National Center for Health Statistics
Data Linkage

Assessing Consent Bias in Linkage Studies

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Outline

- Purpose
- Background: NCHS Data Linkage Program
- Changes in linkage eligibility over time
- Research question
- Methods to assess bias in estimates
- Results
- Conclusions

Purpose

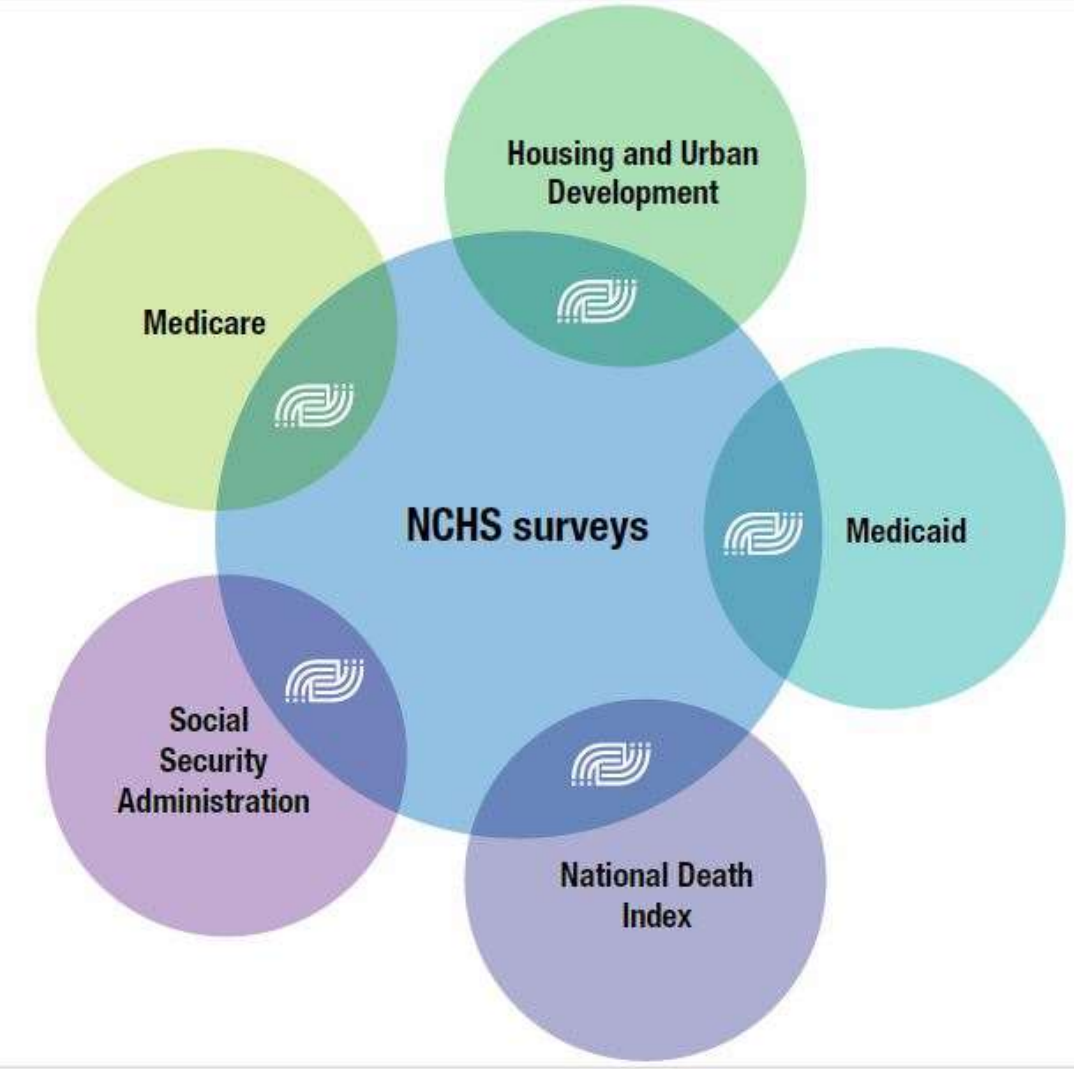
- NCHS only links survey participants who grant linkage consent
- Concerns if inference drawn from linked data represent the full sample
- Linkage consent rates may introduce consent bias with estimates
- In 2007 linkage eligibility criteria changed which increased linkage consent rates
- This talk addresses if changing the linkage eligibility had an impact on consent bias

