The Effect of Ordinances Requiring Smoke-Free Restaurants and Bars on Revenues: A Follow-Up

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ABSTRACT

Objectives. The purpose of this study was to extend an earlier evaluation of the economic effects of ordinances requiring smoke-free restaurants and bars.

Methods. Sales tax data for 15 cities with smoke-free restaurant ordinances, 5 cities and 2 counties with smoke-free bar ordinances, and matched comparison locations were analyzed by multiple regression, including time and a dummy variable for the ordinance.

Results. Ordinances had no significant effect on the fraction of total retail sales that went to eating and drinking places or on the ratio between sales in communities with ordinances and sales in comparison communities. Ordinances requiring smoke-free bars had no significant effect on the fraction of revenues going to eating and drinking places that serve all types of liquor.

Conclusions. Smoke-free ordinances do not adversely affect either restaurant or bar sales. (*Am J Public Health.* 1997;87:1687–1693)

Introduction

By March 1997, more than 150 communities in the United States had eliminated smoking in public places and workplaces.[1] California law now requires that all restaurants be smoke-free and that all bars become smoke-free on January 1, 1998.[2] In 1994, using sales tax data, we evaluated the effects of ordinances requiring smoke-free restaurants on restaurant revenues in the first 15 US cities that had passed ordinances prohibiting smoking in the enclosed areas of restaurants (not necessarily including bar areas).[3] We found that restaurant revenues were not affected, and subsequent studies confirmed this result.[4–8] The tobacco industry and its front groups continue to claim that these ordinances create severe economic problems for restaurants and bars.[9–11] We have added 3 more years of data (through the second quarter of 1996) for the original 15 cities (Table 1) as well as data for the first 5 cities and 2 counties to require bars to be smoke-free (Table 2).

Methods

We conducted two sets of analyses: (1) an analysis of the effects of smoke-free restaurant ordinances on restaurant revenues, and (2) an analysis of the effects of smoke-free bar ordinances on bar revenues.

As before, we obtained data on taxable restaurant sales and total retail sales[12,13] for communities that had smoke-free restaurant ordinances in force as well as for comparison cities (matched on population, income, smoking prevalence, and geographic location) that provided less than 60% of seating for nonsmokers (Table 1; Point Arena is the comparison city for Ross, because Tiburon, the comparison city in our earlier study, passed a smoke-free ordinance). Analysis of the restaurants in California comparison cities could not go beyond December 1994, after which a state law required all restaurants to be smoke-free.[2] All comparison cities were selected before the statistical analysis was performed.

In the study of smoke-free bar ordinances, all communities with ordinances that clearly identified bars as smoke-free and that had been in effect long enough for us to obtain 1 year of sales tax data were included. For the five cities that require bars to be smoke-free, sales tax data were obtained from the Research and Statistics Division of the California Board of Equalization for 1991 through 1995. Data for the two counties with smoke-free bar ordinances, published in quarterly reports,[12] were available from 1986 through 1996. So that we could examine effects on eating and drinking establishments that sell all types of liquor, we gathered sales tax data separately for eating places serving no alcoholic beverages (category 24), those serving beer and wine (category 35), and those serving all types of liquor (category 36). Detailed breakdowns of revenues by category number are available only for 1991 and later years; the Board of Equalization had disposed of the detailed data from earlier years. For San Luis Obispo, however, we have these data from an earlier study.[14] No comparison city is available for San Luis Obispo because its ordinance went into effect in August 1990. Data were also obtained for comparison communities without smoke-free bar ordinances (Table 2).

The analysis was conducted as before. Briefly, we computed (1) the fraction of total retail sales at restaurants and (2) the ratio of restaurant sales in cities with ordinances to restaurant sales in comparable cities without ordinances. The linear regression analysis included time; a dummy variable, *L*, that indicated whether

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This paper was accepted August 8, 1997.

