

# **Contributing Factors for Obesity in the U.S.**

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## **Contributing Factors for Obesity in the U.S.**

The purpose of this project is to discover how the presence of fast food restaurants and recreational opportunities affect obesity levels of people in the U.S.

A cross sectional analysis was performed using a sample consisting of the 50 U.S. states plus the District of Columbia. Statistical data was collected for the following, per state: Obesity rates, population, land square mileage, state park and recreational area square mileage, and the amount of restaurants for the top two fast food chains in America. A bivariate correlation was then used to determine the relationship between the number of residents per fast food restaurant, square miles per fast food restaurant, recreational square mileage, per state, and the percentage of obesity also present in that state.

Graph A: (Residents per fast food restaurant) showed a weak negative correlation and Graph B: (Square miles per fast food restaurant) showed little to no correlation to obesity percentages for each state. Graph C: (Percentage of recreational square mileage) showed a weak positive correlation to obesity percentages for each state.

In conclusion, the results showed that: As the number of residents per fast food restaurant increase the percentage of obesity for each state will decrease. As the number of square miles per fast food restaurant increase the percentage of obesity for each state will neither decrease nor increase. As the amount of state parks and recreational opportunities per square mile increase, the percentage of obesity for each state will not decrease.

## **Introduction**

### **Purpose:**

The purpose of this project is to discover how the presence of fast food restaurants and recreational opportunities affects the obesity levels of people in the United States. Determining if environmental factors affect weight can help people live better, healthier lives.

### **Question:**

Is there a correlation between the number of residents per fast food restaurant and the percentage of obesity for each of the 50 states?

Is there a correlation between the number of square miles per fast food restaurant and the percentage of obesity for each of the 50 states?

Is there a correlation between the amount of state parks and recreational opportunities per square mile and the percentage of obesity in each of the 50 states?

### **Background:**

In the United States the percentage of obesity has dramatically increased in the past twenty years. For example, one in every three adults is obese, and two in every three adults are overweight (The Health Care Center). There are many factors which contribute to obesity, but why does this matter? Obesity is one of the most preventable diseases which contribute to many different health problems. If obesity rates were to decrease in the future, many health problems would also decrease, saving many lives. The goal of this study is to identify if environmental factors, such as fast food restaurants, are major causes of obesity, and to discover how they affect the lifestyles of Americans today. Also, another goal is to discover if increasing or decreasing certain factors like park and recreational areas will help reverse the obesity trends present today.

Even though the knowledge about the dangers of obesity and efforts to reduce them has increased, the problem still seems to get worse. The CDC's Behavioral Risk Factor and Surveillance System has shown that there has been a dramatic increase in obesity in the United States. In 1985 only 8 states had an obesity percentage of 10 – 14 %, which was then the highest obesity level. It is alarming to compare this to 2008 where there is only one state in the 15% - 19% range, 26 states in the 25% - 29% range, and 6 states in the 30% or greater range

(United States). Some other alarming statistics show that obesity is affecting children and teens at an alarming rate. In the past twenty years, the percentage of children who are overweight has doubled and the percentage of adolescents who are obese has tripled (A.D.A.M.).

Obesity can also be called corpulence. It is defined as an excess amount of fat caused by the consumption of more calories than the body needs. These extra calories are then stored as fat, which is called adipose tissue. Adipose tissue is defined simply as fat or body fat (The New Encyclopedia Britannica). Another definition for obesity is having a Body Mass Index (BMI) of 30 or greater (United States). Adults that are overweight have a BMI greater than 25 but less than 30. Adults that are morbidly obese have a BMI greater than 40 (A.D.A.M.). Body Mass Index is defined as a measure of an adult's weight in relation to his or her height, specifically the adult's weight in kilograms divided by the square of his or her height in meters (United States). Although it does not calculate the exact percentage of body fat, BMI can be used to estimate the healthy body weight of a person based on their height.

There are three main ways from which obesity is a result of: Eating more food than the body can use, drinking too much alcohol, and not getting enough exercise (A.D.A.M.). However there are many other factors which contribute to obesity. These include: age, race, ethnicity, gender, education, economic status, regional differences, disabilities, hereditary traits, and nutrition (The New Mexico Department of Health). Race and Ethnicity are key factors for obesity in the United States. African Americans have a 51 percent higher prevalence of obesity and Hispanics have a 21 percent higher prevalence of obesity compared to whites (United States). This can be because of cultural aspects and also regional differences, since foods for these two cultures are usually higher in fat. Hereditary traits can affect obesity by influencing the weight-related processes in the body such as metabolism or fat storage; however, these effects must also be separated from environmental causes. The most influential factor of obesity is lack of physical activity and nutrition. These two directly affect a person's weight and are most often the main cause to this deadly disease.

Many health problems can arise from obesity. These include diseases of the heart, mind, skeletal structure, blood and veins, kidneys, lungs, and liver. The top ten most dangerous obesity caused diseases are: heart disease, type 2 Diabetes, Dyslipidemia, Polycystic Ovary

Syndrome, Sleep Apnea, Arthritis, Blount's Disease, respiratory problems, liver damage, and stroke (Top 10 Dangerous Diseases Caused by Fast Food Obesity). Other diseases include hypertension, certain cancers including breast and colon, depression, osteoarthritis, cardiovascular disease, heart failure, high blood pressure, high cholesterol, deep vein thrombosis, and pulmonary embolism. Other health problems associated with excess weight include: menstrual disorders, infertility, pregnancy complications, birth defects, poor mobility, low back pain, and joint pain (Top 10 Dangerous Diseases Caused by Fast Food Obesity). Obesity can cause or is a major factor in the occurrence of these diseases and health problems. By reducing the current obesity trends, these health risks will also decrease, making America healthier.

Although obesity is a growing problem in current times, there are ways to increase weight loss. One of the easiest ways to lose weight is by combining a nutritional diet and physical activity as part of an everyday lifestyle. When dieting, the goal is to learn how to make healthy eating choices, control portion sizes, and make new, healthier ways to prepare food. Exercise is also an important part of the weight loss process. At least 30 minutes of exercise a day is needed to stay healthy. Besides aiding in weight loss, exercise also helps control some diseases caused by obesity, including heart disease, high blood pressure, diabetes, osteoporosis, and certain types of cancers (A.D.A.M.). Besides diet and exercise, other methods such as surgery and over the counter medication can be used to aid weight loss. Surgeries including gastric bypass surgery can be used for morbidly obese people who cannot lose weight any other way. Most over the counter medications do not work. Some can even be dangerous. Candidates who took the medication had some weight loss progress, but generally gained all the weight back when they stopped taking it. Unless a permanent lifestyle change is made, medication is not a very effective way to lose weight on most people (A.D.A.M.). Out of all these methods, good nutrition and physical activity is the easiest and healthiest way to lose weight.

On any given day in the United States, about one quarter of the adult population visits a fast food restaurant (Schlosser). Fast food restaurants in America have become a sort of epidemic, and they offer a cheap and quick alternative to the family meal. The fast food market

has increased dramatically since 1970 when American's spent approximately 6 billion dollars, compared to 2000 where they spent 110 billion dollars. Americans now spend more on fast food than on higher education, personal computers, computer software, or new cars (Schlosser). The food served at most fast food restaurants is highly processed food which is prepared at a large scale. Because companies want their food to "taste the best", a large amount of food engineering is done. This "food engineering" loads meals with fats and calories which lessen the nutritional value of the food. The constant consumption of such foods has been shown to be unhealthy and increase weight.

With obesity becoming a major epidemic in the United States today, it is important to know the factors which contribute to it. There have been previous studies to show that environmental factors do influence weight. With fast food restaurants becoming increasingly popular, it is also important for people to know how eating at fast food restaurants not only affects their weight, but their health as well.

### **Hypothesis:**

H<sub>0</sub>1: As the number of residents per fast food restaurant increases the percentage of obesity for each state will not decrease.

H<sub>0</sub>2: As the number of square miles per fast food restaurant increases the percentage of obesity for each state will not decrease.

H<sub>0</sub>3: As the amount of square mileage for state parks and recreational opportunities increases the percentage of obesity for each state will not decrease.

H<sub>1</sub>1: As the number of residents per fast food restaurant increases the percentage of obesity for each state will decrease.

H<sub>1</sub>2: As the number of square miles per fast food restaurant increases the percentage of obesity for each state will decrease.

H<sub>1</sub>3: As the amount of square mileage for state parks and recreational opportunities increases the percentage of obesity for each state will decrease.

## Materials and Methods

### Design:

This study is a cross sectional state wide analysis to examine the correlation between the prevalence of fast food restaurants and obesity percentages. Also it examines the correlation between the frequency of state parks and recreational opportunities and obesity percentages.

