# Prevalence of Menthol Use among Adults who Smoke Cigarettes from the United States (US) by Census Division and Demographic Subgroup, 2002–2020

## Findings from the International Tobacco Control (ITC) Project

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3 MUSC Medical University of South Carolina
4 OICR Ontario Institute for Cancer Research

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# Menthol Cigarette Smoking in the US

- Targeted marketing of menthol cigarettes in the US influences disparities in the prevalence of menthol smoking across demographic groups
- Trends from the Tobacco Use Supplement to the Current Population Survey (TUS-CPS):
  - Among adults who smoke cigarettes, the percentage of people using menthol cigarettes increased from 2003 to 2019
  - Menthol cigarette use is more common among specific demographic subgroups (young adults, females, non-Hispanic Black smokers)
  - Differences in use across broad geographic areas (South vs. Midwest)
- **Granular** information about menthol use at **sub-national** levels (e.g., census divisions) can provide greater insights into the possible effects of the proposed FDA ban on menthol cigarettes

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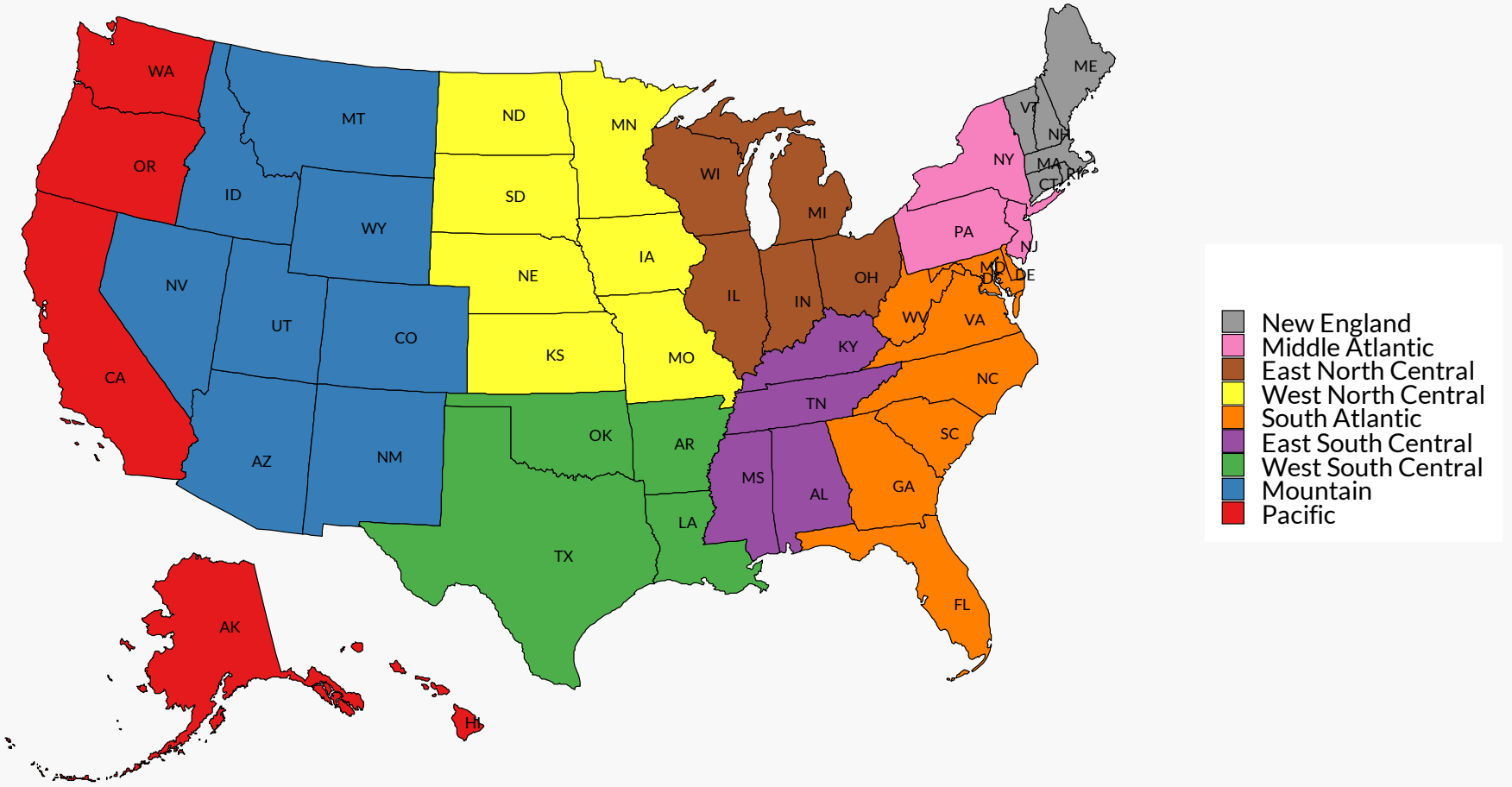
# Study Objectives

To estimate trends in the prevalence of menthol cigarette use among adults who currently smoke for each of the **nine US census divisions** by **sex, age group,** and **race/ethnicity** from 2002 to 2020

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# Methods

**General approach**: Small area estimation (SAE)

- Advantages and features of SAE:
  - Estimate **reliable statistics** using population survey data for specific subgroups having **small sample sizes** in the survey
  - Surveys are **not** usually designed for estimation within these subgroups or "domains"
  - Domains of interest are often, but not always, defined by geographic boundaries
  - SAE methods typically estimate these statistics using linear mixed effects models
  - The study presented here relied on a specific type of SAE model: **multilevel regression and post-stratification** (or "MrP", Gelman & Little, 1997; Zhang et al., 2014; Hanretty, 2020)

# Data Sources

**The International Tobacco Control (ITC) Four Country Surveys**

- Nationally representative samples of adults aged 18+ who smoked cigarettes at least monthly
- Stratified sampling design; 12 waves (2002–2020)
  - ITC 4 Country Survey (ITC 4C): 2002–2015 (Wave 9 split into 2 sub-waves)
  - ITC 4 Country Smoking and Vaping Survey (ITC 4CV): 2016–2020
  - US sample only: 22,703 observations from 12,020 respondents
- Primary outcome measure – use of menthol cigarettes
  - Self-reported use of menthol (Waves 1–4 of ITC 4C)
  - Self-reported brand containing the term “menthol” (Waves 5–9 of ITC 4 and Waves 1–3 of ITC 4CV)

# Data Sources

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**External Data**

- US Behavioral Risk Factor Surveillance System (BRFSS) and the American Community Survey (ACS)
  - Survey years contemporaneous to ITC 4C & ITC 4CV
  - Used to estimate total number of adults who smoke within census divisions for all survey years
- Tobacco Use Supplement to the Current Population Survey (TUS-CPS)
  - Waves 6 (2006/2007) through 10 (2018/2019)
  - Used to validate modeled estimates of menthol use

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# Multilevel Regression and Post-stratification