TABLE 1—Profile of Smoke-Free Restaurant and Comparison Cities

Smoke-Free City and Matched Comparison City	1989 Population[a]	Location[b]	Type of Smoking Restriction[c]	1989 Median Household Income[a]	% of Smokers[d]	Date Ordinance in Effect	No. Months in Effect[e]
Aspen, Colo	5 049	O	100%	37 467	23.5	8/85	119
Vail, Colo	3 659	O	Some	41 211	23.5		
Auburn, Calif	10 592	O	100%	37 272	24.1	4/91	63
Oroville, Calif	11 960	O	Some	16 614	23.6		
Beverly Hills, Calif	31 971	I	100%	54 348	21.8	4/87–7/87	4
Santa Monica, Calif	86 905	I	Some	35 997	21.8		
Bellflower, Calif	61 815	I	100%	32 711	21.8	3/91–6/92	16
Lakewood, Calif	73 000	I	Some	44 700	21.8		
El Cerrito, Calif	22 869	I	100%	39 538	22.9	11/91	56
San Pablo, Calif	25 158	I	Some	25 479	22.9		
Lodi, Calif	51 874	I	100%	30 739	24.1	12/90	67
Merced, Calif	56 216	I	Some	24 727	25.1		
Martinez, Calif	32 038	I	100%	45 964	22.0	3/92	52
Pleasant Hill, Calif	31 585	I	Some	46 885	22.0		
Palo Alto, Calif	55 544	I	100%	55 333	19.7	9/92	46
Mountain View, Calif	67 460	I	Some	42 431	19.7		
Paradise, Calif	25 408	O	100%	22 954	23.6	8/91	59
Red Bluff, Calif	12 363	O	None	19 474	23.6		
Roseville, Calif	44 685	I	100%	39 975	24.1	10/91	57
Chico, Calif	40 076	I	Some	19 005	23.6		
Ross, Calif	2 180	I	100%	84 414	21.6	1/90	78
Pt. Arena, Calif	428	R	None	21 250	23.6		
Sacramento, Calif	369 365	I	100%	28 183	25.2	5/92	50
Fresno, Calif	354 202	I	Some	24 923	25.1		
San Luis Obispo, Calif	41 958	I	100%	25 982	18.9	8/90	71
Santa Maria, Calif	61 284	I	Some	29 492	18.9		
Snowmass, Colo	1 426	R	100%	39 107	23.5	5/89	87
Breckenridge, Colo	1 285	R	None	33 259	23.5		
Telluride, Colo	1 292	R	100%	31 968	23.5	4/88	99
Steamboat Springs, Colo	6 695	O	None	29 363	23.5		

[a]Data are from US Census Bureau.[21]
[b]O = outside urban area; I = inside urban area; R = rural, nonfarm area.
[c]"Some" refers to no more than 60% seating area for nonsmokers.
[d]Data are from Pierce et al.[22] (California) and Centers for Disease Control[23] (Colorado).
[e]Number of months for which data were available for this study.

or not a smoke-free restaurant law was in force; and, for Colorado, a dummy variable for the winter tourist season. The regression coefficient b_L quantifies the magnitude of the effect of the ordinance. In addition to analyzing data for each city separately, we pooled all data on restaurant sales as a percentage of total retail sales for all 15 cities with ordinances for the entire year in a single analysis, including dummy variables to allow for between-city differences.

For analysis of the smoke-free bar ordinances, in addition to the analyses just described, we evaluated sales for eating and drinking establishments with liquor licenses (category 36) as a fraction of all retail sales and as a fraction of all sales by eating and drinking establishments, using the same procedures just described, by computing

$$\frac{\text{Bar Sales}}{\text{Total Eating and Drinking Places Sales}}$$

In a few cases, the residuals showed evidence of a positive serial correlation (evidenced by a statistically significant Durbin-Watson statistic). The residual plots suggested a long-term nonlinear relationship that may have reflected the business cycle in California, which was strong near the beginning and end of our study period and in recession in the middle of the study period (early 1990s). We reanalyzed the data, including a quadratic term in time (after centering the time variable to reduce the structural multicollinearity[15]). $P < .05$ is considered statistically significant.

Results

Table 3 summarizes the results for total restaurant sales as a fraction of all retail sales and for the ratio between total restaurant sales in cities with ordinances and sales in the matched comparison cities. The first column in the table is the mean value observed over the study period.

