Cardiovascular Health and Wellness in the COVID Era

MONUMENT HEALTH

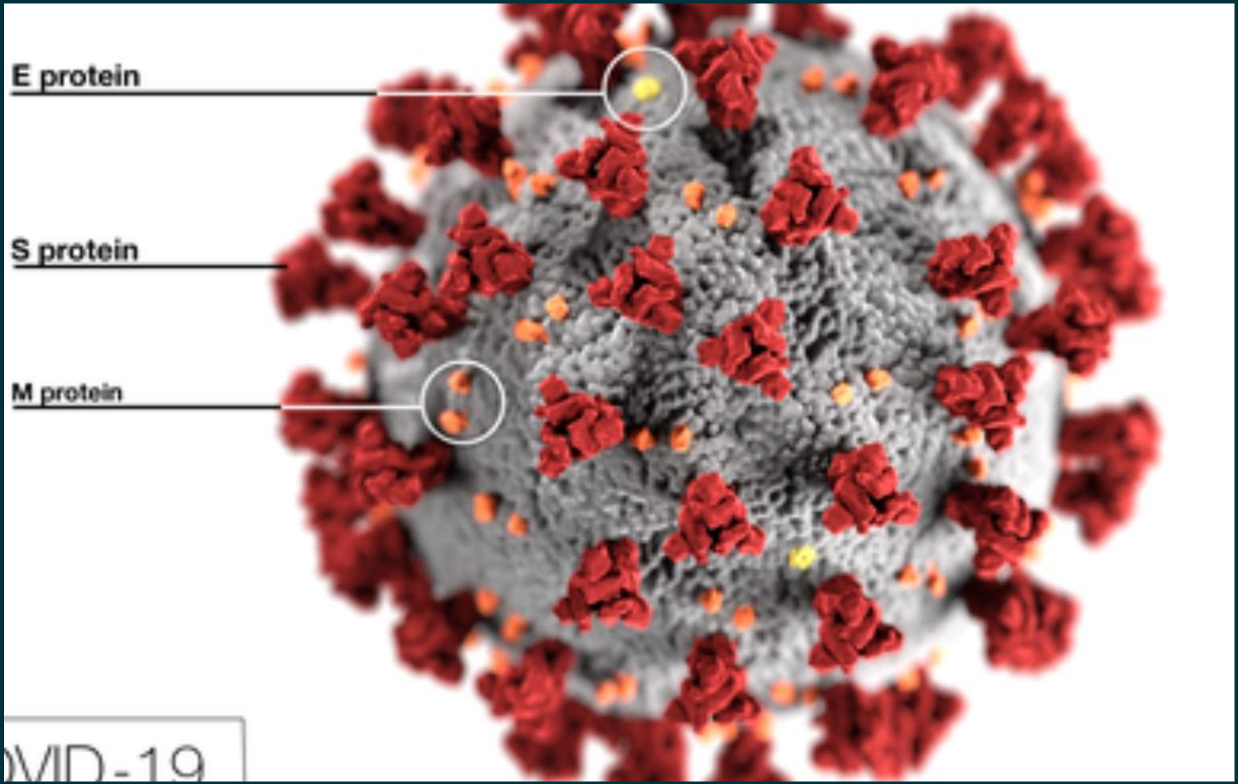
COVID 19

- Coronavirus is a large, enveloped single stranded RNA virus found in humans and other mammals.
- SARS-CoV-2 is the third coronavirus of the last two decades to cause severe disease in humans. SARS and MERS were the other two.

COVID 19

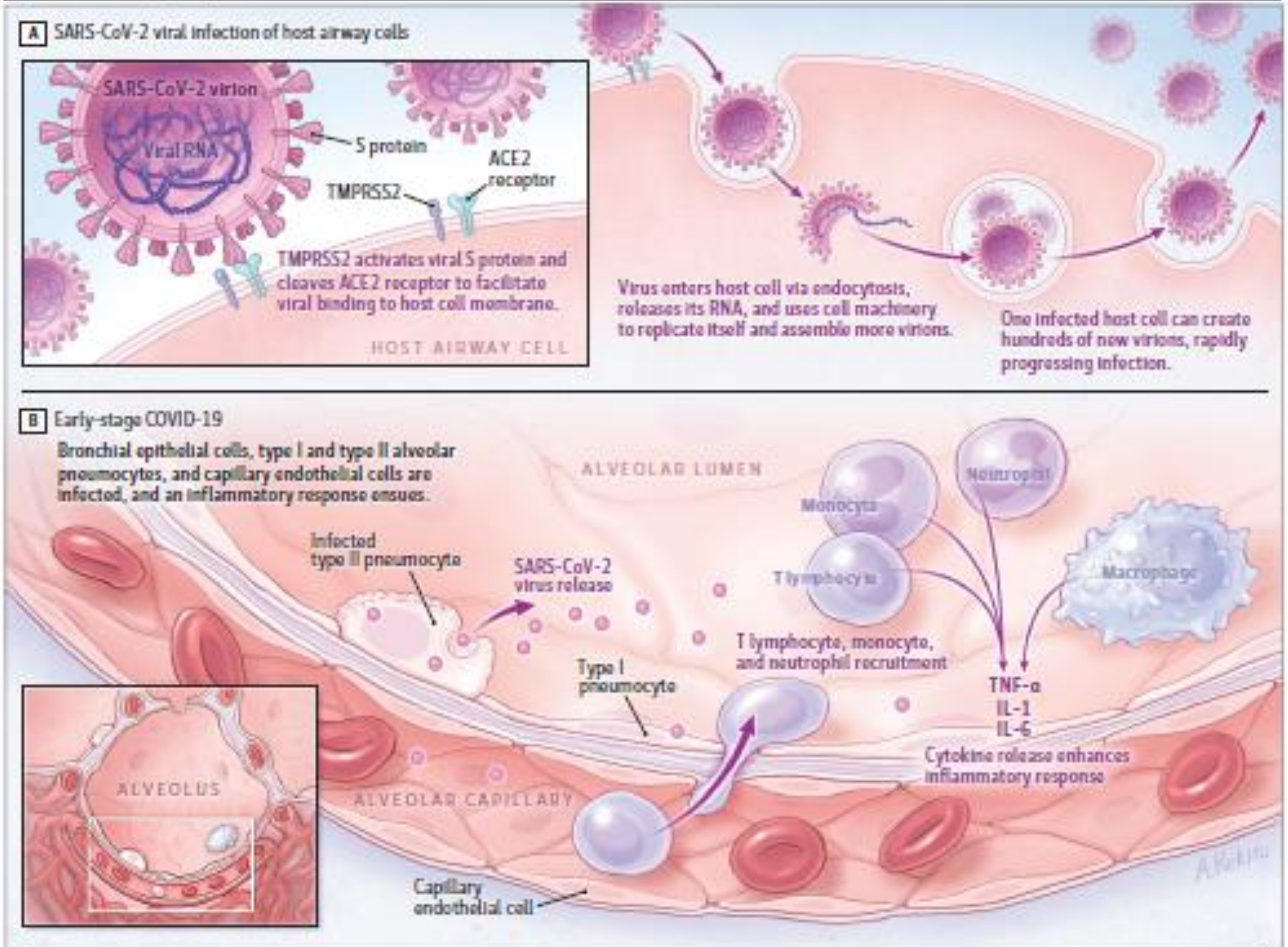
- Early in infection SARS-CoV-2 targets nasal and bronchial epithelial cells with the spike protein (S) attaching to ACE2 gaining entry into the cell. The virus then essentially hijacks the cell and makes copies, killing cells and spreading throughout the body.
- ACE2 is present throughout the body, owing itself to the multiple symptoms COVID-19 causes.

COVID-19



MONUMENT HEALTH

Figure 2. Immunopathogenesis of Coronavirus Disease 2019 (COVID-19)



MONUMENT HEALTH

Case Study

- When can I return to playing soccer?
- Why am I not sick?

Cristiano Ronaldo Tests Positive For Coronavirus

October 13, 2020 · 4:50 PM ET

REESE OXNER

Effects on the Heart

- Direct-viral infiltration, probable myocarditis. Autopsy reports have shown evidence of viral replication. Interstitial cells and macrophages likely the primary source that then infiltrate myocardial tissue.
- Indirect-reduced oxygen supply, respiratory failure, cytokine storm, etc.
- Arrhythmias, heart failure/LV dysfunction, troponin elevation, MI, Myocarditis.

JAMA Cardiology | Original Investigation

Outcomes of Cardiovascular Magnetic Resonance Imaging in Patients Recently Recovered From Coronavirus Disease 2019 (COVID-19)

Valentina O. Puntmann, MD, PhD; M. Ludovica Carerj, MD; Imke Wieters, MD; Masia Fahim; Christophe Arendt, MD; Jedrzej Hoffmann, MD; Anastasia Shchendrygina, MD, PhD; Felicitas Escher, MD; Mariuca Vasa-Nicotera, MD; Andreas M. Zeiher, MD; Maria Vehreschild, MD; Eike Nagel, MD

OBJECTIVE To evaluate the presence of myocardial injury in unselected patients recently recovered from COVID-19 illness.

DESIGN, SETTING, AND PARTICIPANTS In this prospective observational cohort study, 100 patients recently recovered from COVID-19 illness were identified from the University Hospital Frankfurt COVID-19 Registry between April and June 2020.

CONCLUSIONS AND RELEVANCE In this study of a cohort of German patients recently recovered from COVID-19 infection, CMR revealed cardiac involvement in 78 patients (78%) and ongoing myocardial inflammation in 60 patients (60%), independent of preexisting conditions, severity and overall course of the acute illness, and time from the original diagnosis. These findings indicate the need for ongoing investigation of the long-term cardiovascular consequences of COVID-19.

Altmetric Score (weighted count of online attention): >13500

Key Points

- Cardiac MRI was performed on unselected individuals at least 2 weeks post diagnosis with COVID-19.
- Patients recently recovered from COVID-19 that were referred for Cardiac MRI due to active cardiac symptoms were excluded.
- CMR findings originally compared to healthy controls. Paper eventually corrected to compare to risk factor matched controls.
- Observational study. New area of research.
- Data errors, since corrected.

Table 1. Patient Characteristics, Cardiac Magnetic Resonance (CMR) Imaging Findings, and Blood Test Results on the Day of CMR Examination

Characteristic	COVID-19 (n = 100)	Healthy controls (n = 50)	Risk factor-matched controls (n = 57)	P value[a]
Patient characteristics				
Age, mean (SD), y	49 (14)	48 (16)	49 (13)	.91
Male, No. (%)	53 (53)	25 (50)	28 (49)	.88
BMI, median (IQR)[b]	25 (23-28)	23 (20-25)[c]	27 (23-29)	<.001
Hypertension, No. (%)	22 (22)	0[c]	14 (25)	.003
Diabetes, No. (%)	18 (18)	0[c]	12 (22)	.002
Hypercholesterolemia, No. (%)	22 (22)	0[c]	13 (23)	.02
Known CAD, No. (%)	13 (13)	0[c]	9 (16)	.02
Smoking, No. (%)	22 (22)	9 (18)	11 (19)	.54
COPD or asthma, No. (%)	21 (21)	0[c]	13 (23)	.002
Blood pressure, mean (SD), mm Hg				
Systolic	129 (16)	122 (10)[c]	130 (15)	.006
Diastolic	80 (9)	75 (7)[c]	79 (12)	.03
Heart rate, mean (SD), beats per min	67 (10)	64 (10)	67 (12)	.17
SCORE, median (IQR), %	4 (2-6)	NA	4 (3-6)	.31
CMR findings				
LVEF, mean (SD), %	57 (6)	60 (5)[c]	62 (8)[c]	<.001
LVEDV index, mean (SD), mL/m^2	86 (13)	80 (11)[c]	76 (14)[c]	<.001
LV mass index, mean (SD), g/m^2	48 (9)	51 (12)	53 (12)[c]	.005
RVEF, mean (SD), %	54 (7)	60 (8)[c]	59 (9)[c]	<.001
Native T1, median (IQR), ms	1125 (1099-1157)	1082 (1067-1097)[c]	1111 (1098-1124)[c]	<.001
Abnormal native T1, No. (%)	73 (73)	6 (12)[c]	33 (58)[c]	<.001
Significantly abnormal native T1, No. (%)	40 (40)	0[c]	7 (12)[c]	<.001
Native T2, mean (SD), ms	38.2 (2.0)	35.7 (1.5)[c]	36.4 (1.6)[c]	<.001
Abnormal native T2, No. (%)	60 (60)	6 (12)[c]	15 (26)[c]	<.001
Significantly abnormal native T2, No. (%)	22 (22)	0[c]	0[c]	<.001
LGE, No. (%)				
Myocardial	32 (32)	0[c]	9 (17)[c]	<.001
Nonischemic	20 (20)	0[c]	4 (7)[c]	<.001
Pericardial	22 (22)	0[c]	8 (14)	<.001
Pericardial effusion (>10 mm), No. (%)	20 (20)	0[c]	4 (7)[c]	<.001
Blood test results				
High-sensitivity CRP, median (IQR), mg/dL	0.11 (0.06-0.20)	0.11 (0.04-0.19)[c]	0.07 (0.04-0.14)[c]	.007
hsTnT, median (IQR), pg/mL	4.9 (3.0-6.9)	3.0 (3.0-3.0)[c]	3.2 (3.0-4.5)[c]	<.001
Detectable hsTnT (>3 pg/mL), No. (%)	71 (71)	11 (22)[c]	31 (54)[c]	<.001
Significantly elevated hsTnT (>13.9 pg/mL), No. (%)	5 (5)	0	0	.06
NT-proBNP, median (IQR), pg/mL	51 (31-96)	47 (32-63)	59 (35-76)	.26

Abbreviations: BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; COVID-19, coronavirus disease 2019; CRP, C-reactive protein; hsTnT, high-sensitivity troponin T; IQR, interquartile range; LGE, late gadolinium enhancement; LV, left ventricle; LVEDV, left ventricular end-diastolic volume; LVEF, left ventricular ejection fraction; NA, not applicable; NT-proBNP, N-terminal pro-b-type natriuretic peptide; RVEF, right ventricular ejection fraction; SCORE, Systematic Coronary Risk Evaluation.

