

Correlates of Tanning Facility Densities in North Carolina

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BACKGROUND The indoor tanning industry is currently receiving increased attention from policymakers, but this industry has not been well researched. Our study examines economic, demographic, and climate-related variables to better understand variations among North Carolina counties in terms of the number of tanning beds and booths per capita during a recent 3-year period.

METHODS This study used regression analysis to estimate the magnitude and statistical significance of correlations between the density of tanning beds and other relevant variables from 2007 through 2009.

RESULTS The number of indoor tanning beds per capita in a county is positively correlated with the county's unemployment rate and with the proportion of the county's population that consists of white females 18-49 years of age; there is also a weakly positive correlation with the number of days per year of hot weather in the county. All else being equal, tanning beds are marginally more common in counties with higher rates of unemployment, with a greater number of days when the temperature exceeds 90 degrees Fahrenheit, and with residents who are more likely to engage in risky behaviors (as measured by the gonorrhea infection rate and the percentage of the population who smoke cigarettes).

LIMITATIONS The data span a 3-year period (2007-2009) during which economic conditions were depressed.

CONCLUSION Economic, demographic, geographic, and climate-related factors should be considered when policies that affect the tanning industry in North Carolina are being developed and implemented.

The indoor tanning industry has been under intense scrutiny in recent years. Congress included a provision in the Patient Protection and Affordable Care Act of 2010 that introduced a 10% excise tax on fees for indoor tanning services beginning July 1, 2010 [1]. The tax applies to services provided using electronic products designed for tanning that contain 1 or more ultraviolet lamps operating at wavelengths between 200 nm and 400 nm [2]. The tanning industry was targeted for this tax because of the well-documented link between indoor tanning and skin cancer [3-6].

More than 1 million Americans tan indoors every day [7], 70% of whom are white females between 16 years and 29 years of age [5]. According to the indoor tanning industry, individuals between the ages of 16 years and 19 years comprise one of the fastest-growing groups of indoor tanners [8].

As of July 2012, North Carolina was 1 of 33 states that regulated the use of tanning facilities by minors. In North Carolina, adolescents under the age of 13 years are banned from tanning indoors unless they have a prescription from a physician, and adolescents under 18 years of age must have parental permission to tan indoors. California and Vermont, which have the most stringent age-based bans, prohibit indoor tanning by anyone under the age of 18 years. North Carolina introduced legislation in fiscal year 2011-2012 that would have prohibited individuals under the age of 18 years from using a tanning bed without a prescription from a physician, and similar legislation was also introduced in January of 2013. State legislation was proposed in 2009 that would have increased the age below which use of tanning equipment would require a prescription (from 13 years to 15 years), but this legislation failed to pass [9, 10].

To protect the general population from melanoma, the International Agency for Research on Cancer recently recommended that policymakers prohibit minors from using indoor tanning facilities [10]. However, Palmer and colleagues [11] found no significant relationship between a state's indoor tanning youth-access laws and whether adolescents in that state were using indoor tanning services; the authors concluded that current youth tanning laws were not working. Research has also shown that tanning salons fail to follow US Food and Drug Administration (FDA) recommendations regarding tanning frequency. The FDA recommends that indoor tanning be limited to no more than 3 visits during a consumer's first week of using a tanning facility. Despite this recommendation, a 2009 study by Pichon and colleagues [12] found that 71% of the tanning salons surveyed permitted first-time customers to tan daily. A smaller survey described in a 2012 congressional report included similar findings; this survey also noted that some salons did not even require 24-hour intervals between tanning sessions, according to salon employees [13].

Among young adults, tanned skin is associated with health, vitality, and beauty [14]. However, people with fair skin are at the greatest risk of developing skin cancer, so tanning among this group is dangerous [15]. Indoor tan-

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ning before the age of 35 years is linked to a 75% increase in the risk of melanoma [16], which is the deadliest form of skin cancer and one of the most common types of cancer among adolescents [17]. The United States currently spends about \$1.8 billion each year on treatment for skin cancers, including \$300 million on treatment of melanoma [18]. The American Academy of Dermatology Association predicted that the new tanning tax, in combination with state laws that have increased regulation of the indoor tanning industry, will significantly reduce the incidence of skin cancer and the future costs of treating it [18].