Smoke-free ordinances generally had no statistically significant effect, either on the fraction of total retail sales that went to

TABLE 2—Profile of Smoke-Free Bar and Comparison Cities and Counties, California

Smoke-Free City or County and Comparison City or County	1989 Population[a]	Location[b]	Type of Smoking Restriction[c]	1989 Median Household Income[a]	% of Smokers[d]	Date Ordinance in Effect	No. Months in Effect[c]
Anderson[f]	8 299	O	100%	22 321	23.6	2/93	35
Red Bluff	12 363	O	None	19 474			
Davis	46 209	I	100%	29 044	23.6	3/93	33
Chico	40 079	I	None	19 005			
Redding	66 462	I	100%	25 828	23.6	2/93	35
Healdsburg	60 471	I	None	33 712			
San Luis Obispo	41 958	I	100%	41 676	18.9	8/90	65
(None available)							
Shasta County	72 275	R	100%	25 581	23.6	2/93	30
Butte County	98 625	R	None	22 776			
Santa Clara County	106 183	I	100%	48 115	19.7	2/94	42
Alameda County	119 882	I	None	37 544			
Tiburon	7 532	I	100%	75 864	21.7	11/93	25
Sausalito	7 152	I	None	60 471			

[a]Data are from US Census Bureau.[21]
[b]O = outside urban area; I = inside urban area; R = rural, nonfarm area.
[c]"None" refers to localities in which bars are specifically exempted from or not mentioned in any existing ordinance.
[d]Data are from Pierce et al.[22]
[e]Number of months for which data were available for this study.
[f]County ordinance is enforced in city.

restaurants or on the ratio between sales in smoke-free cities and sales in comparison cities (Table 3 and Figure 1). The linear model indicates that the fraction of total retail sales that went to restaurants increased in two cities (Bellflower and Martinez) and decreased in two cities (Paradise and Roseville). Restaurant sales relative to sales in the comparison city increased in one city (Palo Alto) and decreased in another (Paradise). These results are similar to those we previously reported.[3] The nonlinear model produced similar estimates for the ordinance effects; two cities showed an increase and one a significant decrease in terms of restaurant revenues as a fraction of retail sales, and one city showed a significant increase in terms of the ratio between its sales and those of its comparison city (Table 3). Analysis of all the data in pooled regressions did not result in significant changes when either model was used.

The results of the analysis of the bar data appear in Table 4 and Figure 2. The linear model indicates that there were no significant effects of the smoke-free ordinances on bar sales as a fraction of total retail sales, on the ratio between bar sales in cities with ordinances and sales in comparison cities, or on the fraction of all eating and drinking place revenues reported by establishments that sell all types of liquor (category 36). The nonlinear model indicated that there was one significant drop in sales (in Davis relative to its comparison city). Analysis of all the data in pooled regressions did not result in significant changes in any variable when either model was used.

The nonlinear model resolved the few statistically significant serial correlations we observed, but it had little effect on the estimates of the ordinance effects. This result suggests that the estimates of the ordinance effects are not artifacts of the model specification. The lack of consistent response suggests that the few statistically significant changes we estimated may simply reflect random variation, given the large number of P values that were computed, rather than a systematic effect of the ordinances.

Discussion

This study expands and confirms our earlier work showing that smoke-free restaurant ordinances do not affect restaurant revenues. It also shows that the same is true for smoke-free bar ordinances. The cities and counties with smoke-free bar ordinances are diverse. Anderson and Redding are isolated cities within a predominantly agricultural region of California. Davis is a university town. Tiburon is an affluent suburban community that enjoys heavy tourist business. San Luis Obispo is a coastal community that has a major college as well as substantial tourism. The two smoke-free counties, Shasta and Santa Clara, have ordinances that cover unincorporated areas; Shasta is rural and Santa Clara is a suburban county in the San Francisco Bay Area.