[a] P value for 3-group comparison using one-way analysis of variance or Kruskall Wallis, as appropriate for the type of data.

[b] Calculated as weight in kilograms divided by height in meters squared.

[c] Post hoc test for the difference vs COVID-19 group, $P < .05$.

Surprising?

Concerning ?

Reassuring?

Key Points

- Cardiac MRI right after viral infection is a new area of research.
- We don't know what enhanced T1, T2, LGE mean on an MRI right after COVID? Is it predictive?

What do we know?

- Many pathogens cause myocarditis.
- Adenovirus, Arbovirus, Cytomegalovirus, Dengue virus, echovirus, Epstein-Barr Virus, Hepatitis C, Herpesvirus, HIV, Influenza, Mumps, Parvovirus B9, Polio, Rabies, Rubella, Rubeola, Varicella, Variola, Yellow Fever.
- Many bacteria, and other toxins. Antibx (hypersensitivity), ETOH, snake bites…
- Remember we need inflammation. This is our defense again pathogens.

So what do we know?

- Myocarditis can be harmful. Best to avoid exercise with evidence of active myocarditis or active infection.
- Chest pain, Sick, Troponin elevation, EKG changes (<u>Tachycardia, T wave inversion</u>, QRS/QT prolongation, AV conduction defects, diffuse ST elevation, PR depression). Abnormalities on echo (nondilated, thickened, and hypocontractile LV). Cardiac MRI changes.

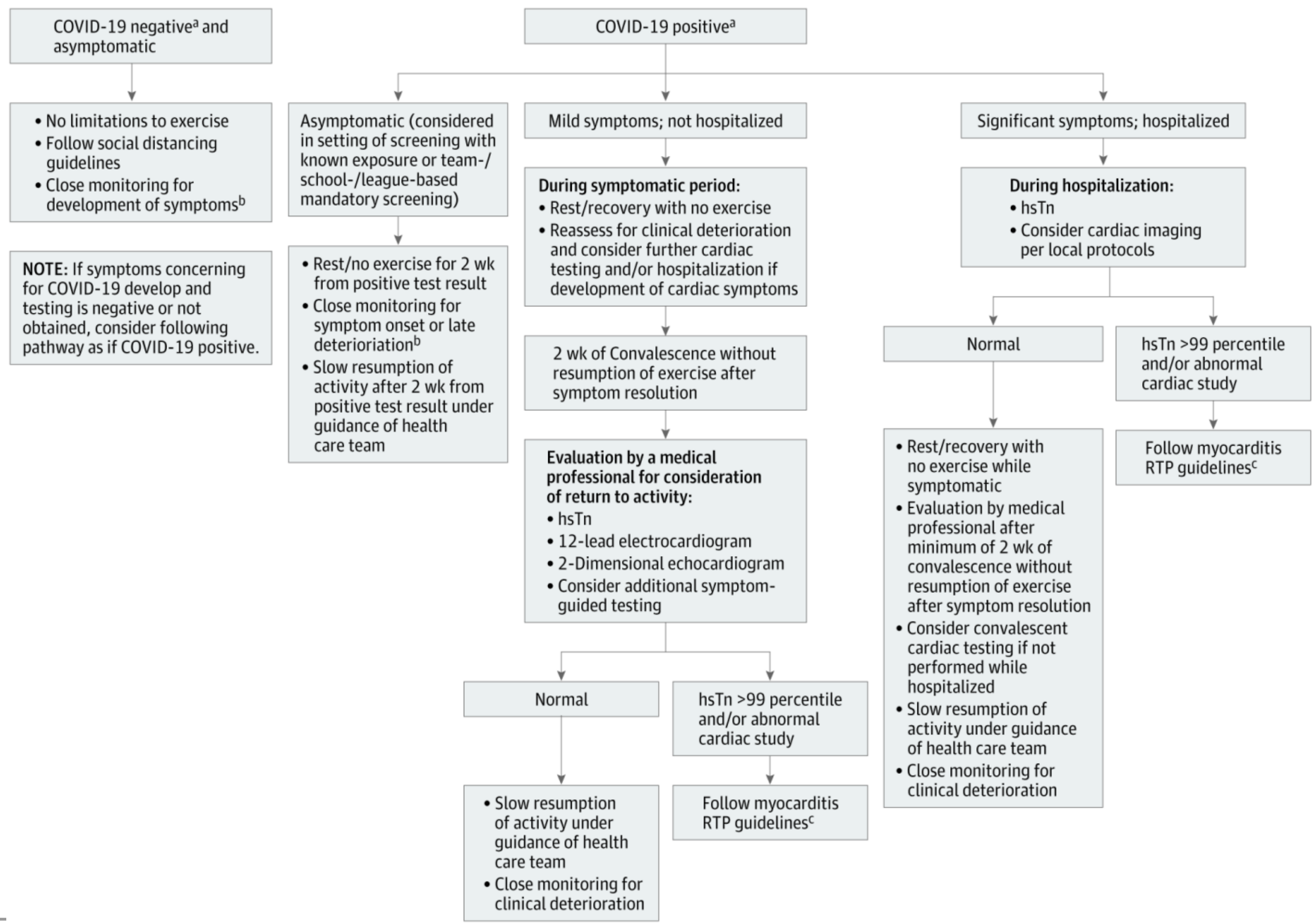
So what do we know?

- So far no conclusive evidence that the incidence rate of myocarditis/viral cardiomyopathy is higher with SARS-CoV-2 than other viruses, but it is making news.
- The clinical significance of MRI abnormalities in asymptomatic patients is unknown
- Balance the actual risk with risk of over diagnosis, and activity restriction. Shared decision making.

JAMA Network

From: **A Game Plan for the Resumption of Sport and Exercise After Coronavirus Disease 2019 (COVID-19) Infection**

JAMA Cardiol. Published online May 13, 2020. doi:10.1001/jamacardio.2020.2136



Date of download: 10/8/2020

Myocarditis

- ACC: Athletes diagnosed with myocarditis should be restricted from strenuous exercise for 3-6 months depending upon clinical severity. Reasonable to resume activity once LV function has normalized, serum biomarkers have normalized, no arrhythmias on ETT.
- Since the predictive value of the above is not known, it would be best to prevent it if possible. Is it preventable?

SPECIAL ARTICLE

Obesity and Outcomes in COVID-19: When an Epidemic and Pandemic Collide

Fabian Sanchis-Gomar, MD, PhD; Carl J. Lavie, MD; Mandeep R. Mehra, MD, MSc; Brandon Michael Henry, MD; and Giuseppe Lippi, MD

Abstract

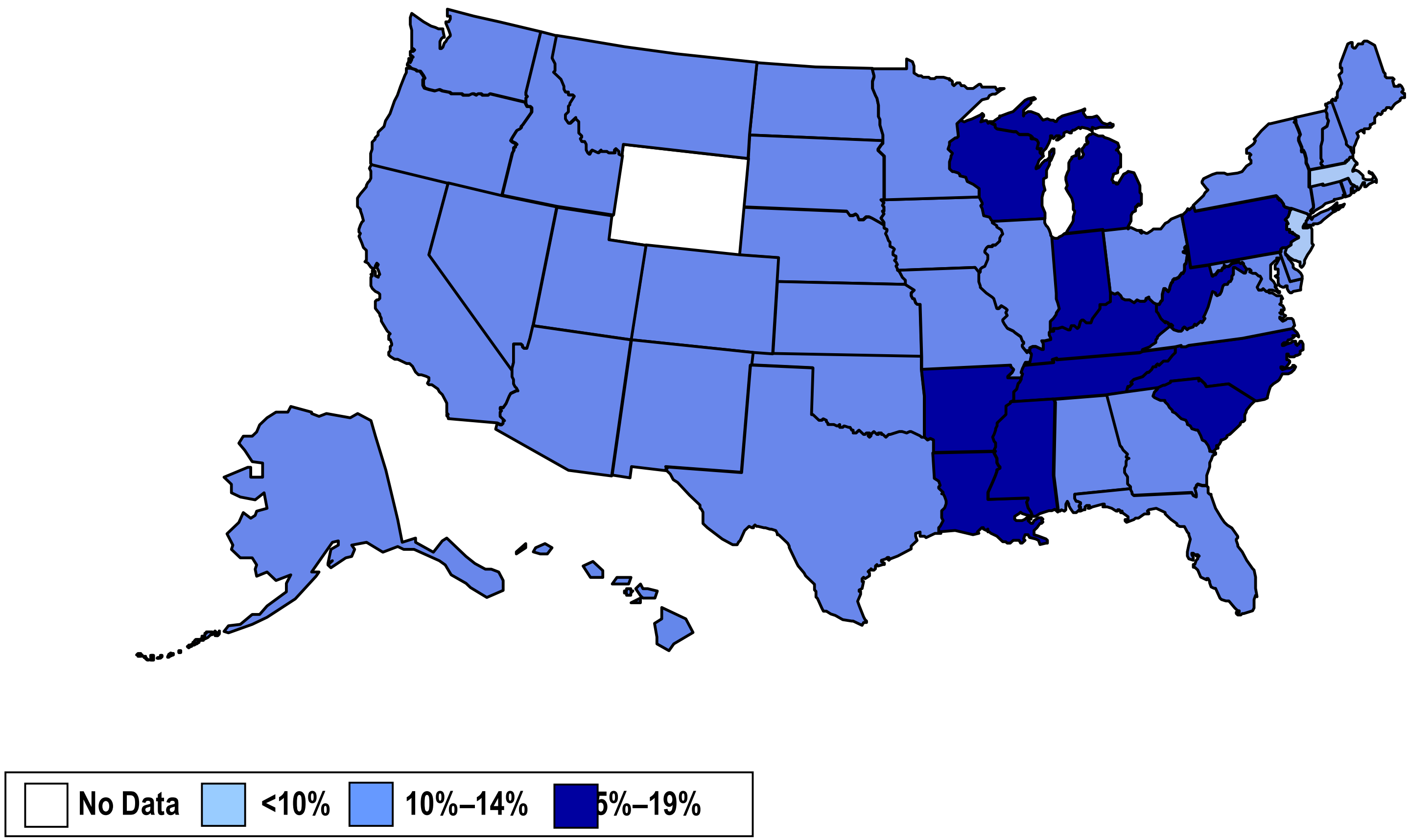
Obesity has reached epidemic proportions in the United States and in much of the westernized world, contributing to considerable morbidity. Several of these obesity-related morbidities are associated with greater risk for death with coronavirus disease 2019 (COVID-19). Severe acute respiratory syndrome coronavirus 2 penetrates human cells through direct binding with angiotensin-converting enzyme 2 receptors on the cell surface. Angiotensin-converting enzyme 2 expression in adipose tissue is higher than that in lung tissue, which means that adipose tissue may be vulnerable to COVID-19 infection. Obese patients also have worse outcomes with COVID-19 infection, including respiratory failure, need for mechanical ventilation, and higher mortality. Clinicians need to be more aggressive when treating obese, especially severely obese, patients with COVID-19 infection.