### Sample:

The sample consists of the 50 states in the U.S. plus the District of Columbia.

### Measures:

*Obesity Rates:* Obesity rates were taken from the 2008 State Obesity Rates by the Centers from Disease Control and Prevention. The data was collected through the CDC's Behavioral Risk Factor Surveillance System (BRFSS). Each year, state health departments use standard procedures to collect data through a series of monthly telephone interviews with U.S. adults (United States).

*Population, square mileage, and state park and recreational areas:* Demographic Data of population, land size, and state park and recreational areas were obtained through the 2000 U.S. Census. Information regarding the state park and recreational areas was reported by state park directors.

*Fast food Data:* Fast food data was collected by using information from the two largest fast food chains in the United States. Data was organized according to the prevalence per state. Some information regarding the prevalence of restaurants per state are not available to the public, so a listing of cities per state were taken from either government websites or Wikipedia.com, depending on the completeness and accuracy of each list. Research was then conducted to find the number of restaurants per city and added to find the total number per state.

### Variables:

*Independent* – State, % obese, size (square mileage), population, fast food restaurants (A and B), square miles per fast food restaurant, residents per fast food restaurant, physical activity, nutrition, household income, age, race.

*Dependent* – Number of fast food restaurants in each state, number of recreational opportunities in each state.

*Constant* - Country, fast food chains, sources of information.



### **Analysis:**

Data will be analyzed according to the frequency of residents per fast food restaurant, square miles per restaurant, and percentage of total recreational square mileage in each of the 50 U.S. States. After all the data were collected the residents per fast food restaurant were calculated by dividing the total state population by the total number of restaurants for each state. The square miles per restaurant were calculated by dividing the total square mileage by the total number of restaurants in each state. The percentage of recreational square miles per state was found by dividing the total recreational square mileage of each state by the total square mileage. With this information, a bivariate correlation was used to determine the relationship between the percentage of obesity and each of the three trials. Scatter plots were used to display the results and determine the correlations. The correlation coefficient was found to determine the nature of the data, by using the Pearson's product – moment correlation coefficient formula shown below.

Pearson's Product – Moment Correlation Coefficient

$$r = \frac{1}{n-1} \sum_{i=1}^n \left( \frac{X_i - \bar{X}}{s_X} \right) \left( \frac{Y_i - \bar{Y}}{s_Y} \right)$$

$n$  = the number of observations

$X_i$  = the initial  $X$

$Y_i$  = the initial  $Y$

$\bar{X}$  = the average of all  $X$ 's

$\bar{Y}$  = the average of all  $Y$ 's

$s_X$  = the standard deviation of  $X$

$s_Y$  = the standard deviation of  $y$

## Critical Values of the Pearson Product-Moment Correlation Coefficient

$df = n - 2$				
<b>Level of Significance (<math>\alpha</math>) for Two-Tailed Test</b>	<b>.10</b>	<b>.05</b>	<b>.02</b>	<b>.01</b>
1	.988	.997	.9995	.9999
2	.900	.950	.980	.990
3	.805	.878	.934	.959
4	.729	.811	.882	.917
5	.669	.754	.833	.874
6	.622	.707	.789	.834
7	.582	.666	.750	.798
8	.549	.632	.716	.765
9	.521	.602	.685	.735
10	.497	.576	.658	.708
11	.476	.553	.634	.684
12	.458	.532	.612	.661
13	.441	.514	.592	.641
14	.426	.497	.574	.623
15	.412	.482	.558	.606
16	.400	.468	.542	.590

17	.389	.456	.528	.575
18	.378	.444	.516	.561
19	.369	.433	.503	.549
20	.360	.423	.492	.537
21	.352	.413	.482	.526
22	.344	.404	.472	.515
23	.337	.396	.462	.505
24	.330	.388	.453	.496
25	.323	.381	.445	.487
26	.317	.374	.437	.479
27	.311	.367	.430	.471
28	.306	.361	.423	.463
29	.301	.355	.416	.456
30	.296	.349	.409	.449
35	.275	.325	.381	.418
40	.257	.304	.358	.393
45	.243	.288	.338	.372
50	.231	.273	.322	.354
60	.211	.250	.295	.325
70	.195	.232	.274	.303
80	.183	.217	.256	.283
90	.173	.205	.242	.267
100	.164	.195	.230	.254

## Data Table

States	Population	Square Miles	Restaurant A	Restaurant B	Total A + B	Rec. Square Miles	% of Obesity
Alabama	4,661,900	50,744.00	233	129	362	50	31.40%
Alaska	686,293	571,951.26	31	8	39	3,291	26.10%
Arizona	6,500,180	113,634.57	243	160	403	59	24.80%
Arkansas	2,855,390	52,068.17	158	69	227	51	28.70%
California	36,756,666	155,959.34	1,170	667	1837	1,376	23.70%
Colorado	4,939,456	103,717.53	198	129	327	346	18.50%
Connecticut	3,501,252	4,844.80	153	67	220	180	21.00%
Delaware	873,092	1,953.56	35	19	54	20	27.00%
District of Columbia	591,833	61.40	34	7	41	N/A	21.80%
Florida	18,328,340	53,926.82	760	547	1307	513	24.40%
Georgia	9,685,744	57,906.14	419	258	677	73	27.30%
Hawaii	1,288,198	6,422.62	73	31	104	25	22.60%
Idaho	1,523,816	82,747.21	58	31	89	43	24.50%
Illinois	12,901,563	55,583.58	674	304	978	411	26.40%
Indiana	6,376,792	35,866.90	349	212	561	178	26.30%
Iowa	3,002,555	55,869.36	142	78	220	63	26.00%
Kansas	2,802,134	81,814.88	163	60	223	52	27.40%
Kentucky	4,269,245	39,728.18	225	93	318	43	29.80%
Louisiana	4,410,796	43,561.85	154	172	326	36	28.30%
Maine	1,316,456	30,861.55	60	35	95	95	25.20%
Maryland	5,633,597	9,773.82	92	121	213	295	26.00%
Massachusetts	6,497,967	7,840.02	249	132	381	287	20.90%
Michigan	10,003,422	56,803.82	390	335	725	265	28.90%
Minnesota	5,220,393	79,610.08	214	132	346	245	24.30%
Mississippi	2,938,618	46,906.96	135	67	202	24	32.80%
Missouri	5,911,605	68,885.93	278	120	398	137	28.50%
Montana	967,440	145,552.43	49	17	66	54	23.90%
Nebraska	1,783,432	76,872.41	80	67	147	133	26.60%
Nevada	2,600,167	109,825.99	126	69	195	133	25.00%
New Hampshire	1,315,809	8,968.10	51	35	86	74	24.00%
New Jersey	8,682,661	7,417.34	157	210	367	343	22.90%
New Mexico	1,984,356	121,355.53	91	44	135	91	25.20%
New York	19,490,297	47,213.79	525	350	875	1,016	24.40%
North Carolina	9,222,414	48,710.88	411	275	686	158	29.00%
North Dakota	641,481	68,975.93	23	19	42	20	27.10%
Ohio	11,485,910	40,948.38	540	367	907	205	28.70%

Oklahoma	3,642,361	68,667.06	199	55	254	72	30.30%
Oregon	3,790,060	95,996.79	162	91	253	94	24.20%
Pennsylvania	12,448,279	44,816.61	449	260	709	283	27.70%
Rhode Island	1,050,788	1,044.93	60	30	90	9	21.50%
South Carolina	4,479,800	30,109.47	202	162	364	82	30.10%
South Dakota	804,194	75,884.64	28	27	55	96	27.60%
Tennessee	6,214,888	41,217.12	293	156	449	286	30.60%
Texas	24,326,974	261,797.12	1057	453	1510	628	28.30%
Utah	2,736,424	82,143.65	104	67	171	114	22.50%
Vermont	621,270	9,249.56	18	9	27	84	22.70%
Virginia	7,769,089	39,594.07	361	213	574	75	25.00%
Washington	6,549,224	66,544.06	263	110	373	262	25.40%
West Virginia	1,814,468	24,077.73	92	54	146	196	31.20%
Wisconsin	5,627,967	54,310.10	291	123	414	129	25.40%
Wyoming	532,668	97,100.40	26	19	45	121	24.60%

