



Update: County estimates of high blood pressure

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Overview

Why is this important?

- Nearly half of adults 18 and older have high blood pressure (Source: [National Health and Nutrition Examination Survey 2017-March 2020](#))
- Hypertension increases risk of heart disease and stroke

What is currently available?

- Nationwide county estimates of hypertension exist
 - BRFSS: annual telephone survey with high rates of non-response
 - Captures only awareness
 - Does not capture unaware high blood pressure
 - COSMOS: electronic health records of 250 million patients from over 1500 participating health systems
 - Contains data only from participating health system among the 50% that use Epic
 - Does not capture unaware high blood pressure

Current Surveillance Approaches

BRFSS 2021

CDC develops questionnaires in collaboration with states and other stakeholders

Random digit dialing to create a probability sample of adults (≥ 18 years)

Interviews conducted by state health departments or contractors in English/Spanish/Other

Sampling weights constructed for probability of selection and adjusted for non-response and to align with US Census counts

Numerator: Have you ever been told by a doctor, nurse, or other health professional that you have high blood pressure? = Yes

Denominator: All respondents

Epic Cosmos

Health systems with Epic EHR choose to participate in Cosmos

Epic anonymizes and harmonizes data through the Care Everywhere platform

Data follows the Epic Cosmos Data Model, different from other EHR database formats (OMOP, PCORnet)

No adjustment for health system contribution. Health systems may not include all their data in Cosmos. Patients may use other health systems

Numerator: Counts of patients with Hypertension code or Antihypertensive Prescription*

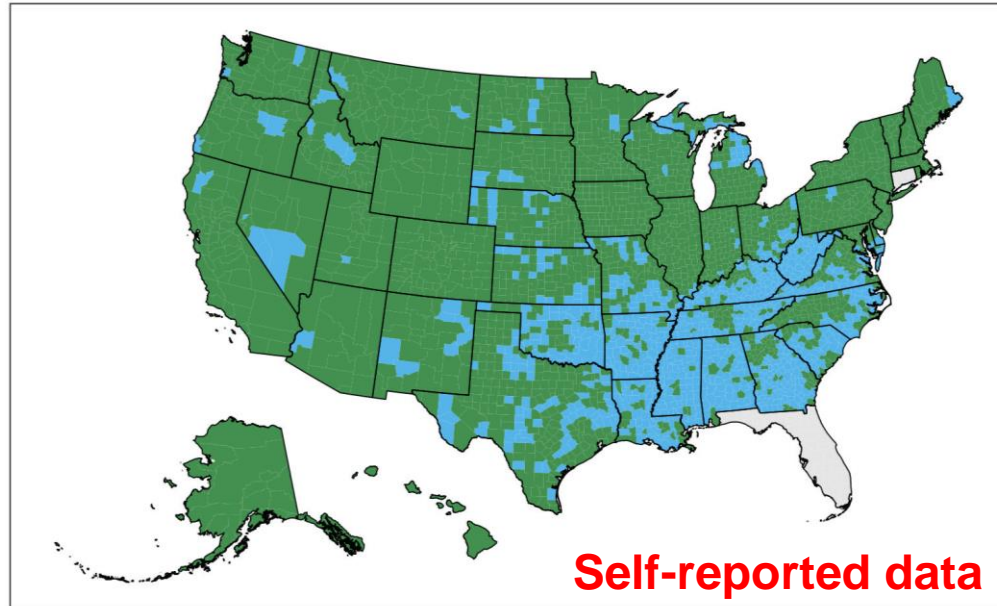
Denominator: Adult patients with at least one encounter in 2021-2022

* This is not available for counties with <10 cases and currently does not include measured high blood pressure

Estimates of prevalence from BRFSS and Cosmos

BRFSS 2021

High Blood Pressure (%), ≥ 18 years, Crude

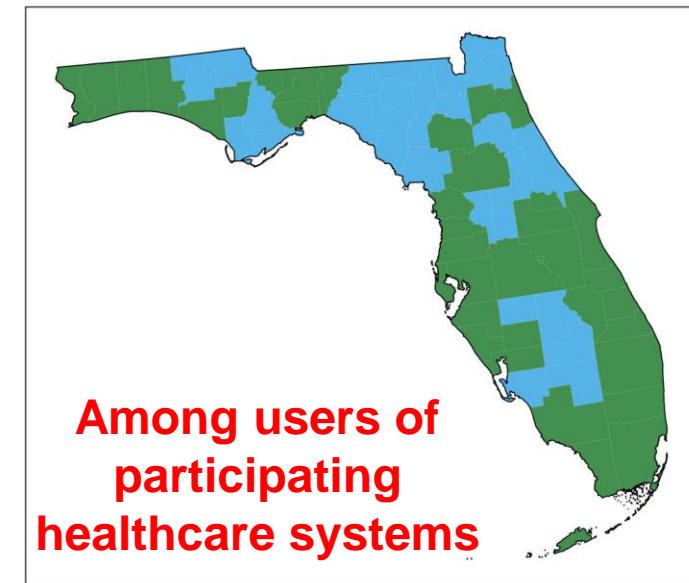


■ 20 to <40 ■ 40 to <60 ■ NA

https://data.cdc.gov/500-Cities-Places/PLACES-Local-Data-for-Better-Health-County-Data-20/swc5-untb/about_data

Epic Cosmos 2021-2022

Hypertension or Antihypertensive Prescription (%),
 ≥ 18 years, Crude
N = 5,495,399 patients