**Two-step modeling approach: Multilevel logistic regression**

- Predict prevalence of menthol use among 72 cross-classified demographic groups of adults who smoke:
  - Sex (male, female)
  - Age group (18-29, 30-49, 50+)
  - Race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other)
  - Socioeconomic status (low, moderate, high)
- Demographic measures were fit as **fixed effects**, fixed temporal effects were fit as **piecewise linear trends**, census divisions fit as a **random intercept**, and race/ethnicity fit as a **random slope**
- Cross-sectional survey weights; model fit using PROC GLIMMIX in SAS (Version 9.4); predictions within census divisions for each survey year estimated with PROC PLM

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# Multilevel Regression and Post-stratification

**Two-step modeling approach: Post-stratification step**

- Predicted prevalence is weighted by estimated population totals for each of the 72 cross-classified demographic groups and aggregated to the census division level in each year to obtain:
  - Overall menthol prevalence
  - Menthol prevalence for specific demographic groups
- 95% confidence intervals estimated using a non-parametric bootstrapping procedure (Wang et al,. 2021)
- **Validation step**: compared modeled estimates ("ITC MrP") against external estimates from TUS-CPS ("direct" survey estimates) using the overall concordance correlation coefficient (Barnhart et al., 2002; Lin, 1989; Lin, 2000)