Background: NCHS Data Linkage Program

- Designed to maximize the scientific value of the NCHS surveys
- Links survey data with vital and administrative records
  - Efficient means to add information
  - Allows analyses that would not be possible with each data source alone
- Includes the following NCHS Surveys :
  - National Health Interview Survey (NHIS)
  - National Health and Nutrition Examination Survey (NHANES)
  - National Health Care Surveys

More information about surveys: http://www.cdc.gov/nchs/data/factsheets/factsheet_summary.pdf

Current NCHS Data Linkages



A summary of the available linkages can be found at: https://www.cdc.gov/nchs/data/datalinkage/linkagetable.pdf

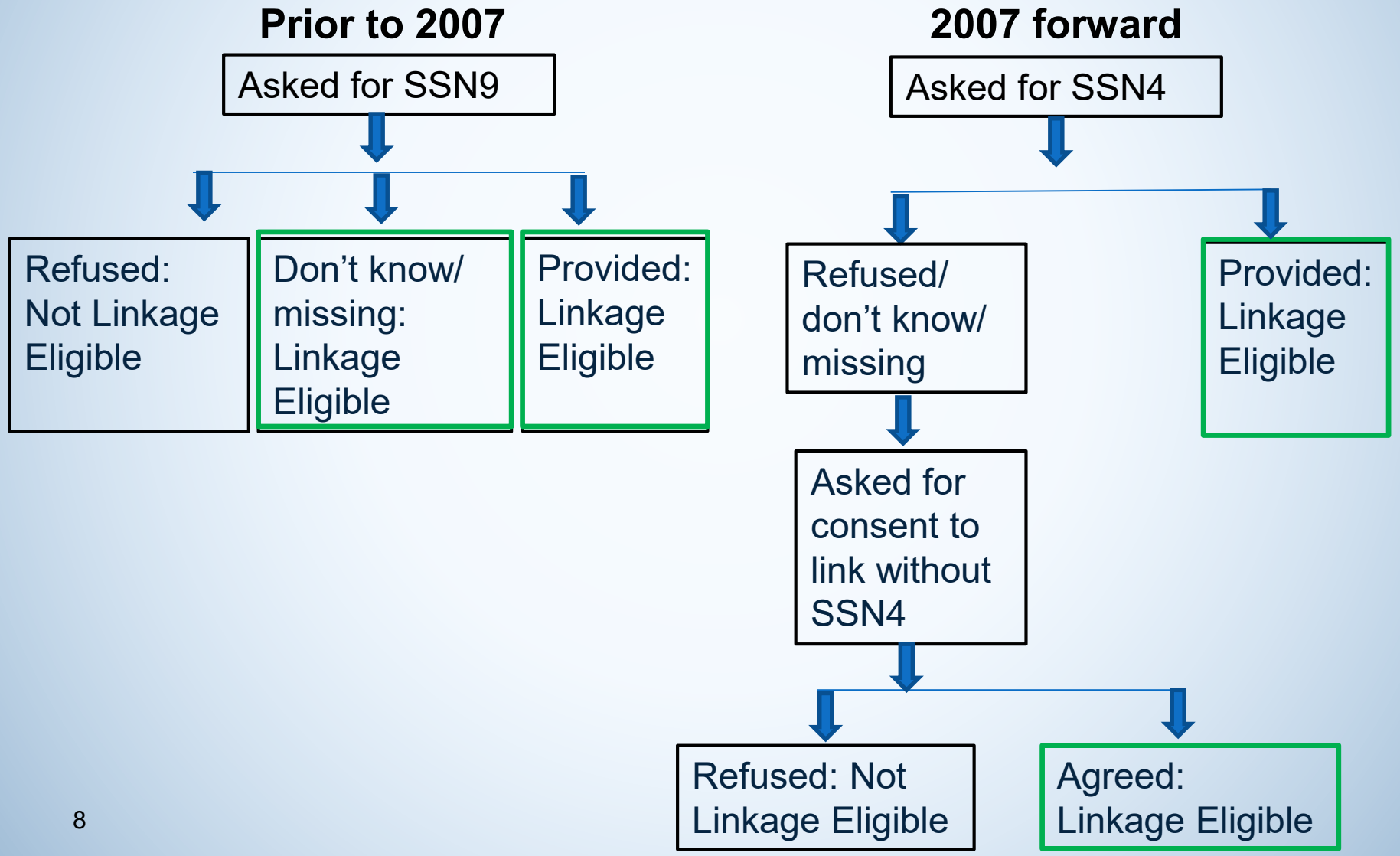
Linkage Eligibility

- Only linkage eligible (LE) survey participants are able to be linked
- Linkage eligibility varies based on survey and year
- Linkage eligibility depends on having sufficient personally identifiable information (PII) and not refusing data linkage
- The fact that not every one is linkage eligible could have implications for inference when using the linked data

