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Geographic Proximity of Waterpipe Smoking Establishments to Colleges in the U.S.

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Abstract

Introduction—Waterpipe tobacco smoking is prevalent among college students in the U.S. and increasing in popularity. Waterpipe smoking establishments are almost completely unregulated and limited information exists documenting the expansion of this industry. The objective of this study was to identify U.S.-based waterpipe establishments and measure their proximity to colleges/universities.

Methods—Waterpipe establishments and their addresses were compiled using five Internet-based directories during 2014 and analyzed in 2015. Addresses were geocoded and overlaid on a U.S. map of accredited colleges/universities. Proximity of colleges/universities to the nearest waterpipe establishment was measured in 3-mile increments. Multinomial logistic regression was used to model the factors associated with proximity of waterpipe establishments to colleges/universities.

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Results—A total of 1,690 waterpipe establishments and 1,454 colleges/universities were included in the study. Overall, 554 colleges/universities (38.1%) were within 3 miles of a waterpipe establishment. Proximity of waterpipe establishments to colleges/universities was associated with higher full-time student enrollment. Public colleges/universities and those with a smoke-free campus policy were at lower odds of having waterpipe establishments within 3 miles of their campuses.

Conclusions—Waterpipe smoking establishments are more likely to be located near large colleges/universities. This study should inform initiatives aimed at reducing retail tobacco establishment exemptions.

Introduction

Waterpipe smoking is an emerging trend, especially among U.S. college students, of which approximately 10% are current users.¹⁻⁴ Waterpipe smoking is misperceived as less harmful and delivering less nicotine than cigarettes because the smoke is filtered through water.^{2,5,6} Recent evidence refutes such claims, suggesting waterpipe smoking may lead to cigarette smoking.⁷⁻⁹

Waterpipe establishments (WPEs) are often exempted from clean indoor air laws, creating an opportunity for them to flourish.¹⁰ Estimates suggest the number of WPEs has grown over the past decade,^{11,12} although divergent methods used in these studies make it difficult to establish a definitive increase.

Greater density of WPEs may promote waterpipe smoking, as a greater density of tobacco retailers is associated with higher levels of cigarette smoking.¹³⁻¹⁵ Therefore, the purpose of this study is to describe the landscape of the U.S. WPE industry and examine the extent to which businesses are located near colleges/universities.

Methods

A database of U.S.-based WPEs was compiled during August/September 2014 using five Internet directories. Building on prior studies using Hookah-Hookah, Better Business Bureau, and Hoovers directories,^{11,16} the Yellow Pages and Yelp were included as additional sources. Yelp's unique search algorithm captured all references to *hookah* from customer reviews and included a variety of businesses offering waterpipe tobacco (e.g., bars, restaurants, and cafés), but whose description does not include the terms *hookah*, *hookah bar*, or *hookah lounge*. Such businesses were called to verify whether waterpipe smoking was allowed on premises. Additional inclusion/exclusion criteria are presented in Figure 1.

Educational institutions included all accredited colleges/universities from the Integrated Postsecondary Education Data System (N=2,847).¹⁷ Institutions with dormitory capacity <250 beds were excluded (n=1,393) because the primary focus was on proximity of residential college/university students to WPEs. For each college/university, city population density was linked using ZIP code. Smoke-free campus status was included to examine whether tobacco-free policies are associated with proximity of WPEs.¹⁸

ArcGIS, version 10.2 was used to geocode street addresses of WPEs and colleges/universities. The point straight-line distance was calculated from each college/university to the nearest WPE, and between WPEs. The number of WPEs within each distance category was reported, stratified by full-time student enrollment. Clustering of WPEs was measured as the percentage of establishments with 1 other WPE within a specified radius (3.0, 3.1–6.0, and 6.1–9.0 miles). WPE density was calculated by dividing the number of establishments by the area population and converted to number of WPEs per 100,000. Thematic maps with gradient color displayed the colleges/universities coded in 3-mile increments based on distance to the nearest WPE. Multinomial logistic regression was used to evaluate the impact of full-time student enrollment, population density, and smoke-free campus policies on distance from colleges/universities to the nearest WPE. The dependent variable included four distance categories (reference, >9.0 miles). SAS, version 9.4 was used for all analyses conducted in February 2015. A p -value <0.05 was considered statistically significant.

Results

Overall, 1,690 WPEs met the inclusion criteria. The largest concentrations of WPEs coincided with large metropolitan areas (Figure 2A): for example, (Northeast) Boston and New York; (Southeast) Atlanta and Miami; (Midwest) Detroit and Chicago; and (West) Los Angeles and San Diego. In terms of proximity, the darker circles on the map represent colleges/universities with 1 WPE within 3 miles (Figure 2B).

