Validating Area-Based Social Measures for Predicting Health and Mortality

Aubrey Limburg, U.S. Census Bureau
David H. Rehkopf, Stanford University
Nicole Gladish, Stanford University
Robert L. Phillips, American Board of Family Medicine
Victoria Udalova, U.S. Census Bureau (presenter)

October 24, 2024
FCSM

Accurately measuring social risk is essential for improving health and reducing inequities

- Individuals frequently face social risks that impact their health and healthcare needs
- Accurately measuring social risk is crucial to improve health and reduce inequities
  - Guiding services and allocating resources
  - Developing social policies
  - Targeting public interventions
  - Adjusting payments to healthcare providers
- Variety of ways to measure social risk

United States® Census Bureau

Different way to measure social risk

- Individual-level measures
  - E.g., income - commonly used to determine eligibility for public programs
- Area-based measures have several advantages over individual measures
  - Easier and less costly to implement
  - Less prone to errors and fraud
  - Capture multi-dimensional aspect of social risk
  - Other countries (UK, New Zealand) use them to adjust healthcare resources
- But area-based measures have not been systematically validated
  - For prediction across different outcomes
  - For prediction of these outcomes across different population subgroups

United States® Census Bureau

In this paper, we assess predictive accuracy of social risk measures

Question 1: How strongly are existing individual and area-based social risk measures correlated?

Question 2: How predictive are these measures of common health outcomes?

- Which measure(s) are the most predictive?

Question 3: How consistent are these predictions across population subgroups defined by age, gender, race, ethnicity, and rurality?

- Which measure(s) have the most consistent predictions?

United States® Census Bureau

New data using record linkages at Census Bureau

- Partnership between the U.S. Census Bureau, American Board of Family Medicine, and Stanford University
- Social risk measures come from American Community Survey (ACS)
  - Area-based measures from public 5-year ACS (2016-2020)
  - Individual measures from restricted ACS microdata (2005-2022)
- Health outcomes
  - Health conditions from electronic health records (EHRs) as part of the American Family Cohort (AFC) data based on a national primary care physician registry (2019-2021)
  - Mortality from the Census Numident File based on Social Security Administration (SSA) records
- Linked EHRs and ACS data at the individual level

United States® Census Bureau

Focus on commonly used social risk measures

15 area-based measures examined

1) Social Deprivation Index (SDI) [census block group (CBG); census tract (CT)]
2) Social Vulnerability Index (SVI) [CBG; CT]
3) Area Deprivation Index (ADI-GS) [CBG; CT]
4) Area Deprivation Index (ADI-UW) [CBG; CT]
5) Neighborhood Stress Score (NSS7) [CBG; CT]
6) Index of Concentration at the Extremes (ICE) for race/ethnicity and income (ICE wb-inc; ICE wpc-inc) [CT]
7) French Deprivation Index (FDep) [CBG; CT]
8) Community Resilience Estimates (CRE) [CT]

3 individual-level measures examined

1) Educational attainment
2) Household poverty index
3) Occupational class

United States® Census Bureau

Focus on common health outcomes

4 health outcomes examined

1) Hypertension
2) Diabetes
3) Chronic kidney disease
4) All-cause mortality

United States® Census Bureau

Statistical analysis to assess predictive power

- 4 outcomes, 18 social risk measures = 72 models
- Unadjusted and adjusted for age, gender, race, ethnicity, and rurality
- Overall and by age, gender, race, ethnicity, and rurality

United States® Census Bureau

Results

Question 1: How strongly are existing individual and area-based social risk measures correlated?

Question 2: How predictive are these measures of common health outcomes?