The health effects of exposure to ultraviolet light have been studied in many settings, but few studies have examined the predictors of tanning-facility density using county-level data, and no such studies have previously been conducted in North Carolina. Given the established link between indoor tanning and skin cancer, identifying county characteristics that are associated with an increased number of tanning salons per capita may aid in the prevention of skin cancer in North Carolina. The density of tanning facilities on a county level may be associated with economic characteristics, such as income and unemployment rate [3]; with the demographic makeup of the county [19]; and/or with average climate conditions in the county [20]. For example, higher levels of income can lead individuals to pursue more education, a healthier lifestyle, and a safer environment.

Our study examined the number of tanning facilities per capita in each county in North Carolina using regression analysis. Based on economic models and previous empirical findings in related research, we predicted that tanning facility prevalence would be significantly correlated with socioeconomic, demographic, and climate characteristics of the county. We therefore analyzed the following variables from 2007 through 2009: income; unemployment rate; prevalence of young, non-Hispanic, white females in the population; and mean temperature and precipitation values.

Methods

Our study aimed to identify possible connections between a county's economic, demographic, and climate-related traits and the number of tanning beds or booths in the county relative to the size of its population (ie, the density of tanning devices). While property values and the costs associated with leasing retail space may influence a tanning supplier's location decisions, tanning suppliers ultimately rely on customer demand. Therefore, we expected that tanning bed densities would be primarily driven by customer demand and by the aforementioned economic, demographic, and climate-related characteristics. To empirically investigate the roles of demand-side factors, we turned to available data from North Carolina.

Data Sources and Sample

Our sample consisted of 300 county-level observations for each variable (1 observation per year, over a 3-year

period, for each of the 100 counties in North Carolina) and included data about the number of indoor tanning beds per capita for every county in North Carolina during fiscal years 2006-2007, 2007-2008, and 2008-2009 (the most recent years for which complete economic, demographic, and tanning data were available). Calendar year data come from the beginning year when matched with fiscal year data on tanning outcomes; for example, 2006-2007 tanning data is matched to 2006 data on income, unemployment, etc. Comparable data from other states are incomplete or unavailable. The dependent variable in our study was tanning-salon density, measured as the number of individual indoor tanning devices (such as beds or booths) per 10,000 residents in each county. These data were obtained from the Registration and Tanning Branch of the Radiation and Protection Section of the Division of Environmental Health in the North Carolina Department of Environment and Natural Resources. We obtained economic and demographic data from the US Census Bureau and data pertaining to climate from the State Climate Office of North Carolina. The following demographic information was collected for each North Carolina county: the percentage of the county's total population that consisted of non-Hispanic white women between the ages of 18 years and 49 years, and the percentage of the county's population that consisted of non-Hispanic white women over the age of 55 years. Estimated coefficients for men and women in other age and racial/ethnic groups were not statistically significant, so these groups were removed from the latter analyses. The remaining coefficients were robust to the removal of the insignificant groups. County-level health data were obtained from the North Carolina State Center for Health Statistics [21]. A county's designation as rural or urban was determined using guidelines from the North Carolina Rural Economic Development Center. Binary indicator variables were also created to distinguish between the state's 4 regions: the Mountains, the Piedmont, the Inner Coastal Plain, and the Tidewater region. Summary statistics for these variables are displayed in Table 1.

Analysis

We estimated a regression model to evaluate how variables relating to income, demographics, geography, and climate affect the number of indoor tanning beds per 10,000 residents. The results are shown in Table 2. We estimated the model with real income per capita and with the unemployment rate, as well as with the square of those variables. This allowed for the model to capture nonlinear effects of income and unemployment separately.

Results

We used regression analysis to look for correlations between observable county characteristics and the location and quantity of indoor tanning beds. Evidence suggests that suppliers in this market face a significant amount of competition in North Carolina. The median number of indoor tanning establishments per county is 15, and 90% of counties

TABLE 1.
Summary Statistics for Certain Variables in North Carolina's 100 Counties in 2007, 2008, and 2009^a