Our earlier work attracted criticism from the tobacco industry,[16] acting through Philip Morris' National Smokers Alliance.[17] The criticisms have included claims that there were errors in the effective dates of the ordinances, that we mischaracterized the ordinances as smoke-free when they were not, and that sales tax data are not accurate (Evans MK. A review of "The effect of ordinances requiring smoke-free restaurants on restaurant sales" by Stanton A. Glantz and Lisa R. A. Smith. March 1997. Unpublished.). Correcting the effective dates of these ordinances does not affect the conclusions in our earlier paper.[18] A careful review of the ordinances for both the smoke-free and comparison cities shows that they meet our stated criteria in both cases.[3] Sales tax data include all restaurant and bar sales and are collected by an agency

TABLE 3—Effect of Smoke-Free Restaurant Ordinances on Total Restaurant Sales

City	Mean	Effect of Ordinance: Change, b_L	Effect of Ordinance: P	Model: R^2	Model: P
Fraction of total retail sales, %					
Aspen, Colo	24.9	−0.3 ± 1.1	.820	.650	.000
		−0.4 ± 1.7	.809	.650	.000
Auburn, Calif	8.6	−0.1 ± 0.8	.865	.640	.000[a]
		−0.1 ± 0.5	.805	.834	.000
Bellflower, Calif	12.6	2.4 ± 0.4	.000	.503	.000
		2.0 ± 0.4	.000	.548	.000
Beverly Hills, Calif	13.0	0.8 ± 1.4	.564	.043	.428
		0.3 ± 1.3	.794	.192	.042
El Cerrito, Calif	12.8	0.0 ± 0.7	.964	.052	.350
		0.3 ± 0.7	.703	.095	.278
Lodi, Calif	11.3	0.0 ± 0.5	.954	.115	.092
		0.0 ± 0.5	.896	.153	.095
Martinez, Calif	11.0	2.5 ± 1.0	.021	.267	.007
		4.4 ± 3.2	.182	.705	.000
Palo Alto, Calif	16.2	0.0 ± 1.0	.988	.176	.023
		0.2 ± 0.1	.896	.177	.058
Paradise, Calif	14.6	−2.0 ± 0.8	.015	.264	.003
		−2.2 ± 0.8	.009	.288	.006
Roseville, Calif	6.8	−1.1 ± 0.4	.006	.402	.000
		−1.0 ± 0.4	.012	.423	.000
Ross, Calif	48.9	−10.9 ± 5.9	.070	.543	.000
		−3.7 ± 7.2	.609	.580	.000
Sacramento, Calif	14.1	1.1 ± 0.6	.066	.145	.048
		1.2 ± 0.6	.076	.147	.106
San Luis Obispo, Calif	13.0	0.0 ± 0.5	.953	.256	.003
		0.1 ± 0.5	.789	.267	.008
Snowmass, Colo	45.3	−4.2 ± 4.3	.337	.530	.000
		−3.9 ± 5.8	.506	.530	.000
Telluride, Colo	30.1	2.8 ± 3.7	.488	.062	.482
		13.5 ± 5.0	.011	.230	.042
All combined	18.9	0.0 ± 0.6	.964	.890	.000
		0.0 ± 0.6	.879	.891	.000
Ratio between sales in smoke-free city and sales in comparison city					
Aspen, Colo	1.17	.09 ± .12	.459	.223	.003
		.32 ± .18	.083	.262	.002
Auburn, Calif	.44	.03 ± .02	.170	.077	.267[a]
		.04 ± .02	.844	.370	.002
Bellflower, Calif	.50	−.01 ± .02	.726	.028	.629
		.01 ± .02	.698	.029	.814
Beverly Hills, Calif	.56	−.06 ± .04	.158	.279	.005
		−.06 ± .04	.178	.283	.015
El Cerrito, Calif	1.32	.08 ± .08	.333	.089	.214
		−.05 ± .10	.606	.221	.148
Lodi, Calif	.86	−.01 ± .03	.834	.554	.000
		.00 ± .03	.921	.572	.000
Martinez, Calif	.44	.04 ± .03	.120	.705	.000
		.04 ± .03	.182	.705	.000
Palo Alto, Calif	1.71	.27 ± .07	.001	.349	.001
		.07 ± .09	.421	.479	.000
Paradise, Calif	.69	−.09 ± .04	.018	.329	.001[a]
		−.07 ± .04	.119	.355	.003
Roseville, Calif	.68	−.02 ± .03	.511	.042	.490
		−.06 ± .03	.081	.173	.104
Ross, Calif	.60	−.12 ± .42	.769	.564	.002
		1.93 ± .62	.008	.784	.000
Sacramento, Calif	1.10	−.03 ± .03	.322	.310	.002
		−.05 ± .04	.211	.324	.005
San Luis Obispo, Calif	1.12	−.08 ± .05	.142	.158	.059
		−.08 ± .05	.154	.179	.094
Snowmass, Colo	.80	−.13 ± .14	.342	.699	.000
		−.27 ± .18	.138	.710	.000
Telluride, Colo	.43	.04 ± .05	.456	.283	.005
		.09 ± .08	.266	.297	.010
All combined	.85	−.01 ± .03	.627	.802	.000
		−.01 ± .03	.589	.805	.000