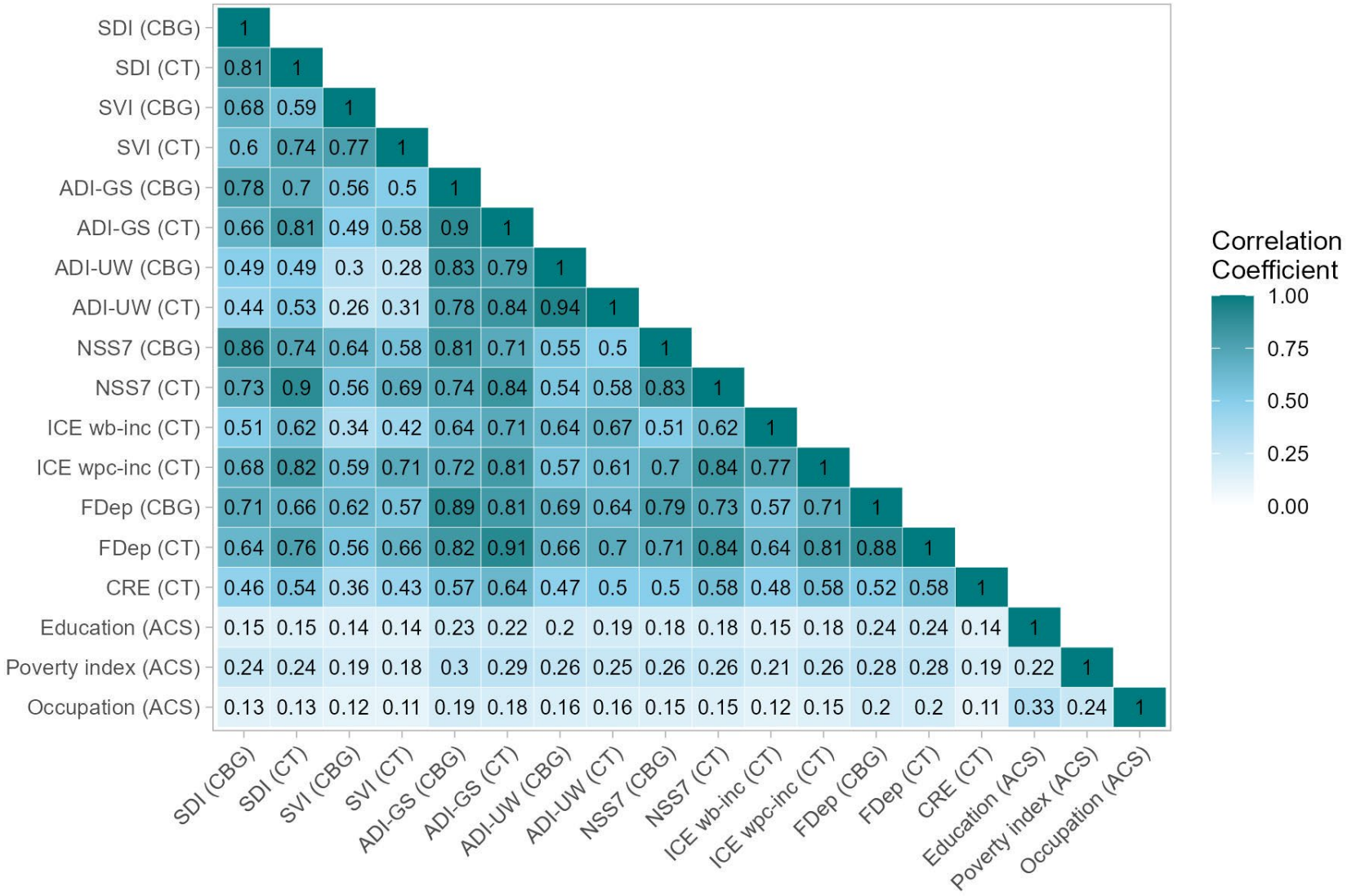
- Which measure(s) are the most predictive?

Question 3: How consistent are these predictions across population subgroups defined by age, gender, race, ethnicity, and rurality?

- Which measure(s) have the most consistent predictions?

United States® Census Bureau

Individual and area-based measures weakly correlated



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022). Notes: Pearson correlation coefficients (all correlations are p<0.001). The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

Results

Question 1: How strongly are existing individual and area-based social risk measures correlated?

Question 2: How predictive are these measures of common health outcomes?

- Which measure(s) are the most predictive?