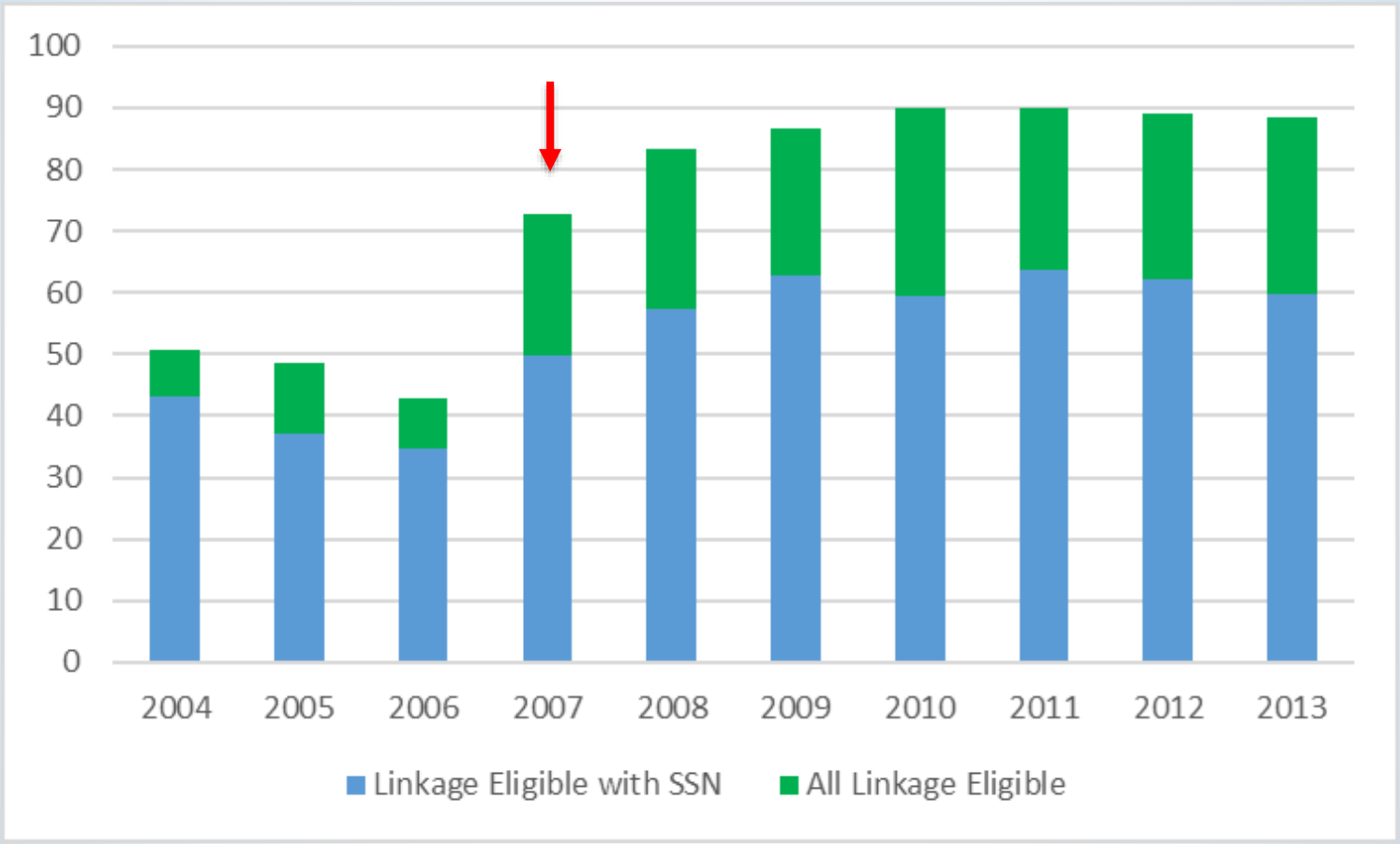
Changes in linkage eligibility over time