Variable	Mean	SD	Minimum	Maximum
Access to tanning salons				
Number of beds per 10,000 population	9.90	4.29	0	29.6
Number of establishments per 10,000 population	2.95	1.39	0	10.4
Economic variables				
Real per-capita income ^b	\$29,329	\$5,117	\$19,604	\$48,017
Unemployment rate	5.78%	1.48%	3.2%	11.2%
Demographic variables				
Percentage of population consisting of non-Hispanic white women aged 18-49 years	15.5%	4.05%	6.2%	24.3%
Percentage of population consisting of non-Hispanic white women aged >55 years	11.7%	3.77%	3.8%	22.2%
Climate-related variables				
Summer precipitation, in inches ^c	3.39	0.91	1.386	8.433
Average daily temperature	59.21° F	3.81° F	42.66° F	64.45° F
Average number of days per year with temperatures >90° F	3.16	1.52	0.04	7.00
Average number of days per year with temperatures <32° F	5.31	2.14	0.67	10.26
Variables relating to risk-taking				
Percentage of population who smoke cigarettes	16.55%	5.44%	4.2%	30.8%
Number of cases of gonorrhea infection per year per 100,000 population	153	130	0	828
Number of counties classified as rural ^d	60			
Number of counties per region				
Inner Coastal Plain	23			
Tidewater region	18			
Piedmont	34			
Mountains	25			

Note. SD, standard deviation.

^aTanning salon variables (the number of tanning beds per 10,000 population and the number of establishments per 10,000 population) are based on fiscal years; all other variables are for calendar years.

^bReal per-capita income is stated in 2009 US dollars, adjusted for inflation based on the Consumer Price Index for all urban consumers.

^cSummer precipitation is monthly average precipitation from June 21 to September 21.

^dClassification of counties as rural or urban was based on guidelines provided by the North Carolina Rural Economic Development Center.

have 8 or more such establishments. Moreover, each establishment tends to be modest in size, with the average tanning salon having approximately 4 tanning beds. With little market power and no county-level regulation, decisions about the locations of tanning salons are likely based on demand in local markets. Thus we expected that the observed tanning densities would reflect the collective preferences of consumers within each county.

Table 2 reports the regression results. The model controls for North Carolina's 4 geographic regions and suggests several statistically significant correlations between economic, demographic, and climate-related variables and the density of indoor tanning beds. The combined quadratic and level coefficients for unemployment suggest that tanning-bed density is likely to increase as unemployment rises, but that prevalence of tanning beds peaks at an unemployment rate of roughly 9% and then declines. During the time frame of our study, the average unemployment rate in North Carolina was 5.78% [22]. This suggests that, controlling for other factors, indoor tanning salons are more likely to be found in areas with above-average unemployment levels. (We do not mean to suggest that tanning salons deliberately locate in counties with high unemployment rates. However, choosing employment in less stable industries is consistent with risk-taking behavior.)

The data also show that counties with a higher proportion of non-Hispanic white women between the ages of 18 years and 49 years are likely to have a higher density of tanning beds. An increase of 1 standard deviation in the percentage of the population that fall into this category corresponds to more than 2 additional tanning beds per 10,000 residents.

Climate also likely plays a small but statistically significant role in the location and quantity of indoor tanning facilities in North Carolina. Counties with more days of hot weather tend to have a slightly greater density of indoor tanning salons, all else being equal. An increase of 1 standard deviation in the number of days per year when the temperature exceeds 90 degrees Fahrenheit corresponds to about 1 extra tanning bed per 70,000 people.

The remaining variables in the model are imprecisely estimated, yet they exhibit reasonable signs and magnitudes. For instance, in our sample period, tanning bed densities rose with real income per capita (which is negatively correlated with unemployment) up to a level above the average income level, after which tanning bed densities declined.

In the process of developing the model presented in Table 2, we explored several alternative specifications, including some with county-specific intercepts to capture unobservable characteristics that do not vary over time. Of the

TABLE 2.
Results of a Regression Model in which the Dependent Variable Is the Number of Tanning Beds per 10,000 Residents

Explanatory variable	Regression coefficient	95% confidence interval
Economic variables		
Real per-capita income	.0008	-.0001727 to .00175
Real per-capita income squared	-9.87×10^{-09}	-2.39×10^{-08} to 4.15×10^{-09}
Unemployment rate (%)	5.430264*	3.149724 to 7.710805
Unemployment rate (%) squared	-.2898244*	-.4417533 to -.1378956
Demographic variables		
Percentage of population consisting of non-Hispanic white women aged 18-49 years	.5674358*	.3309592 to .8039125
Percentage of population consisting of non-Hispanic white women aged >55 years	.1109791	-.1449861 to .3669442
Climate-related variables		
Average number of days per year with temperatures >90° F	.0894524 [†]	-.3544025 to .5333073
Average number of days per year with temperatures <32° F	-.6169223	-1.322748 to .0889032
Rural geography	-.0655824	-1.555282 to 1.424117
Geographic region^a		
Inner Coastal Plain	2.032985	-.5108412 to 4.576812
Piedmont	.3746929	-1.868801 to 2.618186
Mountains	.6608259	-2.625353 to 3.947005