## Population Density

States	Population	Square Miles	Population Density
Alabama	4,661,900	50,744.00	91
Alaska	686,293	571,951.26	1
Arizona	6,500,180	113,634.57	57
Arkansas	2,855,390	52,068.17	54
California	36,756,666	155,959.34	235
Colorado	4,939,456	103,717.53	47
Connecticut	3,501,252	4,844.80	722
Delaware	873,092	1,953.56	446
District of Columbia	591,833	61.40	9638
Florida	18,328,340	53,926.82	339
Georgia	9,685,744	57,906.14	167
Hawaii	1,288,198	6,422.62	200
Idaho	1,523,816	82,747.21	18
Illinois	12,901,563	55,583.58	232
Indiana	6,376,792	35,866.90	177
Iowa	3,002,555	55,869.36	53
Kansas	2,802,134	81,814.88	34
Kentucky	4,269,245	39,728.18	107
Louisiana	4,410,796	43,561.85	101
Maine	1,316,456	30,861.55	42
Maryland	5,633,597	9,773.82	576
Massachusetts	6,497,967	7,840.02	828
Michigan	10,003,422	56,803.82	176
Minnesota	5,220,393	79,610.08	65
Mississippi	2,938,618	46,906.96	62
Missouri	5,911,605	68,885.93	85
Montana	967,440	145,552.43	6
Nebraska	1,783,432	76,872.41	23
Nevada	2,600,167	109,825.99	23
New Hampshire	1,315,809	8,968.10	146
New Jersey	8,682,661	7,417.34	1170
New Mexico	1,984,356	121,355.53	16
New York	19,490,297	47,213.79	412
North Carolina	9,222,414	48,710.88	189
North Dakota	641,481	68,975.93	9
Ohio	11,485,910	40,948.38	280
Oklahoma	3,642,361	68,667.06	53
Oregon	3,790,060	95,996.79	39

Pennsylvania	12,448,279	44,816.61	277
Rhode Island	1,050,788	1,044.93	1005
South Carolina	4,479,800	30,109.47	148
South Dakota	804,194	75,884.64	10
Tennessee	6,214,888	41,217.12	150
Texas	24,326,974	261,797.12	92
Utah	2,736,424	82,143.65	33
Vermont	621,270	9,249.56	67
Virginia	7,769,089	39,594.07	196
Washington	6,549,224	66,544.06	98
West Virginia	1,814,468	24,077.73	75
Wisconsin	5,627,967	54,310.10	103
Wyoming	532,668	97,100.40	5

## Data Table for Graph A

States	Population	Total A + B	residents per fast food restaurant	% of Obesity
Alabama	4661900	362	12878	0.314
Alaska	686293	39	*	*
Arizona	6500180	403	16129	0.248
Arkansas	2855390	227	12578	0.287
California	36756666	1837	20009	0.237
Colorado	4939456	327	15105	0.185
Connecticut	3501252	220	15914	0.21
Delaware	873092	54	16168	0.27
District of Columbia	591833	41	14434	0.218
Florida	18328340	1307	14023	0.244
Georgia	9685744	677	14306	0.273
Hawaii	1288198	104	12386	0.226
Idaho	1523816	89	17121	0.245
Illinois	12901563	978	13191	0.264
Indiana	6376792	561	11366	0.263
Iowa	3002555	220	13647	0.26
Kansas	2802134	223	12565	0.274
Kentucky	4269245	318	13425	0.298
Louisiana	4410796	326	13530	0.283
Maine	1316456	95	13857	0.252
Maryland	5633597	213	26448	0.26
Massachusetts	6497967	381	17055	0.209
Michigan	10003422	725	13797	0.289
Minnesota	5220393	346	15087	0.243
Mississippi	2938618	202	14547	0.328
Missouri	5911605	398	14853	0.285
Montana	967440	66	14658	0.239
Nebraska	1783432	147	12132	0.266
Nevada	2600167	195	13334	0.25
New Hampshire	1315809	86	15300	0.24
New Jersey	8682661	367	23658	0.229
New Mexico	1984356	135	14698	0.252
New York	19490297	875	22274	0.244
North Carolina	9222414	686	13443	0.29
North Dakota	641481	42	15273	0.271
Ohio	11485910	907	12663	0.287
Oklahoma	3642361	254	14340	0.303



Oregon	3790060	253	14980	0.242
Pennsylvania	12448279	709	17557	0.277
Rhode Island	1050788	90	11675	0.215
South Carolina	4479800	364	12307	0.301
South Dakota	804194	55	14621	0.276
Tennessee	6214888	449	13841	0.306
Texas	24326974	1510	16110	0.283
Utah	2736424	171	16002	0.225
Vermont	621270	27	23010	0.227
Virginia	7769089	574	13534	0.25
Washington	6549224	373	17558	0.254
West Virginia	1814468	146	12427	0.312
Wisconsin	5627967	414	13594	0.254
Wyoming	532668	45	11837	0.246

\* Alaska was removed because of its large size and low population density, which made it an outlier.

## Data Table for Graph B

States	Square Miles	Total A + B	Square miles per restaurant	% of Obesity
Alabama	50,744.00	362	140	31.40%
Alaska	571,951.26	39	*	*
Arizona	113,634.57	403	281	24.80%
Arkansas	52,068.17	227	229	28.70%
California	155,959.34	1837	84	23.70%
Colorado	103,717.53	327	317	18.50%
Connecticut	4,844.80	220	22	21.00%
Delaware	1,953.56	54	36	27.00%
District of Columbia	61.40	41	1	21.80%
Florida	53,926.82	1307	41	24.40%
Georgia	57,906.14	677	85	27.30%
Hawaii	6,422.62	104	61	22.60%
Idaho	82,747.21	89	929	24.50%
Illinois	55,583.58	978	56	26.40%
Indiana	35,866.90	561	63	26.30%
Iowa	55,869.36	220	253	26.00%
Kansas	81,814.88	223	366	27.40%
Kentucky	39,728.18	318	124	29.80%
Louisiana	43,561.85	326	133	28.30%
Maine	30,861.55	95	324	25.20%
Maryland	9,773.82	213	45	26.00%
Massachusetts	7,840.02	381	20	20.90%
Michigan	56,803.82	725	78	28.90%
Minnesota	79,610.08	346	230	24.30%
Mississippi	46,906.96	202	232	32.80%
Missouri	68,885.93	398	173	28.50%
Montana	145,552.43	66	2205	23.90%
Nebraska	76,872.41	147	522	26.60%
Nevada	109,825.99	195	563	25.00%
New Hampshire	8,968.10	86	104	24.00%
New Jersey	7,417.34	367	20	22.90%
New Mexico	121,355.53	135	898	25.20%
New York	47,213.79	875	53	24.40%
North Carolina	48,710.88	686	71	29.00%
North Dakota	68,975.93	42	1642	27.10%
Ohio	40,948.38	907	45	28.70%
Oklahoma	68,667.06	254	270	30.30%
Oregon	95,996.79	253	379	24.20%

Pennsylvania	44,816.61	709	63	27.70%
Rhode Island	1,044.93	90	11	21.50%
South Carolina	30,109.47	364	82	30.10%
South Dakota	75,884.64	55	1379	27.60%
Tennessee	41,217.12	449	91	30.60%
Texas	261,797.12	1510	173	28.30%
Utah	82,143.65	171	480	22.50%
Vermont	9,249.56	27	342	22.70%
Virginia	39,594.07	574	68	25.00%
Washington	66,544.06	373	178	25.40%
West Virginia	24,077.73	146	164	31.20%
Wisconsin	54,310.10	414	131	25.40%
Wyoming	97,100.40	45	2157	24.60%

\* Alaska was removed because of its large size and low population density, which made it an outlier.

