Correlation of health outcomes with physician and chiropractor ratios in the United States

John Hart DC, MHS*

Assistant Director of Research, Sherman College of Straight Chiropractic, Spartanburg, NC 29304

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Abstract

Objective: There is controversy as to whether increased doctor-patient ratios result in a commensurate benefit to the health care consumer. This study assesses doctor (allopathic/osteopathic physician and chiropractor) ratios in the 50 states in the United States and correlates these ratios with various health outcomes to determine if one doctor type has stronger correlations in certain outcomes compared with the other doctor type by geographic region.

Methods: A total of 21 health outcomes for the year 2004, such as obesity and cancer deaths, were correlated with 2004 physician and chiropractor ratios (number of doctors per 100 000 population). The 25 highest doctor ratio states, along with the corresponding health outcomes, were compared with the 25 lowest doctor ratio states and the corresponding health outcomes. The Spearman and Wilcoxon tests (for correlation and differences, respectively) were used to assess the data.

Results: Increases in doctor ratios resulted in correlations in 12 outcomes for chiropractors and 8 outcomes for allopathic/osteopathic physicians. When comparing low with high doctor ratios, physicians had improvements in 13 outcomes, whereas chiropractors had 12.

Conclusions: Correlation does not necessarily show causation but may provide clues. Many of the improved outcomes were not surprising for allopathic/osteopathic physicians, for example, cardiovascular deaths, but were surprising for chiropractors. It is possible, although care should be taken to avoid overspeculation, that doctors of chiropractic are having an effect in seemingly unlikely outcomes such as cardiovascular and cancer deaths. Further research is warranted for other years to verify these findings.

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Introduction

Most people assume that more health care, that is, more treatment by more doctors, translates into better health.¹ There is evidence however that disputes this notion.² Previous reports note that the use of chiropractic

* Sherman College of Straight Chiropractic, P.O. Box 1452, Spartanburg, SC 29304, USA. Tel.: +1 864 578 8770x232.

E-mail address: jhart@sherman.edu.

Table 1 Correlation coefficients with their *P* values for doctor ratios and health outcomes

Outcome	Physician Correlation/ <i>P</i>	Chiropractor Correlation/ <i>P</i>
1. Per Capita Income	0.680/.000	0.242/.091
2. Obesity Percentage	-0.588/.000	-0.507/.000
3. Motor Vehicle Deaths	-0.550/.000	-0.124/.3
4. Occupational Fatalities	-0.548/.000	-0.085/.5
5. Percentage Lacking Health Insurance	-0.479/.000	-0.268/.06
6. Adequacy of Prenatal Care	0.311/.02	-0.127/.3
7. Per Capita Public Health Spending	0.208/.1	0.039/.7
8. Public Health Dollars	0.091/.5	0.054/.7
9. Total Mortality	-0.508/.000	-0.598/.000
10. Overall UHF Health Rank	-0.455/.001	-0.580/.000
11. Cardiovascular Deaths	-0.409/.003	-0.579/.000
12. Premature Deaths	-0.484/.000	-0.577/.000
13. Prevalence of Smoking	-0.357/.01	-0.564/.000
14. Cancer Deaths	-0.037/.7	-0.562/.000
15. Limited Days of Work	-0.151/.2	-0.497/.000
16. Infant Mortality	-0.381/.006	-0.448/.001
17. Percentage HS Graduates on Time	0.130/.3	0.400/.004
18. Percentage of Children in Poverty	-0.353/.01	-0.357/.01
19. Violent Crime	-0.080/.5	-0.322/.02
20. Personal Health Care Estimates	-0.008/.9	-0.315/.02
21. Infectious Disease	<i>0.154/.02</i>	-0.295/.03

Spearman test used for correlation coefficient. The *P* value refers to the significance of the correlation coefficient. The health outcomes are arranged in order of strength of correlation, first for allopathic/osteopathic physicians (upper left) then for chiropractors (lower right). Interpretations for the individual health outcomes, numbered accordingly in the table, are as follows: bold = stronger relationship with improved health outcome with that particular doctor type (8 for physicians and 12 for chiropractors); italics = worsened outcome doctor ratio (i.e., with infectious disease for physicians, and adequacy of prenatal care for chiropractors). HS indicates high school.

services could be more cost-effective than medical services for common musculoskeletal complaints,³⁻⁵ although there is also controversy on this point.⁶ Most studies comparing chiropractic care with medical care use the outcome of back pain. Hurwitz,⁷ for example, found in his retrospective study of patients with low back pain that chiropractic was "at least as effective as medical care." Likewise, Skargran et al,⁸ in their clinical trial of patients with back or neck pain, found that chiropractic and physiotherapy had similar effectiveness.