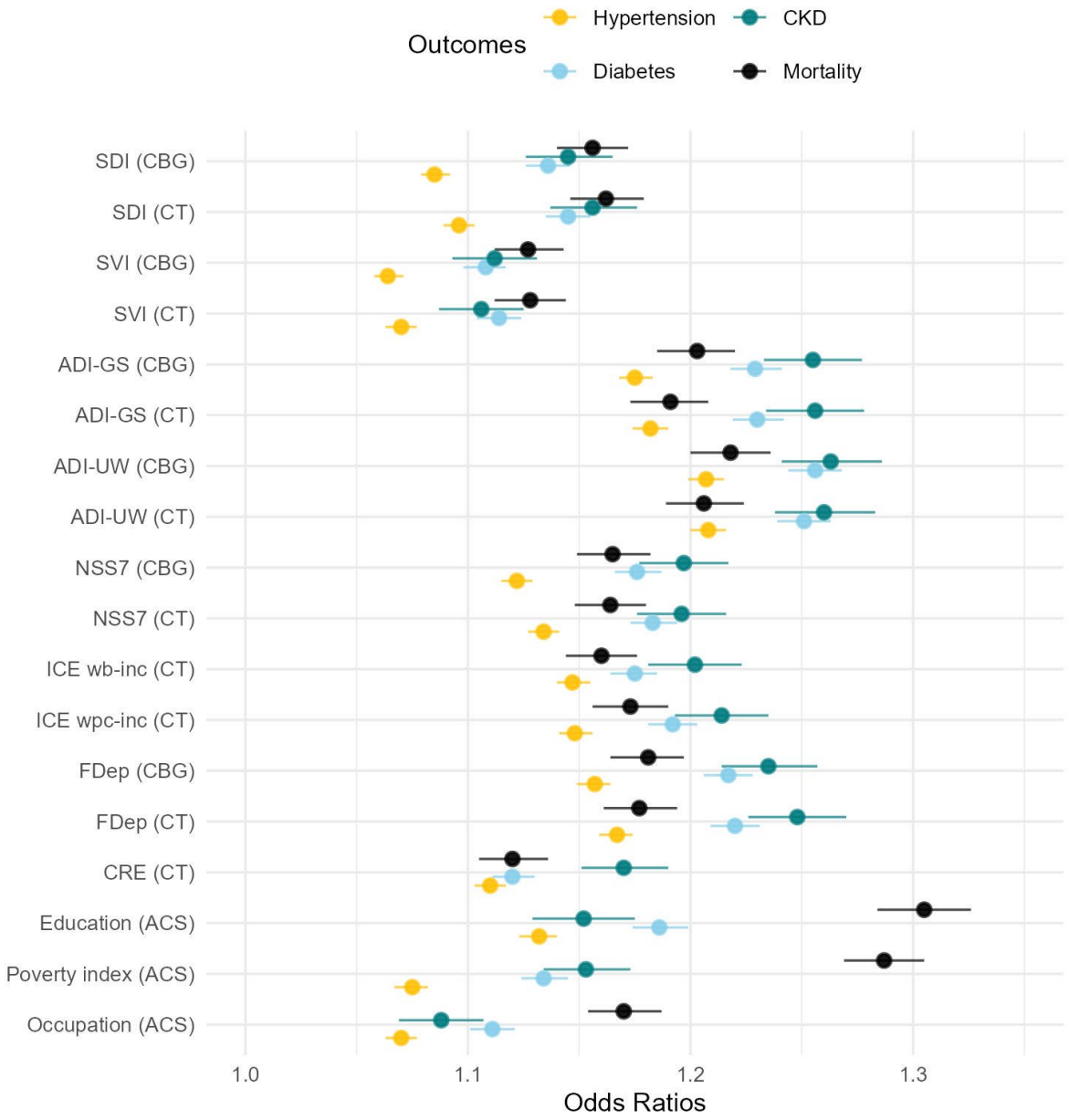
Question 3: How consistent are these predictions across population subgroups defined by age, gender, race, ethnicity, and rurality?

- Which measure(s) have the most consistent predictions?

United States® Census Bureau

Area-based measures strongly predict health outcomes

- Positive, consistent, and statistically significant associations, but variation in prediction magnitude
- Area-based measures strongly predict health outcomes, with ADI being the strongest predictor
- Individual measures are stronger predictors of mortality



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022); Census Numident (Q3, 2023). Models adjust for age, race, ethnicity, gender, and rurality. Notes: CKD = chronic kidney disease; CBG = census block group; CT = census tract. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

Results

Question 1: How strongly are existing individual and area-based social risk measures correlated?

Question 2: How predictive are these measures of common health outcomes?

