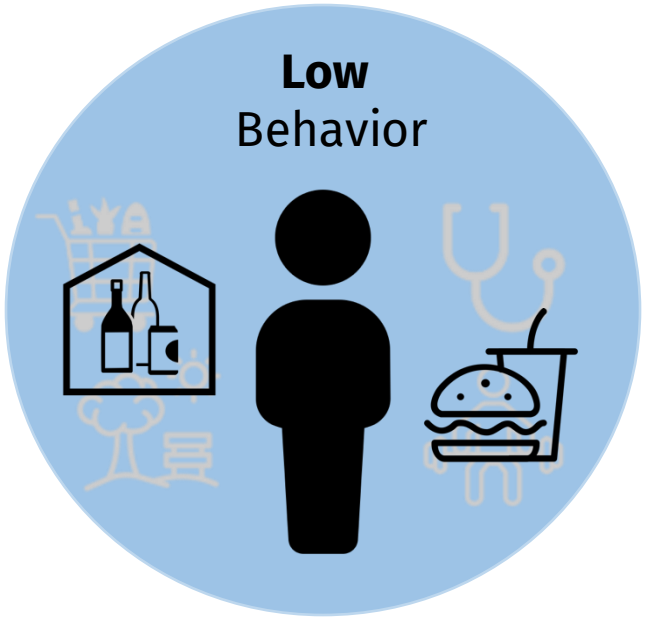
Health Behaviors and Opportunities
MATCH (+)



Health Behaviors and Opportunities
MATCH (-)

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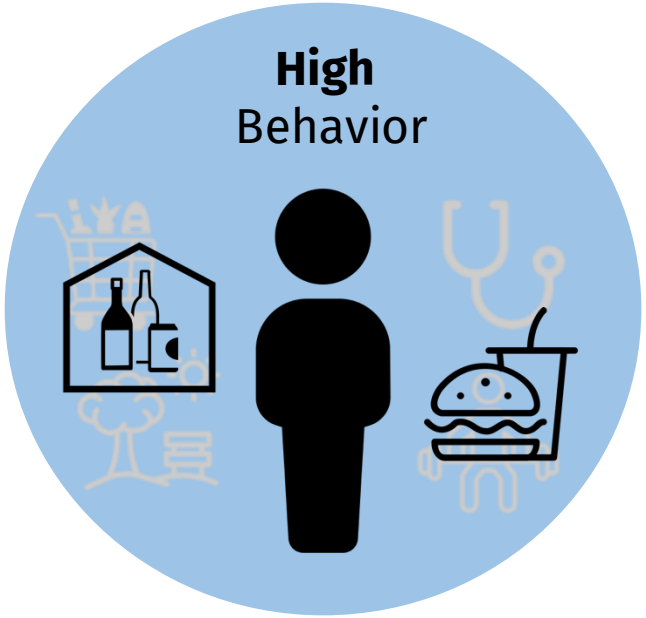
High Health Behavior, Low Opportunity
GAP



Health Behaviors and Opportunities
MATCH (+)

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High Health Behavior,
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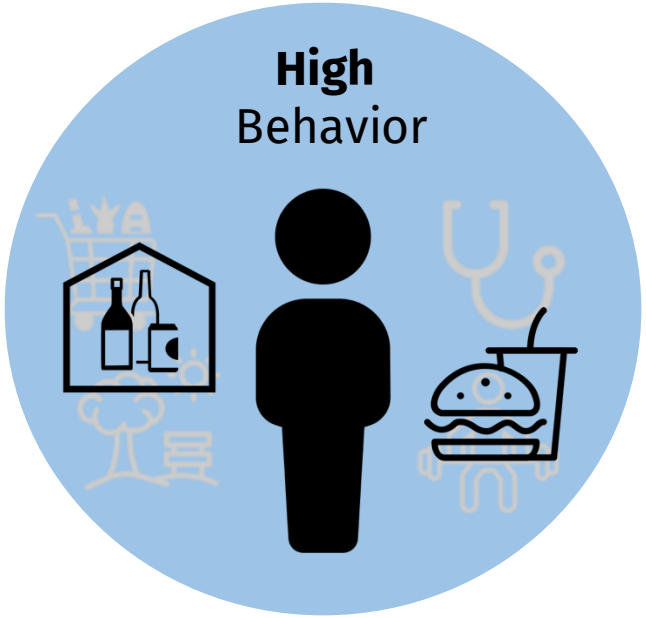