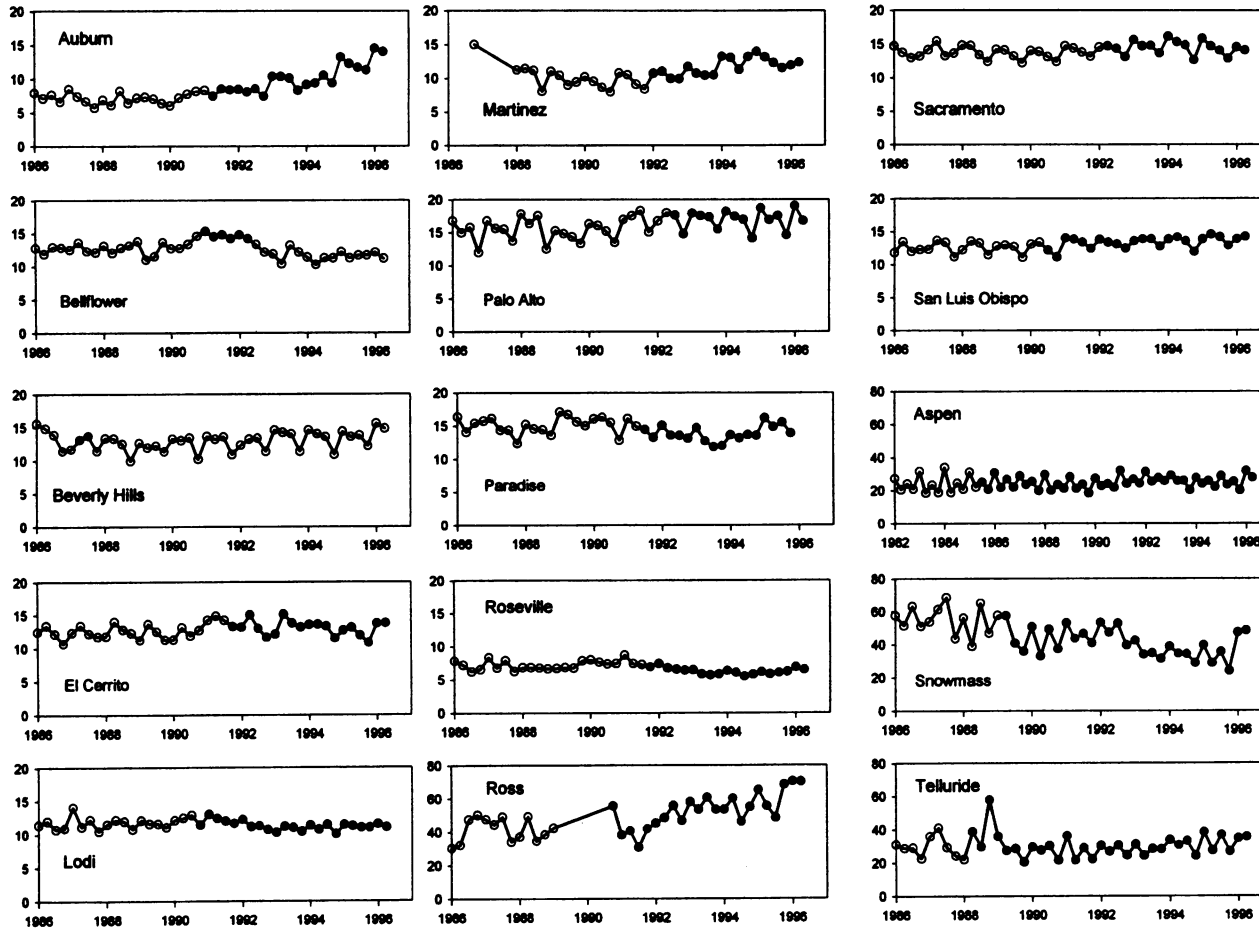
Note. The first row for each city shows results of linear time model; the second row shows results of quadratic time model.
[a]Significant positive serial correlation of residuals.