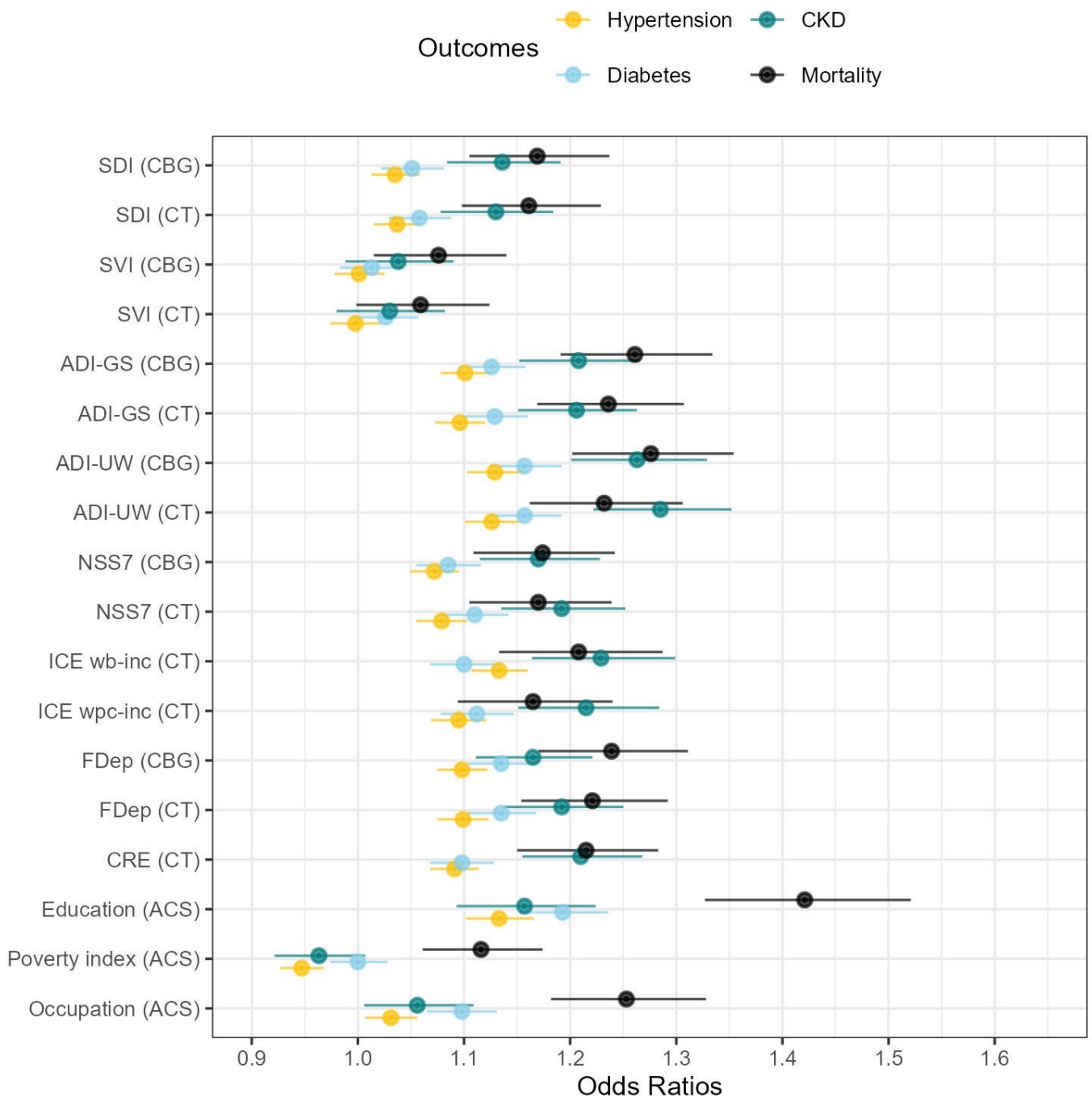
- Which measure(s) are the most predictive?

Question 3: How consistent are these predictions across population subgroups defined by age, gender, race, ethnicity, and rurality?

- Which measure(s) have the most consistent predictions?