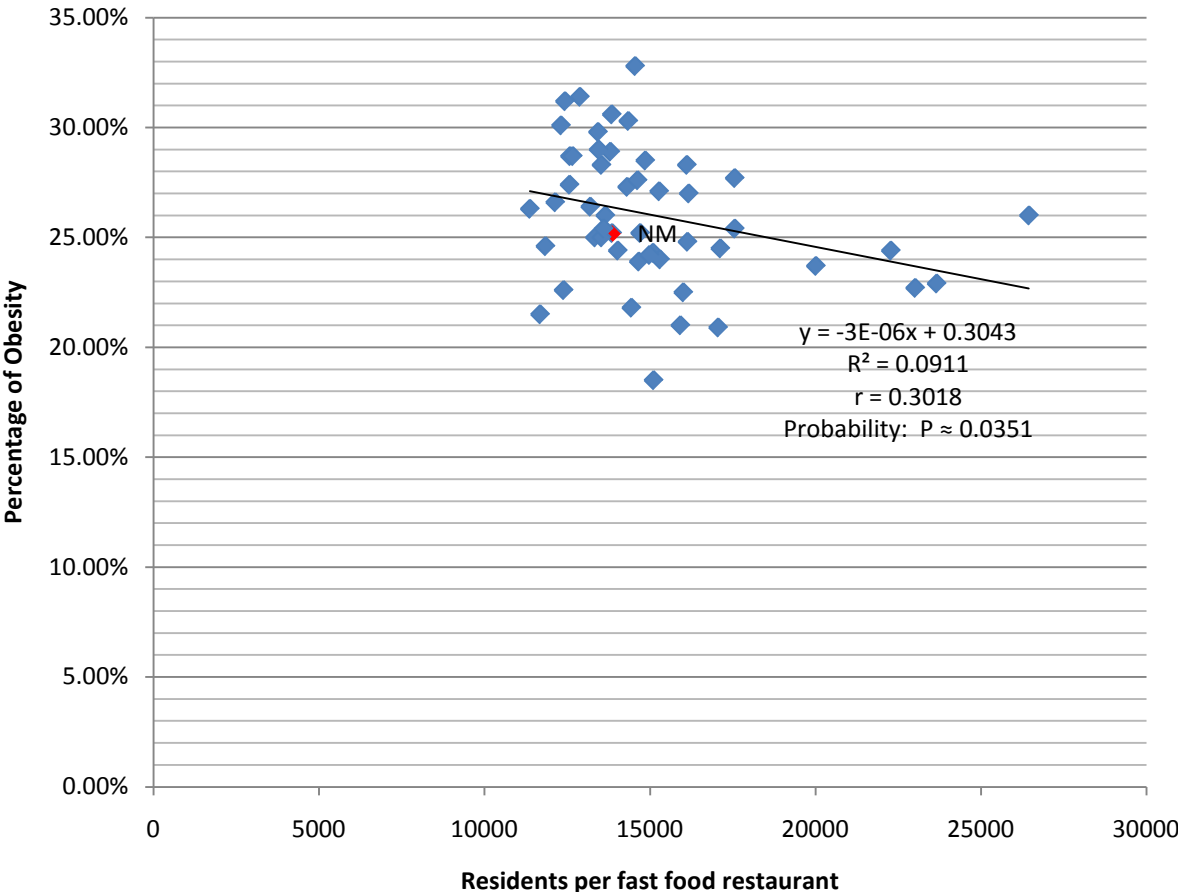
## Data Table for Graph C

States	Rec. Square Miles	Square Miles	Quotient	Percentage	% of Obesity
Alabama	50	50744	0.000985	0.000985	0.314
Alaska	3291	571951.26	0.005753	*	*
Arizona	59	113634.57	0.000519	0.000519	0.248
Arkansas	51	52068.17	0.000979	0.000979	0.287
California	1376	155959.34	0.008822	0.008822	0.237
Colorado	346	103717.53	0.003335	0.003335	0.185
Connecticut	180	4844.8	0.037153	0.037153	0.21
Delaware	20	1953.56	0.010237	0.010237	0.27
District of Columbia	N/A	61.4	N/A	N/A	0.218
Florida	513	53926.82	0.009512	0.009512	0.244
Georgia	73	57906.14	0.001261	0.001261	0.273
Hawaii	25	6422.62	0.003892	0.003892	0.226
Idaho	43	82747.21	0.000519	0.000519	0.245
Illinois	411	55583.58	0.007394	0.007394	0.264
Indiana	178	35866.9	0.004962	0.004962	0.263
Iowa	63	55869.36	0.001127	0.001127	0.26
Kansas	52	81814.88	0.000635	0.000635	0.274
Kentucky	43	39728.18	0.001082	0.001082	0.298
Louisiana	36	43561.85	0.000826	0.000826	0.283
Maine	95	30861.55	0.003078	0.003078	0.252
Maryland	295	9773.82	0.030182	0.030182	0.26
Massachusetts	287	7840.02	0.036607	0.036607	0.209
Michigan	265	56803.82	0.004665	0.004665	0.289
Minnesota	245	79610.08	0.003077	0.003077	0.243
Mississippi	24	46906.96	0.000511	0.0511	0.328
Missouri	137	68885.93	0.001988	0.001988	0.285
Montana	54	145552.43	0.000371	0.0371	0.239
Nebraska	133	76872.41	0.00173	0.00173	0.266
Nevada	133	109825.99	0.001211	0.001211	0.25
New Hampshire	74	8968.1	0.008251	0.008251	0.24
New Jersey	343	7417.34	0.046242	0.046242	0.229
New Mexico	91	121355.53	0.000749	0.000749	0.252
New York	1016	47213.79	0.021519	0.021519	0.244
North Carolina	158	48710.88	0.003243	0.003243	0.29
North Dakota	20	68975.93	0.000289	0.000289	0.271
Ohio	205	40948.38	0.005006	0.005006	0.287
Oklahoma	72	68667.06	0.001048	0.001048	0.303
Oregon	94	95996.79	0.000979	0.000979	0.242

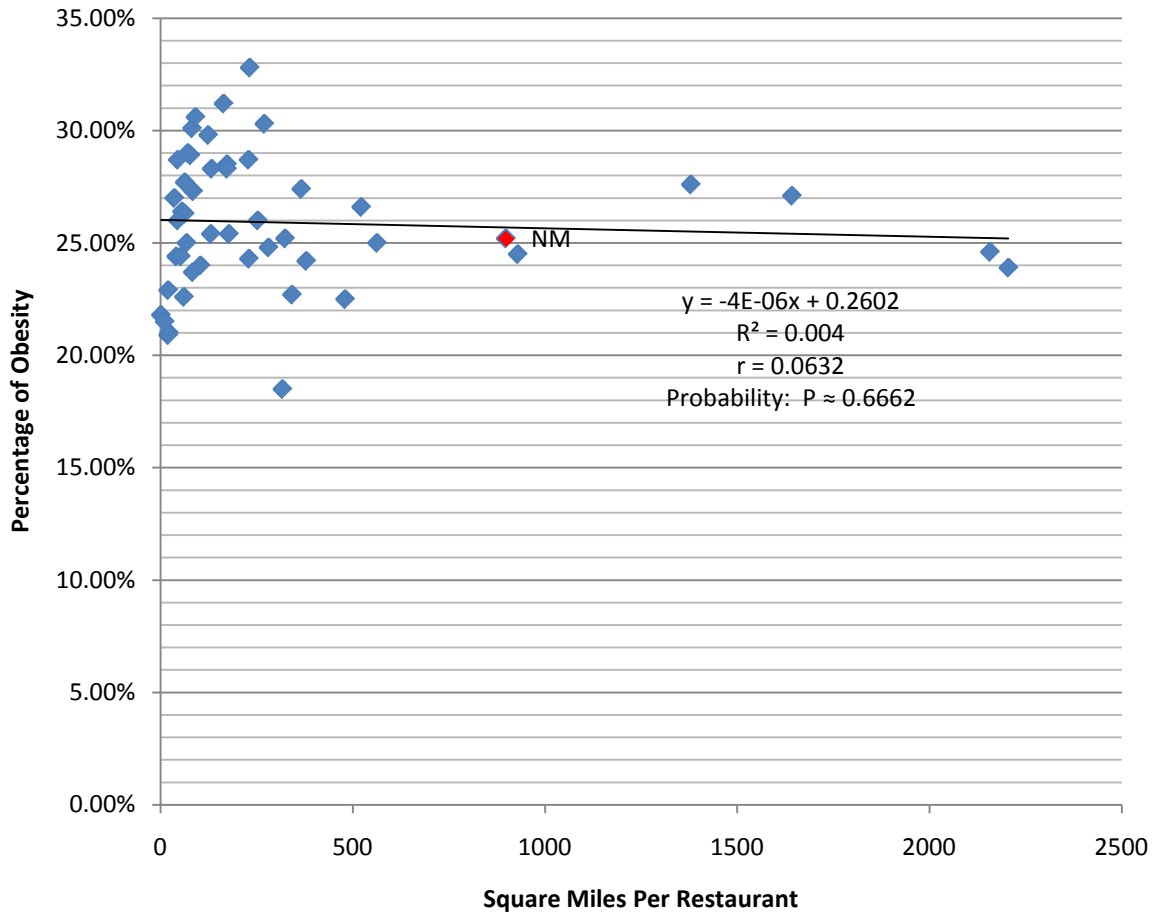
Pennsylvania	283	44816.61	0.006314	0.006314	0.277
Rhode Island	9	1044.93	0.008613	0.008613	0.215
South Carolina	82	30109.47	0.002723	0.002723	0.301
South Dakota	96	75884.64	0.001265	0.001265	0.276
Tennessee	286	41217.12	0.006938	0.006938	0.306
Texas	628	261797.12	0.002398	0.002398	0.283
Utah	114	82143.65	0.001387	0.001387	0.225
Vermont	84	9249.56	0.009081	0.009081	0.227
Virginia	75	39594.07	0.001894	0.001894	0.25
Washington	262	66544.06	0.003937	0.003937	0.254
West Virginia	196	24077.73	0.00814	0.00814	0.312
Wisconsin	129	54310.1	0.002375	0.002375	0.254
Wyoming	121	97100.4	0.001246	0.001246	0.246

\* Alaska was removed because of its large size and low population density, which made it an outlier.

