

# Does the State Level Dental Hygienist Scope of Practice Affect Individual Oral Health Outcomes?: A Multilevel Modeling Analysis Across Time

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## ABSTRACT

Dental hygienists are often the first point of contact for patients, and increasingly provide community outreach to underserved populations. They provide evaluation and risk assessment of patients' oral health status, oral health education, preventive care, and referrals for dental providers for necessary treatment services. Scope of practice (SOP) parameters in some states limit the ability of dental hygienists to effectively provide services to the full extent of their training and ability.

**Objective:** In 2001, a numerical index describing dental hygiene SOP, called the Dental Hygiene Professional Practice Index (DHPPI) was created and scored. The DHPPI was rescored in 2014 to update the indices based on state-specific SOP for dental hygienists in that year. This study provided an update and assessed the validity of the DHPPI scale and the impact of SOP on oral health outcomes in the population.

**Methods:** Factor analysis was conducted to establish the validity of the index to measure SOP. Multi-level modeling was used to evaluate the relationship between individual state DHPPI scores and oral health outcomes in the adult population for each state in 2001 and 2014, respectively.

**Results:** Factor analysis of the DHPPI statistically confirmed its validity as a measure of SOP. Multi-level logistic modeling revealed that SOP exerted a positive and significant effect on individual oral health outcomes in the population for both 2001 and 2014.

**Conclusions:** The DHPPI is a useful tool for comparative analysis of SOP for dental hygienists across states. The professional practice environment for dental hygienists has important ramifications for population oral health.

## BACKGROUND

Variation in states' governing regulations and statutes may limit the ability of dental hygienists to effectively provide services in public health settings. Prior literature examining the relationship between state-level dental hygiene SOP and population oral health outcomes indicates that restrictive practice environments may decrease access to care and limit improvements in population oral health.

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## METHODS

- The DHPPI index is composed of individual variables, each of which is grouped into 1 of 4 categories (regulatory, supervision, tasks, and reimbursement). Each variable coincides with a score which is awarded if the condition or task is permitted in governing statute or regulation in the state.
- Scores from all variables were compiled to achieve a composite DHPPI score (from 0 to 100) for each state to quantify dental hygiene SOP in 2001 and 2014. Higher scores were associated with greater autonomy for dental hygienists to provide educational, preventive, and prophylactic oral health services in public health settings in states (Table 2).
- Exploratory (EFA) and Confirmatory Factor Analysis (CFA) were conducted on the 4 categories for each year (2001 and 2014). Both EFA and CFA statistically validated a one factor model for each year (Table 1).
- The 2002 BRFSS was matched to the 2001 DHPPI indices and the 2012 BRFSS was matched to the 2014 DHPPI indices.
- Due to an inherently nested data structure, multilevel logistic modeling was selected as the most appropriate statistical tool to determine the effect of the state-level dental hygiene SOP on the oral health of individuals residing within states.
- Individual-level variables selected from the 2002 and 2012 BRFSS included:
  - Race (White as reference group)
  - Age
  - Gender (Female=1)
  - Education (Bachelors or higher=1)
  - Employed (Employed=1)
  - Income (HH income \$50,000 or higher=1)
  - Marital Status (Married=1)
  - Last Dental Visit (Last visit less than 12 months ago=1) as an individual-level measure of access to dental care
- The outcome measure was binary (those reporting no teeth removed due to decay or disease were coded 1; those with some teeth removed due to decay or disease were coded 0).
- State level variables (2001 and 2014) included the dentist and dental hygienist rate (per 100,000 population), percent on public fluoridated water systems, per capita income, percent living in urban areas, and the DHPPI.
- The composite index and each of the 4 categories were run separately for 2001 and 2014.

**Table 1. Results from Confirmatory Factor Analysis**

Fit Indices	2001 Default Model	2014 Default Model		
NFI	0.995	1		
RFI	0.986	0.998		
CFI	1	1		
RMSEA	0	0		
PCLOSE	0.819	0.884		
CHI-SQUARE	0.451	0.024		
P VALUE	0.798	0.877		
2001 Factor Analysis				
Variable	Unstandardized Estimate	Standardized Estimate	C.R.	
Regulations	0.877	0.626	4.753	**
Supervision	9.874	0.962	8.523	**
Tasks	4.342	0.691	5.377	**
Reimbursement	4.057	0.785	6.353	**
2014 Factor Analysis				
Variable	Unstandardized Estimate	Standardized Estimate	C.R.	
Regulations	0.926	0.634	4.647	**
Supervision	10.874	0.961	7.526	**
Tasks	3.876	0.716	5.346	**
Reimbursement	4.048	0.616	4.494	**

\*\* Significant at or below the .01 probability level.