with no interest in the effects of smoke-free ordinances. (For a detailed response to the Evans critique, contact the authors. This response is also posted on the World Wide Web at http://www.tobacco.org/Misc/evansresponse.html.)

As noted above, an exemption for the bar area of a restaurant did not disqualify a smoke-free *restaurant* ordinance from our study of smoke-free restaurant ordinances,[3] so long as the eating areas were smoke-free. The present study shows that smoke-free bar ordinances do not affect bar revenues. It is important to note that our analysis of the smoke-free bar ordinances relied on data for establishments with full liquor licenses (category 36). This category includes free-standing bars and bars within restaurants. It is not possible to analyze the effects of these ordinances on these two subcategories of business separately. Nevertheless, it is important to evaluate the effects of smoke-free ordinances on this category of eating and drinking establishments because of claims by the tobacco industry that smoke-free ordinances particularly affect sales of establishments that sell liquor. Moreover, the fact that some of the restaurant ordinances permitted smoking in bar areas does not support the tobacco industry's assertion that the lack of change in restaurant revenues in the cities shown in Table 1 is due to a shift of business to bars and the bar areas of restaurants.

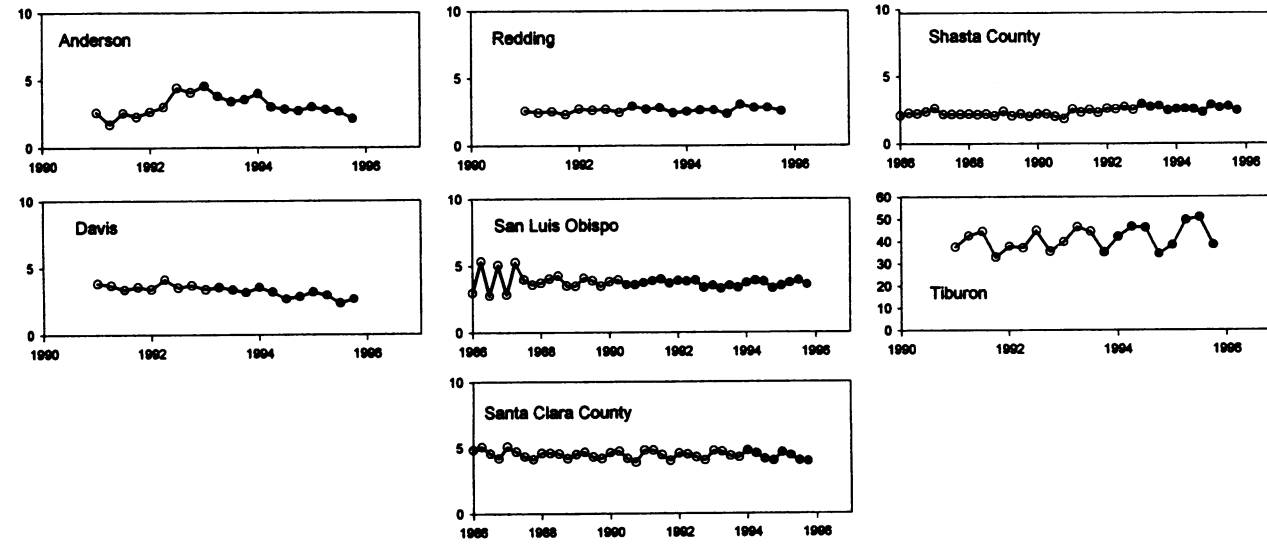
The fact that we did not observe changes in the fraction of eating and drinking establishment revenues going to category 36 businesses is evidence that these ordinances do not cause shifts between types of business. It is also important to emphasize that the purpose of this study, like that of our earlier study, was to address the claim that smoke-free ordinances substantially decrease revenues across the board; the usual claim is a reduction of 30%. The data do not support this claim. (Our analytic methods have a power exceeding .99 to detect a 30% change in restaurant or bar revenues with $\alpha = .05$.)