Health Behaviors and
Opportunities
MATCH (+)

Health Behaviors and
Opportunities
MATCH (-)

Low Health Behavior,
High Opportunity
GAP

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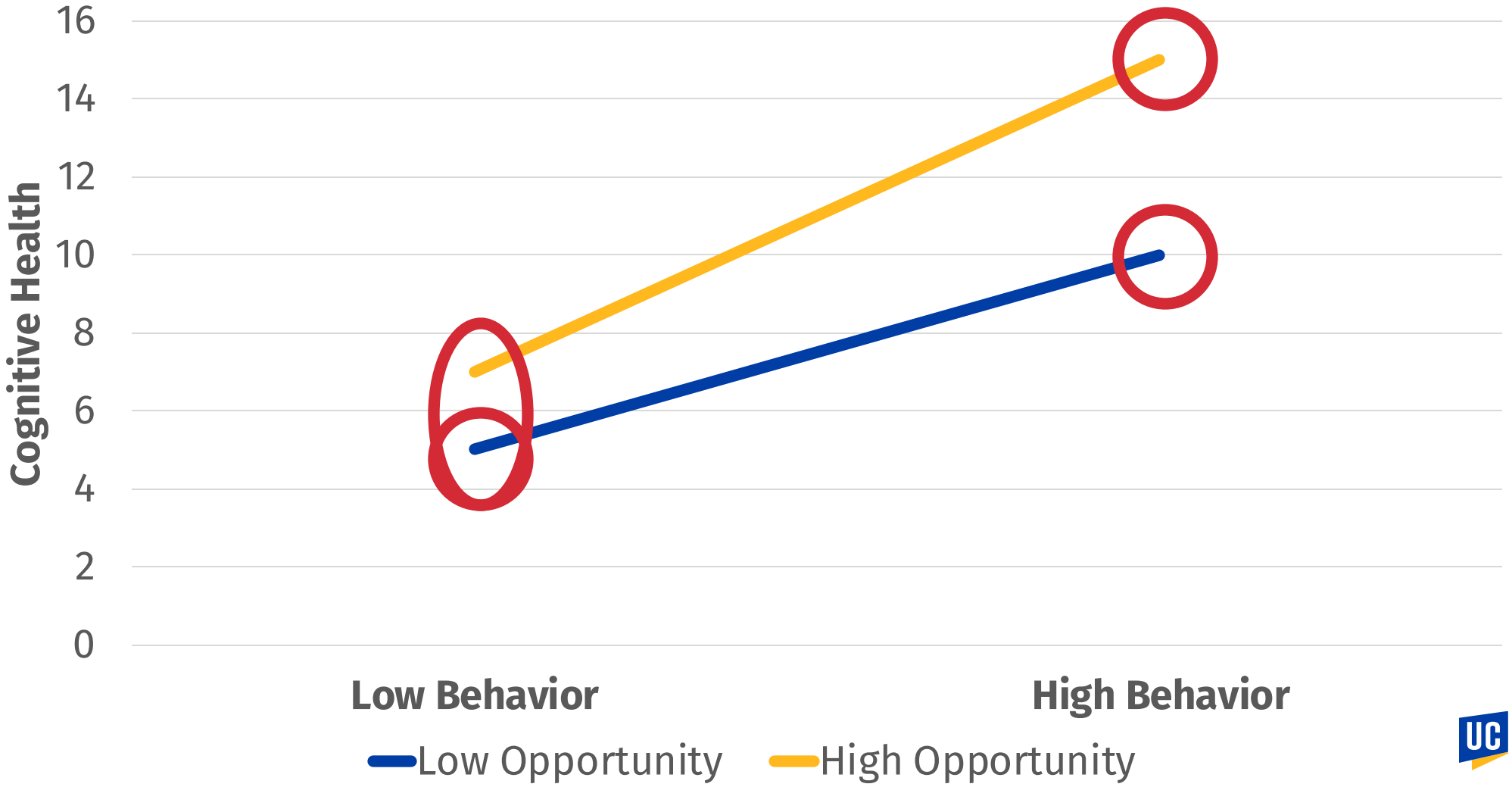
Expected Patterns