- NHIS linkage eligibility changed in 2007
- For PII collection:
  - NHIS only collects last 4 digits of Social Security Number (SSN) instead of 9
- For participants who refuse to provide last 4 digits of SSN:
  - NHIS asks a specific question about permission to link without SSN<*this was not previously asked*>

NHIS


Prior to 2007
Asked for SSN9
Refused: Not Linkage Eligible
Don't know/ missing: Linkage Eligible
Provided: Linkage Eligible
2007 forward
Asked for SSN4
Refused/ don't know/ missing
Provided: Linkage Eligible
Asked for consent to link without SSN4
Refused: Not Linkage Eligible
Agreed: Linkage Eligible

Percent of Participants that are Linkage Eligible



Note: this graph only includes sample adults

Research Question

Did the changes in linkage eligibility affect the bias in estimates for those who consented compared to the full sample?

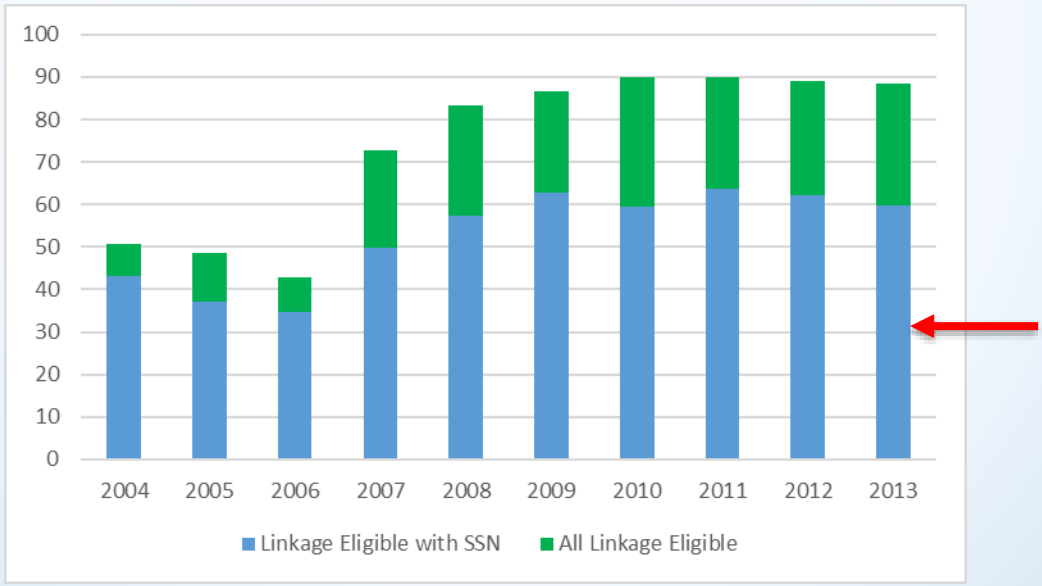
Methods

- Analyzed survey collected variables for sample adults age 18+
- Identified three groups:
  - All sample adults
  - Linkage eligible sample adults who provided SSN (9 or 4)
  - Linkage eligible sample adults
- Calculated estimates for demographic and health related variables
  - Verified questions were asked the same over time