Note. Year effects were found and were statistically significant ($P < 0.01$). These statistical conclusions are based on *t* tests of the null hypothesis that the true coefficient is zero. Thus, low *P*-values (< 0.1) indicate that we reject the null hypothesis and conclude with high ($\geq 90\%$) levels of confidence that the true coefficient is not zero. Adjusted $R^2 = 0.37$. Each regression has 297 observations. County observations have been pooled since the inclusion of year dummy variables does not qualitatively alter the results above. The demographic results for non-Hispanic white women aged 18-49 years are robust, and results for other demographic groups are not statistically significant. Statistical significance is based on robust (county-clustered) standard errors. All data are for calendar years.

^aThe Tidewater region was selected as the reference group; therefore, this region has been omitted from the table.

* $P < 0.01$.

[†] $P < 0.1$.

99 counties that had indoor tanning salons during the 3 years covered by our study, only 8 counties stood out as being markedly distinct from the norm: Cherokee, Edgecombe, Gaston, McDowell, Mitchell, Rutherford, Stanly, and Surry had twice as many tanning beds per capita as the rest of the state, and they had 50% more indoor tanning establishments per capita. In these 8 counties, real income per capita was 10% lower and the unemployment rate was 15% higher than in the other 92 counties in North Carolina; in addition, these 8 counties experienced 5% fewer days with temperatures above 90 degrees Fahrenheit and 20% more days with temperatures below 32 degrees Fahrenheit. These 8 counties also had higher proportions of white women of all ages, including nearly 15% more white women between the ages of 18 years and 49 years.

In comparison with the average of North Carolina's other counties, the 8 standout counties also differed in other meaningful ways. First, their investments in higher education were dramatically lower. The average rate of college completion in these counties was less than half the rate in the rest of the state. This observation could imply that residents in these counties place relatively less importance on the future. These 8 counties also exhibited evidence of greater risk-taking behavior relative to the other 92 counties in North Carolina. Rates of smoking in these 8 counties were approximately 25% higher than in the rest of the state, and

rates of gonorrhea infection were 20% higher. Moreover, the rate of childbirth among women with less than a high school education was nearly 20% higher in the 8 standout counties compared to the rest of the state. However, the average number of cases of skin cancer per capita was only slightly higher in the 8 standout counties than in the rest of the state. Table 3 compares these standout counties with the remaining counties in North Carolina.

Discussion

Although the health effects of ultraviolet light exposure have been studied in many settings, few studies have examined the relationship between economic data and indoor tanning salons in North Carolina. Part of the reason for this deficiency is the difficulty in obtaining reliable demographic, economic, and tanning salon data at a micro level. As a result, several of the papers in medical journals that have estimated the density of indoor tanning facilities in certain US cities obtained their data from telephone books. Palmer and colleagues [11] examined the number of tanning facilities in 80 US cities and found that tanning-facility density was predicted by the percentage of the population that is white, by household income, and by daily temperature. They selected the 20 most populous cities in each of 4 US regions and collected data on the number of tanning facilities using Yellow Pages telephone directories. The number of listings

TABLE 3.
How 8 “Standout” Counties (Cherokee, Edgecombe, Gaston, McDowell, Mitchell, Rutherford, Stanly, and Surry) Compare with the Rest of North Carolina (“Average” Counties)