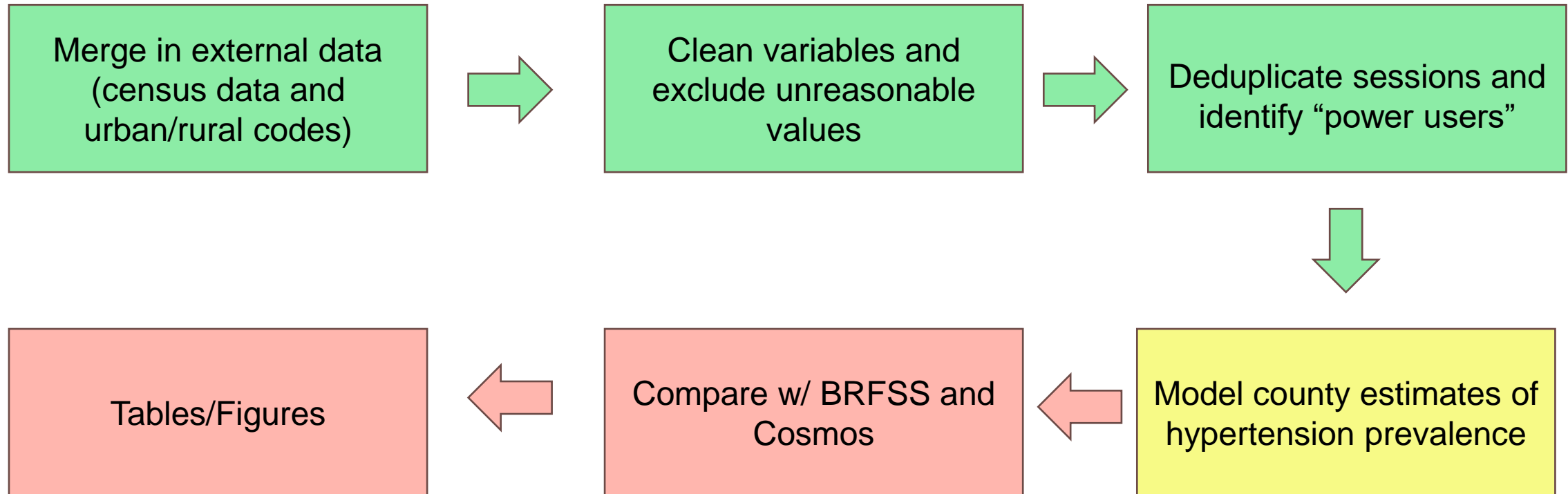


■ 20 to <40 ■ 40 to <60

https://cosmos.epichosted.com/EpicCareLink_AUTH/common/epic_main.asp
Patients 18 years or older between Jan 2021 and Dec 2022 with either
Diagnosis code (I10) or Prescription for Antihypertensives.

12.6% of hypertension cases (N = 2,311,992) did not have a known county

Our approach



Why is our approach better than existing ones?

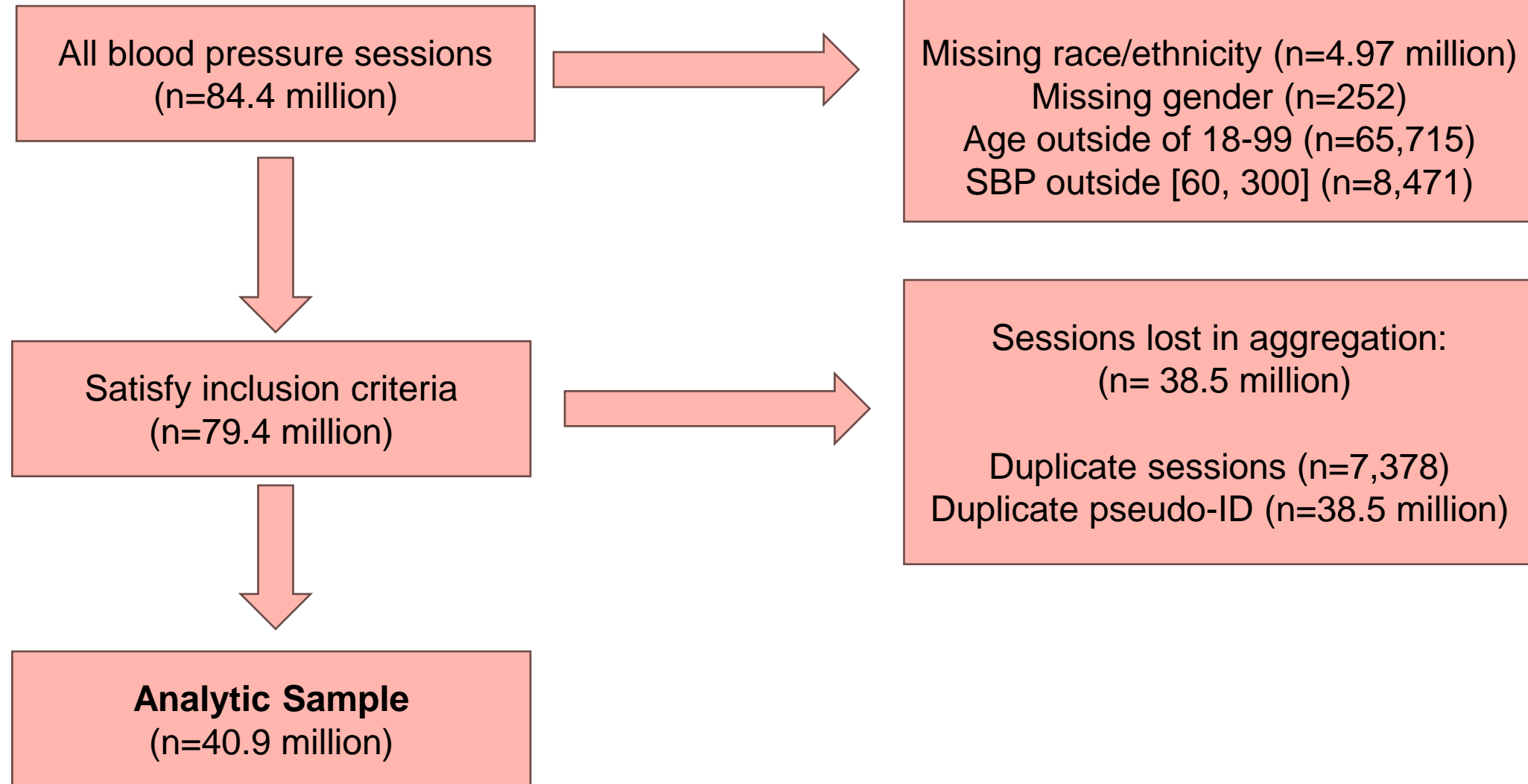
Pursuant Observational Kiosk data

- Massive observational dataset with measurements from real-time blood pressure monitor (~85 million sessions over eight years)
- Potential improved coverage in historically inaccessible rural areas relative to traditional data sources
- Increased accuracy of blood pressure measurements due to repeated sessions