Among 1,454 colleges/universities, 554 (38.1%) had 1 WPE within 3 miles and 719 (49.9%) within 9 miles (Table 1). After stratifying by full-time student enrollment, the percentage of academic institutions having 1 WPE within 3 miles ranged between 29.7% for institutions with <2,500 students and 75.3% for institutions with 20,000 students. Approximately 75% of WPEs had another WPE within 3 miles and there was a statistically significant correlation ($\rho=0.647$) between WPE density and college/university density.

In multinomial logistic regression (Table 2), higher full-time student enrollment was associated with higher odds of having 1 WPE located within 3 or 3.1–6.0 miles compared with >9 miles from a college/university. Public institutions were less likely than private institutions to have 1 WPE within a 3- and 3.1–6.0-mile radius, compared with >9-mile radius. Colleges/universities with smoke-free campus policies were less likely to have 1 WPEs within 3 miles compared with >9-mile radius. Finally, higher population density was associated with higher odds of 1 WPE located within 3, 3.1–6.0, and 6.1–9.0 miles compared with >9 miles from a college/university.

Discussion

Overall, 1,690 distinct U.S. WPEs were listed on five popular Internet directories in August/September 2014. WPEs are very likely to be located near the largest colleges/universities (75% had 1 WPE within 3 miles), and somewhat likely to be located near colleges/universities in general (38% had 1 WPE within 3 miles). Public institutions (versus private)

and those with smoke-free policies (versus without) had lower odds of having 1 WPE within 3 miles.

These findings suggest that colleges/universities with higher full-time student enrollment are more likely to attract WPEs. Private institutions seem more targeted, perhaps for economic considerations such as the stronger purchasing ability of their students. Encouragingly, colleges/universities with smoke-free campus policies had lower odds of having 1 WPE nearby. Although the underlying factors deserve further exploration, it is possible that WPEs may be discouraged from locating in the immediate vicinity of a smoke-free campus or that the college/university is in a jurisdiction with stronger smoke-free laws.

Given prior estimates (e.g., 725 establishments in 2010),¹⁶ it appears that new businesses are rapidly entering the WPE industry—although this cannot be confirmed owing to divergent methods used in prior studies. One of the keys to success for new WPEs is location. Web sites that promote starting a WPE advise that locating near a college is optimal because students are interested “in broadening their cultural horizons,” and recommend marketing to students aged 18–20 years^{19,20} because WPEs offer an alternative social scene particularly attractive to students under the legal age to access bars serving alcohol.^{21,22} Some businesses do not identify themselves as WPEs yet still offer waterpipe, raising questions whether WPEs adhere to local ordinances.

Limitations

As there is no established method for identifying WPEs, search strategies using Internet directories were adopted from prior studies.^{11,12,16} Using physical campus boundaries may be warranted to obtain precise measurements of walking distances from different locations on campus to the nearest WPEs. Proprietary search algorithms can change over time and may not be inclusive of all businesses in this category. The list of establishments was not validated for sensitivity/specificity; some WPEs may not be listed in online directories, and others such as restaurants serving waterpipe tobacco may not be listed under the hookah bar/lounge category. Therefore, it is likely that the number of WPEs was underestimated.

Conclusions

The rising prevalence of waterpipe smoking among youth, coupled with its harmful health effects and potential link to cigarette smoking should prompt state/local governments to evaluate WPE exemptions. High WPE-density areas identified through spatial analyses can be targeted with intervention/regulations. Governments should also consider placing limits on proximity of WPEs to educational institutions.²³ Further, college/university administrators and healthcare practitioners can include waterpipe smoking in designing and implementing tobacco-free campus policies. Education on the harms of all tobacco products should be promoted along with information to dispel the myth that waterpipe smoking is safer than cigarettes.