 ■ Mayo Clin Proc. 2020;95(7):1445-1453

MONUMENT HEALTH

Obesity Trends* Among U.S. Adults
BRFSS, 1993

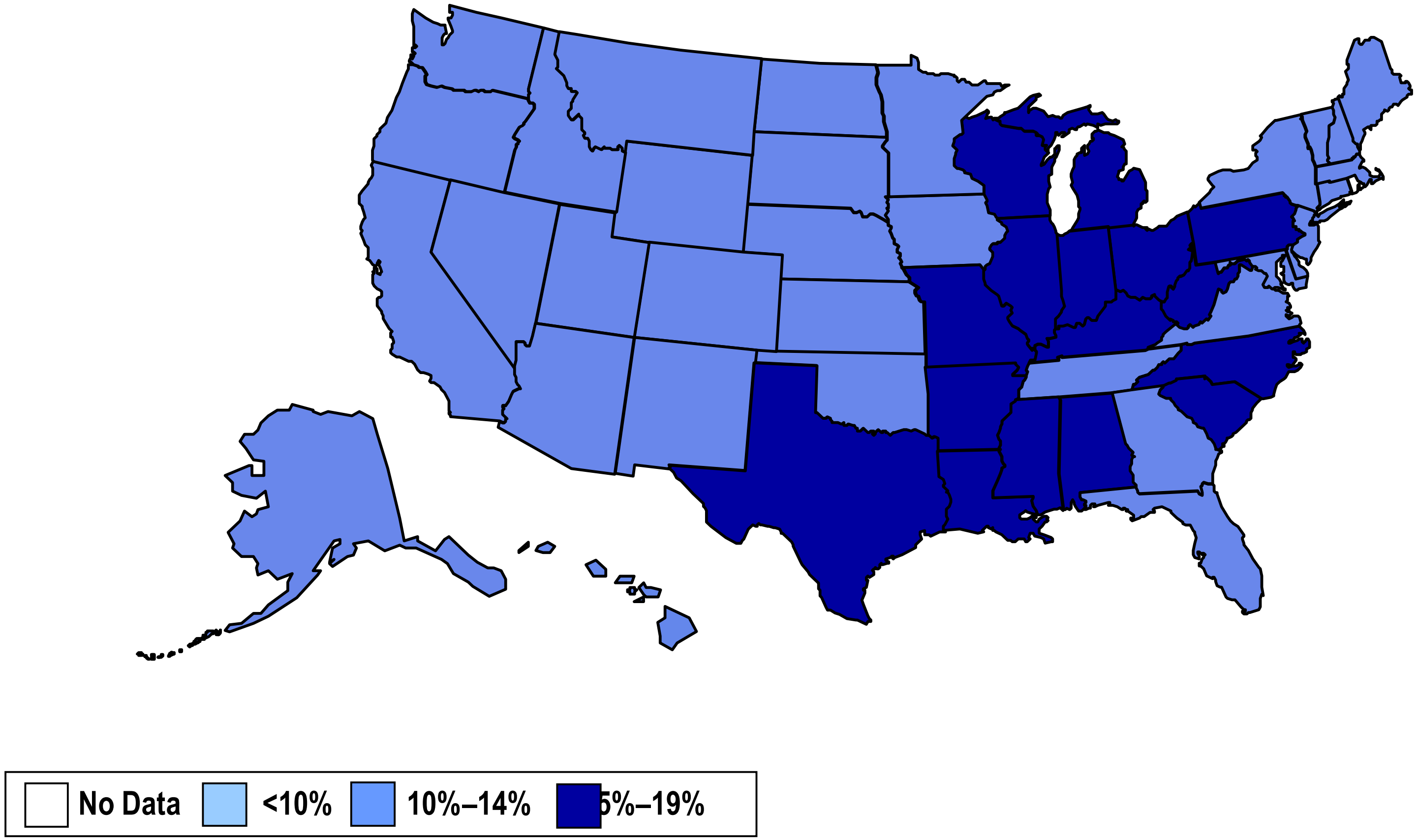
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Obesity Trends* Among U.S. Adults

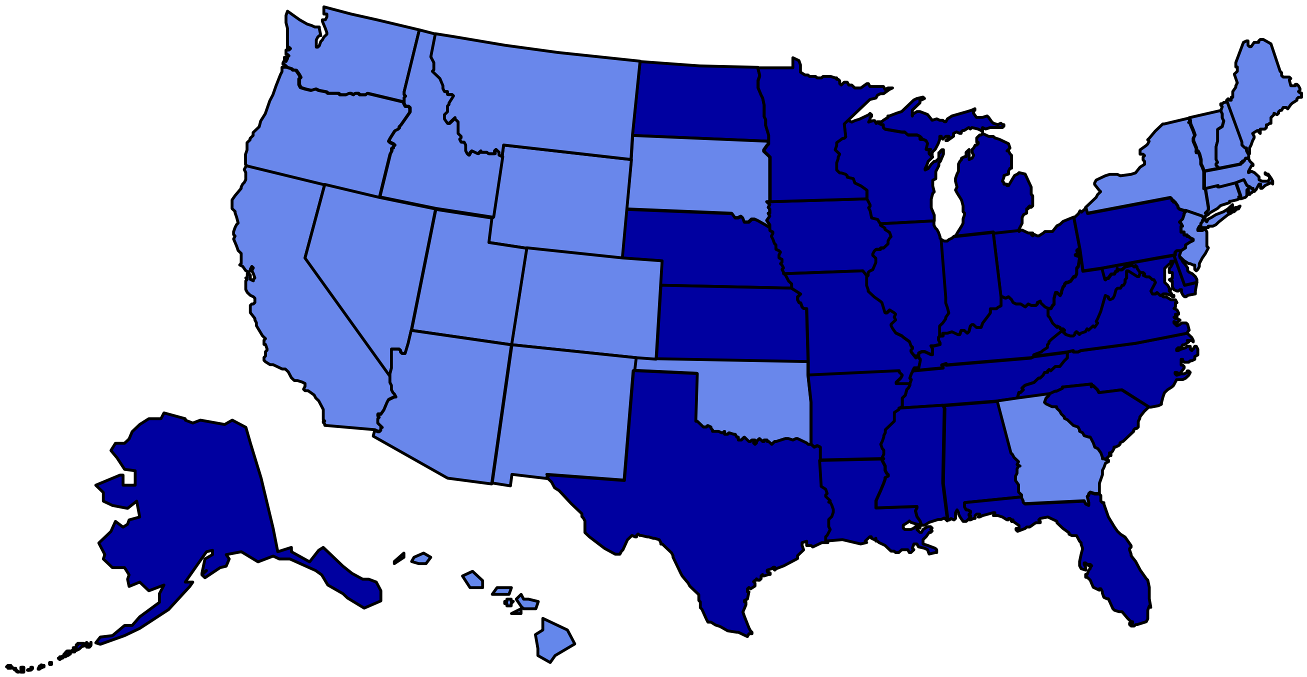
BRFSS, 1994

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Obesity Trends* Among U.S. Adults
BRFSS, 1995

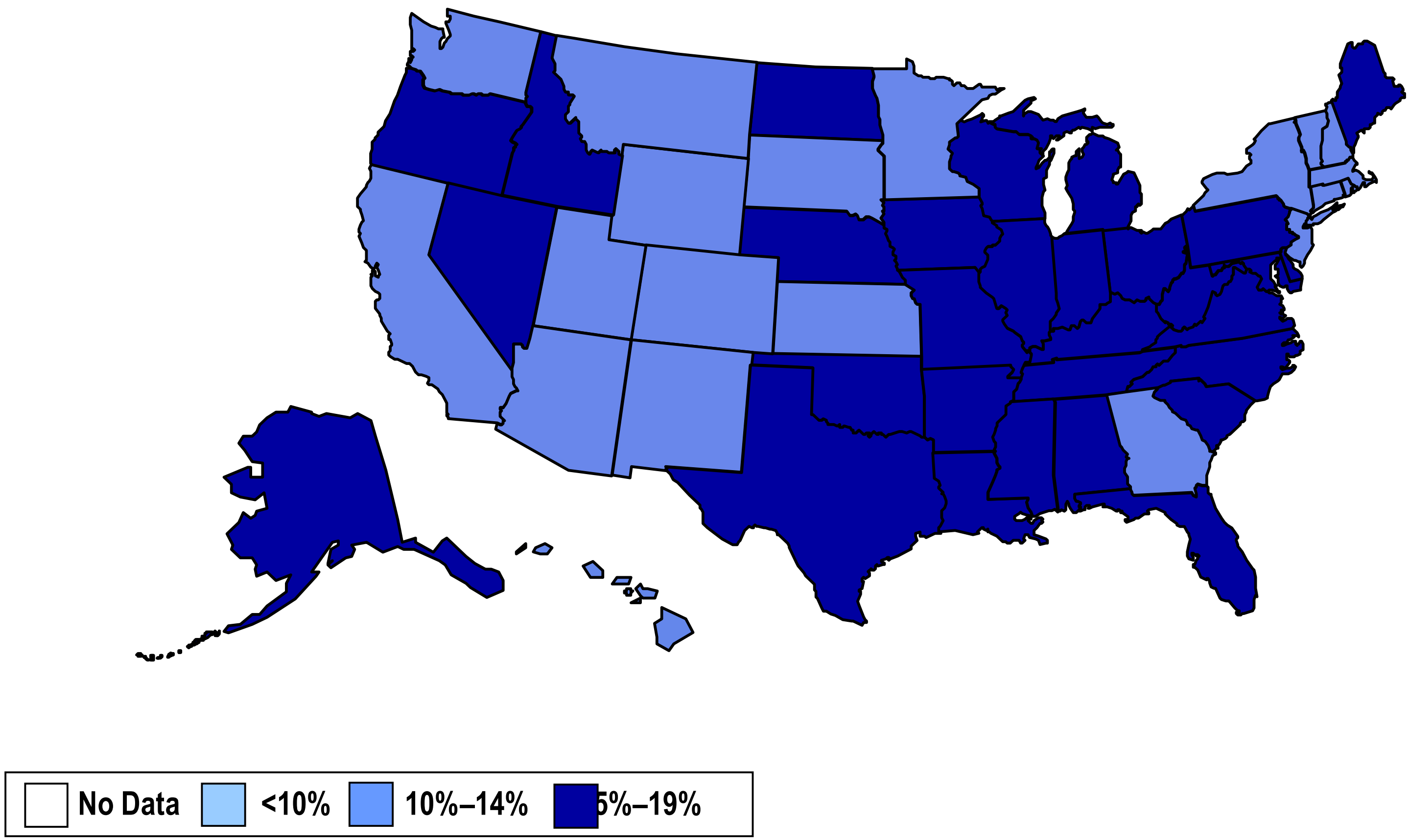
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



No Data | <10% | 10%–14% | 5%–19%

Obesity Trends* Among U.S. Adults
BRFSS, 1996

(*BMI ≥30, or ~ 30 lbs. overweight for 5′ 4″ person)