The present study is unique inasmuch as it attempts to correlate various health outcomes archived

by other agencies with ratios of allopathic/osteopathic physicians and chiropractors in the 50 states in the United States. The research question asked in this inquiry is whether one doctor type has a stronger correlation with health outcomes than the other in a given geographical region (United States).

Methods

Eighteen of the 21 health outcomes (referred to here as *outcomes*), including an overall health ranking, were obtained from the United Health Foundation (UHF) for the year 2004.⁹ Two of the outcomes (also for 2004) not included by UHF, but of interest to the author, consisted

Table 2 Differences between states with low ratios vs states with high ratios

Outcome	Physician <i>P</i>	Chiropractor <i>P</i>
Total Mortality	.003	.001
Overall UHF Health Rank	.003	.001
Cardiovascular Deaths	.01	.001
Premature Deaths	.001	.001
Prevalence of Smoking	.01	.000
Cancer Deaths	.6	.000
Limited Days of Work	.4	.006
Infant Mortality	.01	.01
Percentage of HS Graduates on Time	.5	.01
Percentage of Children in Poverty	.01	.09
Violent Crime	.6	.02
Personal Health Care Estimates	.4	.05
Per Capita Income	.000	.3
Obesity Percentage	.001	.005
Motor Vehicle Deaths	.000	.4
Occupational Fatalities	.000	.5
Percentage Lacking Health Insurance	.01	.2
Infectious Disease	.4	.1
Adequacy of Prenatal Care	.09	.1
Per Capita Public Health Spending	.2	.7
Public Health Dollars	.4	.6
Doctor Ratio	.000	.000

Wilcoxon test used for differences between states with lower vs higher doctor ratios. The *P* value refers to whether the differences are significant between high and low ratio states. Bold = significant improvement in states with higher doctor ratios (13 for physicians and 12 for chiropractors). Italicized = significant improvement in states with *lower* doctor ratios (infectious disease for physicians, and percentage of pregnant women receiving adequate prenatal care and percentage of health dollars for public health for chiropractors.)

Fig 1. Correlations of outcomes. Numbers 1 to 21 on the horizontal axis correspond to the numbered outcomes listed in Table 1. Negative correlation means that the outcome number decreased as the doctor ratio increased and vice versa. All outcomes showed improvement with increasing doctor ratios except for outcomes 6 (infectious diseases-physicians), and 21 (adequacy of prenatal care—chiropractors). The taller the bar in the graph, the stronger the correlation. For example, physicians had a stronger correlation in outcome 14 (per capita income), whereas chiropractors had a stronger correlation in outcome 6 (cancer deaths).

of personal income¹⁰ and total estimated personal health care as a percentage of gross state product.¹⁰ The year 2004 was used for the health outcomes because it (2004) was the only year that ratios for both types of doctors (allopathic/osteopathic physicians and chiropractors) were found. The 2004 doctor ratios (per 100 000 population) were obtained from the *United States Health Workforce Profile*.¹¹ The 21 categories of health outcomes for the population in each state are listed in Tables 1 and 2. A correlation of percentage of population older than 65 years for 2004¹² and cancer death rates for 2004⁹ was also performed.

The outcomes and doctor ratios for each of the 50 states in the United States were entered into SPSS version 14.0 (SPSS Inc, Chicago, IL) for analysis. Because some of the data were not normally distributed according to the Kolmogorov-Smirnov and Shapiro-Wilk statistics ($P < .05$), the nonparametric Spearman test, which ranks the data, was used for correlation. The various strengths of the correlations were characterized as follows: <0.2 = negligible; 0.20 to 0.40 = low; 0.40 to 0.70 = moderate; 0.7 to 0.90 = high; and >0.90 = very high.¹³

For differences, the data were sorted for each doctor type, from lowest ratios to highest, along with corresponding outcomes by state. The 2 groups (of low vs high ratios) were then compared as follows: the 25 states with the lowest doctor ratios compared with

the 25 states with the highest doctor ratios, using the nonparametric Wilcoxon test. The significance level for Spearman and Wilcoxon tests was set at 0.05.

Results

The mean doctor ratio per 100 000 was 211.50 for allopathic/osteopathic physicians and 29.71 for doctors of chiropractic. The highest ratio was 303.19 for physicians (in Massachusetts) and 54.70 for chiropractors (in Colorado). The lowest ratio for both doctor types was found in Mississippi: 157.87 for physicians and 11.40 for chiropractors. The state with the overall healthiest rank was Minnesota, whereas the least healthy rank went to Louisiana.