Methods

- The dataset here is unique and requires unique analytic methods
- To account for non-response, we compute adjustment weights based on the age/sex/race/ethnicity profile at the county level
- We will implement models leveraging space-time information to improve our estimates

Analytic Sample Selection

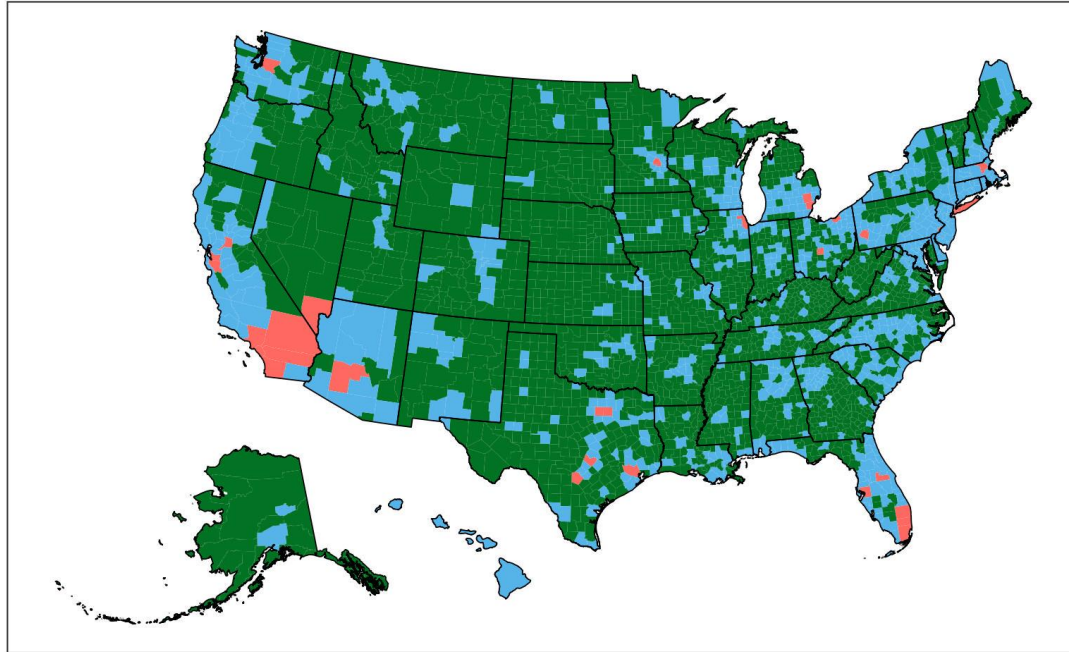


Demographic Comparison

	US Population ACS (2018-2022) (N=334,369,975)	Pursuant Data 2017-2024 (Obs = 40,868,043)	Unique pseudo-ID 2017-2024 (N = 34,939,658)	Pursuant Data 2021-2022 (Obs = 11,526,017)
Age group				
18 to <20	4%	2%	2%	1%
20 to <45	43%	42%	43%	42%
45 to <65	32%	38%	37%	38%
65 and over	21%	18%	18%	18%
Male	49%	55%	54%	54%
Race/ethnicity				
NH White	59%	51%	50%	52%
NH Black	12%	14%	14%	14%
NH Asian	6%	5%	5%	5%
NH Other	5%	6%	7%	4%
Hispanic	19%	24%	24%	25%
Urban	86%	82%	82%	81%