Food service workers enjoy less protection from secondhand tobacco smoke than any other group of employees.[19] Legislators and government officials can enact health and safety regulations to protect patrons and employees[20] in restaurants and bars from the toxins in secondhand tobacco smoke without fear of adverse economic consequences. □



Note. The quarters in which 100% smoke-free restaurant ordinances were in effect are shown as solid points.

FIGURE 1—Restaurant sales as a percentage of total retail sales for the 15 communities with smoke-free restaurant ordinances included in this study.



Note. The quarters in which 100% smoke-free bar ordinances were in effect are shown as solid points.

FIGURE 2—Bar sales as a percentage of total retail sales for the 7 California communities with smoke-free bar ordinances included in this study.

TABLE 4—Effects of Smoke-Free Bar Ordinances on Total Bar Sales, California

City	Mean	Effect of Ordinance: Change, b_L	Effect of Ordinance: P	Model: R^2	Model: P
Fraction of total retail sales, %					
Anderson	3.1	−0.7 ± 0.8	.404	.043	.689[a]
		−0.4 ± 0.5	.514	.613	.001
Davis	3.3	0.1 ± 0.8	.752	.658	.000
		0.0 ± 0.2	.943	.718	.000
Redding	2.6	0.1 ± 0.2	.456	.098	.417
		0.0 ± 0.2	.731	.129	.516
San Luis Obispo	3.8	0.0 ± 0.3	.907	.052	.374
		0.0 ± 0.3	.945	.053	.574
Santa Clara County	4.5	0.0 ± 0.2	.775	.135	.059
		0.0 ± 0.2	.996	.137	.129
Shasta County	2.4	0.2 ± 0.1	.076	.505	.000
		0.2 ± 0.1	.270	.508	.000
Tiburon	41.3	0.6 ± 5.1	.904	.103	.396
		0.3 ± 0.6	.964	.105	.610
All combined	7.1	0.5 ± 0.4	.258	.979	.000
		0.3 ± 0.5	.456	.979	.000
Ratio between sales in smoke-free city and sales in comparison city					
Anderson	.49	−.15 ± .12	.224	.153	.244[a]
		−.27 ± .11	.033	.400	.038
Davis	.42	−.08 ± .04	.073	.696	.000
		−.10 ± .04	.021	.767	.000
Redding	18.05	.66 ± 5.3	.902	.023	.823[a]
		−7.41 ± 3.91	.076	.596	.002
San Luis Obispo	.31	...	...	...	...
		...	...	...	...
Santa Clara County	1.52	.05 ± .06	.411	.486	.000
		.04 ± .09	.664	.486	.000
Shasta County	1.07	.02 ± .01	.067	.576	.000
		−.02 ± .08	.757	.601	.000
Tiburon	0.70	−.10 ± .06	.134	.411	.011
		−.09 ± .07	.205	.413	.032
All combined	2.76	−.24 ± .45	.589	.898	.000
		.21 ± .53	.695	.903	.000
Fraction of total restaurant sales, %					
Anderson	19.9	4.8 ± 5.5	.401	.042	.692
		−3.2 ± 3.4	.358	.711	.000
Davis	17.9	−1.5 ± 1.1	.194	.739	.000
		−1.6 ± 1.1	.147	.753	.000
Redding	26.6	−0.9 ± 0.9	.373	.533	.002
		−1.1 ± 1.1	.331	.539	.005
San Luis Obispo	29.3	0.0 ± 0.3	.907	.052	.374
		1.0 ± 2.6	.704	.197	.046
Santa Clara County	34.8	0.9 ± 0.5	.065	.809	.000
		0.1 ± 0.7	.890	.827	.000
Shasta County	23.9	1.5 ± 0.8	.067	.576	.000*
		0.5 ± 1.0	.597	.603	.000
Tiburon	76.6	−1.6 ± 3.1	.603	.036	.732
		−1.7 ± 3.4	.623	.036	.894
All combined	.32	0.6 ± 0.8	.505	.955	.000
		0.4 ± 1.0	.692	.955	.000

Note. For each city, the first row of data shows results of the linear time model; the second row shows results of the quadratic time model.
[a]Significant positive serial correlation of residuals.