Calculation of Relative Bias: Linkage Eligible with SSN

- Absolute Relative Bias=

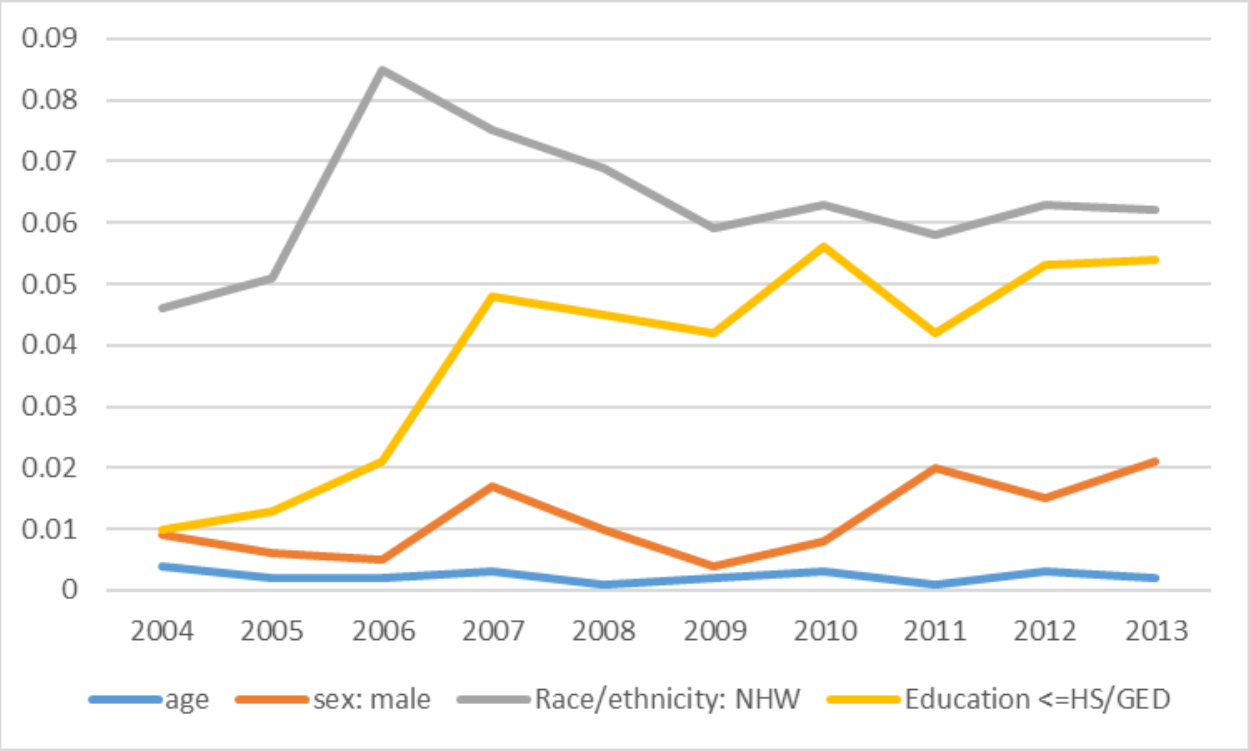
$$\frac{\text{Estimate of LE w/SSN- Estimate of all Sample Adults}}{\text{Estimate of all Sample Adults}}$$



Sakshaug, J. W., & Huber, M. (2016). An Evaluation of Panel Nonresponse and Linkage Consent Bias in a Survey of Employees in Germany. *Journal of Survey Statistics and Methodology, 4*(1), 71-93. doi:10.1093/jssam/smv034

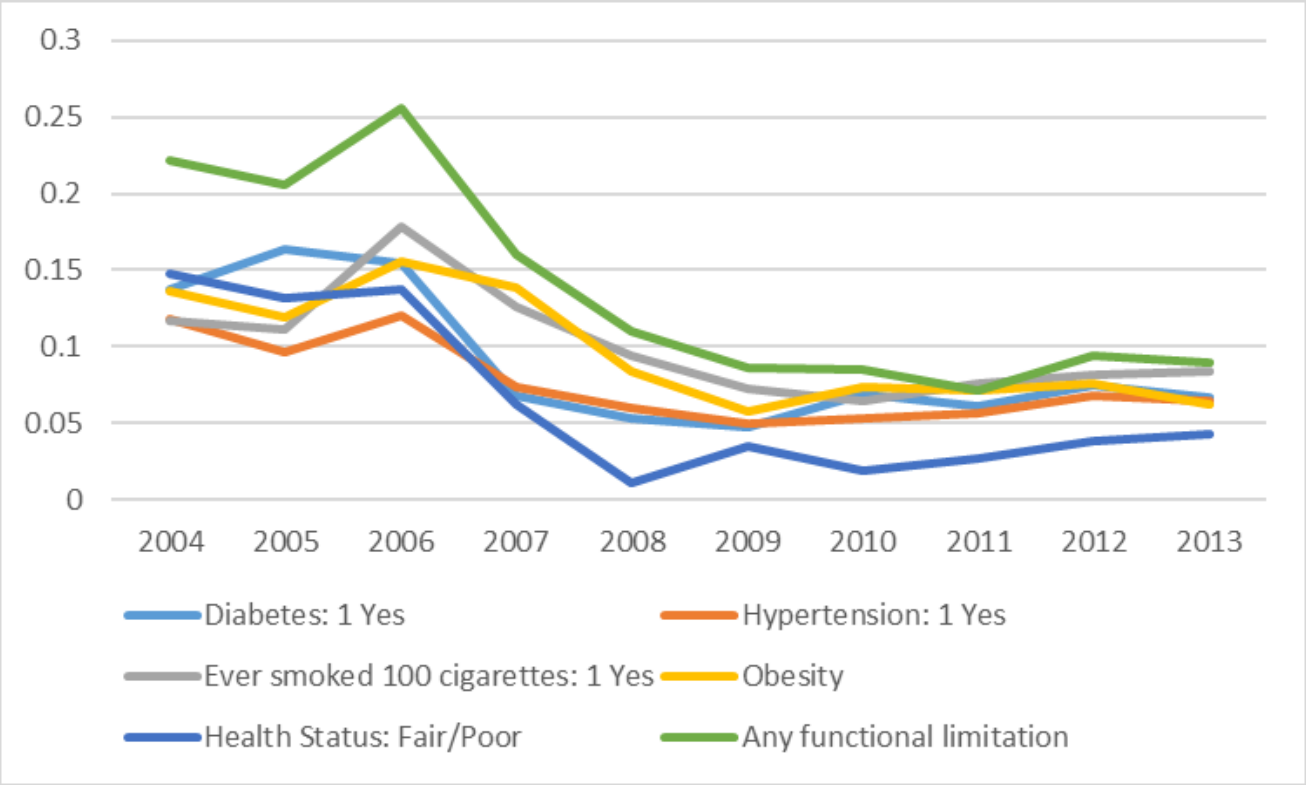
Relative Bias Demographics: Linkage Eligible with SSN