United States® Census Bureau

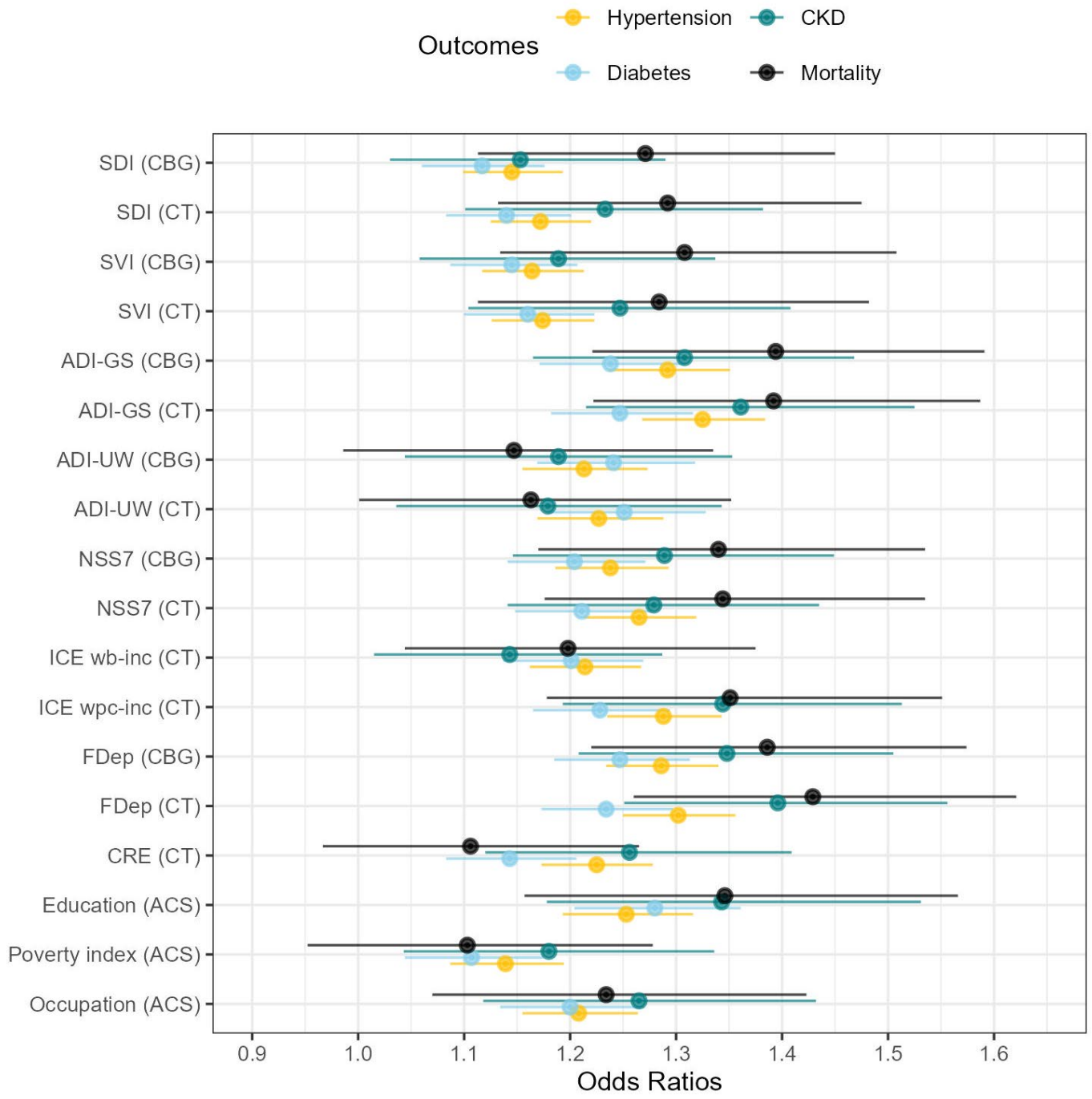
Equal validity across different racial and ethnic populations: Black Individuals



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022); Census Numident (Q3, 2023). Models are unadjusted. Notes: CKD = chronic kidney disease; CBG = census block group; CT = census tract. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