Acknowledgment

This work was supported by National Cancer Institute grant CA-61021.

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Thyroxine Values from Newborn Screening of 919 Infants Born before 29 Weeks' Gestation

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ABSTRACT

Objectives. Severe transient hypothyroxinemia in premature infants is associated with cerebral palsy and mental retardation; this study assessed its prevalence in very premature infants.

Methods. Congenital hypothyroidism screening programs in three states provided thyroxine values for 919 newborn infants younger than 29 weeks who were enrolled in a multicenter study.

Results. Thyroxine values were lower than 4.0 μg/dL in 21% of survivors and increased each week by 0.6 μg/dL (95% confidence interval [CI] = 0.4, 0.7). At tests done 1 to 2 days after birth, levels were 2.5 μg/dL higher (95% CI = 1.8, 3.3) than at tests done at 8 to 14 days. In New York, levels were 1.0 μg/dL higher (95% CI = 0.3, 1.6) than elsewhere. The levels of infants who died were 1.3 μg/dL lower (95% CI = 0.6, 2.0) than those of survivors.

Conclusions. Severe transient hypothyroxinemia is common in very premature infants and deserves further study. (*Am J Public Health.* 1997;87:1693–1697)

Introduction

Preterm infants often have low thyroxine levels postnatally, a condition referred to as transient hypothyroxinemia of prematurity.[1–13] Transient hypothyroxinemia of prematurity is a self-limited phenomenon thought to be caused by immaturity of the hypothalamic-pituitary-thyroid system and by changes in thyroid function that accompany severe illness, that is, nonthyroidal illness. Congenital hypothyroidism is not thought to explain why transient hypothyroxinemia is detected at newborn screening of premature infants because thyrotropin levels are normal. However, recent studies of preterm infants have linked very low thyroxine levels with abnormal cognitive and neurological development at ages 2 through 9 years.[14–18] It has been difficult to establish what represents a very low thyroxine level at any given gestational age because little is known about the gestational age–specific distribution of thyroxine values in very preterm infants. State screening programs tend to collect and report information classified by birthweight, not by gestational age,[12] and they rarely report quantitative results.

In this paper we describe thyroxine-screening findings in 919 preterm infants born before 29 weeks' gestation and enrolled in a multicenter study of cranial ultrasonographic abnormalities, the Developmental Epidemiology Network Study. These infants, whose gestational ages were established according to a study protocol, received intensive neonatal care in one of four nurseries in three states: Massachusetts, New Jersey, and New York. Quantitative thyroxine-screening results were obtained from state congenital hypothyroidism–screening programs and were assessed in relation to survival, postmenstrual and postnatal age at the time of screening, and site of care.

Methods

From January 1991 through December 1993, 1662 infants weighing 500 through 1500 g were systematically enrolled in a multicenter study of neonatal brain injury, the Developmental Epidemiology Network Study. Study infants were born in four hospitals in Massachusetts, New Jersey, and New York (two hospitals). Of the 919 born at less than 29 weeks' gestation, and therefore at high risk for severe transient hypothyroxinemia of prematurity, 746 survived to discharge from the intensive care nursery.

Gestational-age estimates were based on fetal ultrasound obtained before the 14th week of gestation (32%), dates in the prenatal record (62%), maternal postpartum interview (4%), and the admission logbook of the neonatal intensive care unit (2%).

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This paper was accepted November 8, 1996.

Editor's Note. Dr Heinz Berendes served as the responsible editor and Dr Mary Northridge as editor for this paper. As is our practice, Dr Mervyn Susser had no part in the review and decision process.