# Results

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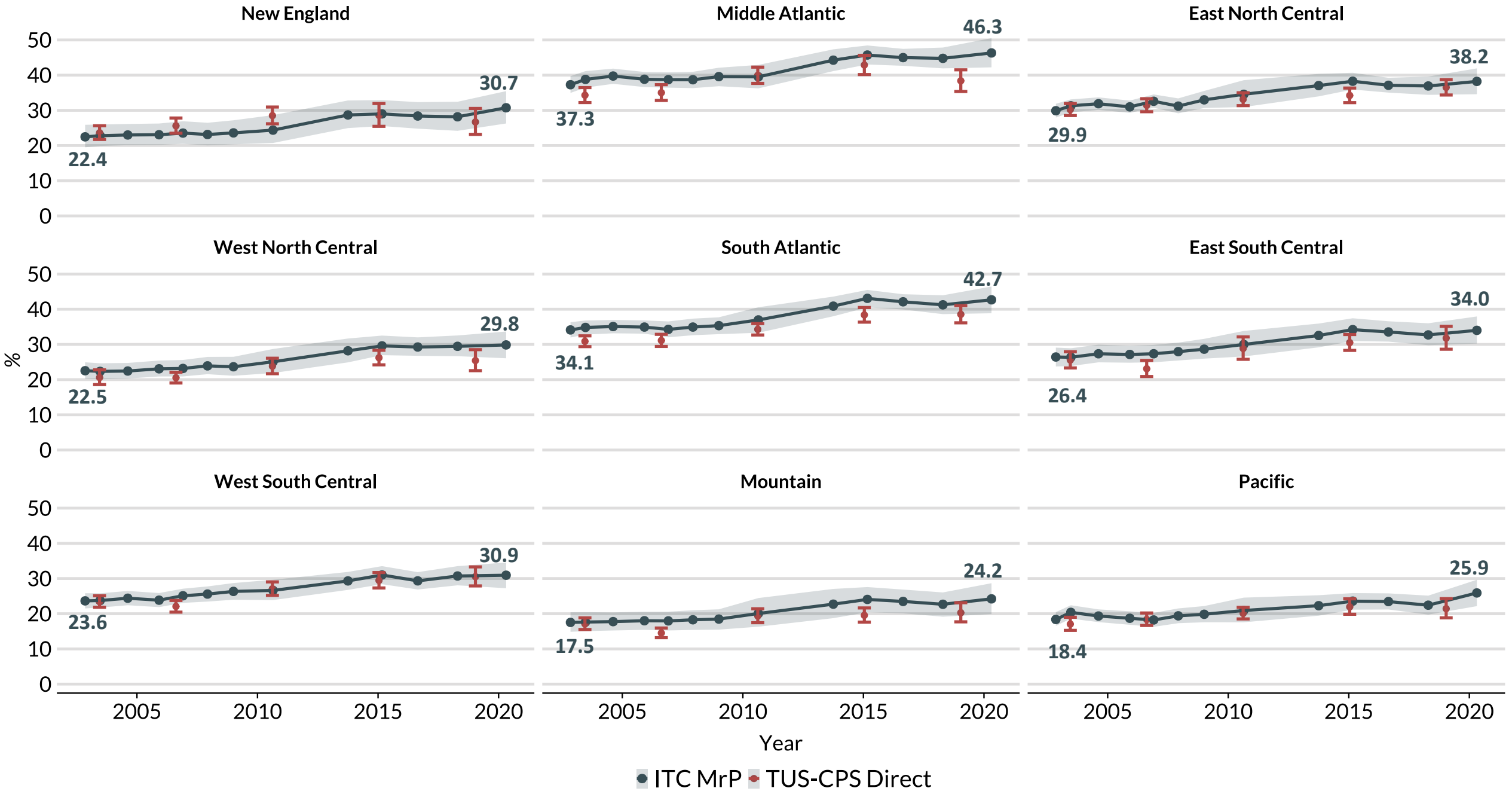
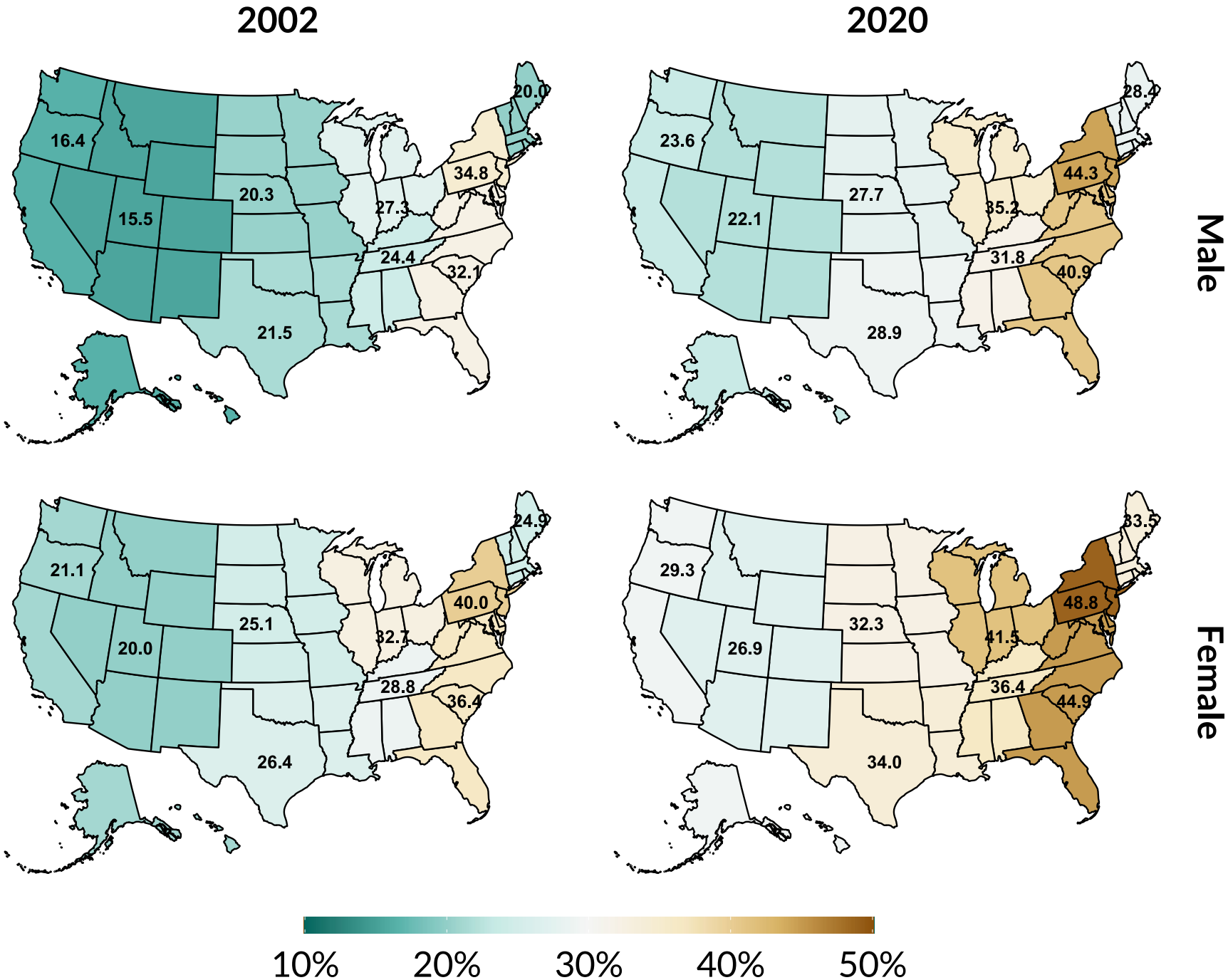
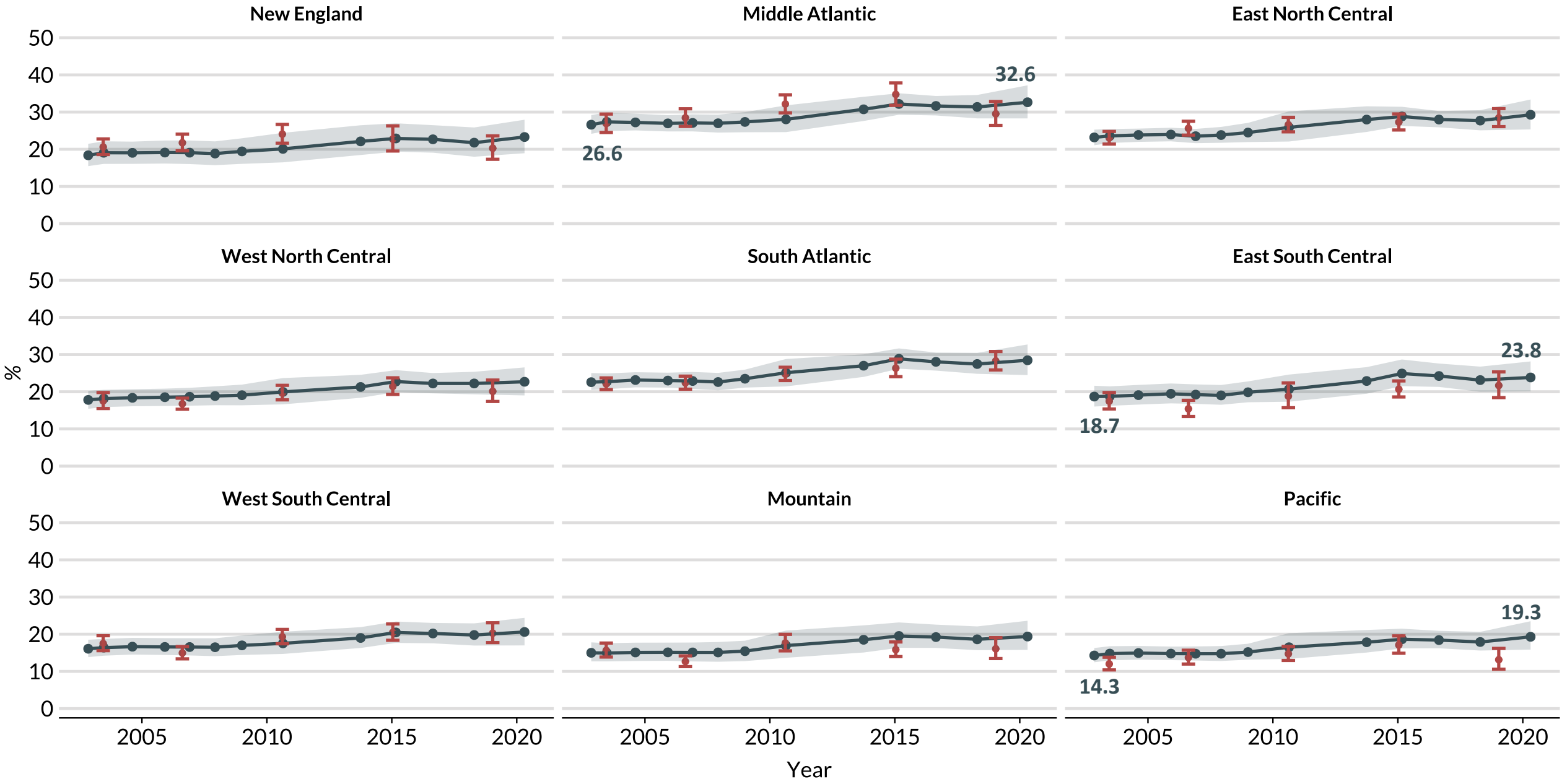
# Overall prevalence of menthol use among adults who smoke by US census division