Obesity Trends* Among U.S. Adults
BRFSS, 1997

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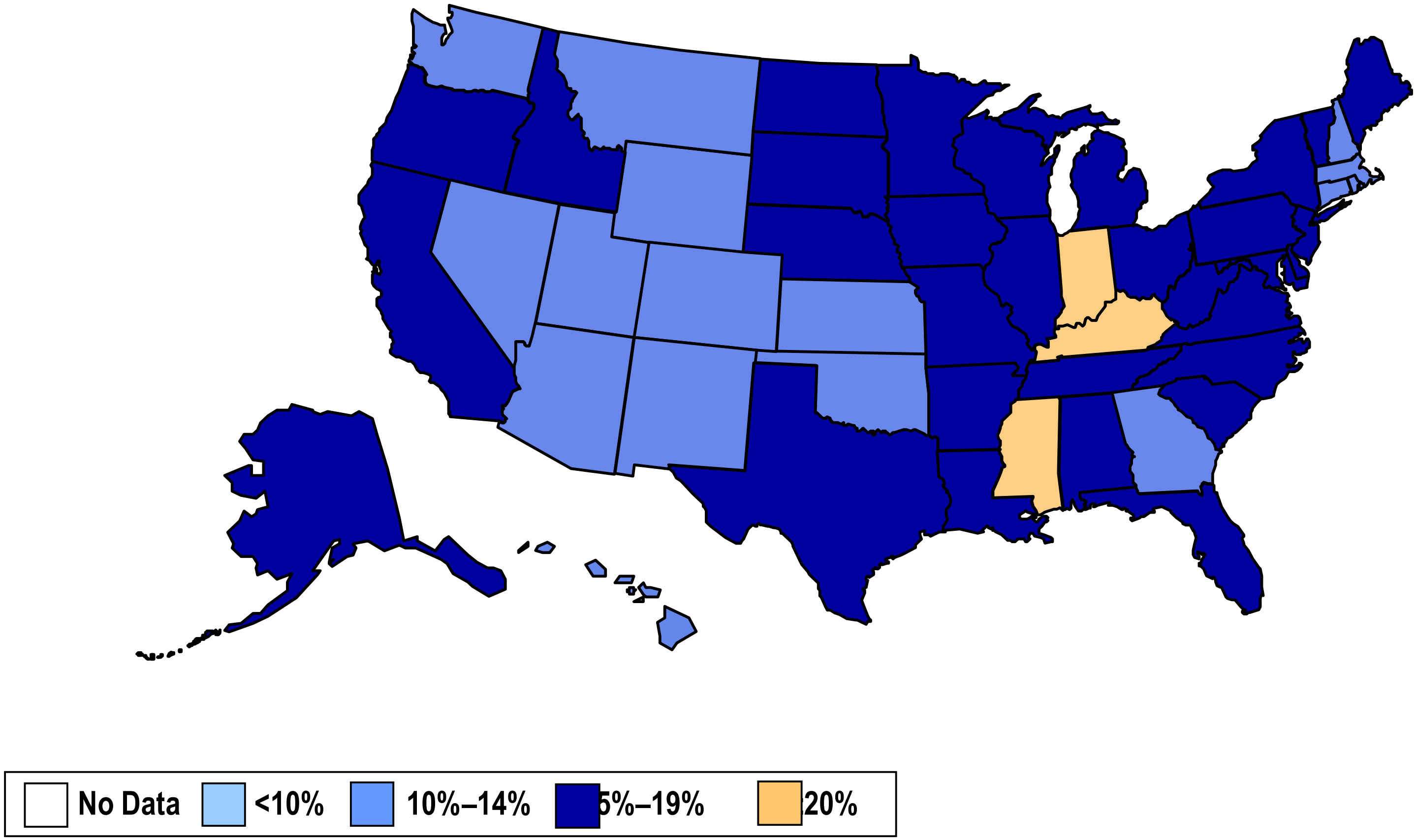
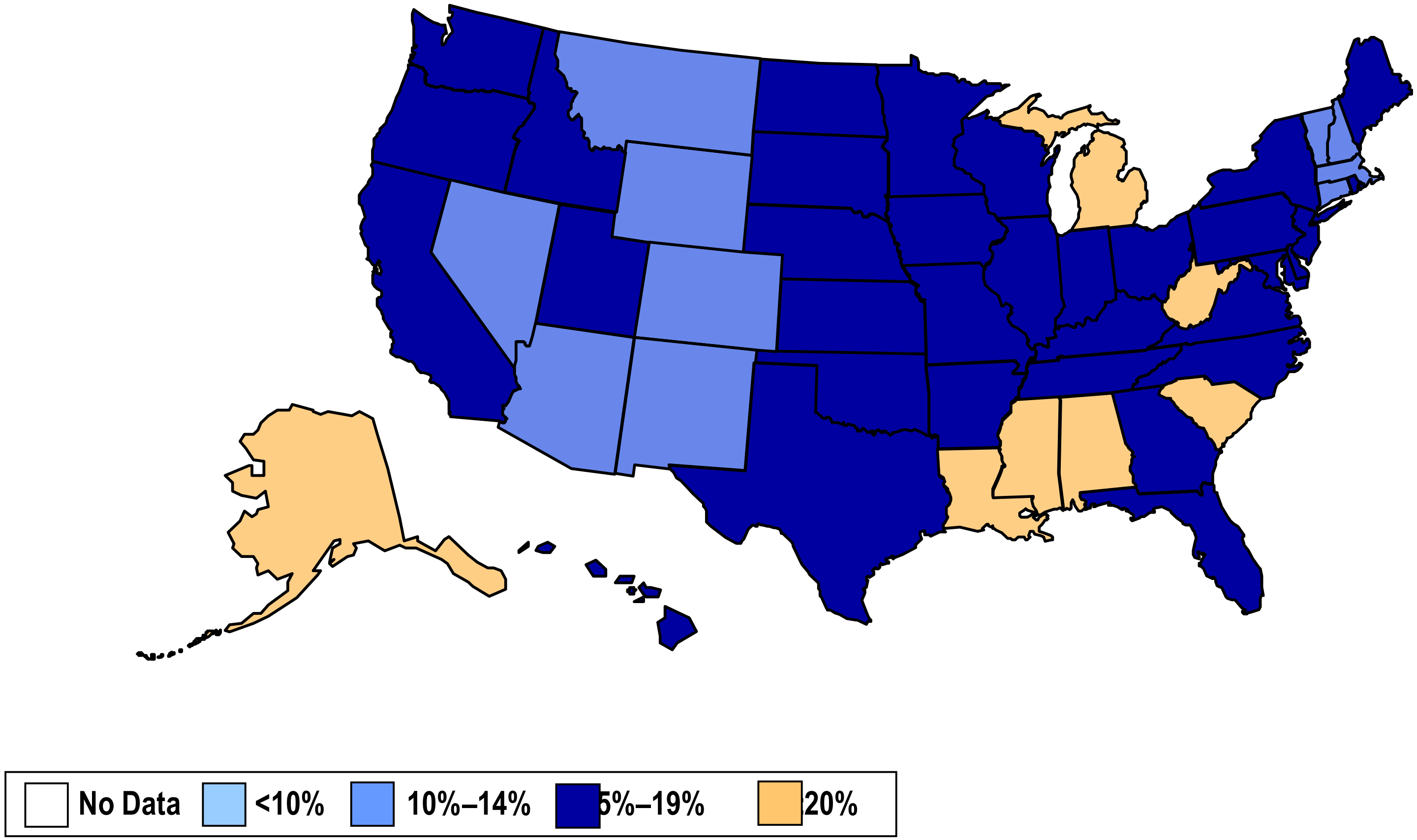


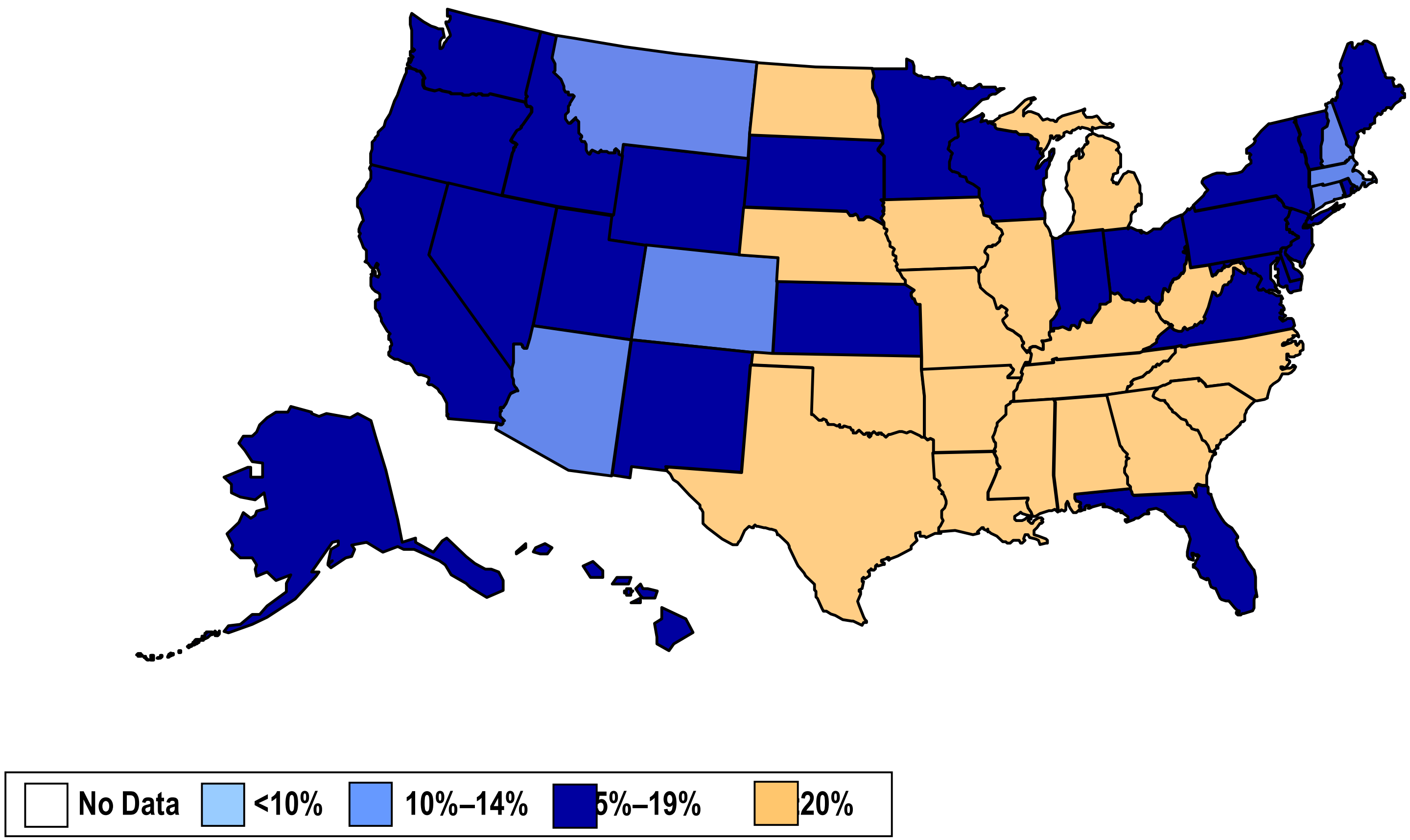
Obesity Trends* Among U.S. Adults
BRFSS, 1998

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



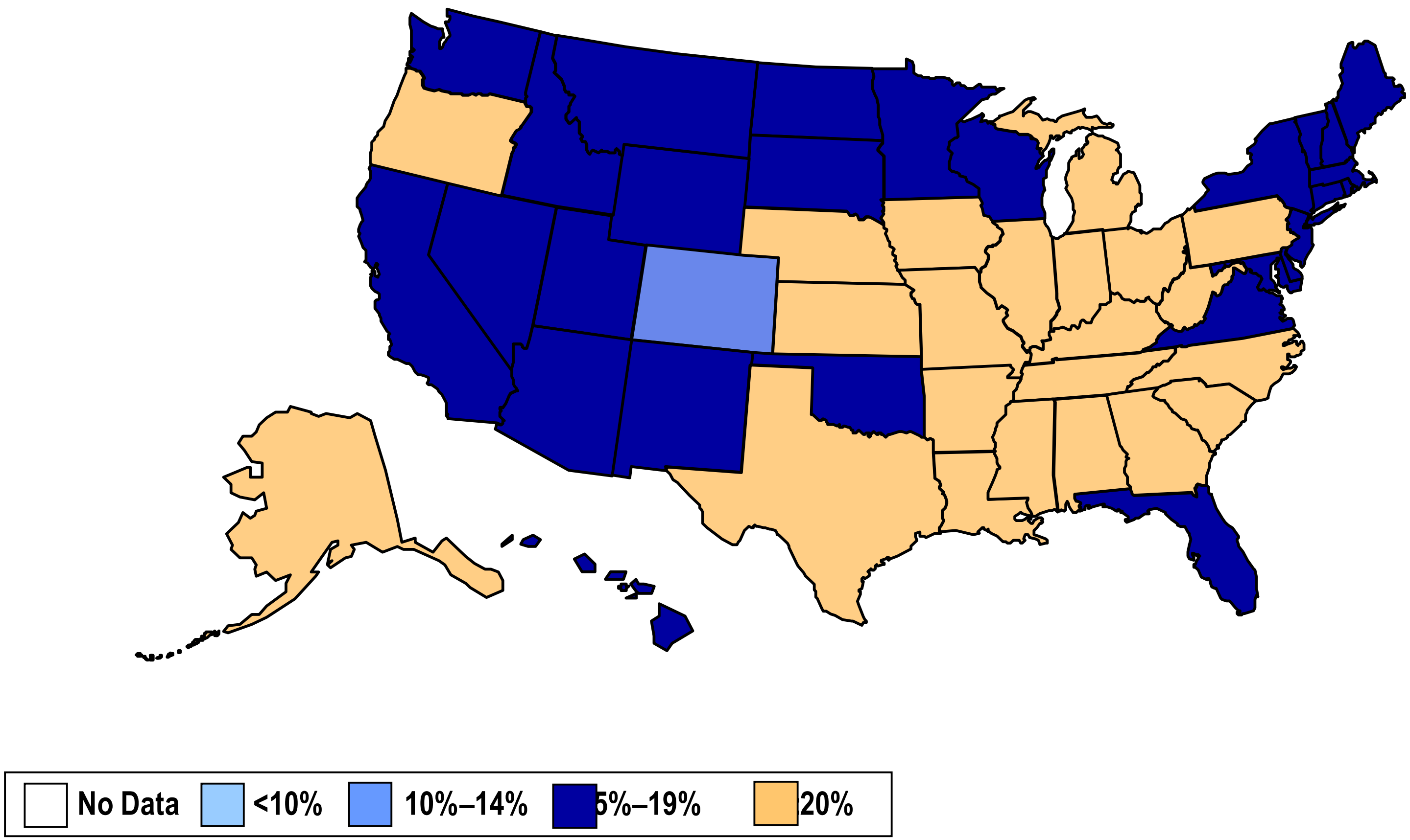
Obesity Trends* Among U.S. Adults
BRFSS, 1999