United States® Census Bureau

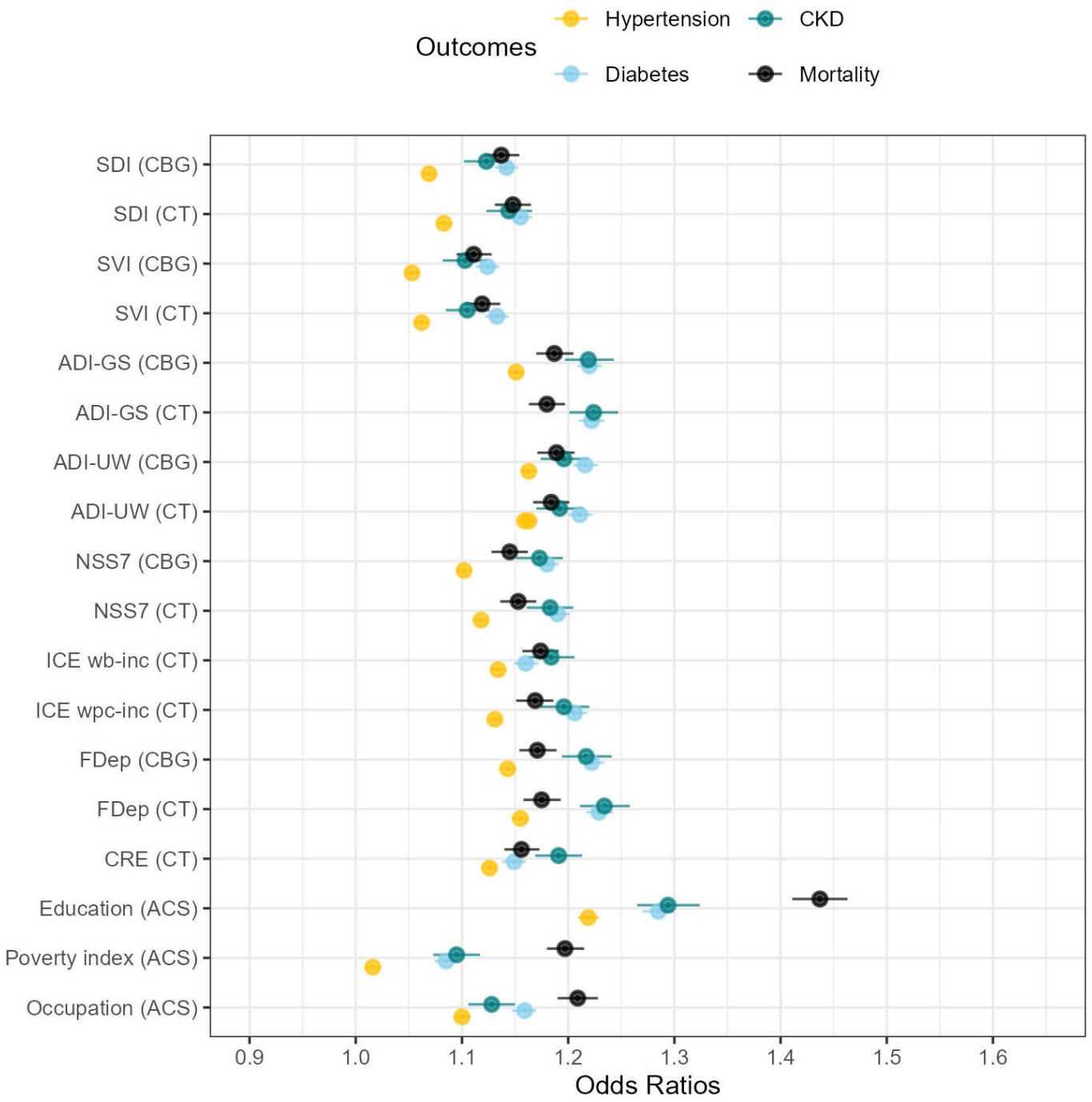
Equal validity across different racial and ethnic populations: Asian Individuals



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022); Census Numident (Q3, 2023). Models are unadjusted. Notes: CKD = chronic kidney disease; CBG = census block group; CT = census tract. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