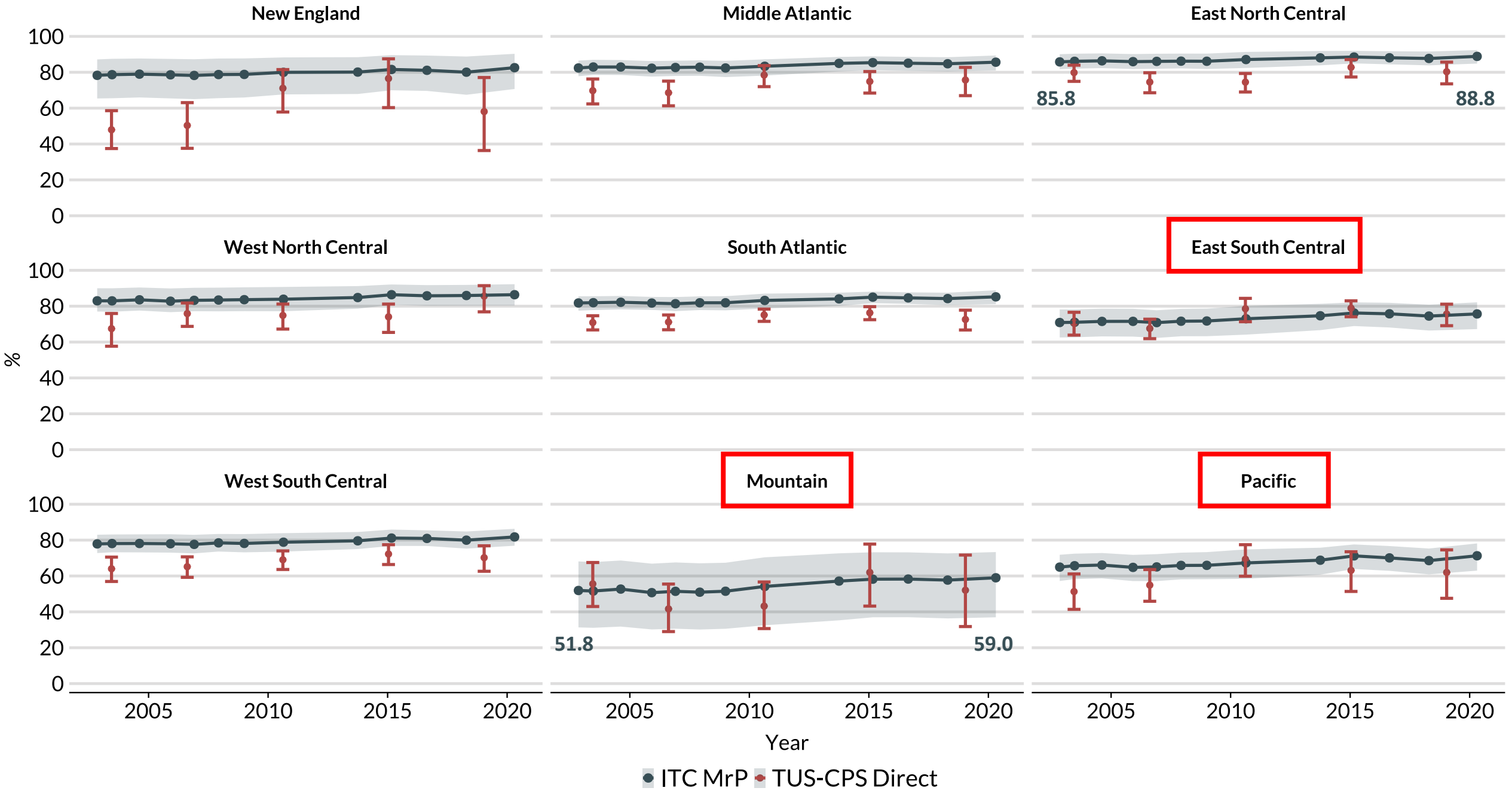



2002
2020
Male
Female
16.4
15.5
20.3
21.5
27.3
24.4
34.8
32.1
20.0
23.6
22.1
27.7
28.9
35.2
31.8
44.3
40.9
28.4
21.1
20.0
25.1
26.4
32.7
28.8
40.0
36.4
24.9
29.3
26.9
32.3
34.0
41.5
36.4
48.8
44.9
33.5
10%
20%
30%
40%
50%

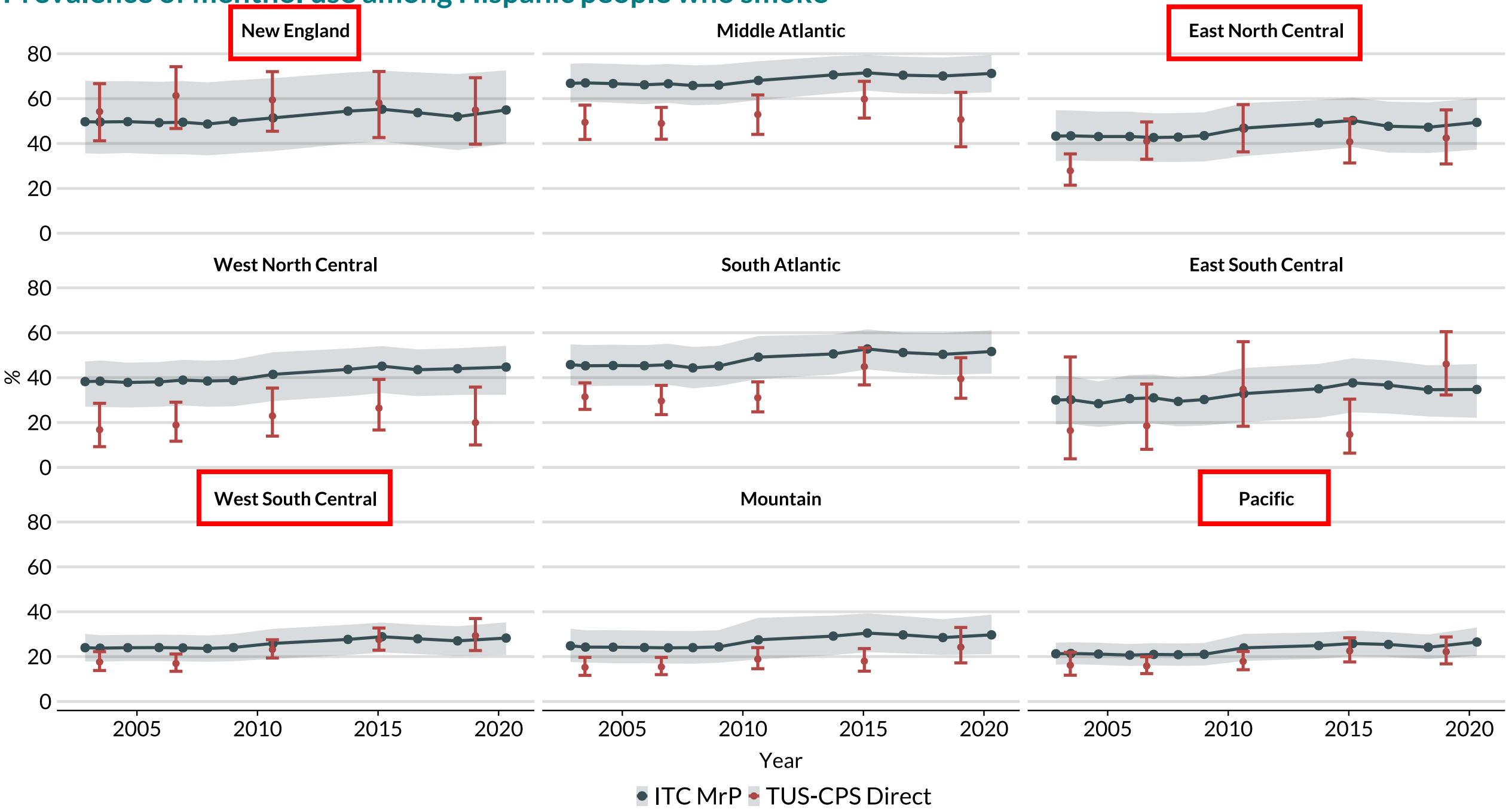
# Prevalence of menthol use among non-Hispanic White people who smoke