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Research Aims

- **Aim 1:** Identify the association between behavior-opportunity gaps and cognitive health
  - Physical Activity, Substance Use, Food Consumption, Healthcare Use
- **Aim 2:** Investigate whether the associations between behavior-opportunity gaps and cognitive function vary by key social determinants of health
  - Age, sex, race, ethnicity, rural-urban, SES

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Study 1: Method

OSF Project Page

- **Health and Retirement Study (HRS):** https://hrs.isr.umich.edu/
  - Nationally-representative longitudinal study of U.S. Americans (51+ years) that began in 1992 and continues to the present
  - Individual-level AND geographically-linked data available on the same participants over time
- *N* = 20,289 participants (nested in ~5,874 census tracts) in 2010
  - Mean age = 65 (range=18-109)
  - 58% female
  - 73% White, 19% Black or African American, 8% "Other"
  - 13% Hispanic/Latino
  - 80% RUCC 1-3, 20% RUCC 4-9

Support for this research was provided by a pilot grant from the Interdisciplinary Research Network on Rural Population Health and Aging (R24AG065159).

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Study 1: Method

OSF Project Page

- **Physical Activity**
  - Health Behavior (3 items): measuring mild, moderate, and vigorous physical activity
  - Built Environment (NAICS 7139): census tract area density of fitness and recreational sports centers, such as gyms, skating rinks, and pools, golf courses, bowling alleys, ski resorts, marinas, day camps, and miniature golf courses
- **Substance Use**
  - Health Behavior (4 items): measuring tobacco and alcohol use per week
  - Built Environment (NAICS 453991, 722410, 4453): census tract area density of cigar, cigarette, and tobacco stores; drinking places such as bars, taverns, and cocktail lounges; and beer, wine, and liquor stores

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Study 1: Method

OSF Project Page

- **Cognitive Health**
  - Langa-Weir Classification of Cognitive Function: mode-adjusted cognition summary score comprised of immediate recall (0-10), delayed recall (0-10), serial 7s (0-5), and backwards count from 20 (0-2)
  - Summary scores range from 0 to 27; higher scores indicate better cognitive health

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Statistical Analyses

OSF Project Page

Analytic approach: Multilevel modeling

Level 1 (individuals): $Y_{ij} = \beta 0_j + \beta 1_j X_{ij} + e_{ij}$

Level 2 (neighborhoods): $\beta 0_j = \gamma 00 + \gamma 01 Z_j + u 0_j$

$\beta 1_j = \gamma 10 + u 1_j$

Approx. 82% of variance in cognitive health due to within-tract variation (rather than between-tract differences)

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Results: Physical Activity

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Predictor	B (95% CI)	*p*
Within-Neighborhood PA Behavior	0.03 (0.02 – 0.03)	<0.01
Between-Neighborhood PA Behavior	0.04 (0.03 – 0.05)	<0.01
Area Density of PA Structures	-0.01 (-0.03 – 0.02)	0.49
Within (PA Behavior) * Area Density	0.00 (-0.00 – 0.00)	0.13
Between (PA Behavior) * Area Density	0.00 (-0.00 – 0.00)	0.29

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Results: Substance Use

OSF Project Page

Predictor	B (95% CI)	*p*
Within-Neighborhood SU Behavior	0.02 (-0.01 – 0.05)	0.12
Between-Neighborhood SU Behavior	0.01 (-0.01 – 0.04)	0.18
Area Density of SU Structures	-0.01 (-0.06 – 0.04)	0.62
Within (SU Behavior) * Area Density	-0.00 (-0.01 – 0.01)	0.49
Between (SU Behavior) * Area Density	-0.00 (-0.01 – 0.01)	0.89