There were no correlation coefficients that were stronger than moderate. Allopathic/osteopathic physicians had the strongest correlation coefficient for the outcome of per capita income ($r = 0.680$, Table 1). For physicians and chiropractors, all moderate correlation coefficients indicated that the more concentrated they (physicians and chiropractors) were, the greater the improvement for the health outcome (Fig 1, Table 1).

One outcome worsened for physicians as their ratio increased: infectious disease (insignificant, negligible correlation coefficient strength). For chiropractors,

Fig 2. Outcome with the largest correlation coefficient difference. For cancer deaths and increasing doctor ratios, cancer deaths decreased negligibly for physicians but moderately for chiropractors.

the outcome of adequacy of prenatal care worsened (insignificant, negligible correlation coefficient strength) as their ratio increased (Fig 1, Table 1).

Allopathic/osteopathic physicians had stronger correlation coefficients in 8 of the 21 outcomes, 6 of which had correlation coefficients in the moderate range. Chiropractors had stronger correlations in 12 of the 21 outcomes, 4 of which had correlation coefficients in the moderate range (Fig 1, Table 1). The largest difference between physicians and chiropractors was seen in cancer deaths, where chiropractors had a correlation coefficient that was greater by a value of approximately -0.6 (Fig 2, Table 1). There was a low, positive, and insignificant correlation between percentage of population older than 65 years and cancer death rate in 2004 ($r = 0.202$, $P = .1$).

For differences (Table 2), when separating the doctor ratios into 2 groups (lowest vs highest, along with corresponding outcomes), physicians had 13 significant outcome improvements in states with higher ratios (209.92 and higher per 100 000 population), whereas chiropractors had 12 such improvements in high ratio states (30.68 and higher per 100 000 population) (Table 2).

Discussion

The purpose of the article is not to speculate as to which doctor is more valuable to society, as both have their place. Correlation does not necessarily imply causation, but it can provide clues. Many of the correlated outcomes seem plausible, such as for allopathic/osteopathic physician ratios and (a) cardio-

vascular deaths, (b) motor vehicle deaths, and (c) occupational fatalities. Other outcomes however seem less plausible, such as for chiropractors and cardiovascular deaths and cancer deaths (Table 2). For both doctor types, outcomes that may seem rather obscure, such as graduating from high school on time and motor vehicle accidents, may be correlated with doctor ratios because of the possibility that quality health care (medical and chiropractic) may help improve mental function (in school) and reaction time (on the road). Variables that are unrelated can sometimes be correlated with each other. Consequently, the reasons why the outcomes and ratios correlate require further study before any definite conclusions could be offered. The reason for this correlation is not clear, and interpretation should be made with caution.

Limitations to this study include the following: Patient demographic data were not evaluated in this study. Because some areas of the country may have populations with greater health risks (eg, age, genetic backgrounds), this may have played a role in health outcomes regardless of the health care providers available in that region. It is possible that medical osteopathic care is more prevalent in areas where more cancer is present and that chiropractic care is more prevalent in areas where healthier people tend to live. In addition, measurement of access to care was not measured. Presence of health care providers does not imply that these services were actually accessed. Therefore, direct correlation of service to health status cannot be made with the data in this study. State licensure and scope of practice may have had an impact on services provided by chiropractors because some states allow a broader or a narrower scope of chiropractic practice. Furthermore, there are

many other factors that affect patient health status and the presence of provider type; and these should also be considered.

Future study might evaluate the possible correlation between manual care of the spine (ie, spinal adjustment) and organic illness,¹⁴⁻¹⁷ especially because most (77%) of the chiropractors surveyed in one study¹⁸ believe there is an association between subluxation of the spine and health of the organs. Possible explanations for underlying neurological mechanisms for spinal adjustment have been offered^{17,19} that should be more closely examined. In addition to spinal care, approximately one half²⁰ to two thirds of chiropractors²¹ provide nutritional services that may contribute to the correlation of improved outcomes in the unlikely areas such as cancer and cardiovascular deaths. However, because no causal relationships can be made from this study, further research is warranted.

Conclusion

Health outcomes improved as ratios increased for both doctor types. Allopathic/osteopathic physicians and chiropractors had similar strengths for correlations and differences for the health outcomes studied. Chiropractors however had stronger correlations for a greater number of outcomes. The most striking difference found was in the outcome of cancer deaths, where chiropractor ratios had a substantially stronger inverse correlation with the outcome of cancer deaths. Further research is indicated, for example, to investigate other years, to verify the findings of this study.

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