- Age, sex, race/ethnicity and education



Relative Bias Health Related: Linkage Eligible with SSN

- Diabetes, smoking status, overall health status, hypertension, obesity, and any functional limitation



Results Absolute Relative Bias: Linkage Eligible with SSN

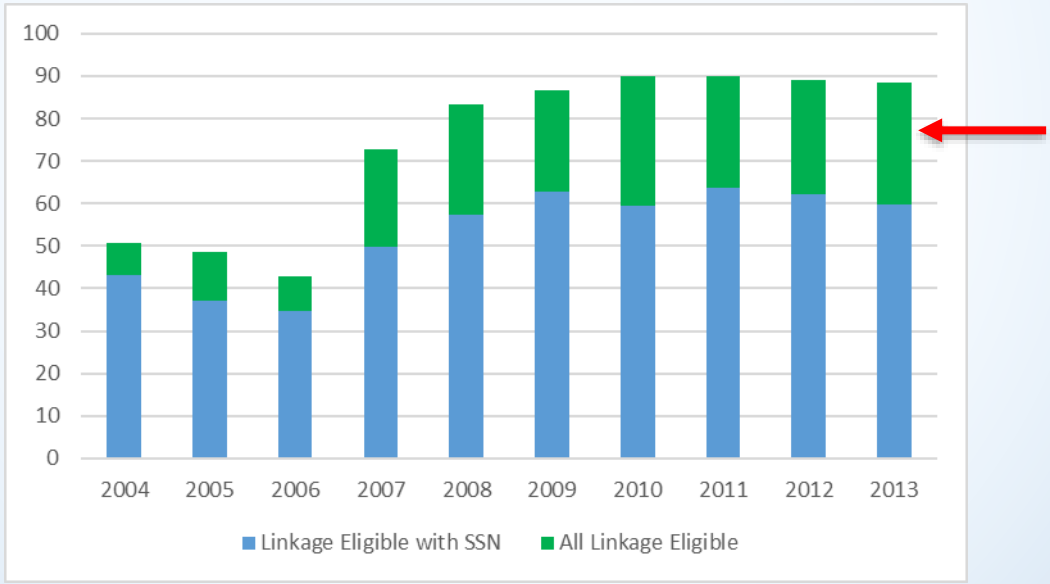
Variable Type	Maximum Relative Bias Before 2007	Maximum Relative Bias After 2007
Demographic	9%	6%
Health Related	25%	15%

- Education increased in relative bias after 2007
- The relative bias for the other demographic variables stayed relatively constant
- The relative bias for health related variables decreased after 2007