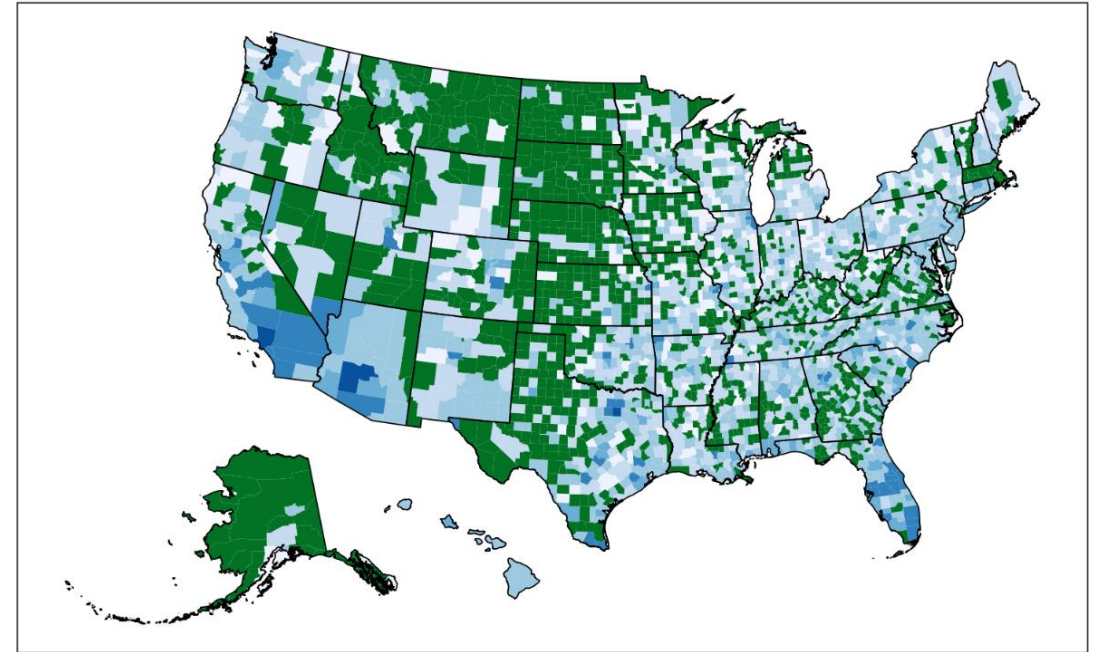
Spatial distribution of observations

ACS 5Y 2016-2020
Population in 1000s, ≥ 18 years, Crude



0 to <50 50 to <1000 1000 to <8000

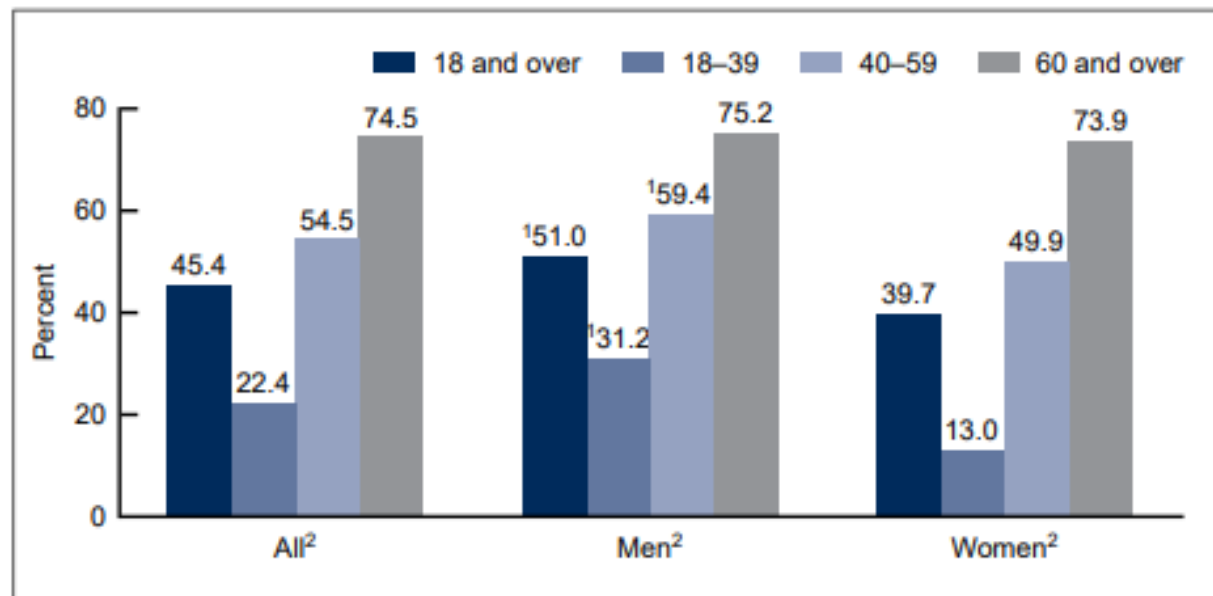
Pursuant observations 2017-2024
Population in 1000s, ≥ 18 years, Crude
Observations = 40,868,043



>0 to <5 10 to <50 100 to <500 NA
5 to <10 50 to <100 500 to <750

Prevalence of hypertension among adults 18 and over by age and sex (2017-2018)

Figure 1. Prevalence of hypertension among adults aged 18 and over, by sex and age: United States, 2017–2018



¹Significantly different from women within the same age group.

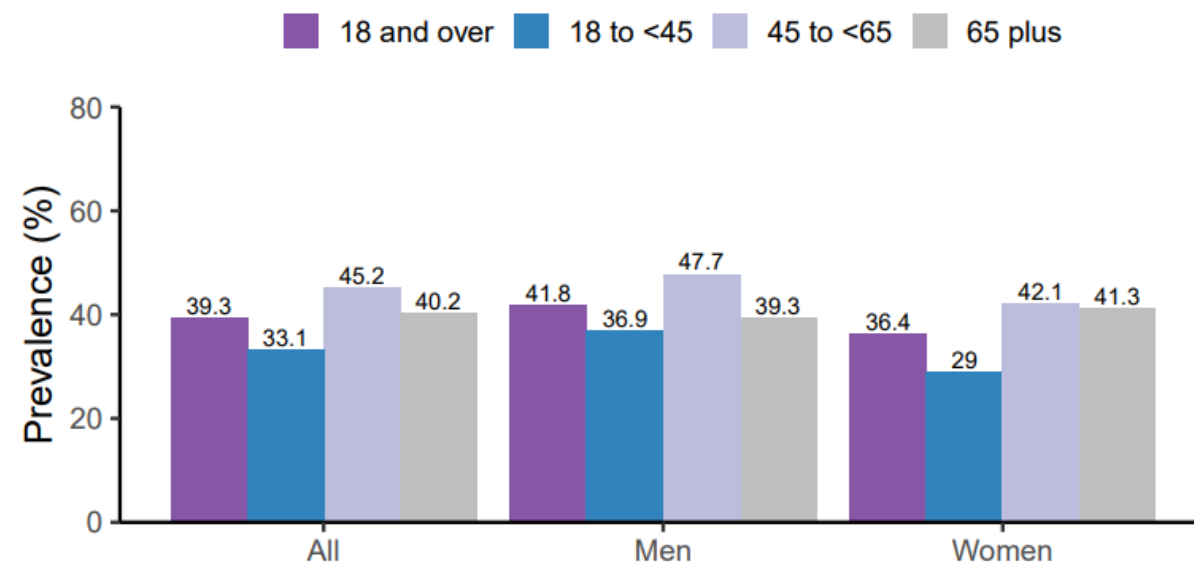
²Significant increasing trend by age.

NOTES: Hypertension is defined as systolic blood pressure greater than or equal to 130 mmHg or diastolic blood pressure greater than or equal to 80 mmHg, or currently taking medication to lower blood pressure. Estimates for age group 18 and over are age adjusted by the direct method to the U.S. Census 2000 population using age groups 18–39, 40–59, and 60 and over. Crude estimates are 48.2% for all persons, 52.5% for men, and 44.0% for women. Access data table for Figure 1 at:

<https://www.cdc.gov/nchs/data/databriefs/db364-tables-508.pdf#1>.