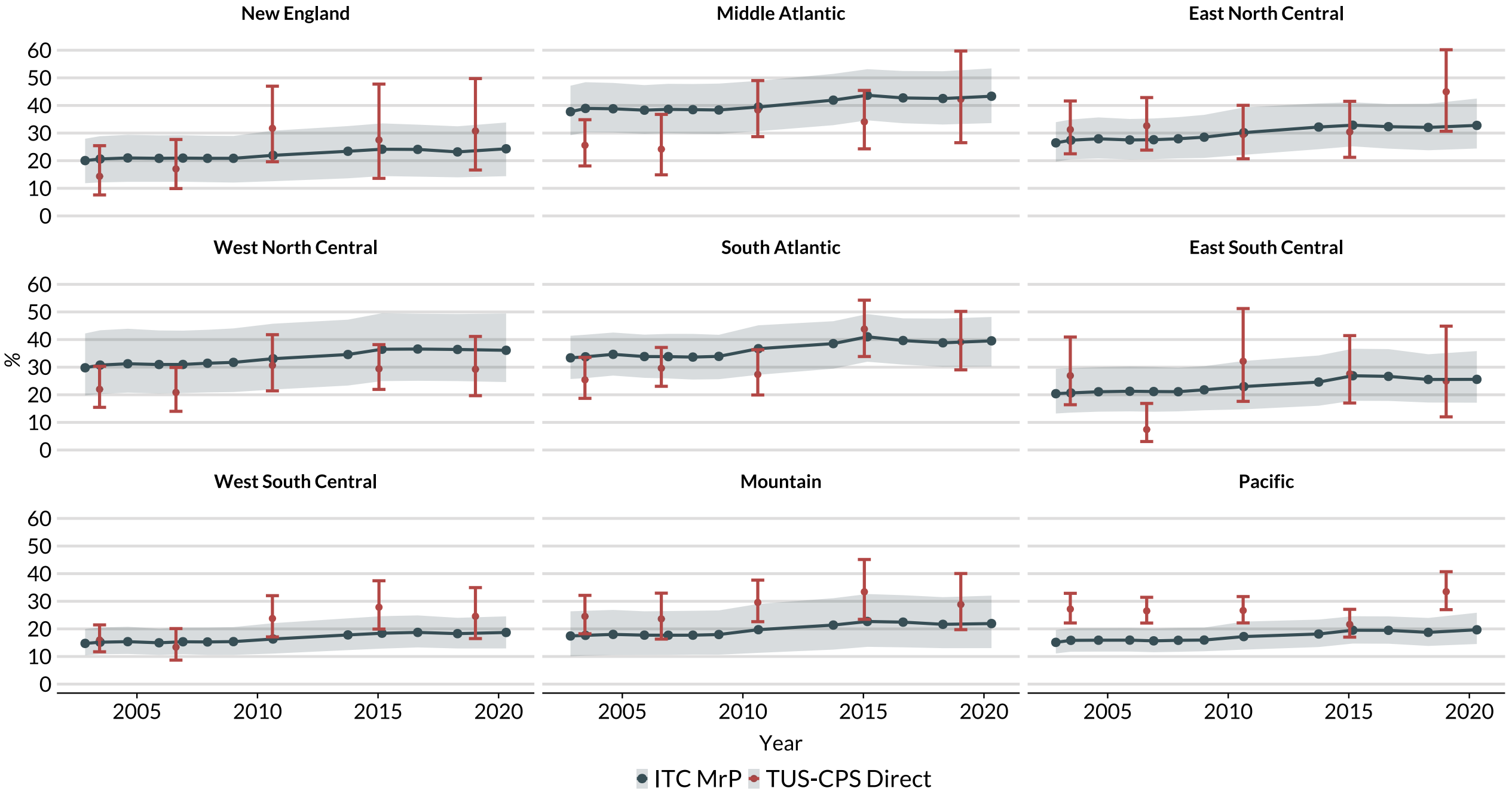
# Prevalence of menthol use among non-Hispanic Black people who smoke



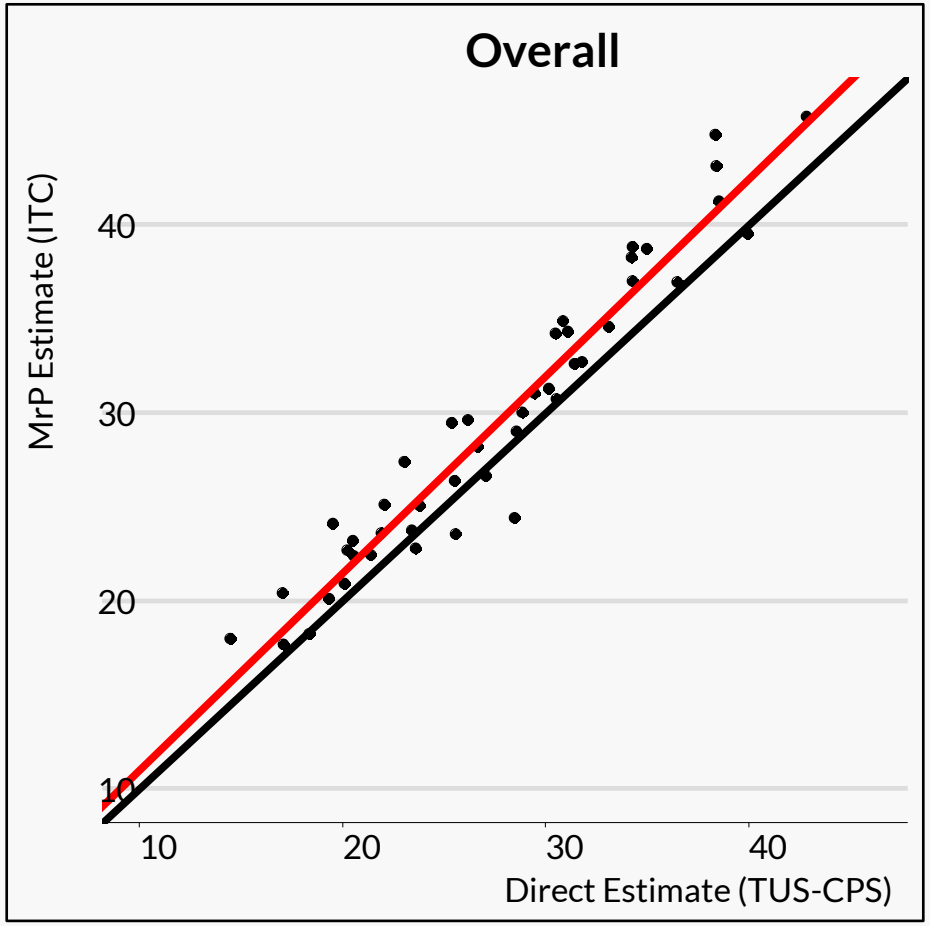
# Prevalence of menthol use among Hispanic people who smoke