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



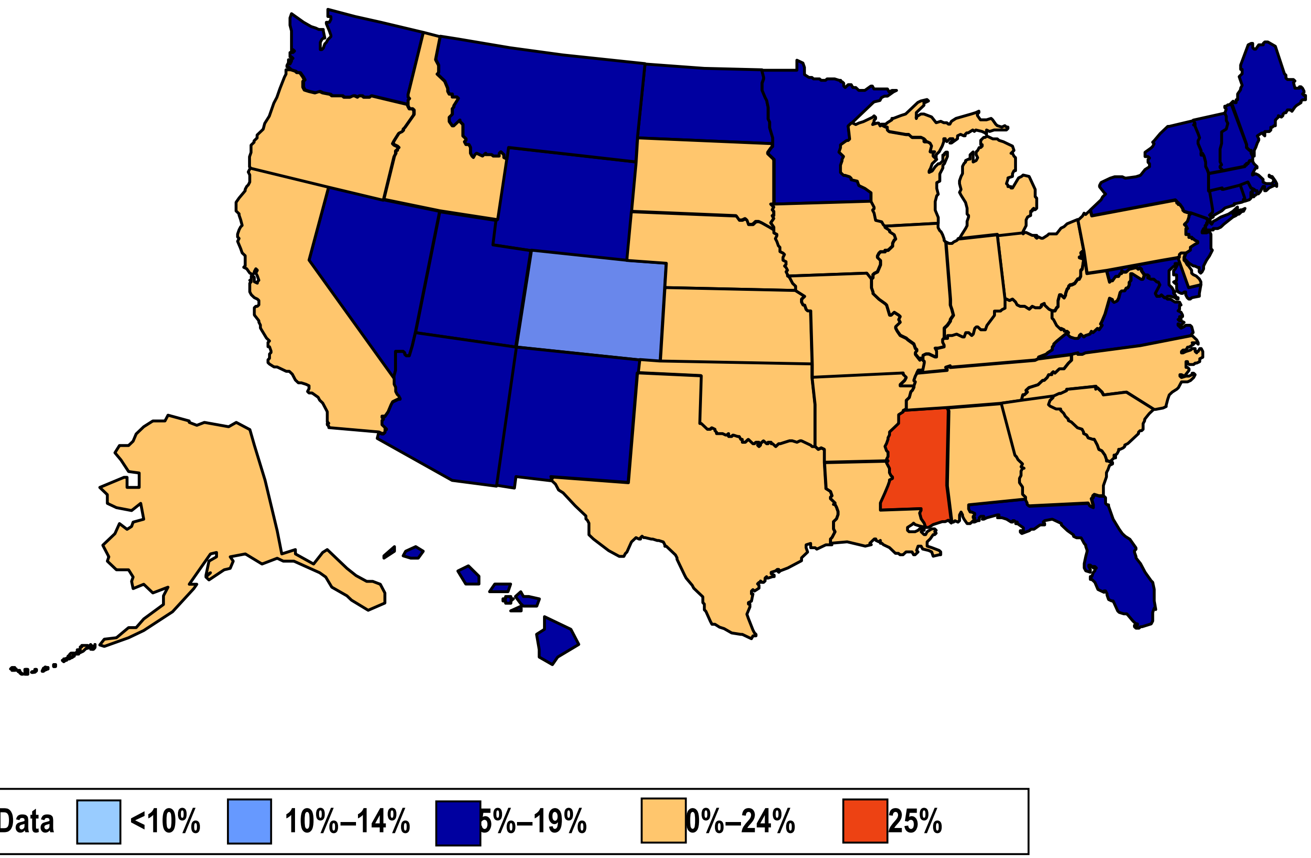
Obesity Trends* Among U.S. Adults
BRFSS, 2000

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Obesity Trends* Among U.S. Adults
BRFSS, 2001

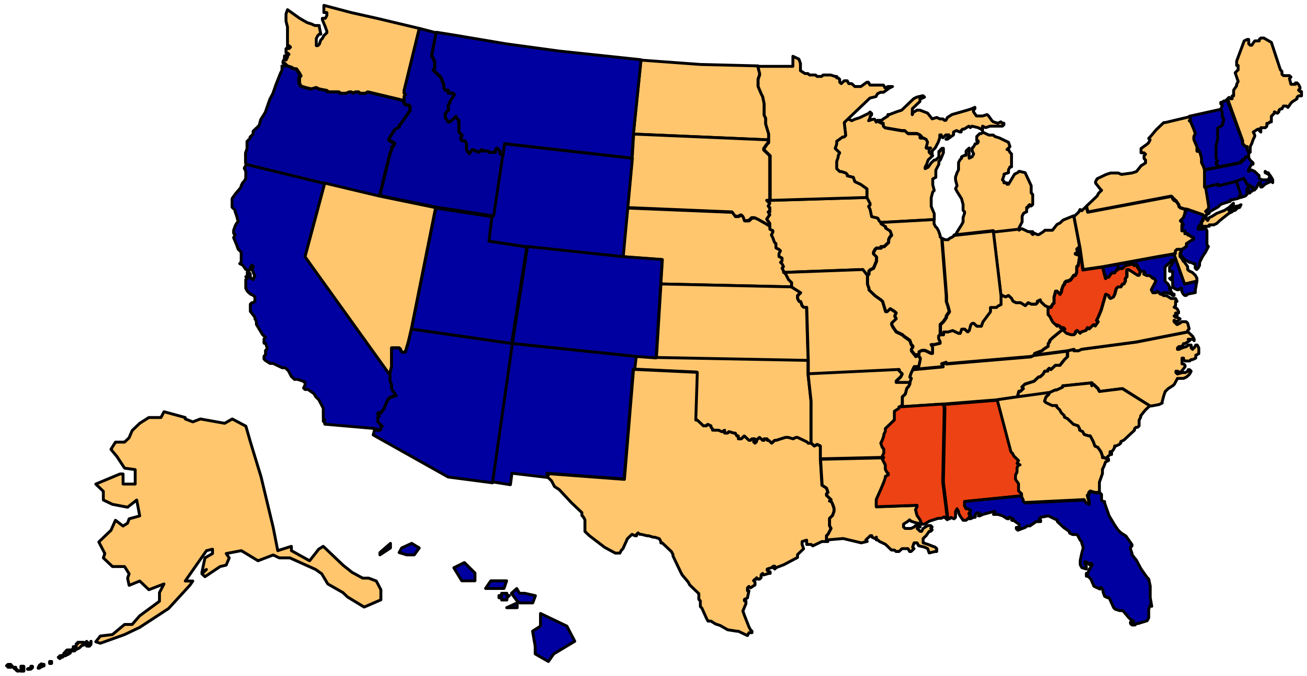
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Obesity Trends* Among U.S. Adults