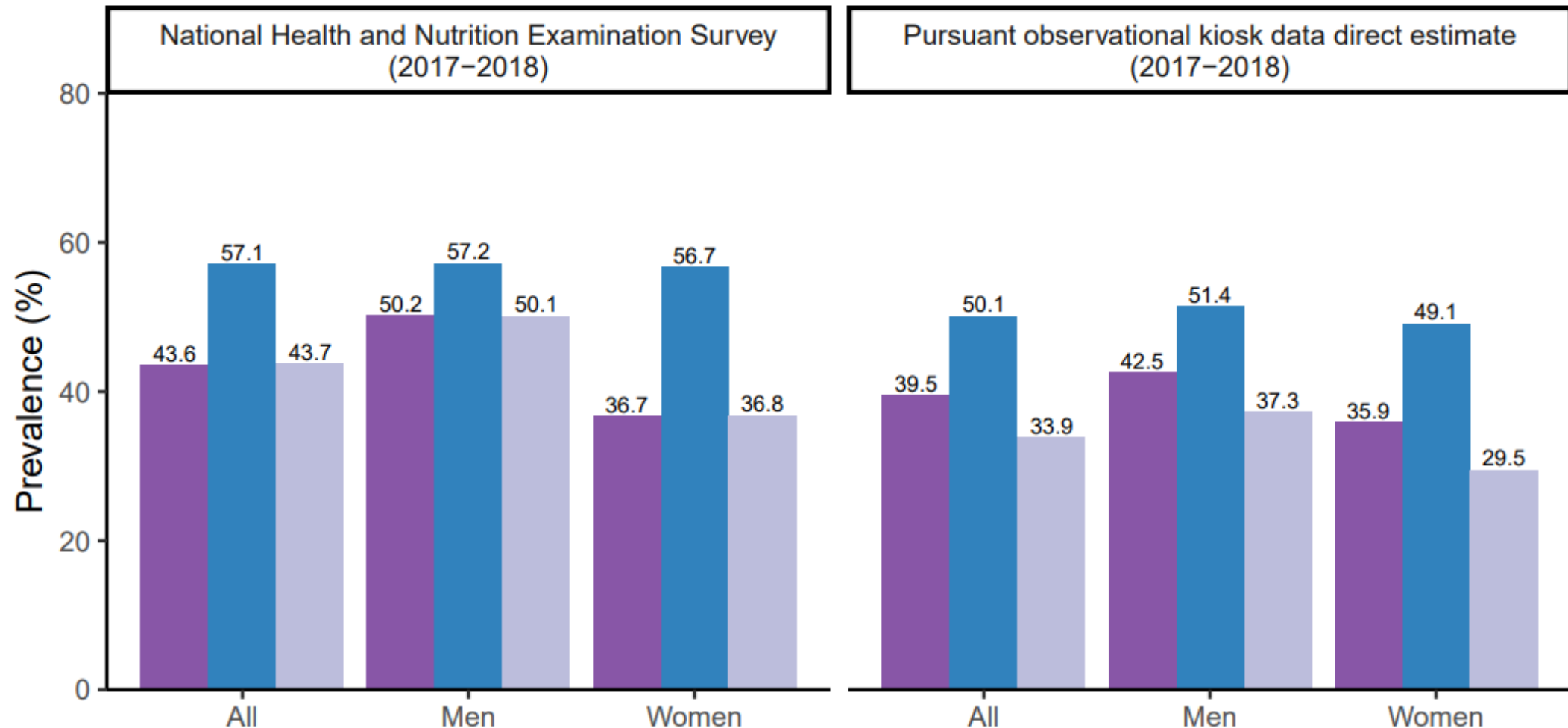
SOURCE: NCHS, National Health and Nutrition Examination Survey, 2017–2018.

Pursuant direct estimate (2017-2018)



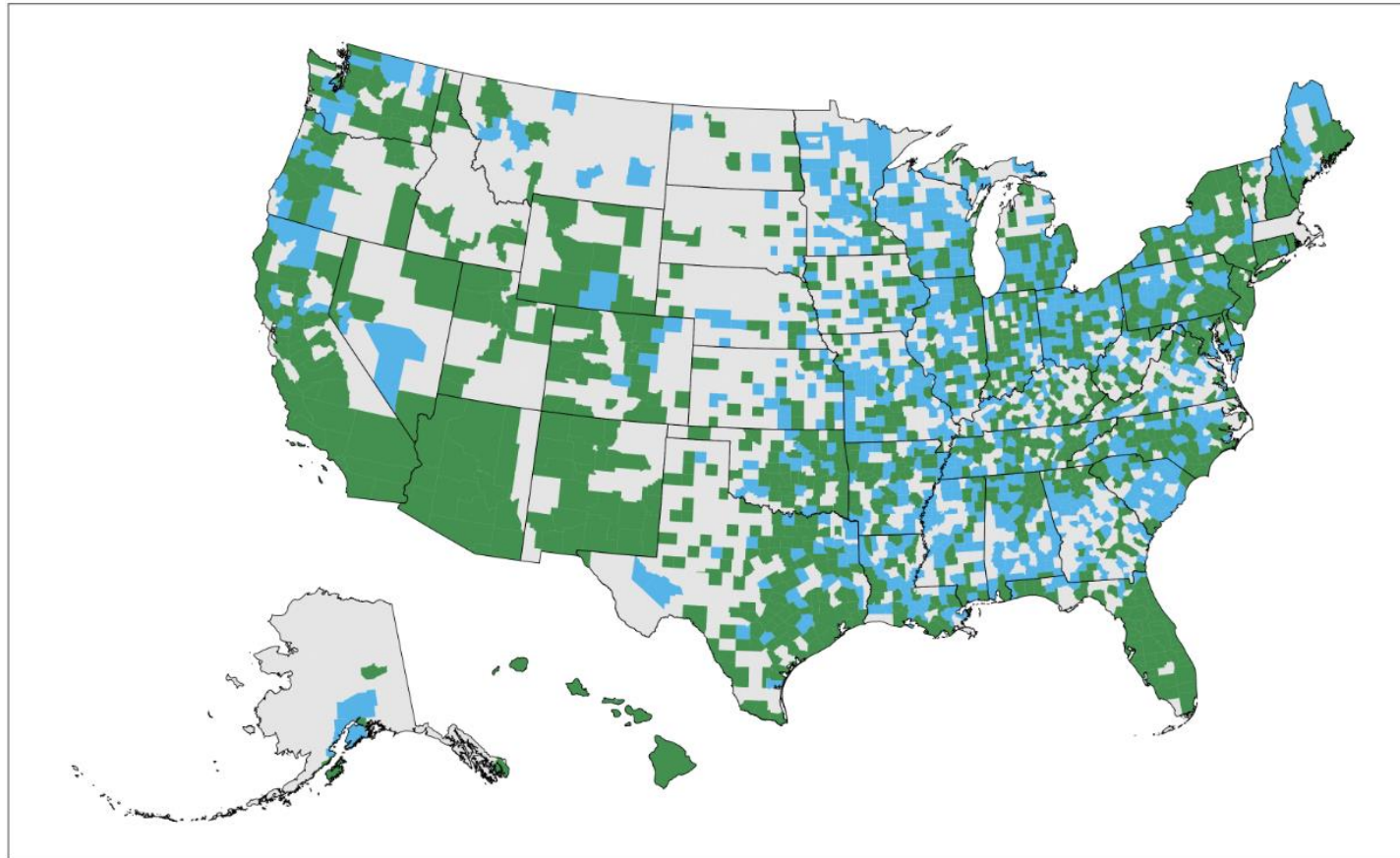
Prevalence of hypertension among adults 18 and over by sex and race/ethnicity (2017-2018)