# Prevalence of menthol use among people from other racial/ethnic groups who smoke



# Validity of Modeled Estimates




Black line: concordance line (perfect agreement)
Red line: line of best fit

| Estimate | CCC | Precision | Accuracy |
|---|---|---|---|
| **Overall** | **0.9317** | **0.9657** | **0.9648** |
| Male | 0.8334 | 0.9668 | 0.8620 |
| Female | 0.9300 | 0.9314 | 0.9985 |
| White | 0.9317 | 0.9312 | 0.9812 |
| Black | 0.5533 | 0.7490 | 0.7387 |
| Hispanic | 0.7021 | 0.8105 | 0.8662 |
| Other | 0.5316 | 0.5315 | 0.9812 |

CCC = overall concordance correlation
CCC = precision * accuracy
Precision: Pearson correlation
Accuracy: Measure of bias

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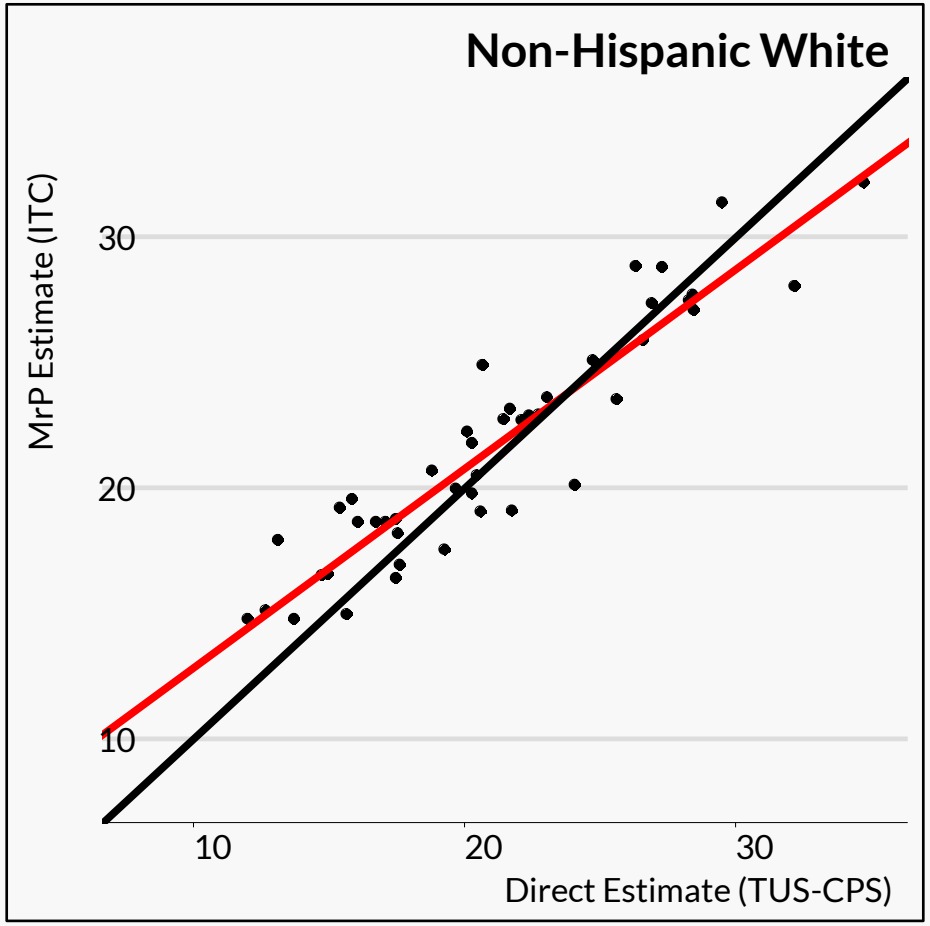


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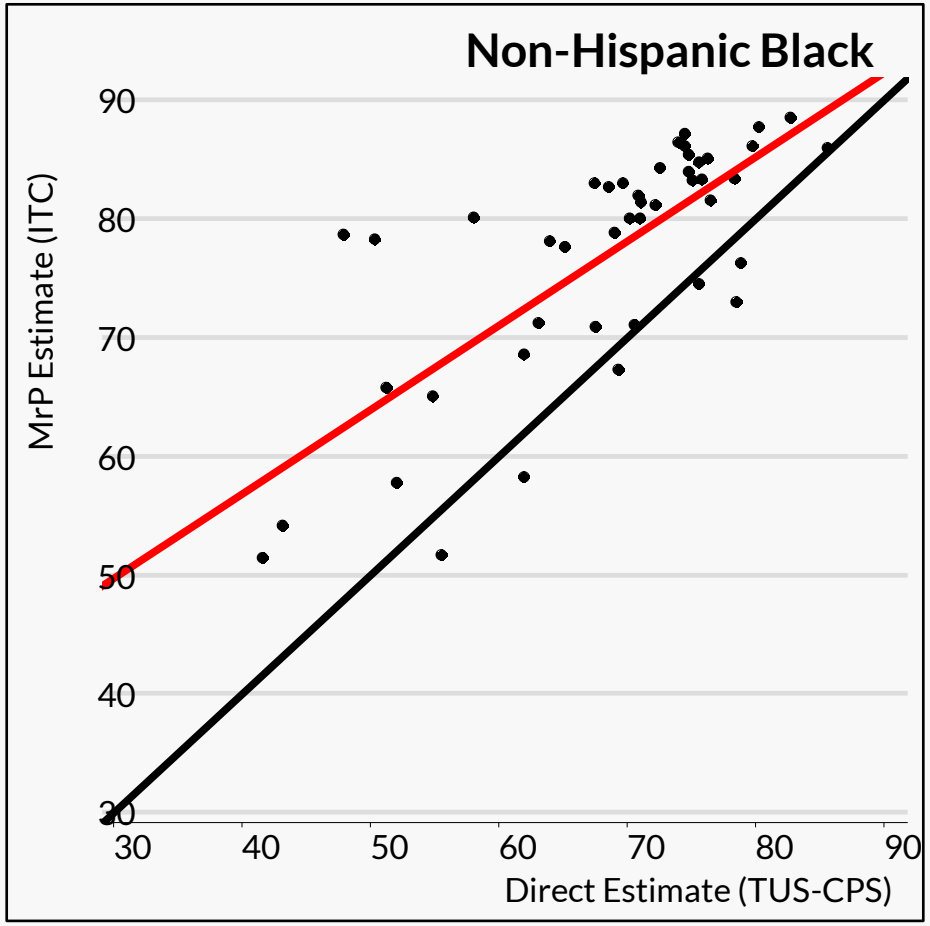