Calculation of Relative Bias: All Linkage Eligible

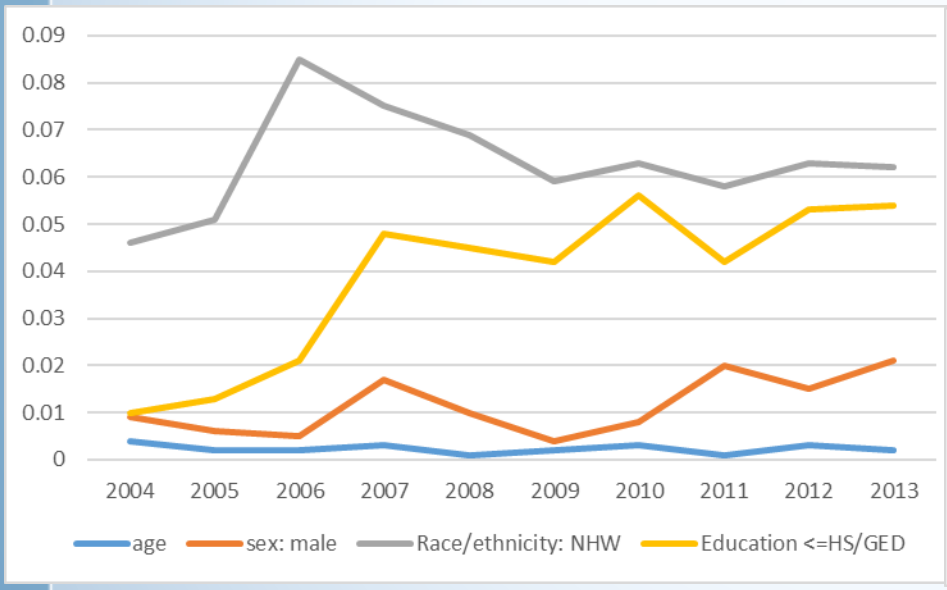
- Absolute Relative Bias=

$$\frac{\text{Estimate of Linkage Eligible- Estimate of all Sample Adults}}{\text{Estimate of all Sample Adults}}$$