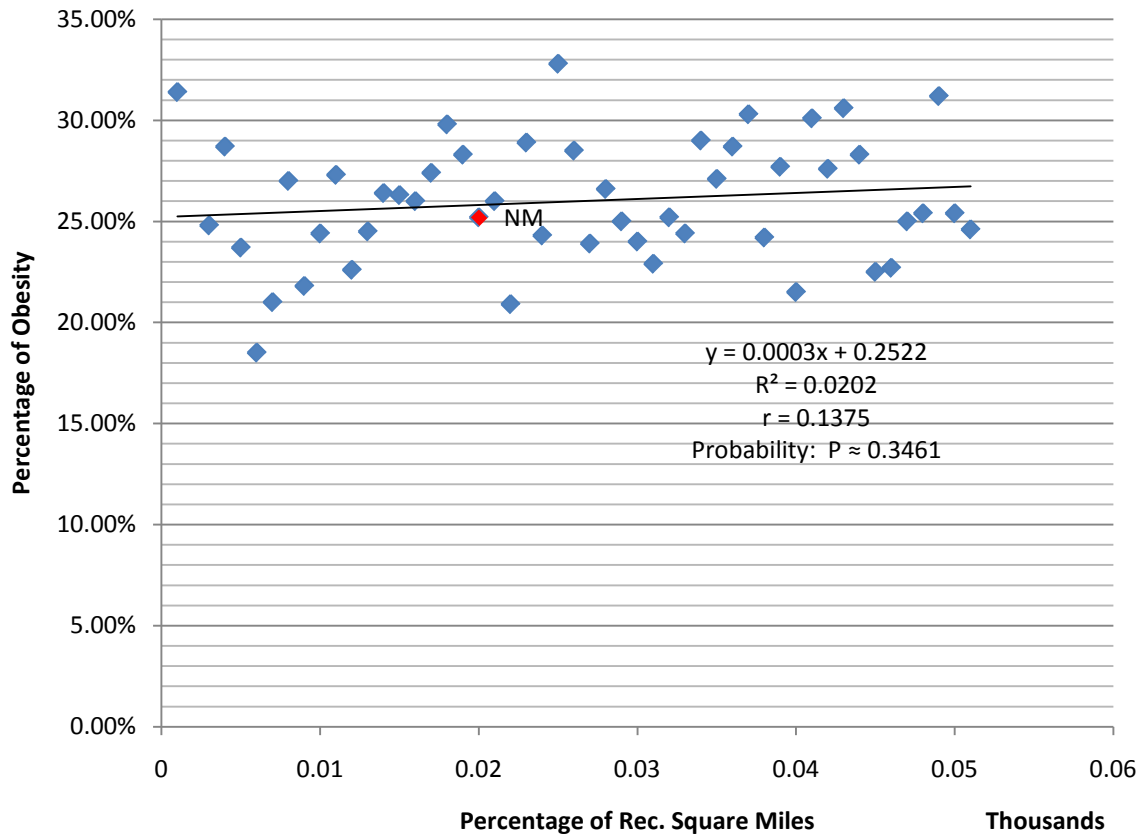
### Graph A: Residents per Fast Food Restaurant



### Graph B: Square Miles per Restaurant



### Graph C: Percentage of Recreational Square Miles





## State Rankings

States	% of Obesity	Square miles per restaurant	residents per fast food restaurant
Colorado	18.50%	317 (36)	15105 (33)
Massachusetts	20.90%	20 (3)	17055 (41)
Connecticut	21.00%	22 (5)	15914 (36)
Rhode Island	21.50%	11 (2)	11675 (2)
District of Columbia	21.80%	1 (1)	14434 (25)
Utah	22.50%	480 (41)	16002 (37)
Hawaii	22.60%	61 (12)	12386 (6)
Vermont	22.70%	342 (38)	23010 (47)
New Jersey	22.90%	20 (4)	23658 (48)
California	23.70%	84 (19)	20009 (45)
Montana	23.90%	2205 (49)	14658 (28)
New Hampshire	24.00%	104 (22)	15300 (35)
Oregon	24.20%	379 (40)	14980 (31)
Minnesota	24.30%	230 (32)	15087 (32)
Florida	24.40%	41 (7)	14023 (22)
New York	24.40%	53 (10)	22274 (46)
Idaho	24.50%	929 (45)	17121 (42)
Wyoming	24.60%	2157 (48)	11837 (3)
Arizona	24.80%	281 (35)	16129 (39)
Virginia	25.00%	68 (15)	13534 (16)
Nevada	25.00%	563 (43)	13334 (12)
Maine	25.20%	324 (37)	13857 (21)
New Mexico	25.20%	898 (44)	14698 (29)
Wisconsin	25.40%	131 (24)	13594 (17)
Washington	25.40%	178 (30)	17558 (44)
Maryland	26.00%	45 (9)	26448 (49)
Iowa	26.00%	253 (34)	13647 (18)
Alaska	26.10%	*	*
Indiana	26.30%	63 (13)	11366 (1)
Illinois	26.40%	56 (11)	13191 (11)
Nebraska	26.60%	522 (42)	12132 (4)
Delaware	27.00%	36 (6)	16168 (40)
North Dakota	27.10%	1642 (47)	15273 (34)
Georgia	27.30%	85 (20)	14306 (23)
Kansas	27.40%	366 (39)	12565 (8)
South Dakota	27.60%	1379 (46)	14621 (27)

Pennsylvania	27.70%	63 (14)	17557 (43)
Louisiana	28.30%	133 (25)	13530 (15)
Texas	28.30%	173 (29)	16110 (38)
Missouri	28.50%	173 (28)	14853 (30)
Ohio	28.70%	45 (8)	12663 (9)
Arkansas	28.70%	229 (31)	12578 (9)
Michigan	28.90%	78 (17)	13797 (19)
North Carolina	29.00%	71 (16)	13443 (14)
Kentucky	29.80%	124 (23)	13425 (13)
South Carolina	30.10%	82 (18)	12307 (5)
Oklahoma	30.30%	270 (35)	14340 (24)
Tennessee	30.60%	91 (21)	13841 (20)
West Virginia	31.20%	164 (27)	12427 (7)
Alabama	31.40%	140 (26)	12878 (10)
Mississippi	32.80%	232 (33)	14547 (26)

\* Alaska was removed because of its large size and low population density, which made it an outlier.

## Results

The results are as follows: Using population density for all states, it was determined that Alaska was an outlier because of its large size and low population density. In graph A, Residents per Fast Food Restaurant,  $r = 0.3018$  in which  $0 < r \leq 0.5$ . This shows the graph is a weak negative correlation. However, the graph also shows that as the residents per fast food restaurant increase, the percentage of obesity decreases. The probability of the results occurring by chance is 3.51%. Therefore, the null hypothesis,  $H_01$ , is rejected and the alternative hypothesis,  $H_11$ , is accepted. In graph B, Square Miles per Restaurant,  $r = 0.0632$  in which  $0 < r \leq 0.5$ . This shows the graph is also a weak negative correlation. However, this indicates that there is little to no correlation. The graph also shows that as the number of square miles per restaurant increases, the percentage of obesity decreases. The probability of the results occurring by chance is 66.62%. Therefore, null hypothesis  $H_02$  and alternative hypothesis  $H_12$  are neither rejected nor accepted. In graph C, Percentage of Recreational Square Miles,  $r = 0.1375$  in which  $0 < r \leq 0.5$ . This shows the graph is a weak positive. The probability of the results occurring by chance is 34.61%. Therefore, alternative hypothesis  $H_13$  is rejected and null hypothesis  $H_03$  is accepted.

## Discussion

The alternative hypotheses of the experiment are as follows: As the number of residents per fast food restaurant increased the percentage of obesity for each state would decrease. As the number of square miles per fast food restaurant increased, the percentage of obesity for each state would decrease. As the amount of state parks and recreational opportunities per square mile increased the percentage of obesity for each state would decrease. The results of the data show that null hypothesis  $H_01$  was rejected and alternative hypothesis  $H_11$  was accepted. Both null hypothesis  $H_02$  and alternative hypothesis  $H_12$  were neither accepted nor rejected. Alternative hypothesis  $H_13$  was rejected and null hypothesis  $H_03$  was accepted.

The results of this experiment show that the prevalence of fast food restaurants does influence the obesity rate of each state. The amount of residents per fast food restaurant affected obesity rates more than the amount of square miles per restaurant. The results show that the amount of recreational square miles does not necessarily have an impact on the obesity rates of each state. This could be because there is a correlation between the amount of fast food restaurants in a state and the percentages of recreational square miles. A state could have a large amount of recreational square miles but even more fast food restaurants compared to other states. Another possibility is that other environmental factors such as things like bike paths, gyms, local parks, community centers, etc. have more of an influence on reducing people's weight.