## RESULTS

- The average DHPPI score across states increased from 43.7 in 2001 to 57.6 in 2014 on a 100 point scale (Table 2). Most notably, the Supervision category progressed from a mean score in all states of 19.1 in 2001 to 27.3 in 2014. The maximum state score increased only slightly from 97 in Colorado in 2001 to 98 in Maine in 2014, but the minimum score changed more noticeably from 10 in West Virginia in 2001 to 18 in Mississippi in 2014. More states distributed higher on the index in 2014 than in 2001.

**Table 2. DHPPI Scores by State, 2001 and 2014**

State	Total		Component Scores								Change in Score	
	Composite Score		Regulation		Supervision		Tasks		Reimbursement			
	2001	2014	2001	2014	2001	2014	2001	2014	2001	2014		
Alabama	18	18	6	6	12	12	0	0	0	0	0	0
Alaska	35	54	9	7	12	33	14	14	0	0	0	19
Arizona	43	75	8	8	21	21	18	18	0	15	15	20
Arkansas	27	60	6	6	5	36	16	16	0	0	0	33
California	86	95	8	10	37	44	26	26	15	15	15	9
Colorado	97	97	9	9	47	47	26	26	15	15	15	0
Connecticut	75	83	9	9	33	39	18	20	15	15	15	4
Delaware	32	36	8	8	16	16	8	12	0	0	0	4
District of Columbia	32	41	6	6	6	17	10	18	0	0	0	9
Florida	33	41	6	6	21	21	6	14	0	0	0	8
Georgia	23	24	8	8	9	13	6	3	0	0	0	1
Hawaii	32	39	5	7	11	16	16	16	0	0	0	7
Idaho	45	45	7	7	18	18	20	20	0	0	0	0
Illinois	36	39	7	7	11	16	16	16	0	0	0	3
Indiana	37	42	8	8	19	20	10	14	0	0	0	5
Iowa	36	51	8	8	10	23	16	20	0	0	0	15
Kansas	39	63	7	7	14	36	18	20	0	0	0	24
Kentucky	18	53	6	6	8	29	4	18	0	0	0	35
Louisiana	41	40	6	6	15	16	18	18	0	0	0	-1
Maine	56	98	8	10	30	47	18	26	0	15	15	42
Maryland	36	49	10	10	16	21	10	18	0	0	0	13
Massachusetts	34	82	6	9	16	36	12	22	0	15	15	48
Michigan	35	54	7	7	18	19	10	18	0	10	10	19
Minnesota	64	85	8	8	36	38	20	24	0	15	15	21
Mississippi	15	18	6	8	7	6	2	4	0	0	0	3
Missouri	74	74	8	10	29	27	22	22	15	15	15	0
Montana	41	89	9	10	16	44	16	20	0	15	15	48
Nebraska	44	77	7	10	21	36	16	16	0	15	15	33
Nevada	65	78	9	10	36	38	20	20	0	10	10	13
New Hampshire	38	69	9	10	16	37	14	22	0	0	0	30
New Jersey	37	40	6	6	15	16	16	18	0	0	0	3
New Mexico	86	87	10	10	37	38	24	24	15	15	15	1
New York	50	57	9	9	23	30	18	18	0	0	0	7
North Carolina	28	33	6	6	9	13	14	14	0	0	0	4
North Dakota	32	36	6	6	16	16	10	14	0	0	0	4
Ohio	38	43	6	7	16	16	16	20	0	0	0	5
Oklahoma	31	49	6	8	7	21	18	20	0	0	0	18
Oregon	88	96	10	10	41	45	22	26	15	15	15	8
Pennsylvania	42	71	8	7	18	44	16	20	0	0	0	29
Rhode Island	33	40	7	7	16	17	10	16	0	0	0	7
South Carolina	45	51	8	6	21	29	16	16	0	0	0	6
South Dakota	42	53	6	6	16	23	16	16	0	0	0	11
Tennessee	39	43	7	7	14	16	18	18	0	0	0	4
Texas	41	42	8	8	23	24	10	10	0	0	0	-1
Utah	53	48	7	7	21	21	20	20	5	0	0	-5
Vermont	39	47	9	7	16	22	14	18	0	0	0	8
Virginia	17	68	7	9	8	35	3	24	0	0	0	51
Washington	95	94	10	10	45	45	26	24	15	15	15	-2
West Virginia	10	70	6	8	2	44	2	18	0	0	0	60
Wisconsin	44	58	7	9	21	21	16	18	0	10	10	14
Wyoming	34	42	4	6	14	16	16	20	0	0	0	8

- Multi-level logistic modeling showed that overall dental hygiene SOP, represented by the **composite DHPPI** score, exerted a positive and significant effect on oral health outcomes. The effect was stronger in 2001 than in 2014 (Table 3). Scope of practice exerted the strongest state-level effect in 2001. The rate of dentists and dental hygienists was both positive and significant in 2001, but not in 2014. That effect was stronger for dental hygienists than for dentists in 2001.