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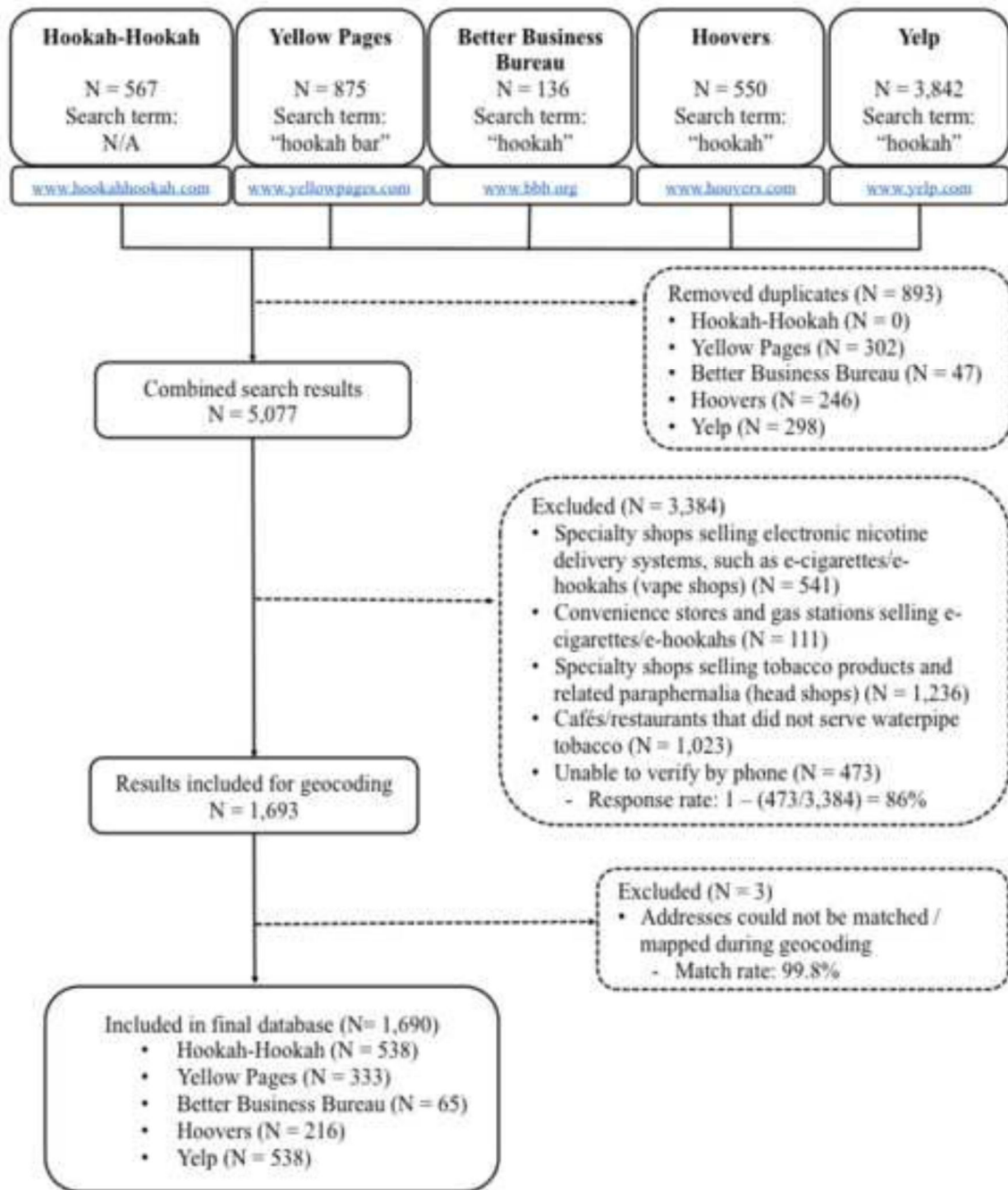
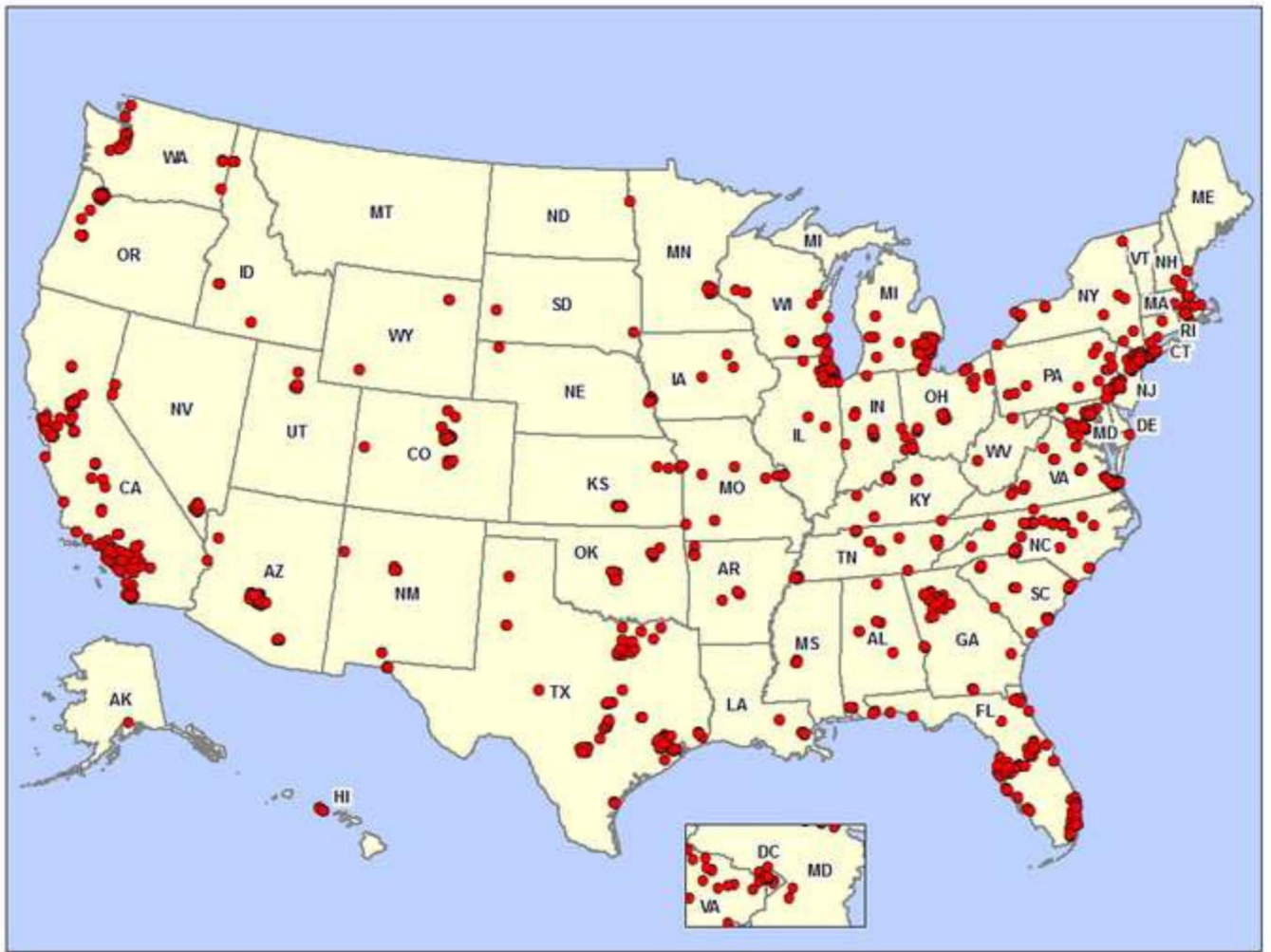