BRFSS, 2002

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

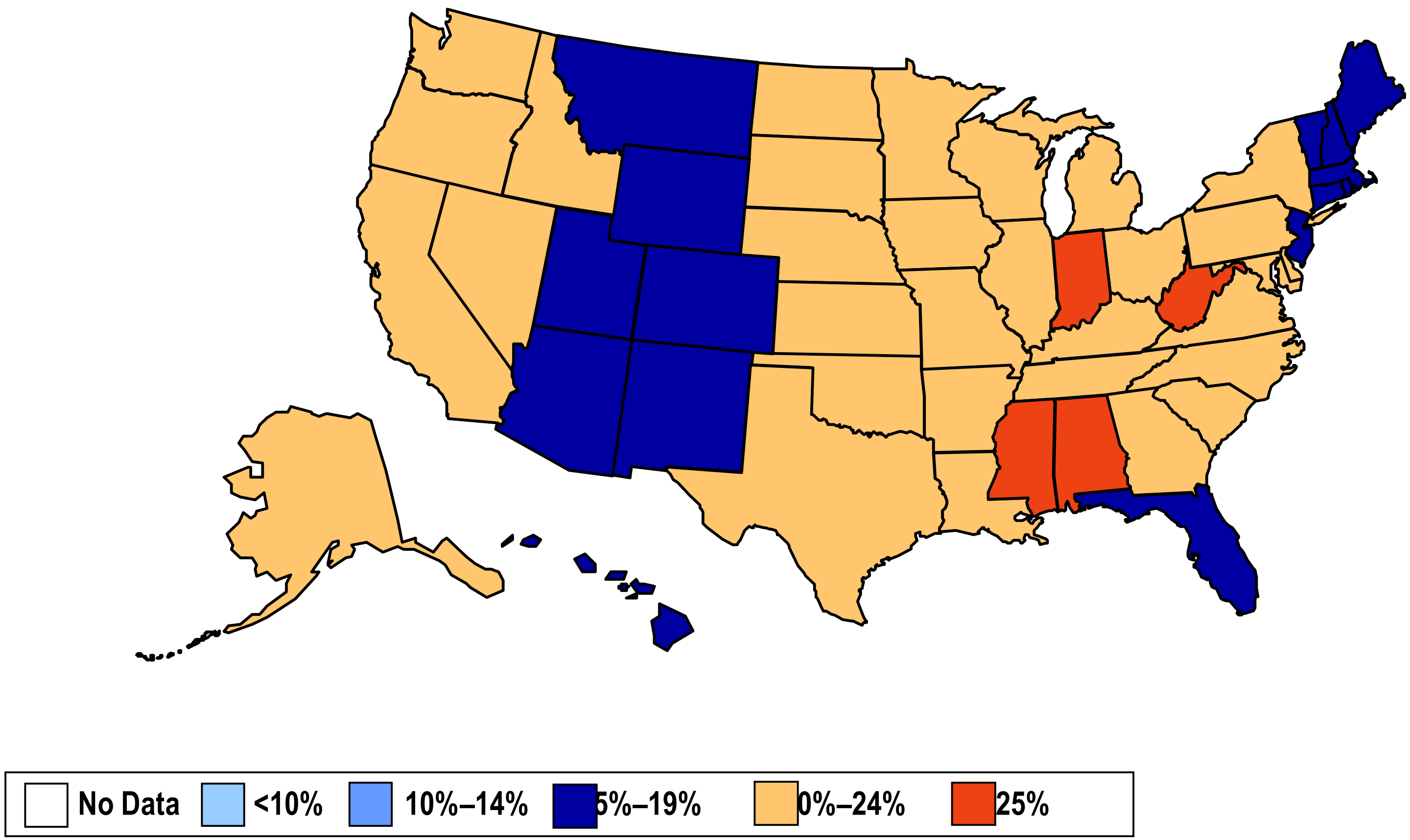


No Data <10% 10%–14% 5%–19% 0%–24% 25%

Obesity Trends* Among U.S. Adults

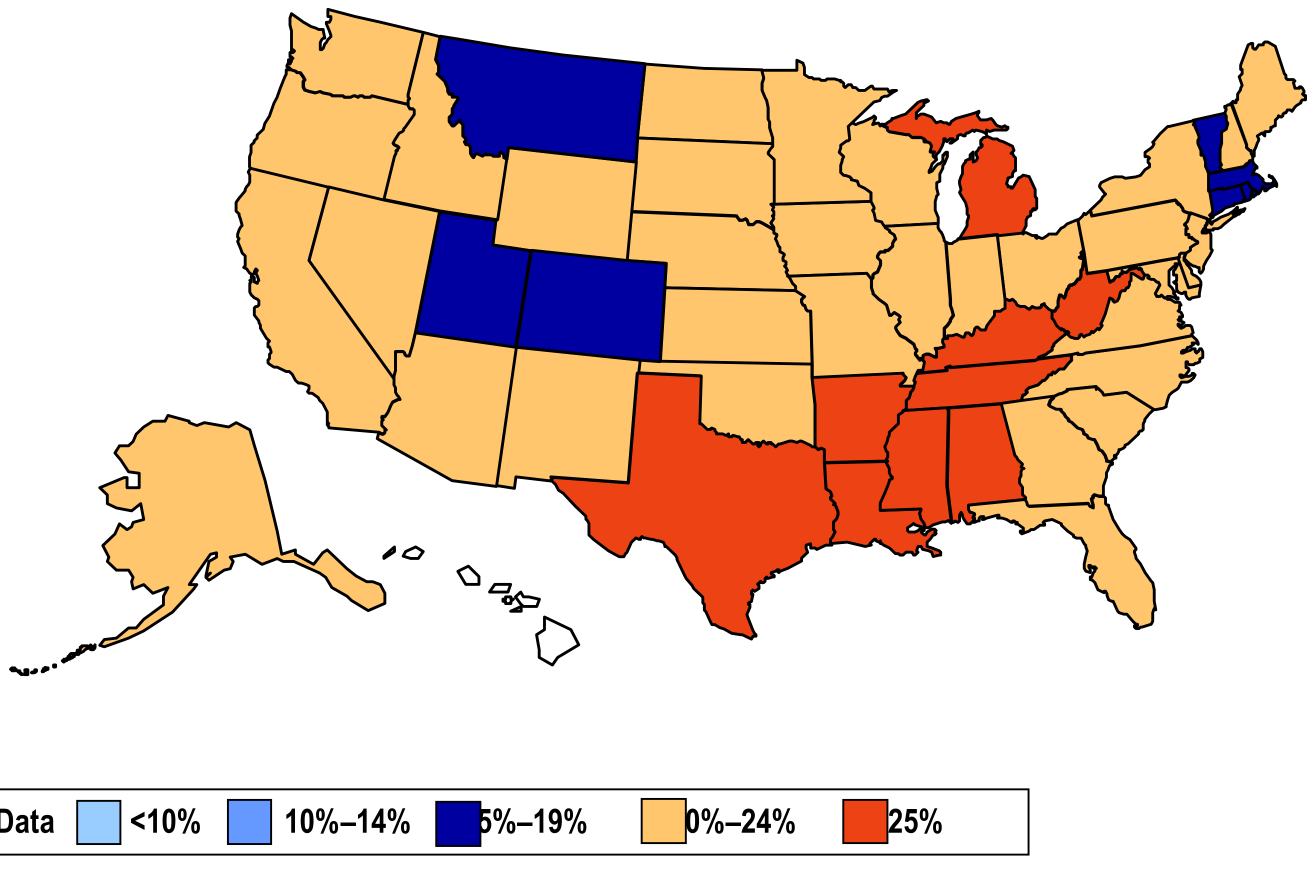
BRFSS, 2003

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



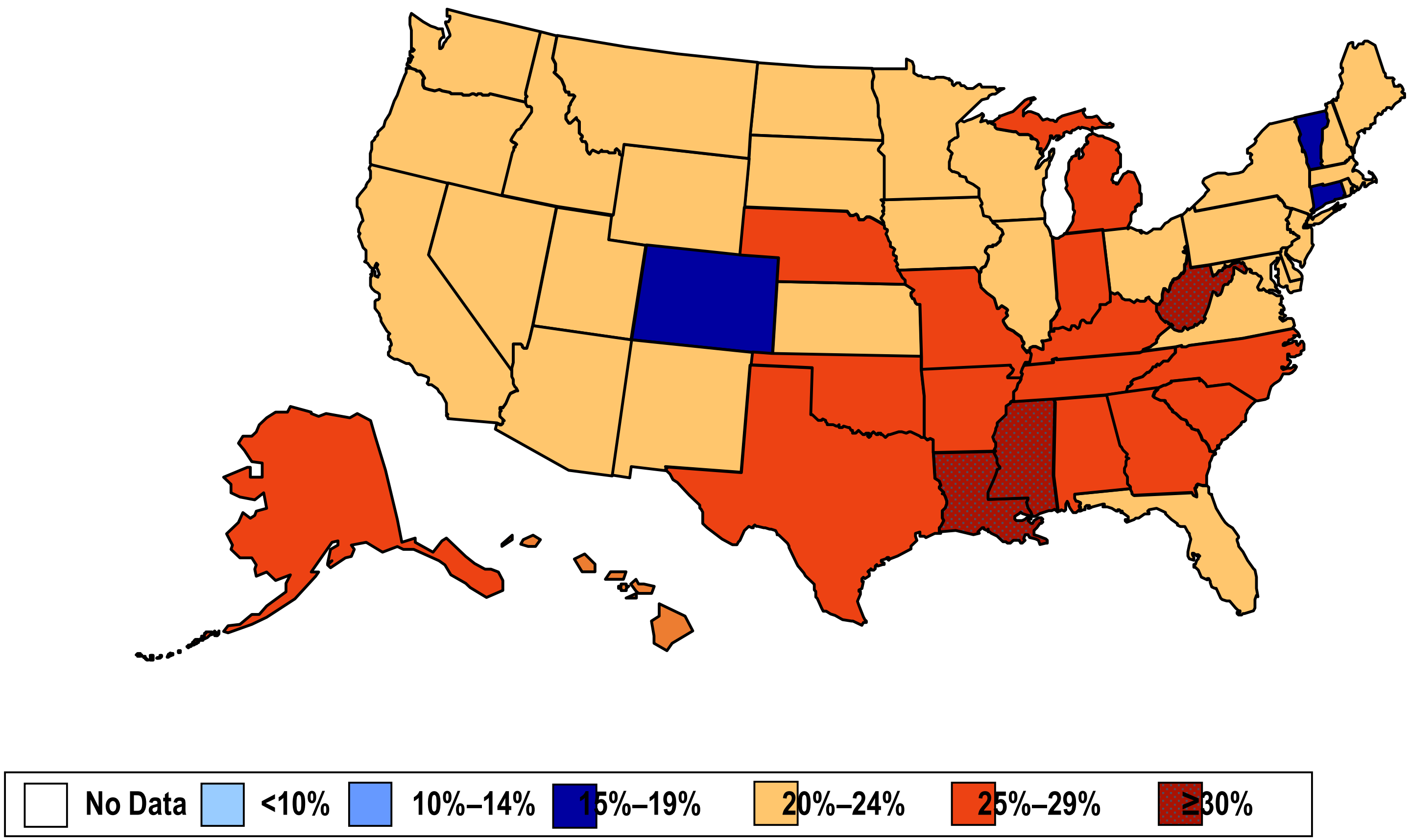
Obesity Trends* Among U.S. Adults
BRFSS, 2004

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



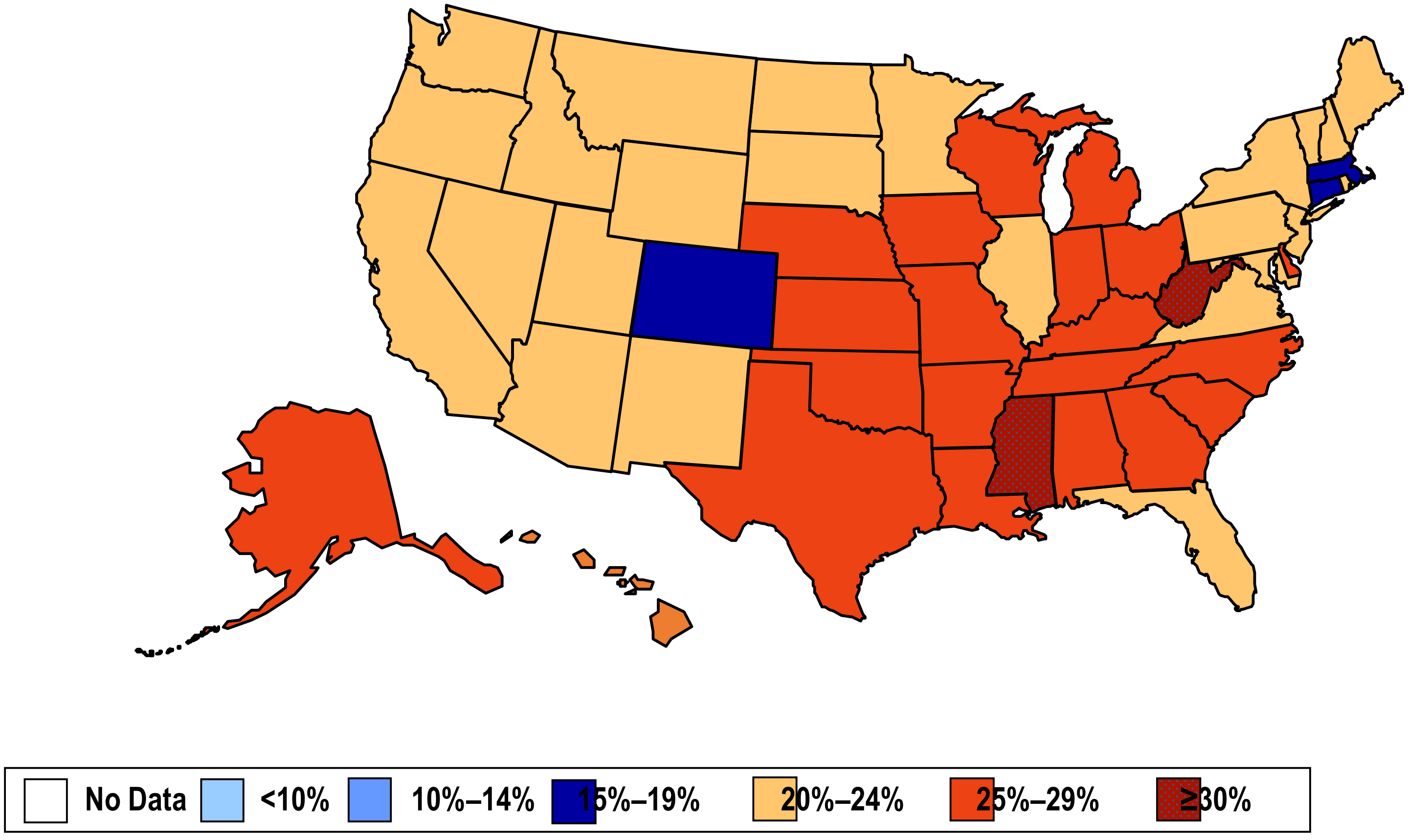
Obesity Trends* Among U.S. Adults
BRFSS, 2005

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



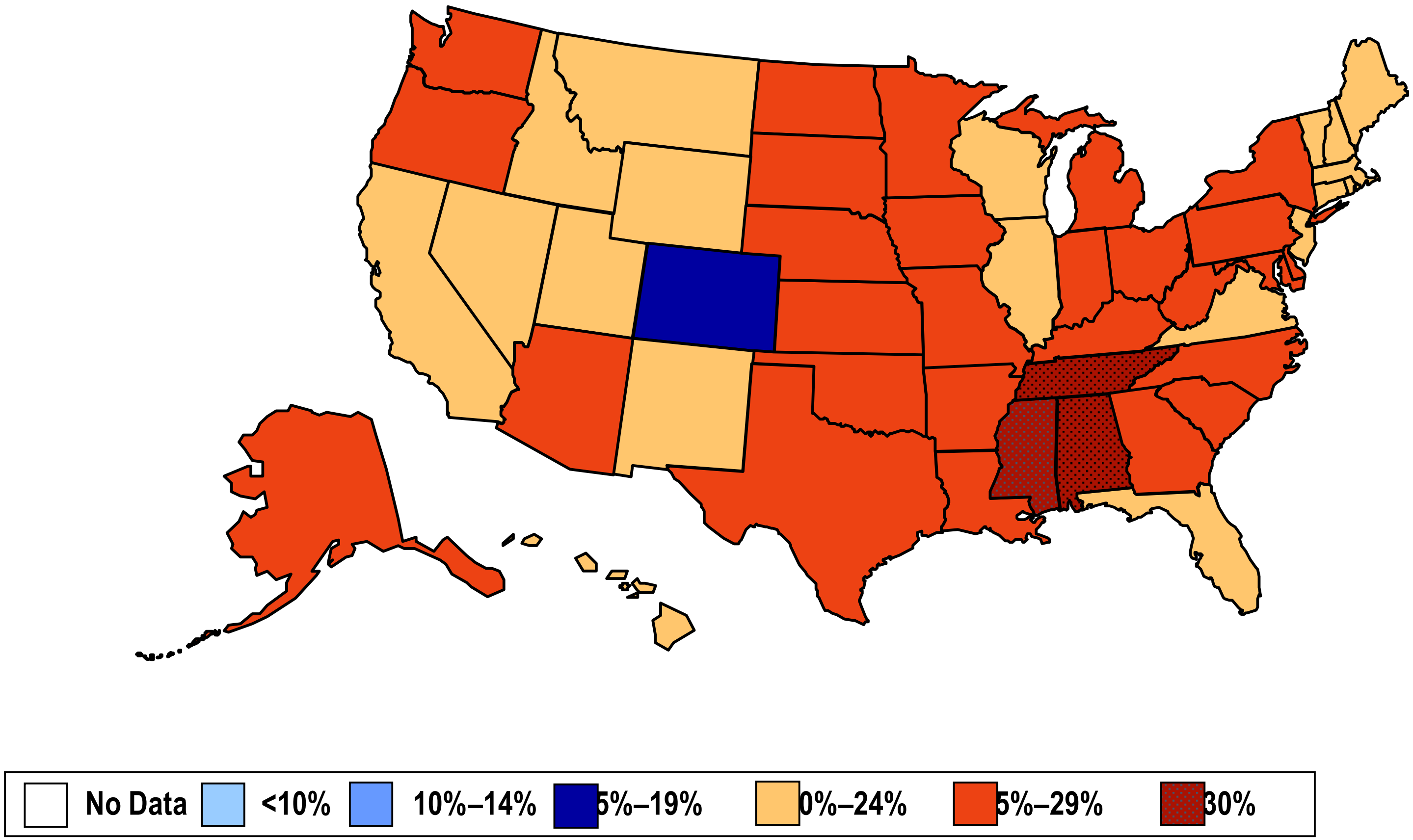
Obesity Trends* Among U.S. Adults
BRFSS, 2006