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Preliminary Takeaways

- **Physical activity:**
  - Self-reported physical activity behavior is related to cognitive health, at the individual- and neighborhood levels
  - No effects of built environment nor behavior-opportunity gaps on cognitive health
- **Substance use:**
  - No significant associations for health behaviors, built environment, or behavior-opportunity gaps on cognitive health

Preliminary Takeaways

- **Why?**
  - Lifespan processes and developmental window
  - Sample characteristics
  - Characterizing built environment
    - Area density (vs. per capita density)
    - Accounting for spatial dependencies
    - Census tract (vs. block)
    - Other ways of scoring physical activity/substance use structures
  - Moderation by sociodemographic characteristics
  - The true effects are largely null in this sample ☺

California Families Project
Geographical Linkages

Study 2: CFP-GEO

- **California Families Project (CFP)**
  - 674 Mexican-origin youth (50% female) and 1,100 parents living in Northern CA
  - Study began in 2006
  - *Ongoing* longitudinal study spanning 18 years (Wave 15 in progress)

Table 1. Sample characteristics.
Parent Sample
N = 1,110 (61% mothers) 86% first-gen. immigrants to US Median age (Wave 1) = 38 Median age (Wave 12) = 50 Median education (Wave 1) = 9 years Median income (Wave 1) = $32,500 *35% below federal poverty line*
Focal Child Sample
N = 674 (50% female) 29% first-gen. immigrants to US Median age (Wave 1) = 10 Median age (Wave 12) = 23

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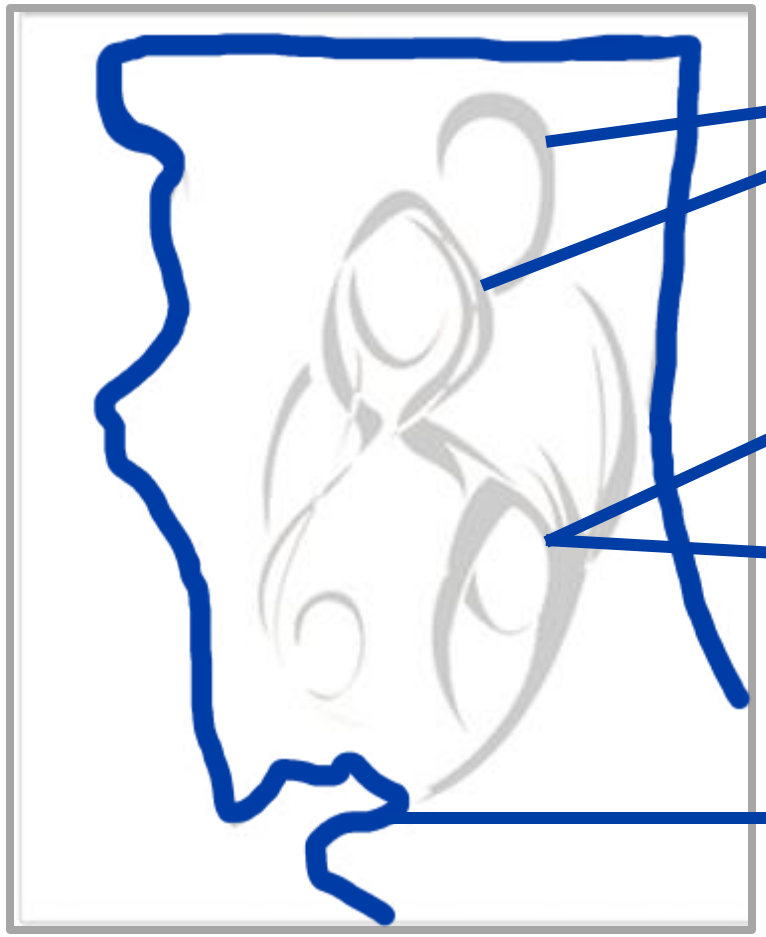
Study 2: CFP-GEO

- **California Families Project (CFP)**
  - 674 Mexican-origin youth (50% female) and 1,100 parents living in Northern CA
  - Study began in 2006
  - *Ongoing* longitudinal study spanning 18 years (Wave 15 in progress)
  - Original grant (NIDA) focused on youth substance use
  - Comprehensive, multi-method assessments of biopsychosocial functioning (30,000+ variables)