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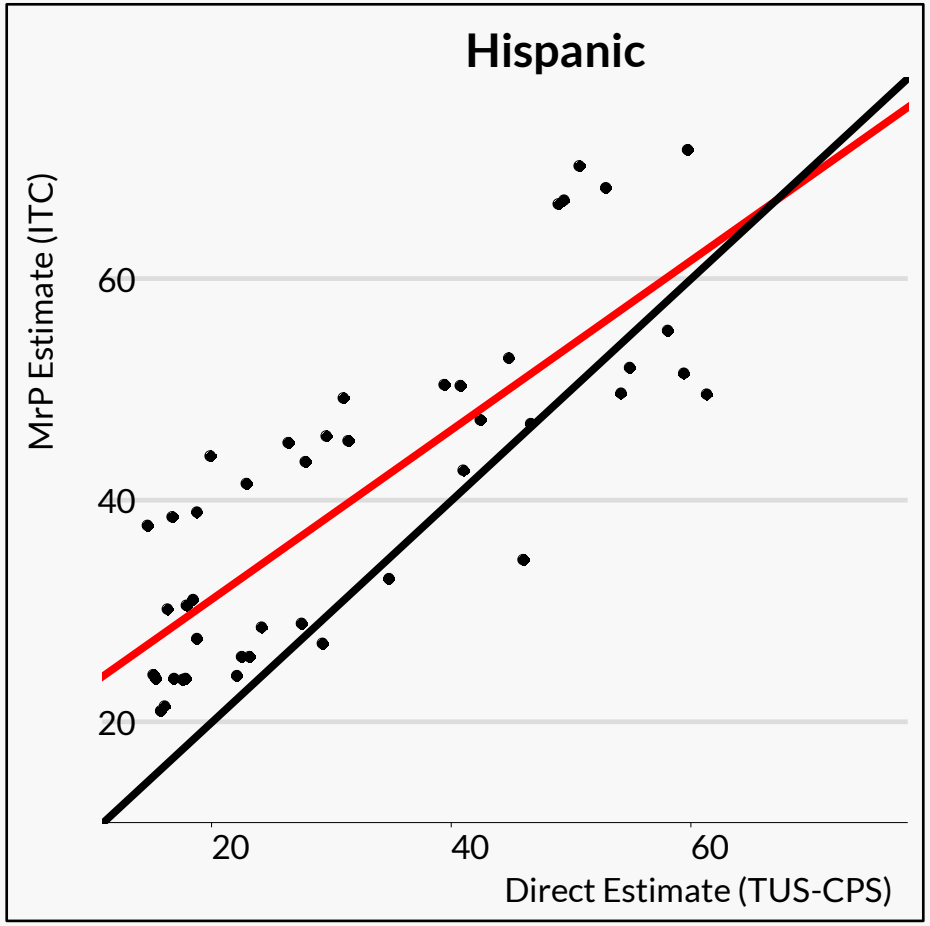


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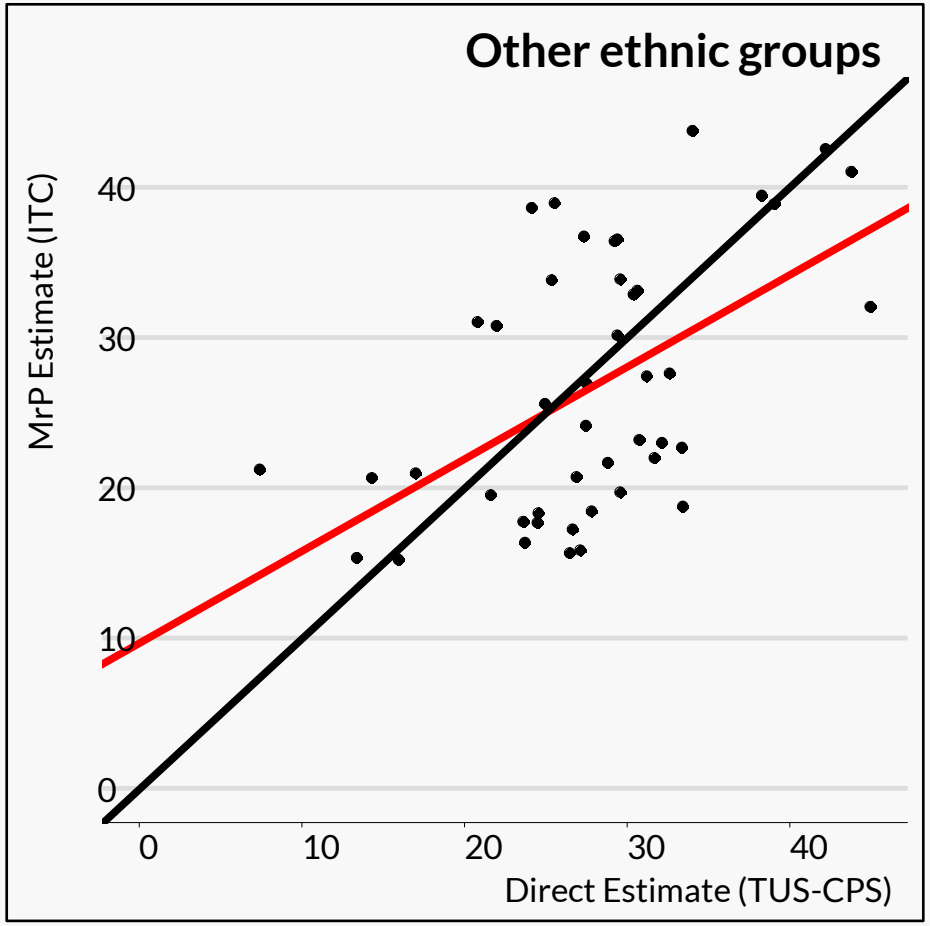