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



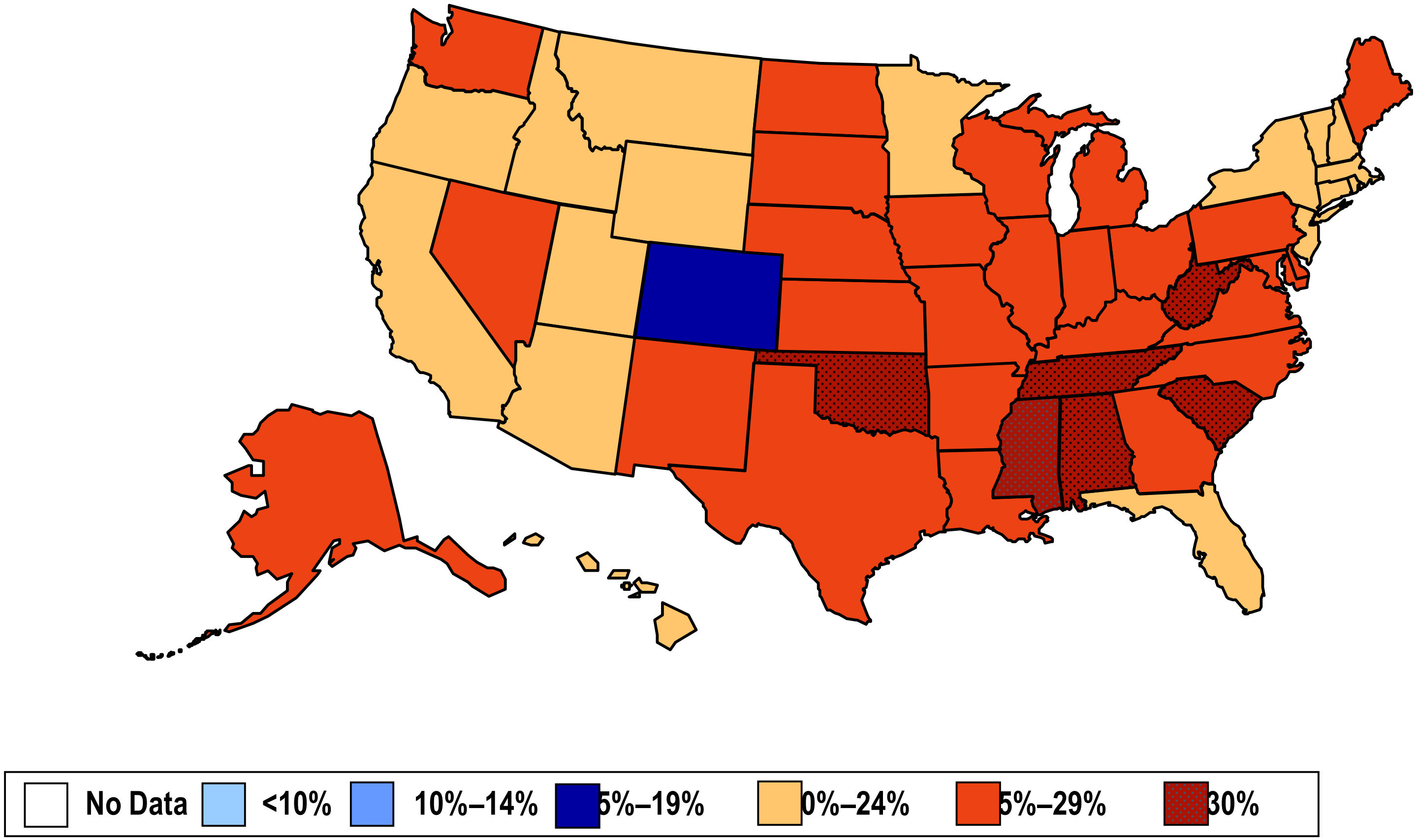
Obesity Trends* Among U.S. Adults
BRFSS, 2007

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



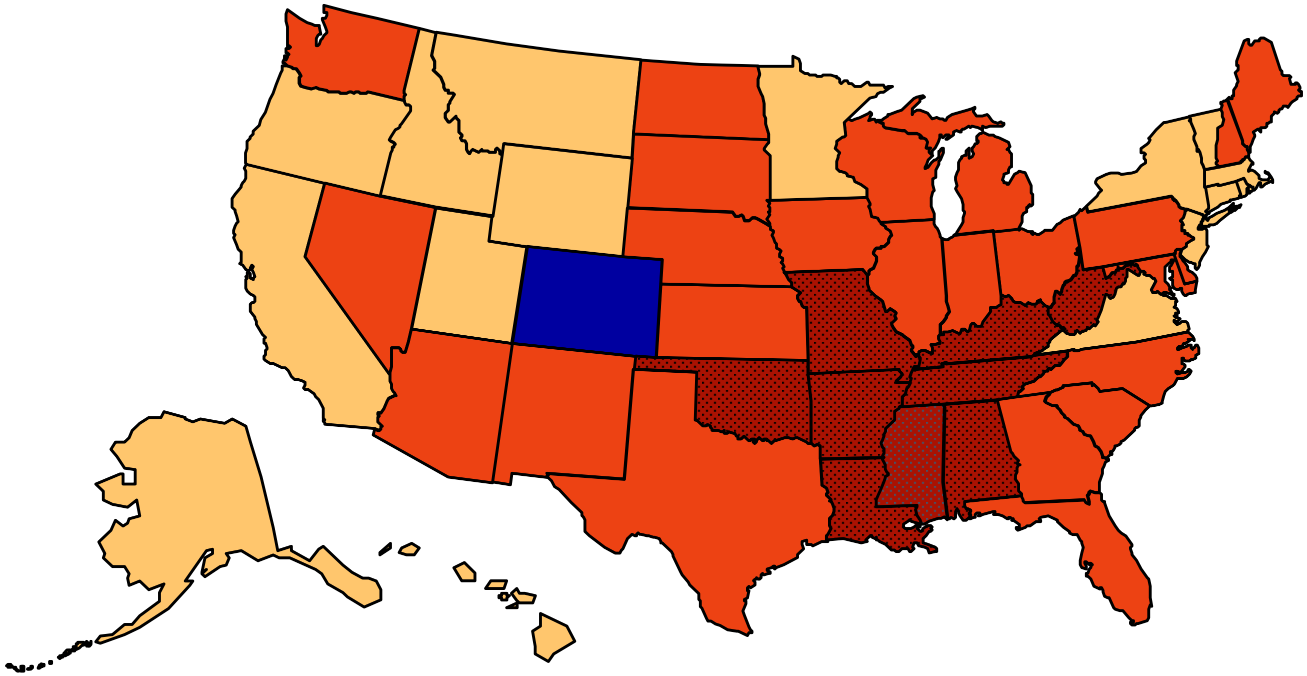
Obesity Trends* Among U.S. Adults
BRFSS, 2008

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Obesity Trends* Among U.S. Adults
BRFSS, 2009

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



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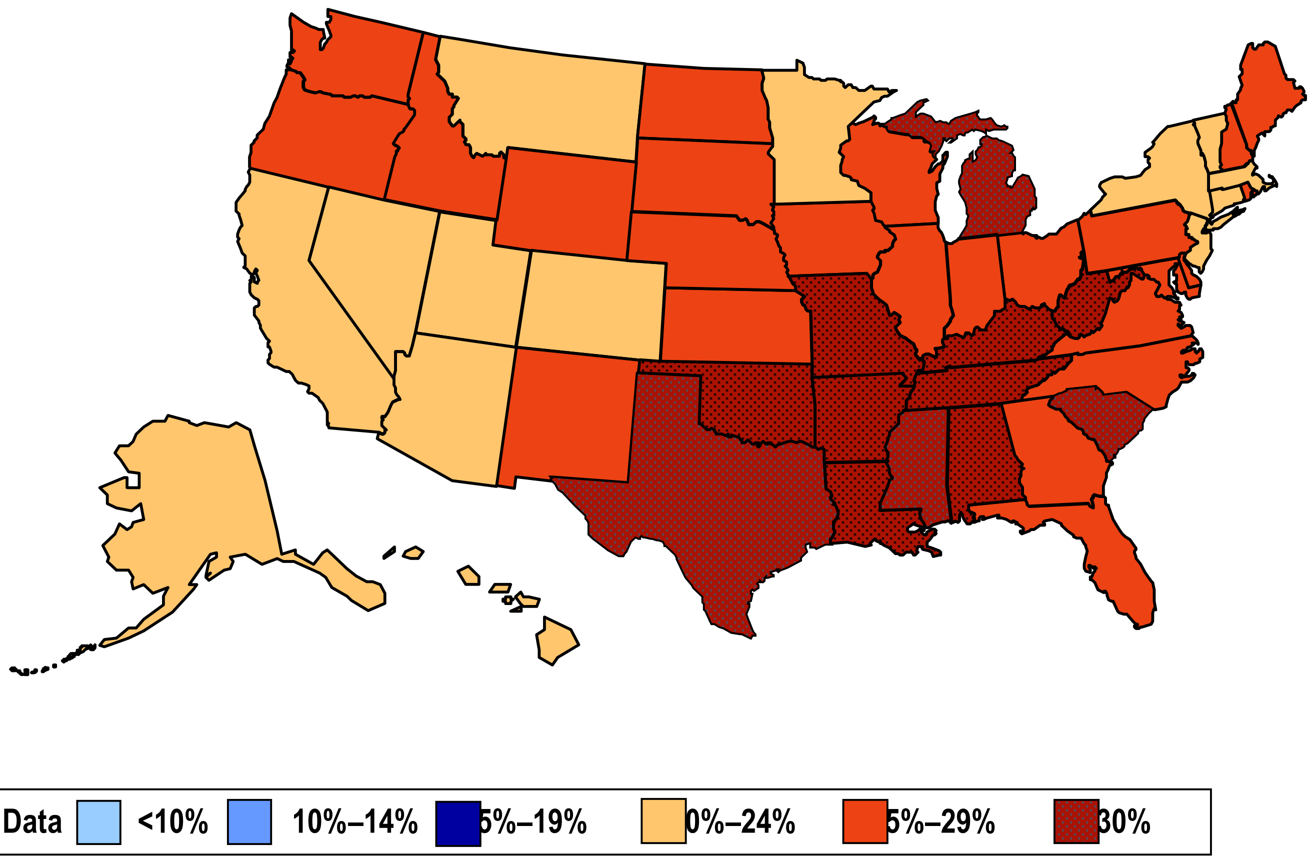
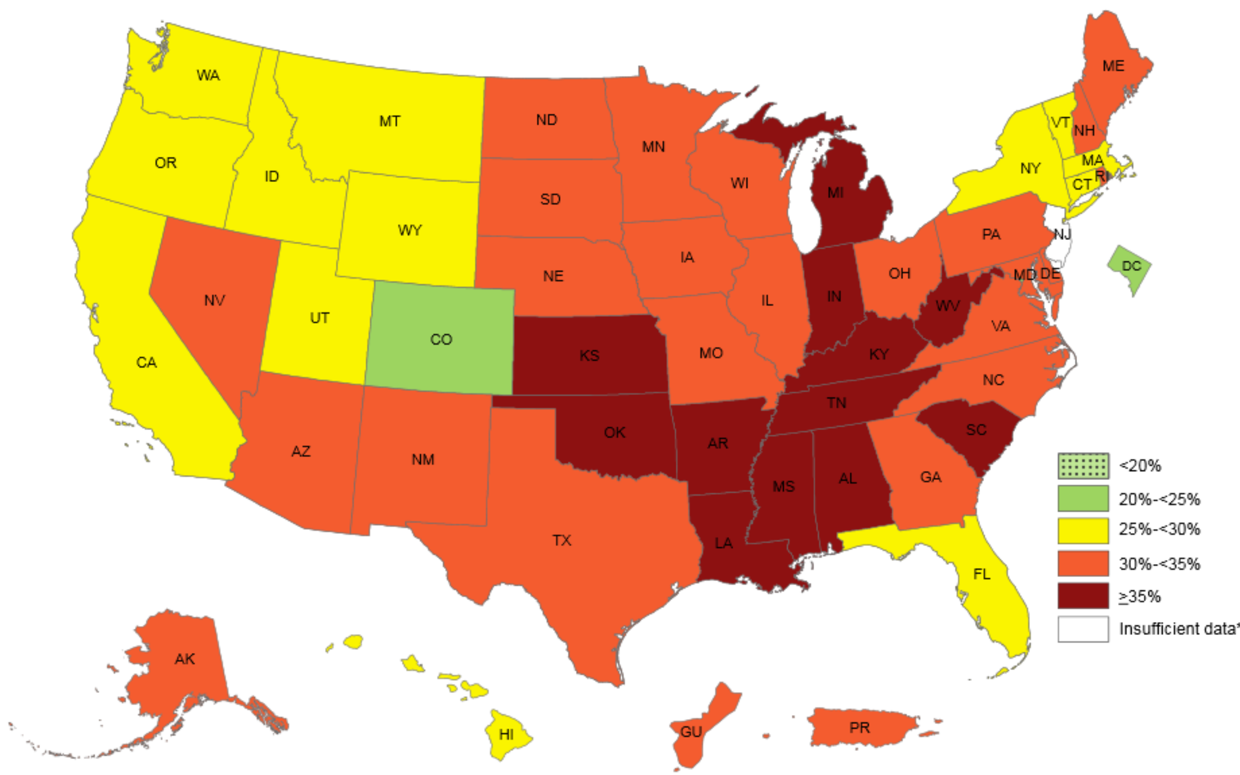
Obesity Trends* Among U.S. Adults
BRFSS, 2010