United States® Census Bureau

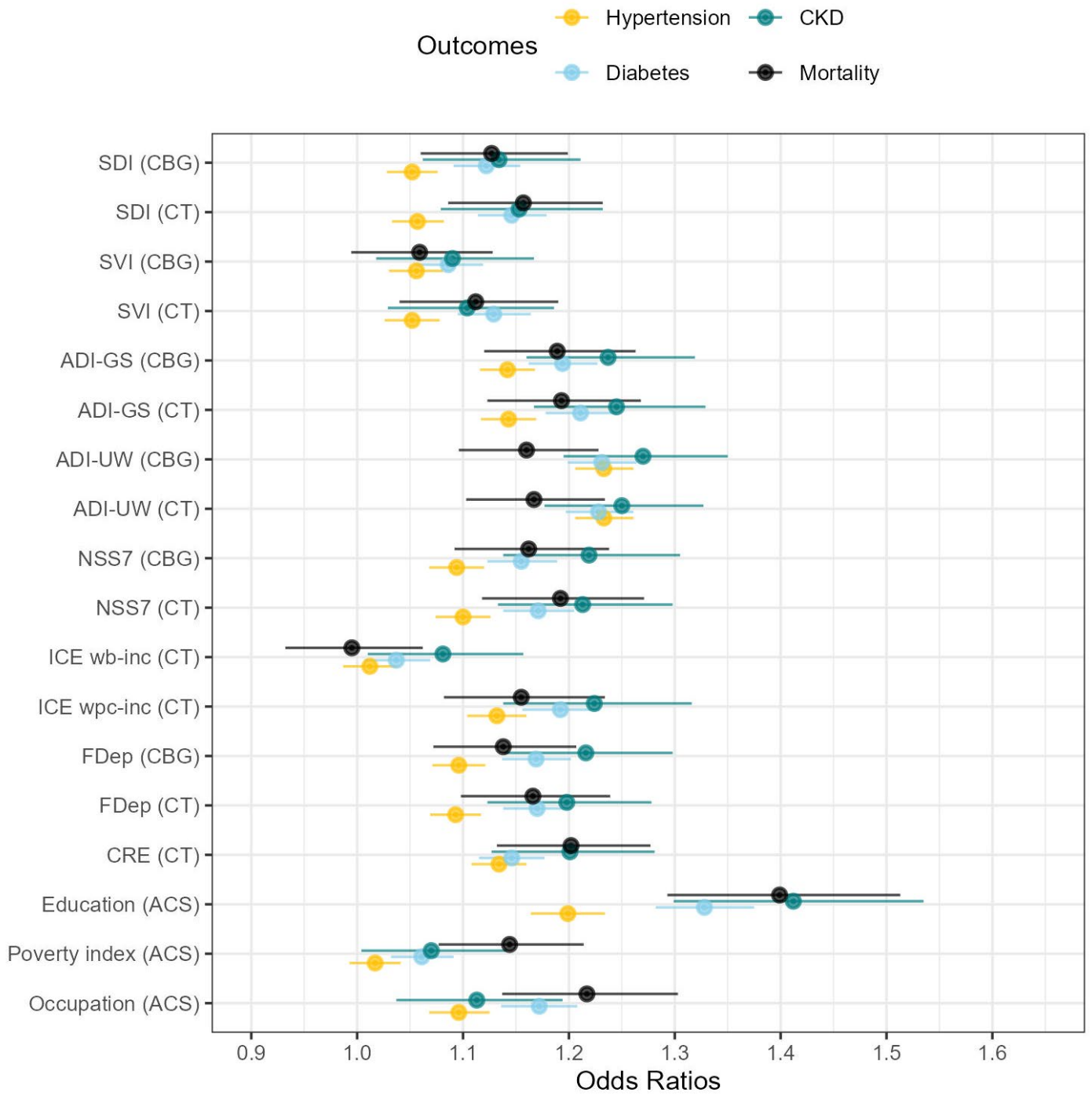
Equal validity across different racial and ethnic populations: White Individuals



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022); Census Numident (Q3, 2023). Models are unadjusted. Notes: CKD = chronic kidney disease; CBG = census block group; CT = census tract. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