■ NH White
 ■ NH Black
 ■ Hispanic

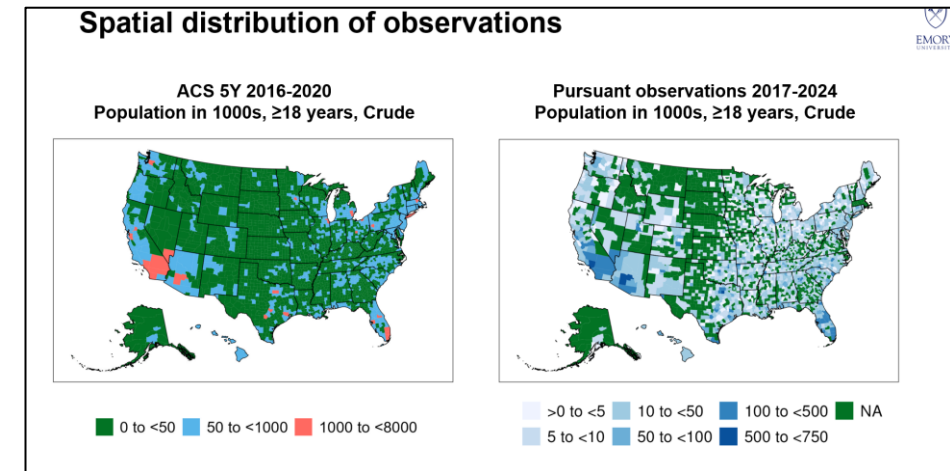


Direct estimate of county-level prevalence from Pursuant

Pursuant (2021-2022), Obs = 11,526,017
High Blood Pressure (%), ≥ 18 years, Crude



Prevalence (%) ■ 20 to <40 ■ 40 to <60 ■ NA



Potential Reasons

Selection Bias

- Are patients with high blood pressure less likely to use kiosks for monitoring?
- Are older patients with high blood pressure less likely to use kiosks, and measure their BP elsewhere (home, clinic)?
- Are there regional/socio-demographic patterns in routine usage?

Information Bias

- Do older patients (with high blood pressure) have trouble using kiosks?
- Do kiosks perform better for specific population groups or for different cuff sizes?

What's Next?

Adjusting the Data

- Estimates in previous slide do not account for the selection mechanism for kiosk use
- We will adjust our estimates using weights to match the demographic profile of each US county

Modeling

- Statistical space-time model to estimate hypertension prevalence
- Model will also account for the adjustment factor for kiosk use
- Detailed comparison with BRFSS and COSMOS

Sensitivity Analyses

Below are some areas to explore to test the robustness of our results.

Hypertension definition

- Current: Mean of blood pressure measurements above 140/90 or diagnosed
- Alternative: Instead of mean, consider hypertensive if any of the multiple measurements are above 140/90