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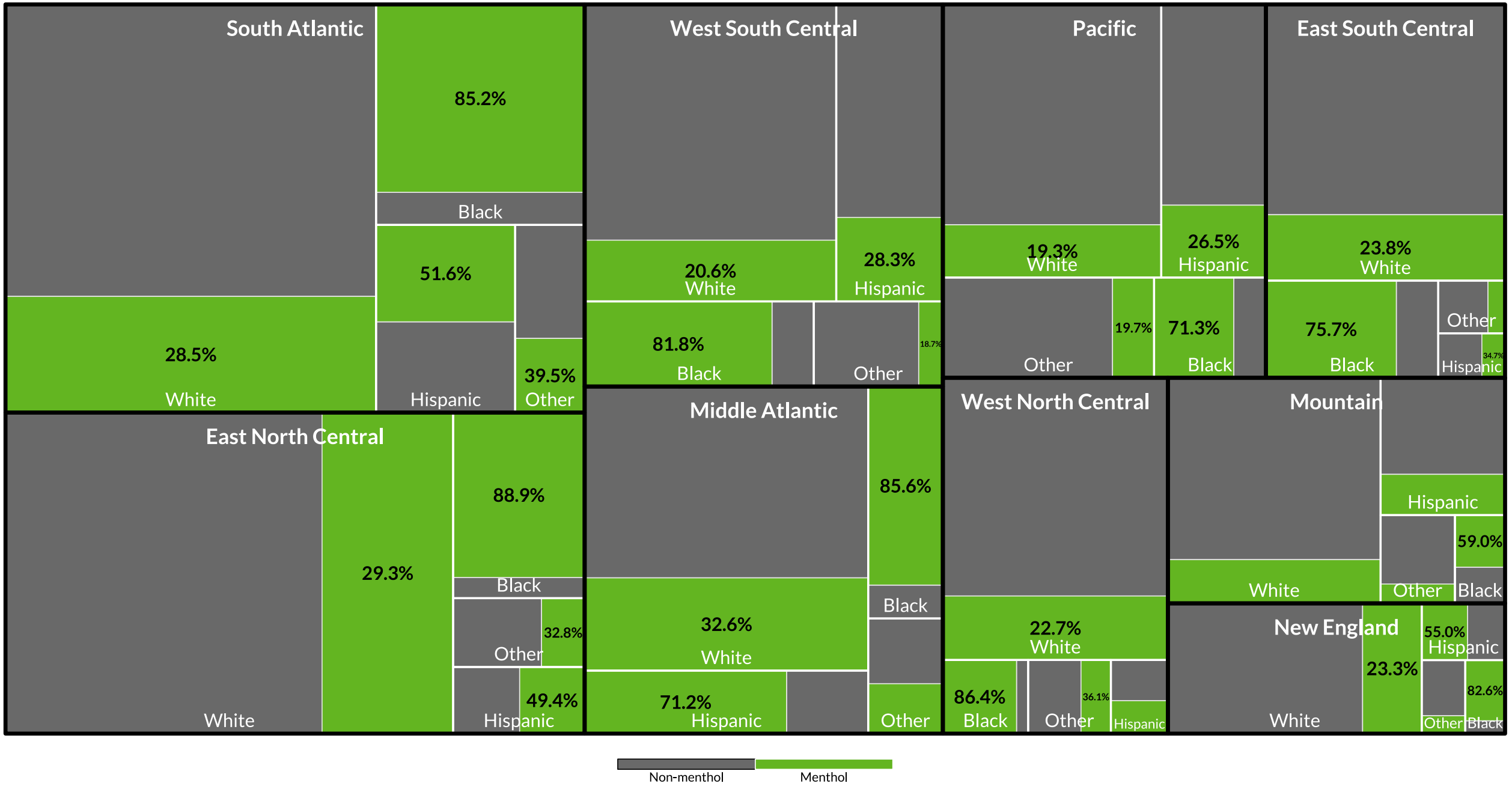

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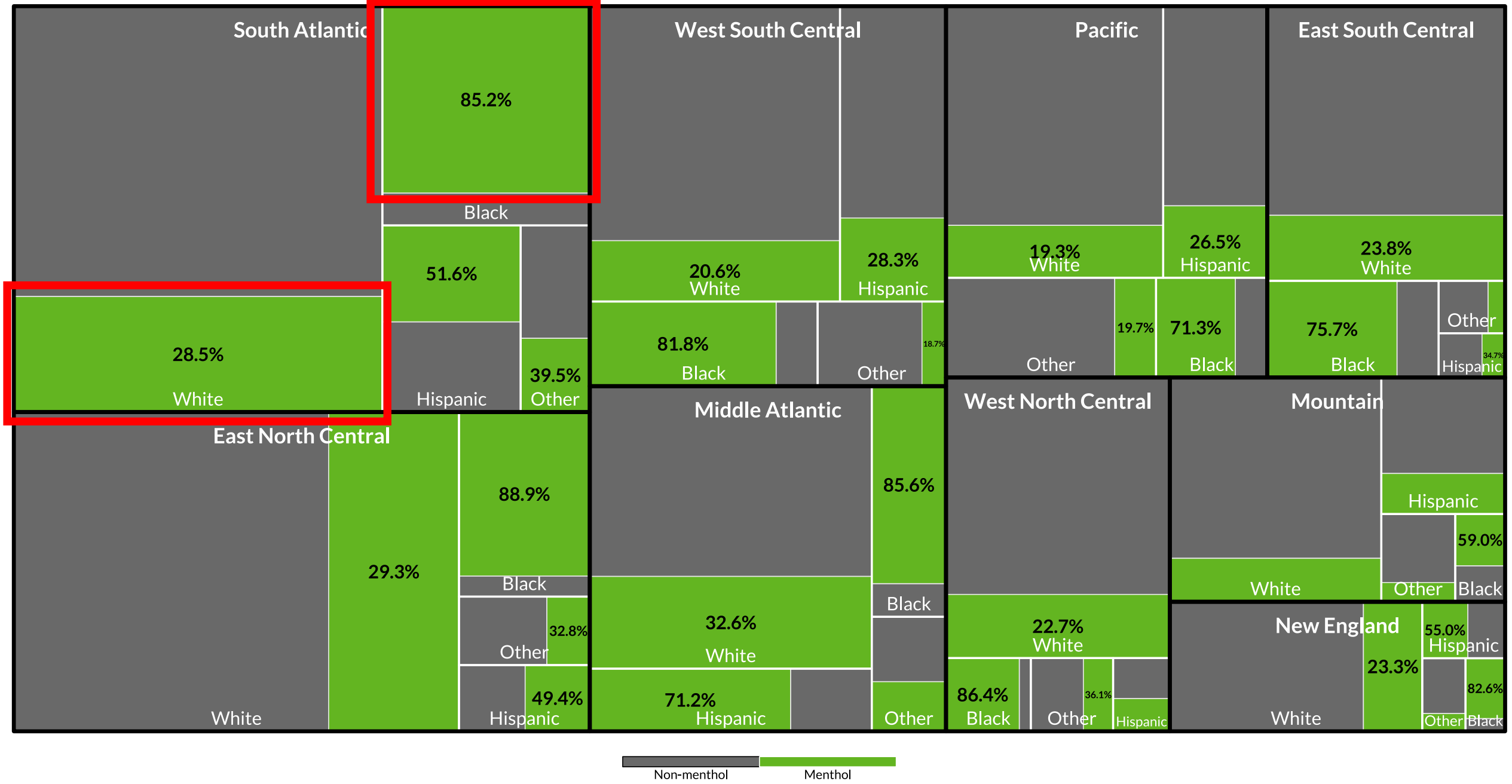

# Implications and Conclusions

- The proposed US FDA menthol ban may exert different effects across geographic and demographic subgroups depending on the demographic composition of the population of adults who smoke in different areas of the US
- Among people who smoke menthol brands, the percentage expected to quit following the ban **may/may** not differ across divisions. E.g., Fong et al. (2022) found a 7.3% greater quit rate among people who smoke menthol vs. non-menthol – Will this apply across all areas in the US?

**Expected demand for smoking cessation services may vary by geography and demographic group. States should plan how to accommodate anticipated needs for cessation services prior to implementation of the FDA menthol ban.**

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## ITC Project Research Organizations


## ITC Project Research Support