Obesity has largely increased in the past 20 years. This can be due to many factors such as: age, race, ethnicity, gender, education, economic status, regional differences, disabilities, hereditary traits, lack of physical activity, and nutrition. Nevertheless, the results of this study show that a person's nutritional environment affects the way they live and the way they eat. This further affects an individual's weight and health. This growing trend might be reversed in the future if a population's nutritional environment changes, concentrating more on the nutritional value of the food instead of the convenience which fast food restaurants bring.

In the process of collecting the data, set-backs occurred which may have caused the data to not be 100% accurate. This is because the research required for collecting the amount of fast food restaurants in each city had to be done by hand according to the individual fast food restaurant websites. Because complete city listings for each state could not always be found to be 100% accurate, some restaurants may not have been accounted for. However, this would not have greatly affected the outcome of the experimental results. Also statistics gathered for the percent of recreational square miles in each state came from state park directors. This data could have only included the square mileage of state parks. If this is true, then states which have low amounts of state park square mileage would not have accurate results.

In conclusion, the results showed that: As the number of residents per fast food restaurant increase the percentage of obesity for each state will decrease. As the number of

square miles per fast food restaurant increase the percentage of obesity for each state will neither decrease nor increase. As the amount of state parks and recreational opportunities per square mile increase, the percentage of obesity for each state will not decrease. Therefore, null hypothesis  $H_01$  was rejected and alternative hypothesis  $H_11$  was accepted. Null hypothesis  $H_02$  and alternative hypothesis  $H_12$  were neither rejected nor accepted. Null hypothesis  $H_03$  was accepted and alternative hypothesis  $H_13$  was rejected.

## **Conclusions**

As the number of residents per fast food restaurant increases the percentage of obesity for each state did decrease.

As the number of square miles per fast food restaurant increases the percentage of obesity for each state will neither decrease nor increase.

As the amount of square mileage for state parks and recreational opportunities increases the percentage of obesity for each state did not decrease.

## **Acknowledgements**

We would like to thank everyone who helped us in our project. We are very grateful for their support and involvement in this project.

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<<http://www.census.gov/popest/states/NST-ann-est.html>>.

# **U.S. Obesity Trends**

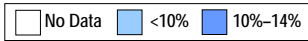
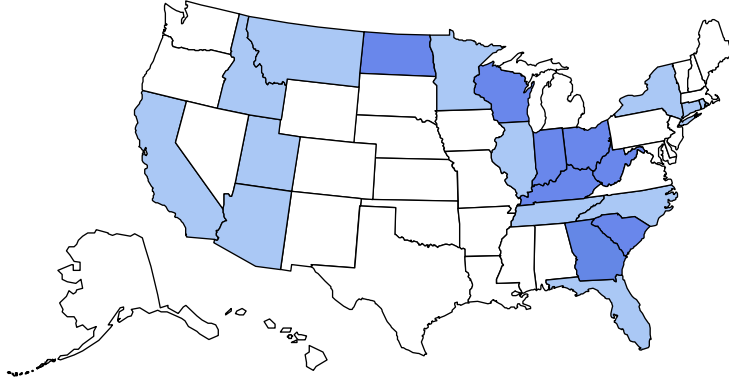
## **1985-2008**

**Source: CDC Behavioral Risk Factor Surveillance System**



## Obesity Trends\* Among U.S. Adults BRFSS, 1985

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)

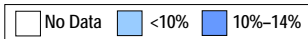
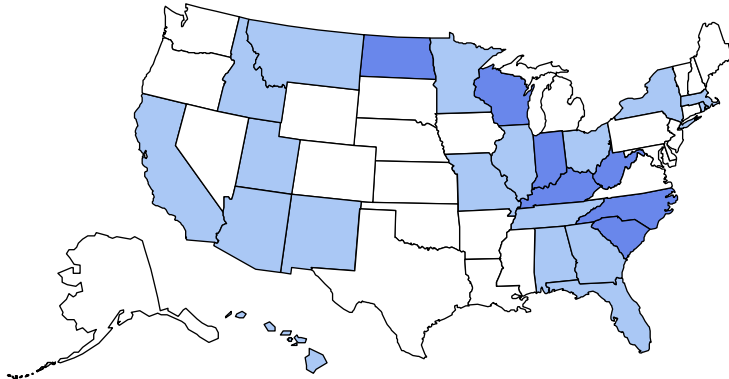


Source: CDC Behavioral Risk Factor Surveillance System.



## Obesity Trends\* Among U.S. Adults BRFSS, 1986

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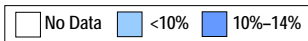
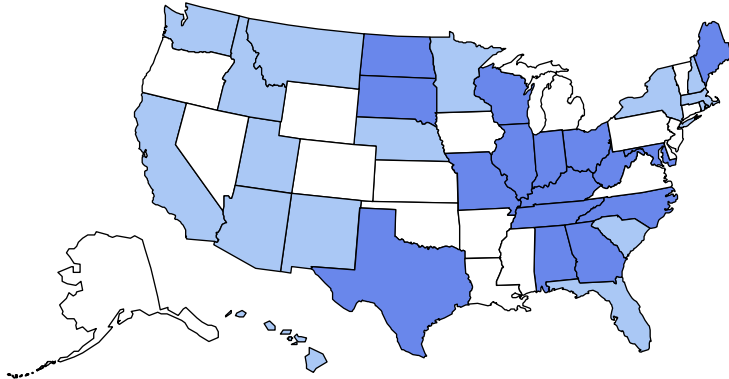


Source: CDC Behavioral Risk Factor Surveillance System.



## Obesity Trends\* Among U.S. Adults BRFSS, 1987

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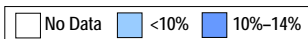
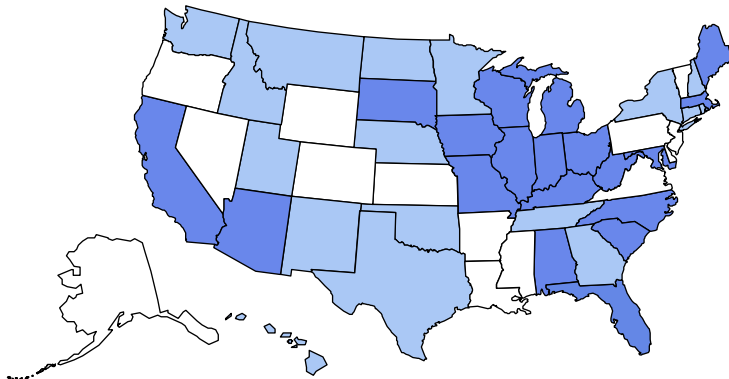


Source: CDC Behavioral Risk Factor Surveillance System.



## Obesity Trends\* Among U.S. Adults BRFSS, 1988

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)

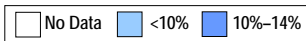
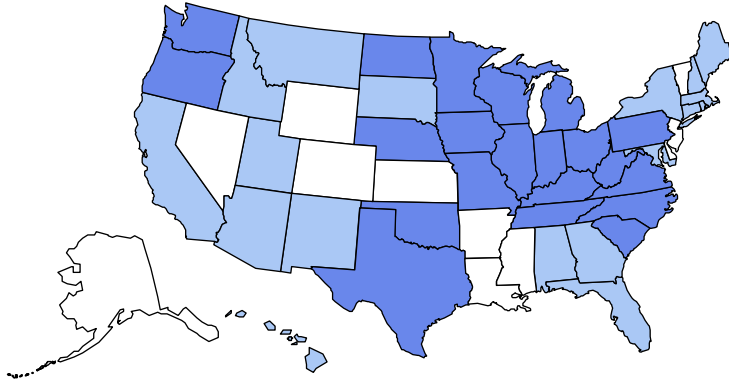


Source: CDC Behavioral Risk Factor Surveillance System.



## Obesity Trends\* Among U.S. Adults BRFSS, 1989

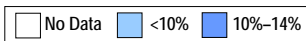
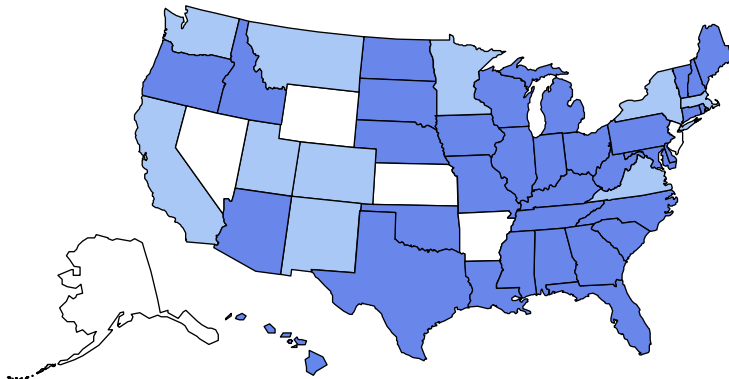
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Source: CDC Behavioral Risk Factor Surveillance System.