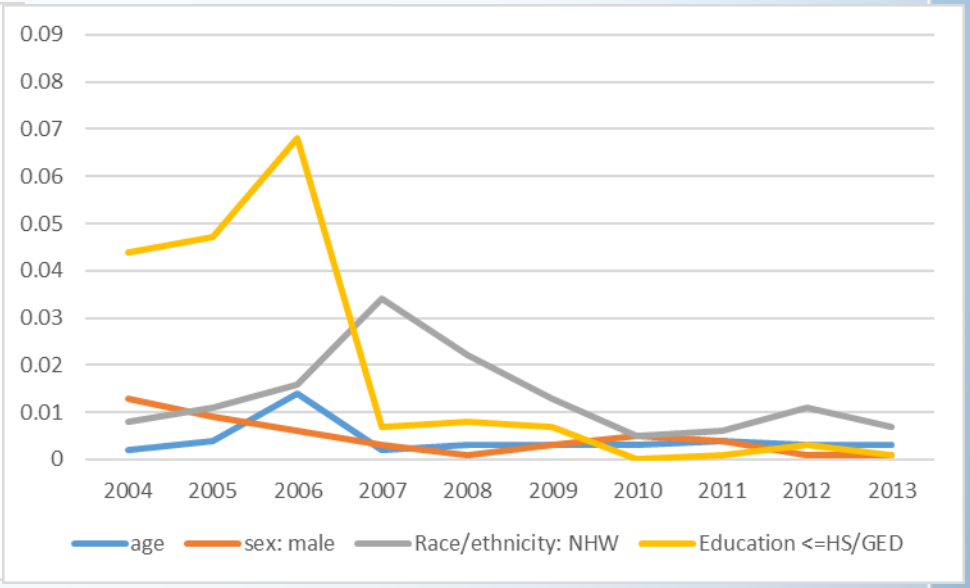


Comparing Relative Bias: Demographic Variables

Linkage Eligible with SSN

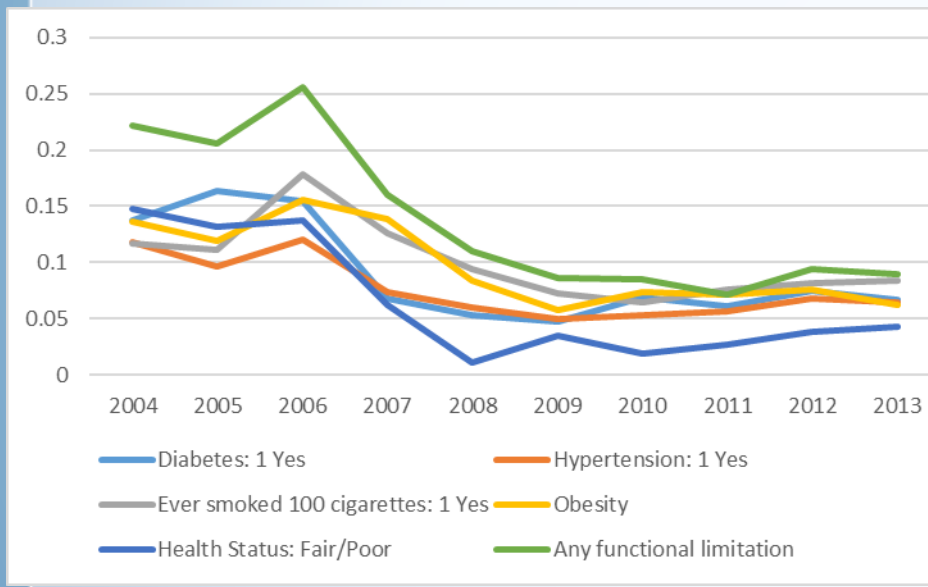


Linkage Eligible

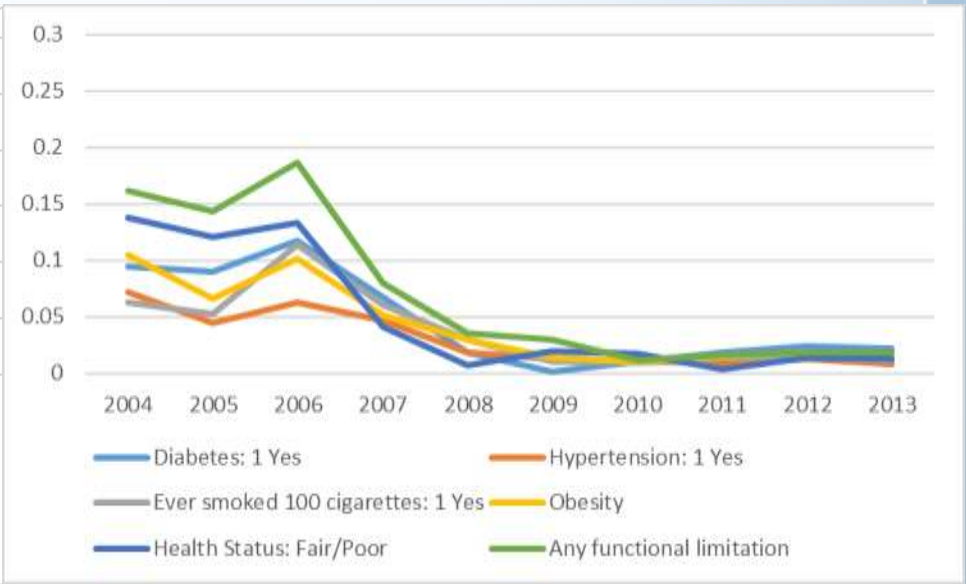


Comparing Relative Bias: Health Related Variables

Linkage Eligible with SSN



Linkage Eligible



Results Absolute Relative Bias: Linkage Eligible

Variable Type	Maximum Relative Bias Before 2007	Maximum Relative Bias After 2007
Demographic	7%	3%
Health Related	19%	7%

- Decrease in relative bias in 2007 when linkage eligibility criteria changed
- Since 2007 relative bias has remained relatively constant

Comparison of Relative Bias

- Estimates for all linkage eligible appear to have lower relative bias than when restrict to linkage eligible who also provided SSN
- Note: no statistical testing was done for comparisons

Conclusions

- Changing the linkage eligibility criteria in 2007 helped with both increasing sample sizes and decreasing linkage consent bias
- Some estimates remained unchanged but others were more affected by linkage consent
- Caveat: assessments of bias used survey variables and may not indicate bias for analyses using variables from the linkages (e.g. from the administrative data source)

Next steps

- Develop algorithms that incorporate all linkage eligible not just those who also provided SSN
  - More evidence of bias when restrict to linkage eligible who also provided SSN
- Assess bias with other non-health related variables from the survey
- Explore methods to mitigate potential bias for specific analyses with linked data
  - Weight adjustments
  - Imputation

Acknowledgements

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Questions?

Thank you!

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https://www.cdc.gov/nchs/data-linkage/index.htm