Figure 1.
Selection of Waterpipe Establishments Using Internet Directories



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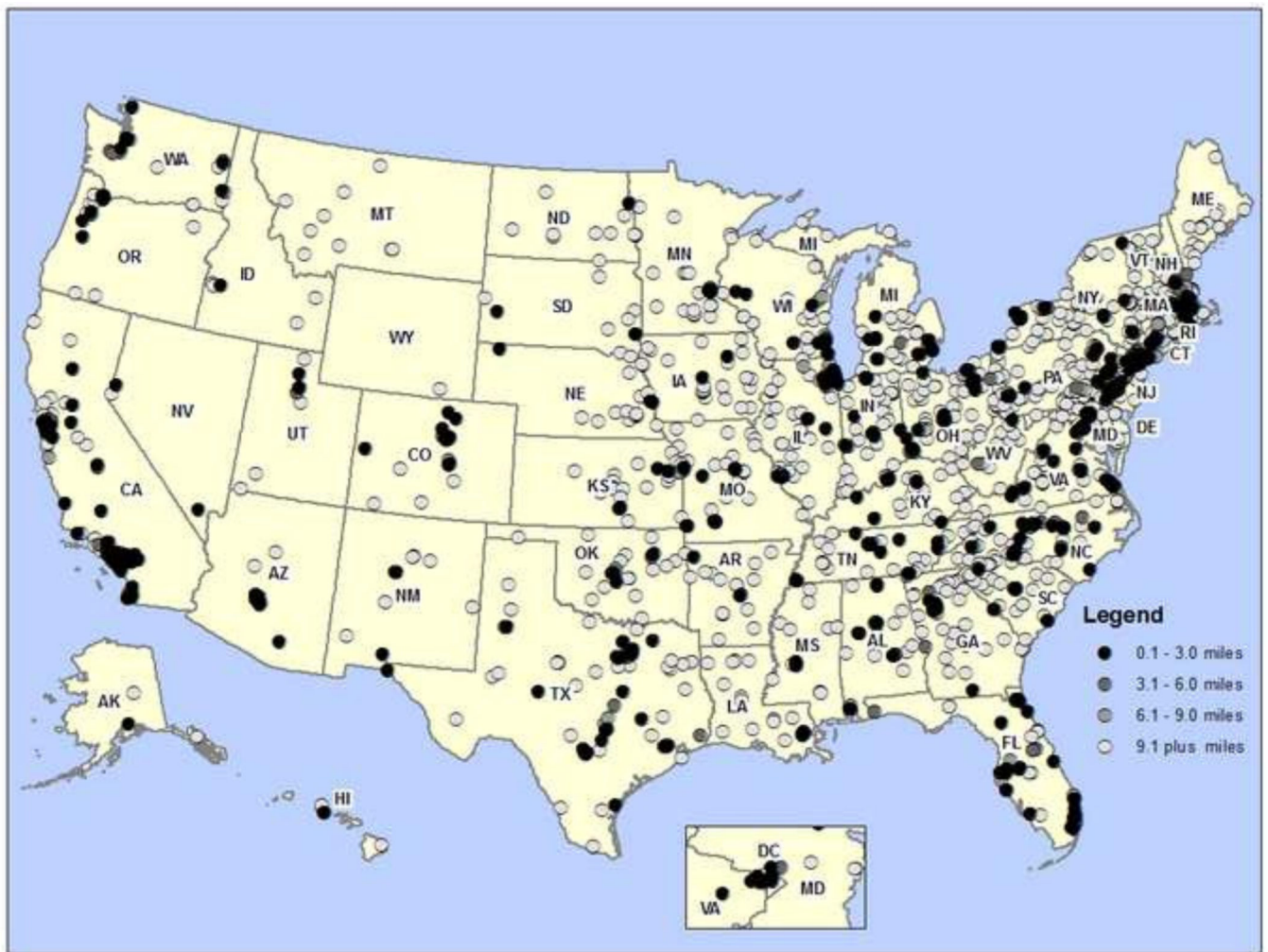