## Obesity Trends\* Among U.S. Adults BRFSS, 1990

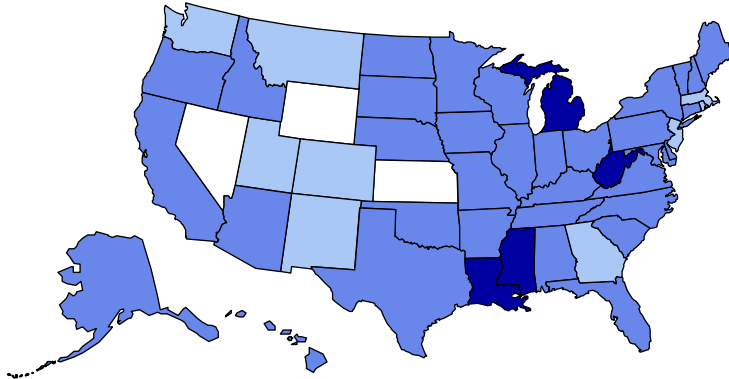
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Source: CDC Behavioral Risk Factor Surveillance System.

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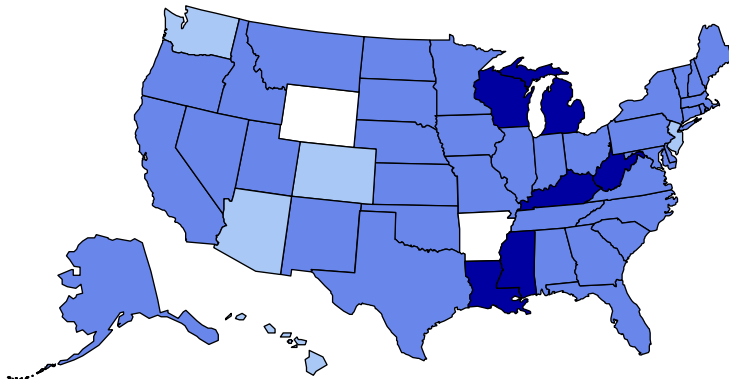
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

## Obesity Trends\* Among U.S. Adults BRFSS, 1992

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)

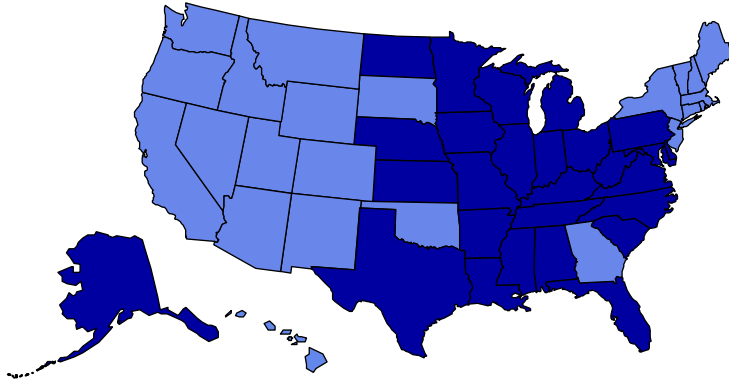


Source: CDC Behavioral Risk Factor Surveillance System.



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

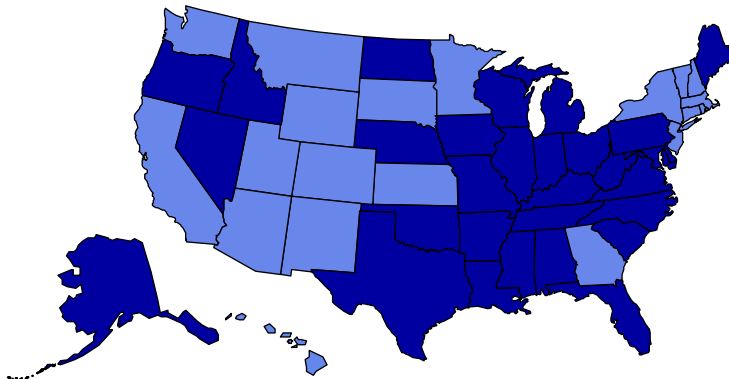
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

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

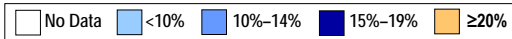
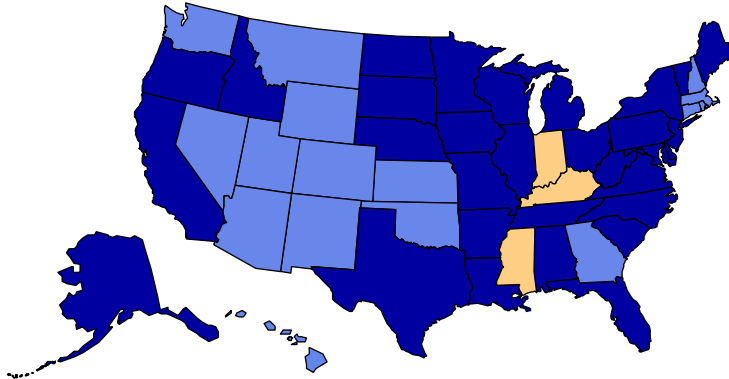
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Source: CDC Behavioral Risk Factor Surveillance System.

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

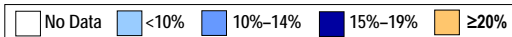
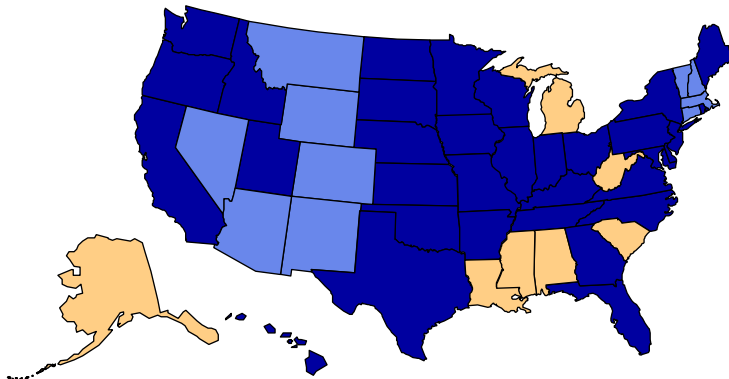
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Source: CDC Behavioral Risk Factor Surveillance System.

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

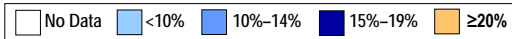
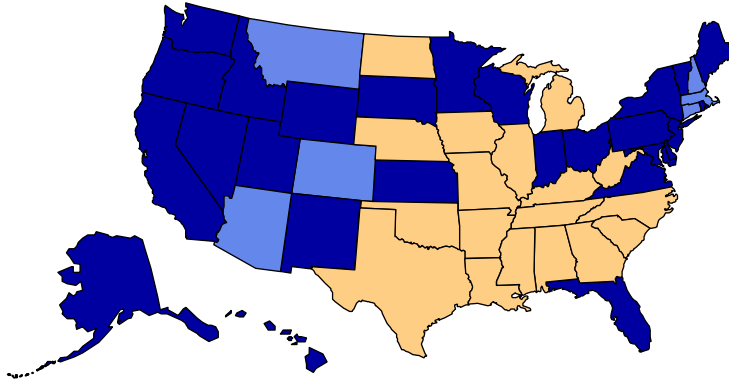
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

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

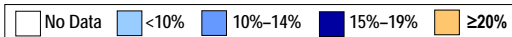
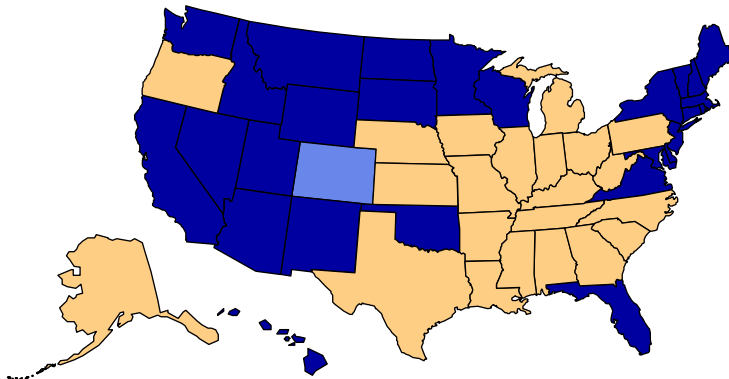
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

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

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)

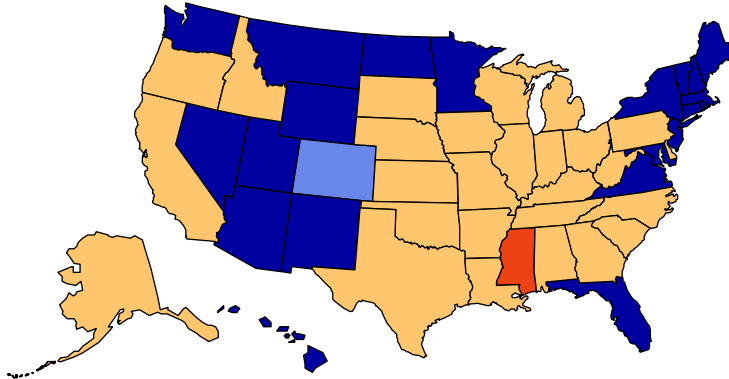


Source: CDC Behavioral Risk Factor Surveillance System.