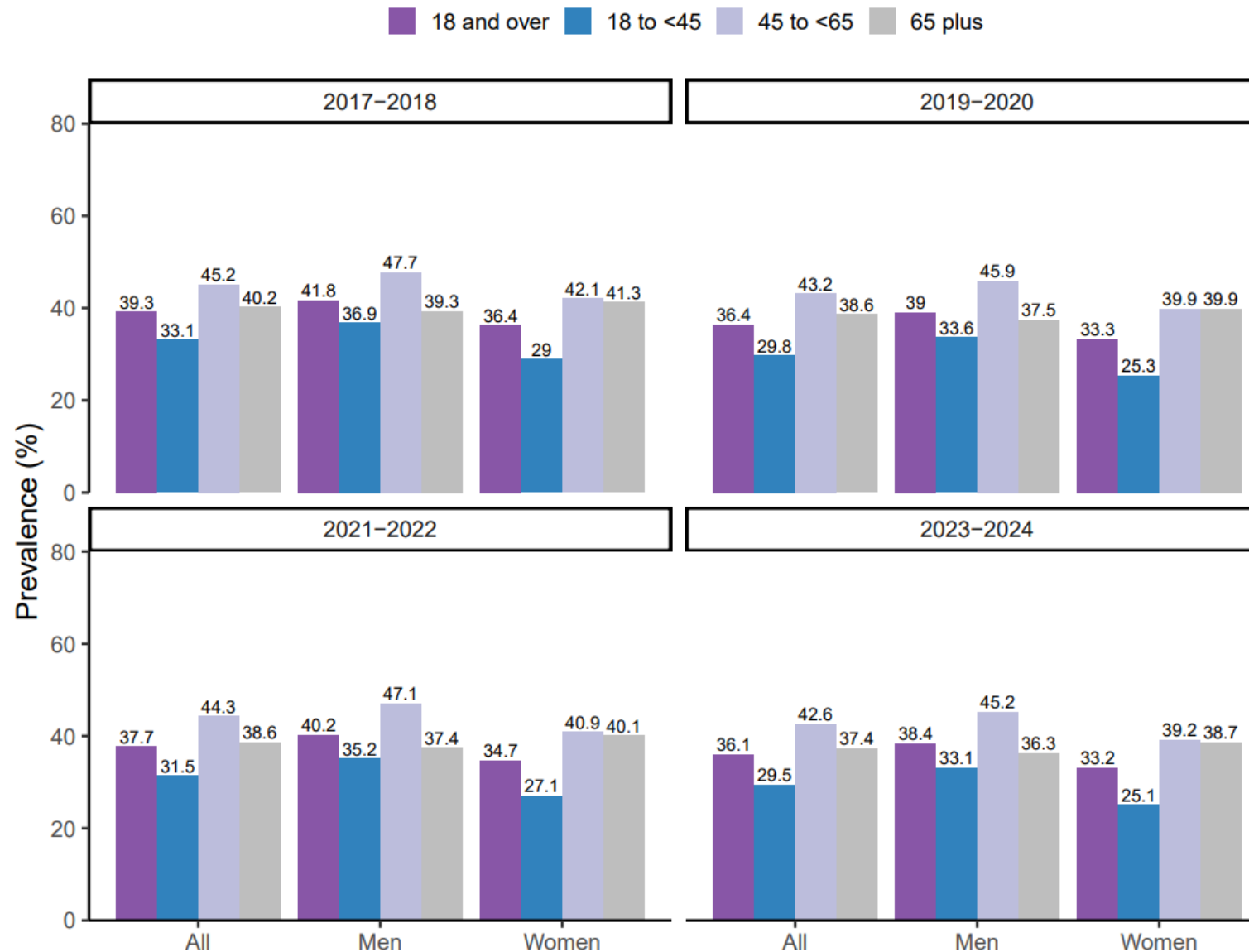
Deduplication strategy

- Current: Deduplicating on session ID, pseudo-ID (DOB, gender, race/ethnicity, location), and 2-yr interval (2017-18, 2019-20, etc.)
- Alternative: Incorporate specific time at measurement into deduplication strategy, shorten time interval for averaging over measurements, understand behavior of “power users” better



Questions?

Pursuant direct estimate by age group, sex, year range



Prevalence of hypertension from Pursuant by age and urban/rural status (Unadjusted)

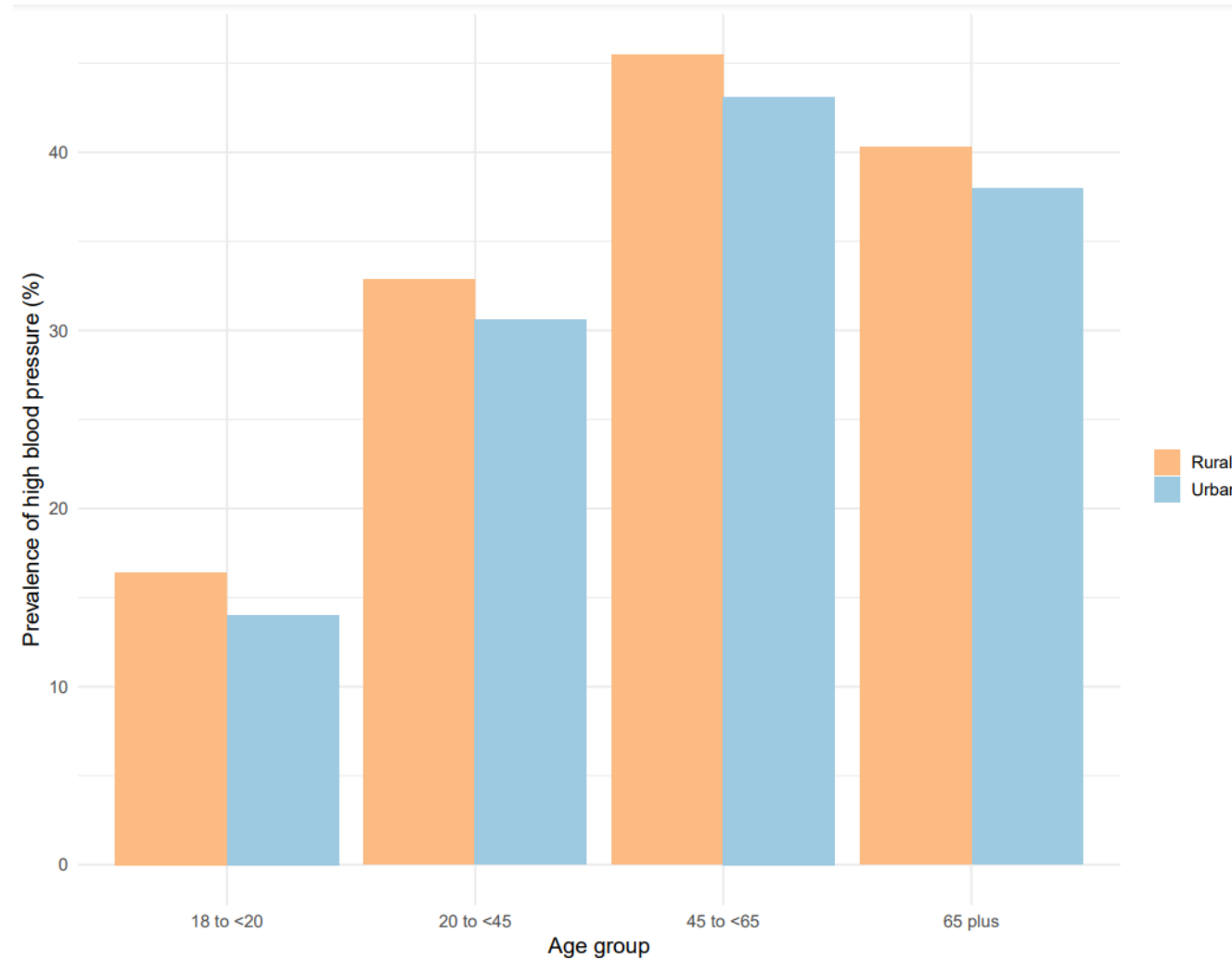
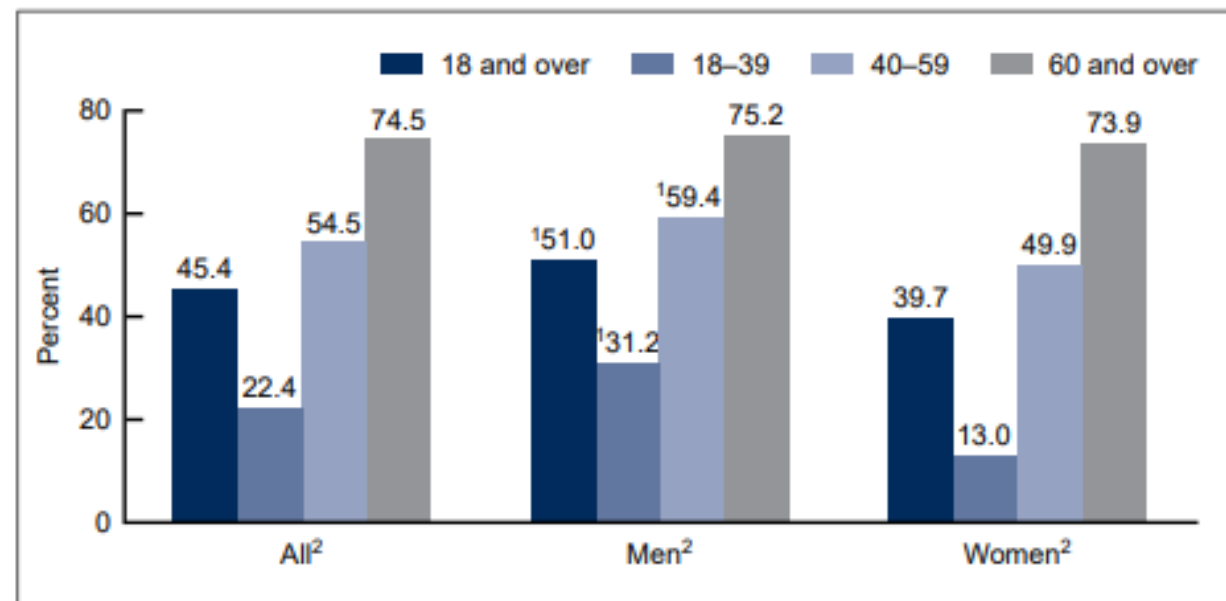