Figure 2.
 Geographic Distribution of Waterpipe Establishments in the U.S., and Proximity to Colleges and Universities
 Panel A: Waterpipe establishments in the U.S., 2014 (N=1,690)
 Panel B: Distance from colleges and universities to the nearest waterpipe establishment
 Sources: Hookah-Hookah, Yellow Pages, Better Business Bureau, Hoovers, and Yelp

Table 1

Proximity of Waterpipe Establishments to Colleges and Universities, 2014

	Overall	0.1 – 3.0 miles	3.1 – 6.0 miles	6.1 – 9.0 miles	9.1 + miles
Distance from college/university to nearest WPE, by full-time enrolment, N (%)					
All	1,454	554 (38.1)	126 (8.7)	55 (3.8)	719 (49.9)
<2,500	772	229 (29.7)	64 (8.3)	34 (4.4)	445 (57.6)
2,500-4,999	276	99 (35.9)	34 (12.3)	12 (4.3)	131 (47.5)
5,000-9,999	199	89 (44.7)	13 (6.5)	6 (3.0)	91 (45.7)
10,000-19,999	130	79 (60.8)	10 (7.7)	3 (2.3)	38 (29.2)
20,000+	77	58 (75.3)	5 (6.5)	0 (0.0)	14 (18.2)
Clustering of WPEs ^a , 1 other WPE within specified radius, %					
3 miles	75.6				
6 miles	86.6				
9 miles	90.3				
WPE density, per 100,000	2.85				
College/university density, per 100,000	11.03				
Correlation between WPE density and college/university density, rho (<i>p</i> -value)	0.647 (<0.001)				

WPE: waterpipe establishment

^a 1 other WPE within 9-mile radius

Table 2

Multinomial Logistic Model: Distance from Colleges and Universities to the Nearest Waterpipe Establishment^a

College/University Characteristics	0.1-3.0 miles OR [95% CI]	3.1-6.0 miles OR [95% CI]	6.1-9.0 miles OR [95% CI]
Full-time student enrollment, per 1,000 students	1.16 [1.08, 1.24] ***	1.10 [1.01, 1.20] *	1.03 [0.86, 1.24]
Public institution (vs. private)	0.62 [0.42, 0.91] *	0.42 [0.23, 0.75] **	0.76 [0.35, 1.67]
Smoke-free campus	0.57 [0.39, 0.83] **	0.61 [0.35, 1.08]	0.54 [0.24, 1.23]
Population density, per 1,000 students / square mile	2.53 [2.22, 2.89] ***	2.87 [2.08, 2.73] ***	2.14 [1.81, 2.54] ***

Note: Model controlled for dormitory capacity and full-time faculty equivalent

Boldface indicates statistical significance

^aReference category: >9.0 miles

*
 $p < 0.05$

**
 $p < 0.01$

 $p < 0.001$