**Table 3. Multilevel Logistic Modeling: Composite DHPPI Index, 2001 and 2014**

Variable	2001 Model		2014 Model	
	Odds Ratio	P-value	Odds Ratio	P-value
STATE LEVEL				
Intercept	0.921216	0.011	0.921065	0.016
Scope of Practice Index	1.005161	<0.001**	1.002744	0.011*
Dental Hygienist Rate	1.004925	0.009**	1.003614	0.057
Dentist Rate	1.003856	0.040*	1.003154	0.215
% Fluoridated Water	1.002542	0.039*	1.001726	0.053
Per Capita Income	0.999978	0.006**	0.999988	0.05*
% Urban	1.004195	0.098	1.004863	0.028*
INDIVIDUAL LEVEL				
Age	0.939298	<0.001**	0.947811	<0.001**
Sex	1.074283	0.001**	0.938606	<0.001**
Marital Status	0.951859	0.005**	0.931333	0.003**
Education	2.167903	<0.001**	2.122161	<0.001**
Employed	0.917515	0.001**	1.133762	<0.001**
Income	1.604209	<0.001**	1.668291	<0.001**
Black NH	1.017108	0.613	0.540519	<0.001**
Asian/PINH	0.959888	0.56	0.711651	<0.001**
American Indian/Alaskan Native NH	1.195283	0.026*	0.642701	<0.001**
Other2 or More Races NH	0.980379	0.868	0.797761	<0.001**
Hispanic	0.923882	0.062	0.804444	<0.001**
Last Dental Visit	1.140513	<0.001**	1.175174	<0.001**

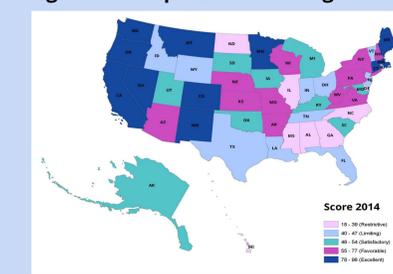
\* Statistically significant at or below the .05 probability level.

\*\* Statistically significant at or below the .01 probability level.

## RESULTS (cont.)

- The **Regulatory** environment component was statistically significant in 2014 (p-value = .026) although not in 2001 (p-value = .178). The dental hygienist rate was statistically significant in both 2001 (p-value = 0.007) and 2014 (p-value = 0.029) (Table 4).
- The **Supervision** component exerted a positive and statistically significant effect (p <0.001) on the oral health of individuals in 2001, holding constant all relevant state- and individual-level factors; it exerted the strongest state-level effect. Supervision was not significant in the 2014 model.
- The **Task** component exhibited the strongest state-level effect, compared with all the other variables, with a positive and statistically significant relationship (p = 0.004) in the 2001 model. However, the relationship was not significant in 2014 (p = 0.299). The rates of dentists and dental hygienists were significant in 2001, but not in 2014.
- The **Reimbursement** component demonstrated positive and significant correlations in 2001, holding constant all other state- and individual-level variables. The dental hygienist rate and the dentist rate were also significant. Reimbursement was also statistically significant in 2014 (p = 0.002).
- For 2001, 4 out of the 5 multilevel logistic models indicated a positive, statistically significant effect of state level professional practice environment upon oral health outcomes, while in 2014, 3 out of the 5 multilevel logistic models revealed a positive and statistically significant effect. The overall increase in scope of practice over the decade reduced variation among states and therefore, produced fewer statistically significant differences in the 2014 analysis.

**Figure 1. Comparative Ranking of States' DHPPI Scores 2014**



- State DHPPI scores were ranked as excellent, favorable, acceptable, limiting, or restrictive to describe the practice environment for dental hygienists in public health settings (Figure 1).

## CONCLUSIONS

- The DHPPI is a valid tool for assessing differences in dental hygienist scope of practice across states.
- Multilevel modeling demonstrates that dental hygiene scope of practice exerts a positive and significant impact on oral health outcomes in the population.
- Permitting dental hygienists to work to the full extent of their professional competency facilitates access to services, especially for underserved populations. Professional regulation that enables use of an array of skills can support innovation while still protecting patient safety and ensuring quality of care.

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