Study 2: CFP-GEO



Healthy Aging
N = 1,100 mothers and fathers
In-depth cognitive and health assessments

Neurobiology of Depression
N = 280 youth
fMRI and physiological measures

California Babies Project
N = ~100 babies of CFP youth
Observational and physiological data

Geographical Linkages Study (CFP-GEO)
N = ~2,000 youth, mothers, fathers
Geographical linkages across 18 years

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Study 2: CFP-GEO

N = ~2,000 individuals (nested within 674 families)

Support for this research is provided by NIA (R21AG088948).

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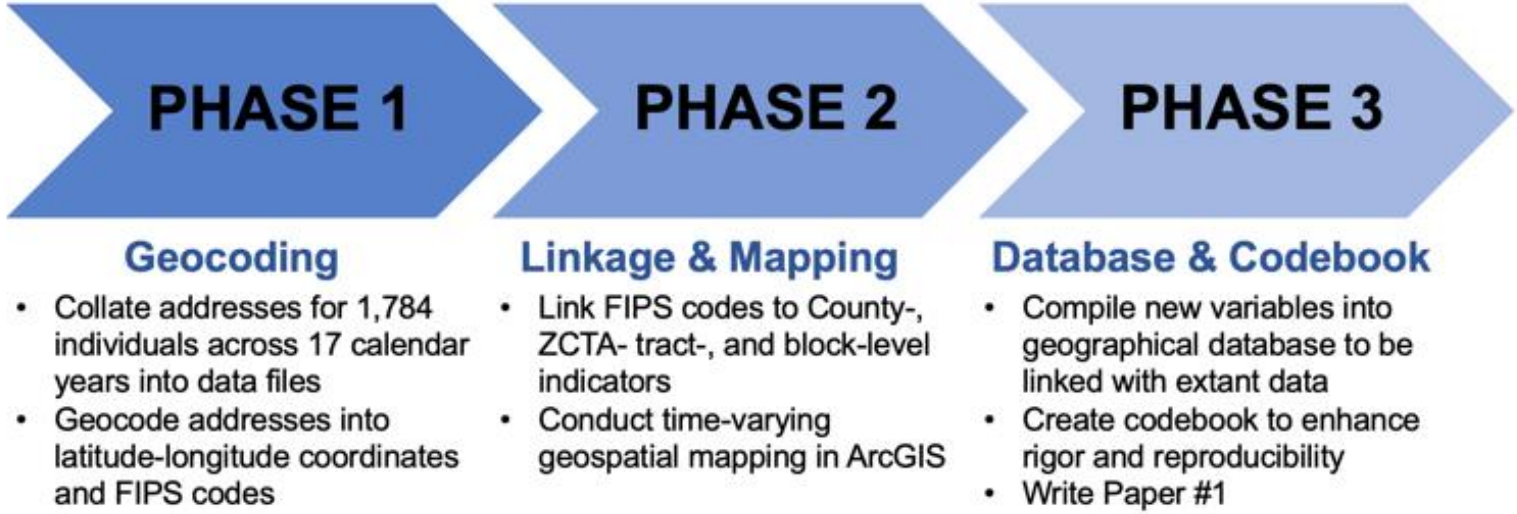
Study 2: CFP-GEO

Figure 2. Overview of Aim 1 Geographical Linkage Process (Phases 1-3)



- Approx. 20% of people were still living at the same address 18 years later
- Some people move to other places in California, or other parts of the U.S.
- ~4% of people move back to Mexico

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Future Directions

- Modeling longitudinal changes in health behaviors, environmental opportunities, and behavior-opportunity gaps
- Examining familial/household patterns
- Considering the environment at different levels:
  - E.g., census tract vs. block vs. point distances
  - E.g., Cognability; dollar stores (vs. grocery stores)

Identifying the direction of behavior-opportunity gaps is critical because it impacts potential targets for effectively preventing dementia:

Develop interventions that provide individuals with resources to support **health behavior change.**

Enact policy changes that **target the built environment** to increase access to environmental opportunities.

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Thank you!

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