United States® Census Bureau

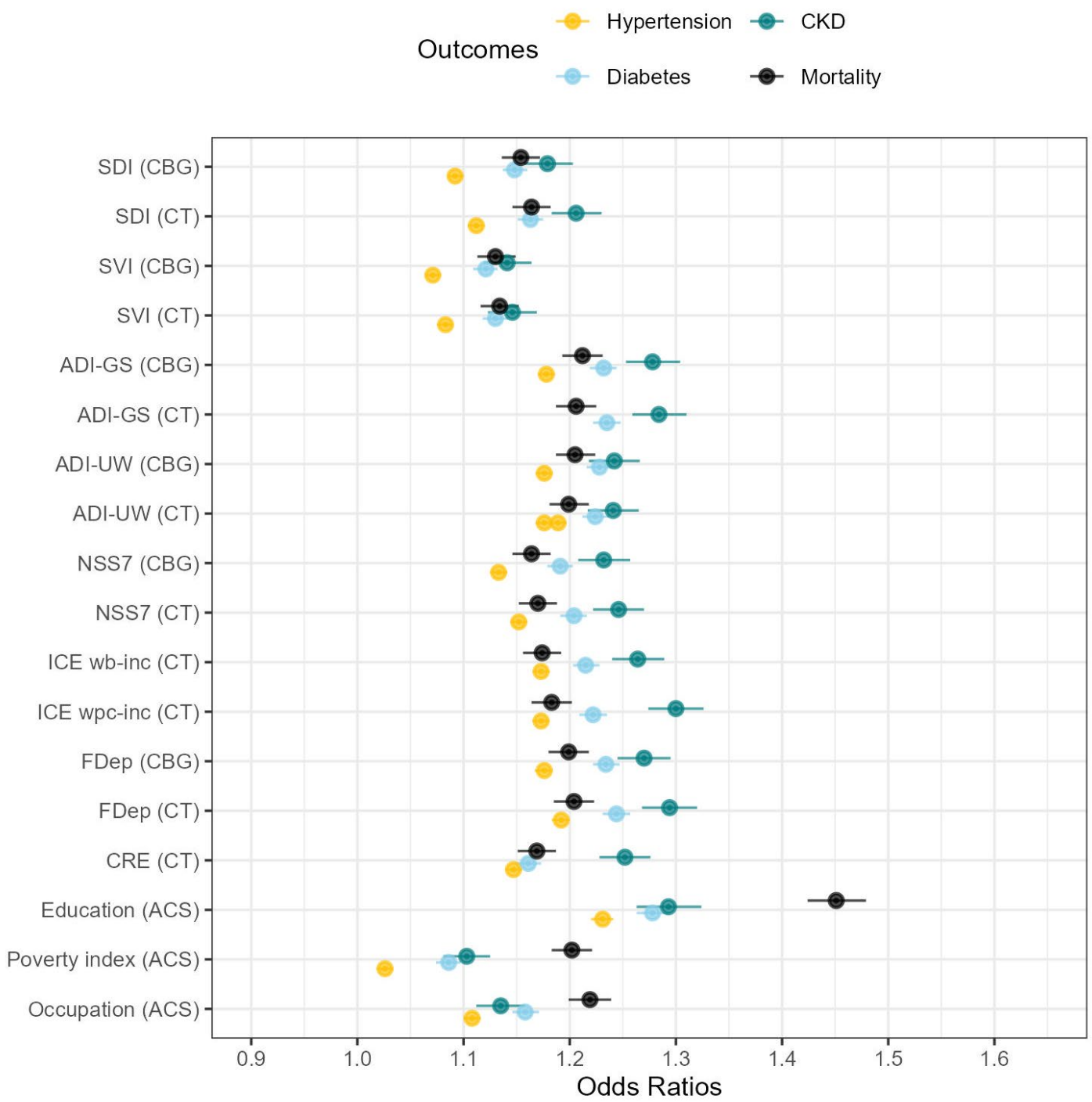
Equal validity across different racial and ethnic populations: Hispanic Individuals



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022); Census Numident (Q3, 2023). Models are unadjusted. Notes: CKD = chronic kidney disease; CBG = census block group; CT = census tract. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

United States® Census Bureau

Equal validity across different racial and ethnic populations: Non-Hispanic Individuals



Source: American Family Cohort (AFC) data 2019-2021; American Community Survey (2005-2022); Census Numident (Q3, 2023). Models are unadjusted. Notes: CKD = chronic kidney disease; CBG = census block group; CT = census tract. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product (Data Management System (DMS) number: P-7532672, Disclosure Review Board (DRB) approval number: CBDRB-FY24-POP001-0090).

United States® Census Bureau

Equal validity across other key population subgroups

- Geography
  - All measures are better at predicting health outcomes for patients in metropolitan areas
  - Area Deprivation Index (ADI-GS) is the most predictive
- Age
  - Similar predictors across age groups
- Gender
  - Similar predictors for men and women

United States® Census Bureau

Conclusion

- Area-based social risk measures strongly predict health outcomes
- Predictions are broadly consistent across age, gender, race, ethnicity, and rurality
- Several measures have particularly strong and consistent predictions
  - ADI-GS, FDep, ICE
- Equal performance of measures at census block group and census tract level

United States® Census Bureau

Contact information

Victoria Udalova, PhD

Principal Economist

Director, Enhancing Health Data (EHealth) Program

U.S. Census Bureau

victoria.m.udalova@census.gov

United States® Census Bureau