Variable ^a	“Average” counties	“Standout” counties	Statistical significance
Access to tanning salons			
Number of beds per 10,000 population	9.19	18.8	P<0.01
Number of establishments per 10,000 population	2.84	4.21	P<0.01
Economic variables			
Real per-capita income ^b	\$29,608	\$26,133	Not significant
Unemployment rate (%)	5.68	6.90	P<0.01
Demographic variables			
Percentage of population consisting of non-Hispanic white women aged 18-49 years	15.4	17.0	P<0.05
Percentage of population consisting of non-Hispanic white women aged >55 years	11.5	14.1	P<0.01
Climate-related variables			
Summer precipitation, in inches ^c	3.4	3.3	Not significant
Average daily temperature	59.3° F	57.9° F	Not significant
Average number of days per year with temperatures >90° F	3.2	3.0	Not significant
Average number of days per year with temperatures <32° F	5.2	6.6	P<0.01
Variables relating to risk-taking			
Percentage of population who smoke cigarettes	16.2%	20.6%	P<0.01
Number of cases of gonorrhea infection per year per 100,000 population	150	186	P<0.1
Number of cases of cancer per year per 100,000 population	439	442	Not significant
Number of births to mothers with less than a high school education, per year per 100,000 population	93	119	P<0.1
Percentage of counties classified as rural ^d	59%	75%	P<0.1
Distribution of counties by region			
Inner Coastal Plain	24%	13%	Not significant
Tidewater region	19%	0%	Not significant
Piedmont	35%	25%	Not significant
Mountains	22%	63%	P<0.01

Note: A *t* test for the comparison of 2 means was used to determine statistical significance.

^aTanning salon variables (the number of tanning beds per 10,000 population and the number of establishments per 10,000 population) are based on fiscal years; all other variables are for calendar years.

^bReal per-capita income is stated in 2009 US dollars, adjusted for inflation based on the Consumer Price Index for all urban consumers.

^cSummer precipitation is monthly average precipitation from June 21 to September 21.

^dClassification of counties as rural or urban was based on guidelines provided by the North Carolina Rural Economic Development Center.

under the heading “Tanning Salons” was counted for each city. Hoerster and colleagues [23] also identified commercial indoor tanning facilities in 116 large US cities using the Yellow Pages directories; they then computed the number and density of such facilities for each city and looked for associations between tanning-facility density and selected geographic, climate-related, demographic, and legislative variables.

Our study found a statistically significant connection between the unemployment rate in a county and its density of indoor tanning facilities. This research also contributes to the existing literature by examining more specific demographic variables than those considered in other studies: the percentage of the population comprised of non-Hispanic white women between the ages of 18 years and 49 years, and the percentage of non-Hispanic white women older than 55 years. This new information enables a more specific analysis of the impact of these demographic factors on tanning-bed densities. Finally, our study is one of only a few to

examine the North Carolina indoor tanning salon industry [24, 25]. North Carolina’s diverse geography and climate arguably make it a suitable and representative state in which to conduct such studies.

Our results make some initial connections between tanning salon locations and underlying county-level economic, demographic, geographic, and climate-related characteristics. This information should improve policymakers’ understanding of how the indoor tanning excise tax and economic determinants will impact the state’s tanning industry.

Our main conclusion is that the number of indoor tanning beds per capita is associated with demographics (specifically, the proportion of the population comprised of non-Hispanic white women between the ages of 18 years and 49 years); economic health, as measured by the unemployment rate; and, to a lesser degree, exposure to extreme heat, as measured by the average number of days with temperatures above 90 degrees Fahrenheit. Tanning beds tend to be

located in counties with higher unemployment rates and a greater number of days when the temperature rises above 90 degrees Fahrenheit. Eight counties in North Carolina have a particularly high density of indoor tanning beds compared to the rest of the state.

Because we are investigating correlations, we cannot claim causal links between variables. We only want to suggest that there may be a connection between the aforementioned economic, demographic, and climate-related variables and the number of tanning beds per capita. However, Table 3, which highlights the differences between the 8 standout counties and the rest of North Carolina, does paint a picture consistent with the idea that tanning salons are more likely to be found in areas where residents tend to undertake other types of risky behavior, tend to be less forward-looking, and have less education.

This study estimates the associations between the density of indoor tanning beds and the unemployment rate, climate-related variables, and demographic variables. Previous studies have focused on the relationship between tanning salon usage and climate or skin cancer rates, and our study contributes to the existing literature by examining more specific demographic, economic, and climate-related variables in North Carolina. Results from this research offer policymakers initial insights into the magnitude of the state's indoor tanning industry and the economic determinants of the location of tanning facilities. Our study also shows which North Carolina counties are likely to be most affected by the excise tax on indoor tanning, which is meant to help finance the Patient Protection and Affordable Care Act. Our future research will pair the most recent tanning-bed data with economic, education, and health variables to determine whether the indoor tanning salon tax is high enough to discourage indoor tanning salon use. *NCMJ*

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