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

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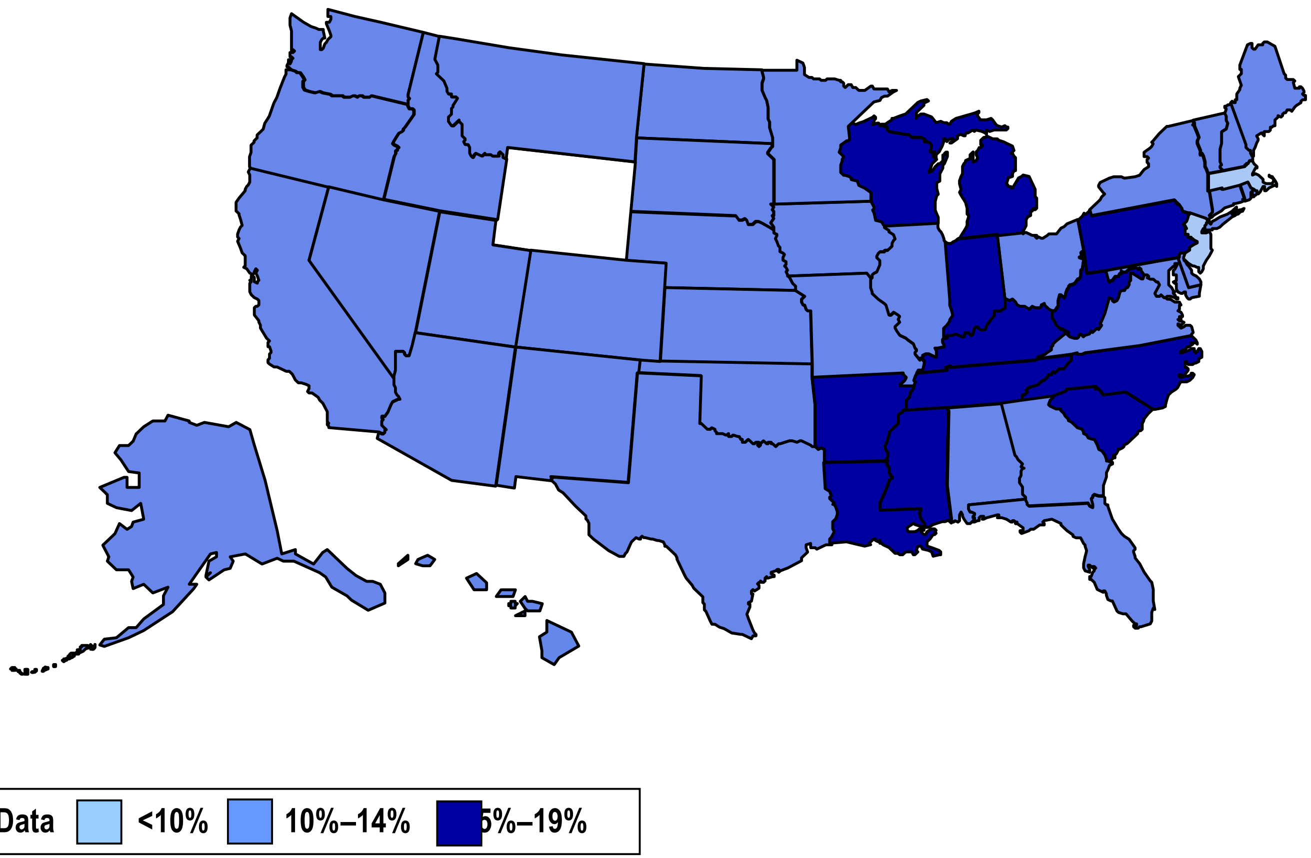
25%-<30%
30%-<35%
≥35%
Insufficient data*

Obesity Trends* Among U.S. Adults
BRFSS, 1993

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Primary prevention of severe illness from COVID-19?

- Many of the same risk factors for CAD are increasing mortality rates with SARS-CoV-2 (Hypertension, obesity, smoking, diabetes)
- 655,000 Americans die of heart disease each year making it the leading cause of death for Americans (1 in 4 deaths).
- Estimated 80% of CV disease is preventable.

Obesity and Outcomes in COVID-19

- Compared to normal weight, obesity is associated with 2.42 fold higher odds of severe pneumonia with SARS-CoV-2 infection.
- Odds ratio for severe pneumonia in COVID-19 infection is 1.96 for overweight men, 5.7 for obese men!
- BMI >35=7 fold greater risk of need for mechanical ventilation than BMI <25.
- BMI > 40 is the strongest risk factor for hospitalization.

Obesity and Outcomes in COVID-19

- CDC-Obesity triples risk of hospitalization.
- 25% of patients who died of COVID-19 had A-fib in report published by Italian National Institute of Heath.
- ACE2 expression is higher in adipose tissue than the lung, suggesting adipose tissue is vulnerable to COVID-19 infection allowing for possible direct entry into adipocytes by the SARS-CoV-2 virus.

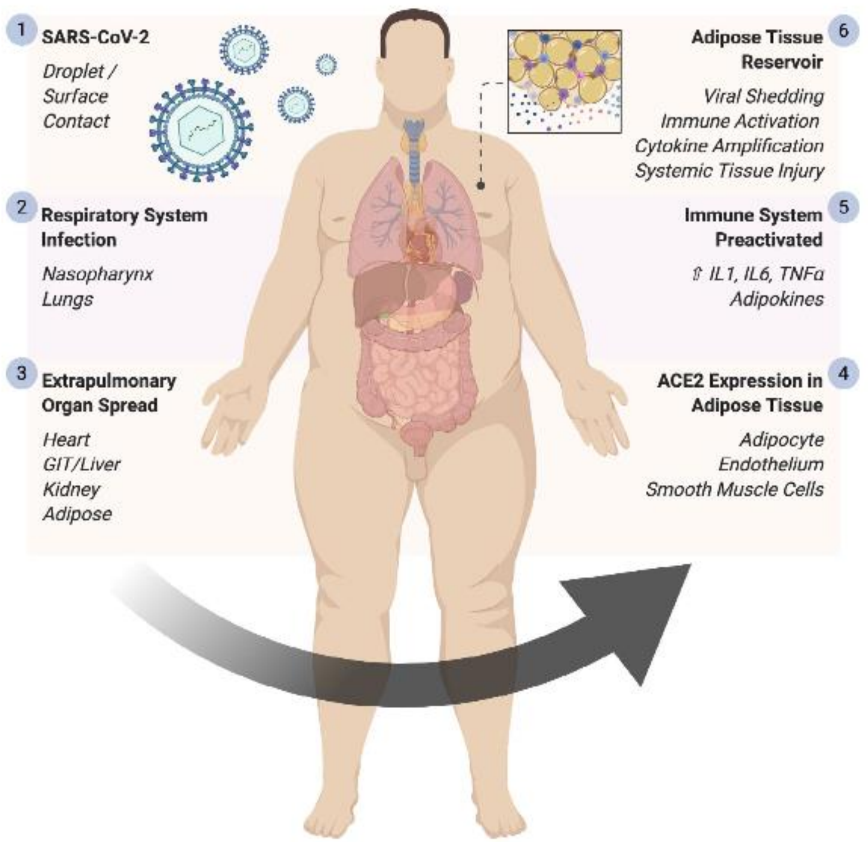


Figure 1 Adipose tissue as a reservoir for SARS-CoV-2 spread, viral shedding, immune activation, and cytokine amplification. Schematic demonstrating the proposed centrality of adipose tissue in the dissemination of SARS-CoV-2 and the ensuing systemic immune activation. Created with Biorender.com. GIT, gastrointestinal tract; IL, interleukin; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; TNF, tumor necrosis factor.

Obesity paradox?

- Obesity enhances most risk factors for CAD, but is protective?
- Collider bias. Researchers sample patients with heart failure admitted to the hospital. The collider is something that makes sicker patients leaner such as cancer or COPD making obesity appear protective.
- Lead time bias. Patients with obesity are diagnosed with CVD earlier so therefore live longer with the diagnosis.

Fitness Matters

- Fitness not measured on many prognosis reports on patients with obesity and CVD which strongly influences prognosis.
- Physical activity and exercise training have been to shown to drastically improve prognosis of patients with CVD independent of weight status. Survival rates across most if not all underlying health conditions are excellent regardless of weight/BMI when fitness is preserved. Likely true in COVID infection too.

Fitness Matters

HeartRhythm

ATRIAL FIBRILLATION | VOLUME 17, ISSUE 10, P1687-1693, OCTOBER 01, 2020

Higher baseline cardiorespiratory fitness is associated with lower arrhythmia recurrence and death after atrial fibrillation ablation

Eoin Donnellan, MD • Oussama M. Wazni, MD, FHRS • Serge Harb, MD • Mohamed Kanj, MD, FHRS • Walid I. Saliba, MD, FHRS • Wael A. Jaber, MD

Published: August 02, 2020 • DOI: https://doi.org/10.1016/j.hrthm.2020.05.013 • Check for updates

Fitness Matters

Methods

We studied 591 patients who underwent EST within 12 months before AF ablation. Patients were categorized into low (<85% predicted), adequate (85%–100% predicted), and high (>100% predicted) CRF groups. Outcomes of interest included arrhythmia recurrence, cessation of antiarrhythmic therapy, repeat hospitalization for arrhythmia, repeat rhythm control procedures, and all-cause mortality.

Results

During mean follow-up of 32 months after ablation, arrhythmia recurrence was observed in 79% of patients in the low CRF group compared to 54% in the adequate CRF group and 27.5% in the high CRF group ($P < .0001$). Similarly, rates of repeat arrhythmia-related hospitalization, repeat rhythm control procedures, and need for ongoing antiarrhythmic therapy were significantly lower in the high CRF group ($P < .0001$). Death occurred in 2.5% of patients in the high CRF group compared to 4% in the adequate CRF group and 11% in the low CRF group ($P < .0001$). In Cox proportional hazards analyses, high CRF was significantly associated with lower arrhythmia recurrence.

Benefits of Regular Exercise

- Decrease risk MI, Stroke, Death.
- Enhances immune defense systems.
- Reduced markers of low grade inflammation.
- More robust immune response to vaccines.
- Enhanced immunosurveillance.
- Reduces risk of illness, cancer.
- Enhanced mental well being.
- Enhanced cardiopulmonary reserve.