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

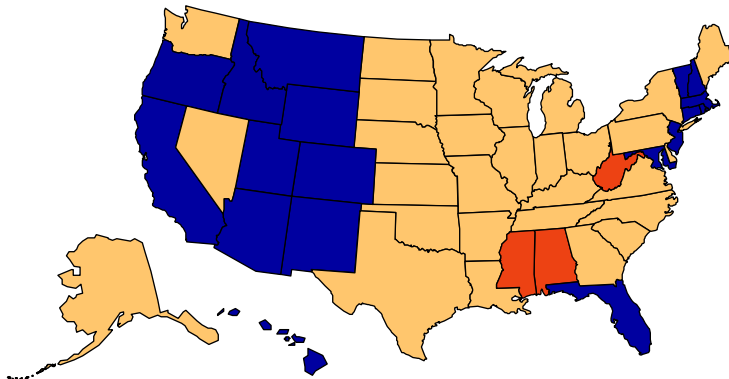
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

## Obesity Trends\* Among U.S. Adults BRFSS, 2002

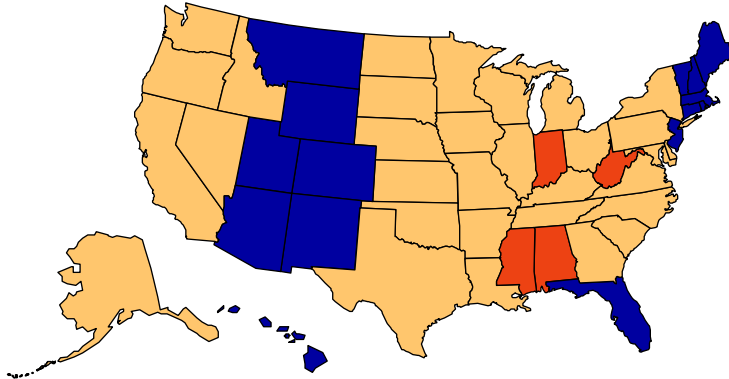
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

## Obesity Trends\* Among U.S. Adults BRFSS, 2003

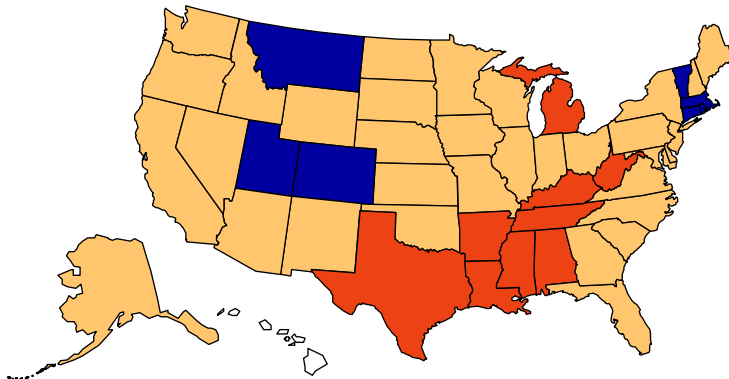
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: CDC Behavioral Risk Factor Surveillance System.

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

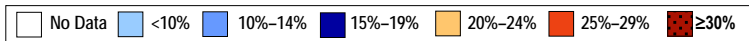
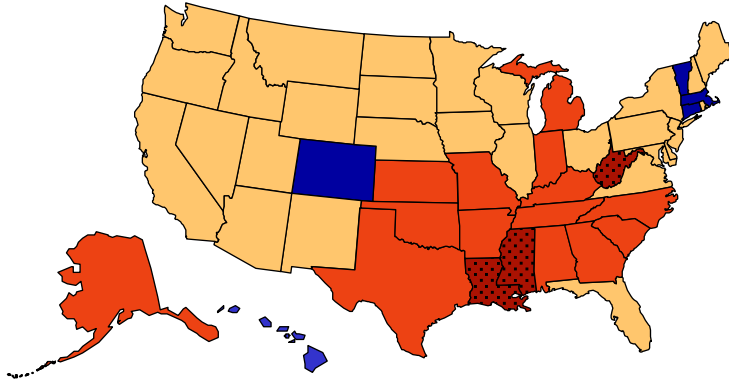
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.

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

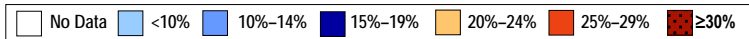
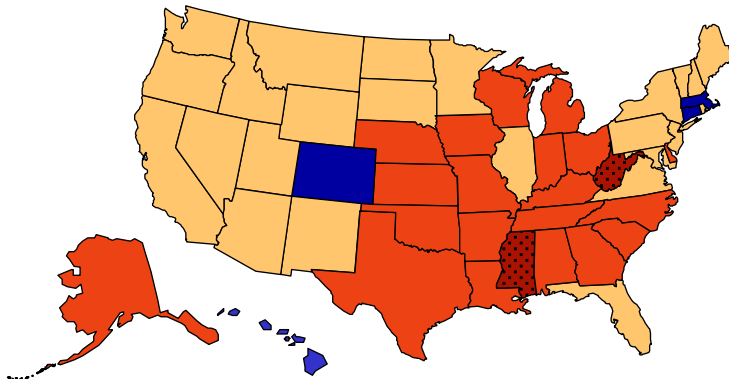
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.

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

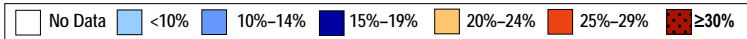
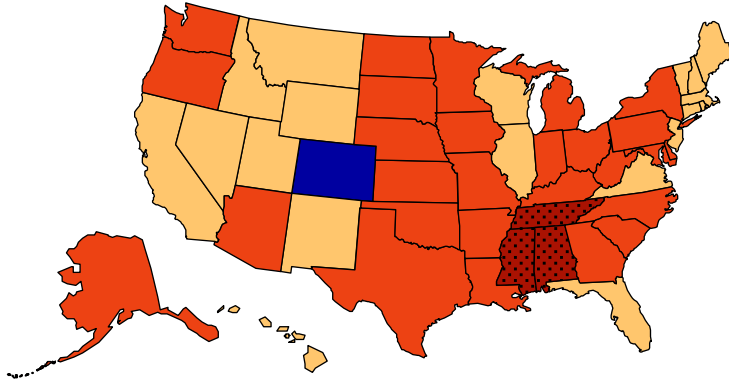
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.

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

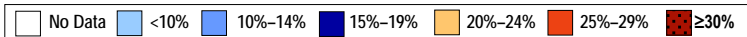
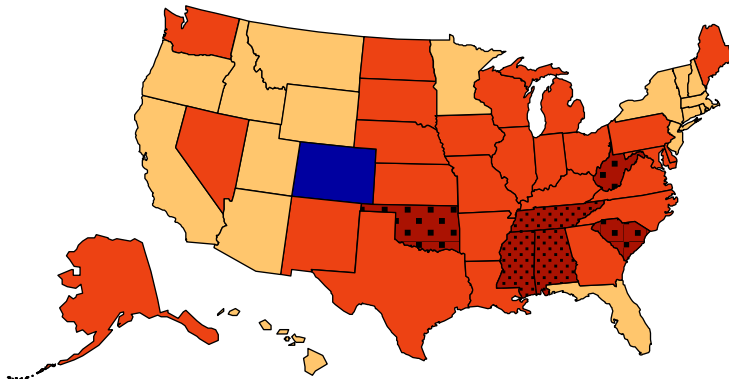
(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.

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

(\*BMI  $\geq 30$ , or  $\sim 30$  lbs. overweight for 5' 4" person)



Source: Behavioral Risk Factor Surveillance System, CDC.