Figure 1. Prevalence of hypertension among adults aged 18 and over, by sex and age: United States, 2017–2018



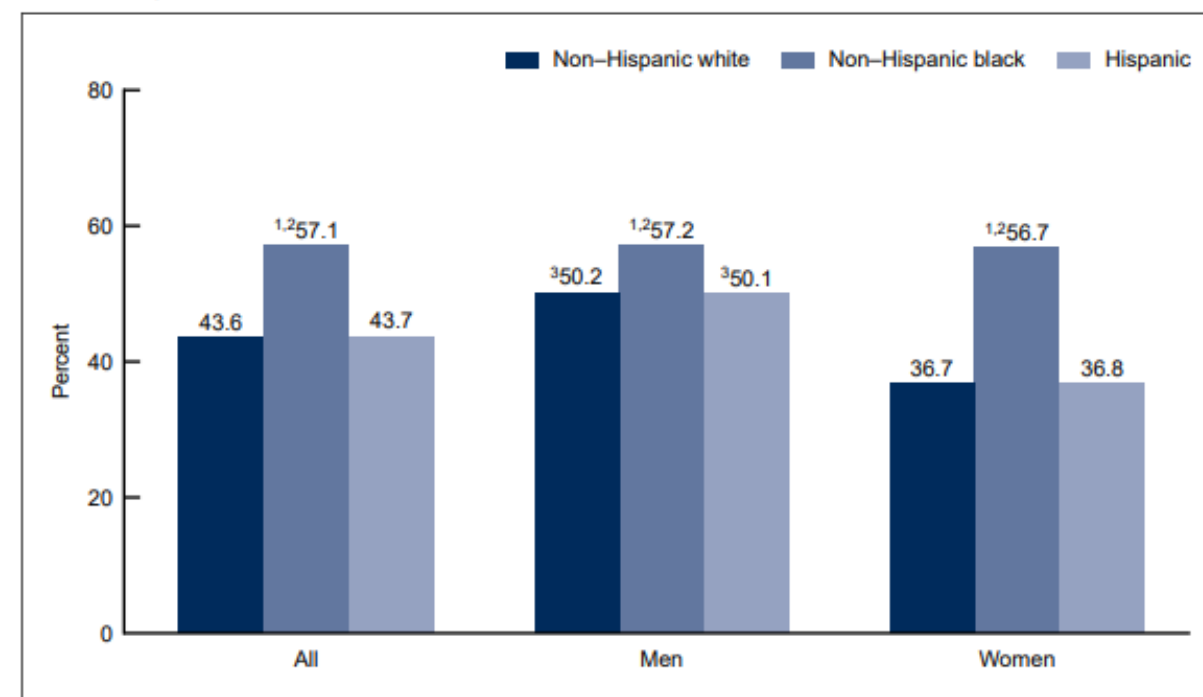
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SOURCE: NCHS, National Health and Nutrition Examination Survey, 2017–2018.

Figure 2. Age-adjusted prevalence of hypertension among adults aged 18 and over, by sex and race and Hispanic origin: United States, 2017–2018



¹Significantly different from non-Hispanic white.

²Significantly different from Hispanic.

³Significantly different from women in the same race and Hispanic-origin group.

NOTES: Hypertension is defined as systolic blood pressure greater than or equal to 130 mmHg or diastolic blood pressure greater than or equal to 80 mmHg, or currently taking medication to lower blood pressure. All estimates are age adjusted by the direct method to the U.S. Census 2000 population using age groups 18–39, 40–59, and 60 and over. Access data table for Figure 2 at: <https://www.cdc.gov/nchs/data/databriefs/db364-tables-508.pdf#2>.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2017–2018.