Association of Heart Disease Mortality Rates with Concentrations of Chiropractors and Medical Doctors in the U.S., 2007

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Citation

Abstract

Introduction: It is presumed that as concentration of health care practitioners increases, health outcomes such as heart disease mortality rates (HDMR) decrease. This ecological study compares HDMRs with concentrations of: a) doctors of chiropractic ("DC ratios") and medical doctors ("MD ratios").Methods: The ratios were calculated by dividing total population in each state by total numbers of DCs and MDs in each state. The ratios were then compared to heart disease mortality rates using Pearson correlation and multiple linear regression.

Results: DC ratios showed stronger associations with decreased HDMR compared to MD ratios. Discussion: Reasons for the stronger DC ratio associations are unclear. Two possible explanations are: a) dietary services that many DCs provide may not be provided generally by MDs, and b) spinal manipulation (also known as "adjustment") may have, by way of neurological pathways, visceral benefits. Limitations to the study are its ecological design, where populations rather than individuals are studied. The study is intended only as a first step for further research.Conclusion: DC ratios showed stronger associations with decreased HDMR compared to MD ratios in this study. Further research with other designs, such as the case-control design is indicated. Since this is an observational study, causal inference is not claimed.

INTRODUCTION

Obviously many factors affect health, such as socioeconomic factors and genetics. It would seem that the supply of health care practitioners would also affect health. There is some evidence showing that primary care medical doctor supply is related to improved health outcomes [1-2] but the relationship is not as strong compared to socioeconomic factors. [1]Other evidence suggests that there is no association between physician supply and mortality rates. [3]Such findings appear to be based on ecological designs, where populations rather known individuals are studied. There are few, if any studies comparing: a) DCs and mortality rates to b) MDs and mortality rates. A previous study correlated DC and MD supplies with various health outcomes. [4]In that study, the year for the doctor data (2004) was different than the years the outcomes were based on (from 1999-2003). The present study compares DC and MD ratio data for 2005 and heart disease mortality rates (HDMR) for 2007. This outcome was selected because a) it was the top single cause of death for that year [5] and b) there is plausibility in subtle problems of the spine and heart problems. [6-10]The purpose of the study is not to determine what the causes or cures are for heart disease, as the main factors for heart disease are already known. The purpose of the study is instead simply to compare the strength of association of DC ratios and HDMR with MD ratios and HDMR. An assumption of the study is that increased concentration of a profession (DC or MD) is directly related to increased services from the profession while an expectation is that their increased concentration results in decreased HDMR..

METHODS

Age-adjusted HDMR death rates per 100,000 population from 2007 for all 50 states and the District of Columbia ("states") were obtained. [5] DC [11] and MD [12] data were obtained for 2005 by dividing their respective total state population numbers by state in 2005 (in thousands) [13] by their total practitioner numbers by state. These values are referred to as "DC ratios" and "MD ratios." As an example regarding how a ratio was calculated, Alabama's population in thousands was 4,558 (4,558,000) and its DC number was

776. Thus, the DC ratio for Alabama is 4,558,000 / 776 or 5873.7/1 (or simply 5873.7). This means there was one DC to every 5874 persons in the state. The MD number for Alabama was 10,809, making its MD ratio 421.7. Consequently, smaller ratio numbers (e.g., 421.7 versus 5873.7) reflect greater concentration of practitioners.

Data analysis consisted of Pearson correlation and linear regression in Stata IC 12.1 (StataCorp, College Station, Texas). Since two tests were performed in correlation, a Bonferroni-adjusted alpha of 0.025 was used (0.05/2) for Pearson analysis. P-values $\leq$ to this alpha are considered statistically significant for correlation analysis. Multiple linear regression (MLR) was performed with the DC and MD ratios serving as predictors and HDMR as the response variable. Influential observations were assessed visually in correlation analysis using scatter plots. For MLR, influential observations were assessed using delta-beta analysis, which indicated the amount of influence each data point has on the regression coefficients. A value that exceeded $2/\sqrt{n}$ was considered influential. [14] A negative coefficient reveals an inverse relationship (fewer deaths with fewer practitioners, which would be unexpected) while positive relationship (no sign on coefficient) reveals a direct relationship (fewer deaths with more practitioners which is expected). Thus, direct relationships are desirable in this study.

RESULTS

One influential observation was observed in correlation for MD ratios (Figure 1) while none were observed for DC ratios (Figure 2). A total of eight influential observations were observed for MLR (three for DCs and seven for MDs with two states overlapping, that is, two states had both DC and MD influential observations). Results are reported with and without these observations for both statistical analyses. Descriptive statistics are shown in Table 1. DC ratios revealed a statistically significant, direct, strong correlation with HDMR (r = 0.703, p = 0.0000) while MD ratios revealed weak, statistically insignificant correlations, with or without outliers (Table 2). In MLR, DC ratios also revealed a stronger relationship with HDMR compared to MD ratios (DC: t = 8.21, p = 0.000 with outliers, and t = 7.06, p = 0.000 without outliers; MD: t = 1.23, p = 0.225 with outliers, and t = 2.58, p = 0.014 without outliers; Table 3). The regression coefficients were 0.01 for DC ratios with and without outliers; for MD ratios the coefficients were 0.04 with outliers and 0.07 without outliers. The intercept for the regression equation is 120.3 with outliers and 103.5 without outliers.

Table 1

Descriptive statistics. SD = standard deviation. DC and MD ratios per total population / total practitioner number.

Variable	N	Mean	SD	Minimum	Maximum
Heart	51	188.6	30.1	129.8	266.5
DC ratio	51	3858.5	1623.4	2024.7	8798.2
MD ratio	51	404.1	92.6	122.9	588.3

Table 2

Correlations with HDMR

Predictor	With outliers			Without outliers		
	n	r	p	n	r	p
DC ratios	51	0.703	0.0000	no outliers observed		
MD ratios	51	0.084	0.5594	50	0.215	0.1331

Table 3

Multiple linear regression with HDMR as response variable. Coef = regression coefficient. Intercept with outliers = 120.3 and without outliers = 103.5.

Predictor	With outliers			Without outliers		
	n	Coef	t	p	n	Coef	t	p
DC ratios	51	0.01	8.21	0.000	43	0.01	7.06	0.000
MD ratios	51	0.04	1.23	0.225	43	0.07	2.58	0.014

Figure 1

MD ratios and HDMR. Suspected influential observation noted on left side of graph. Without the outlier, a stronger correlation is noted (please see Table 2). MD ratio = number of people in the general population per one MD.
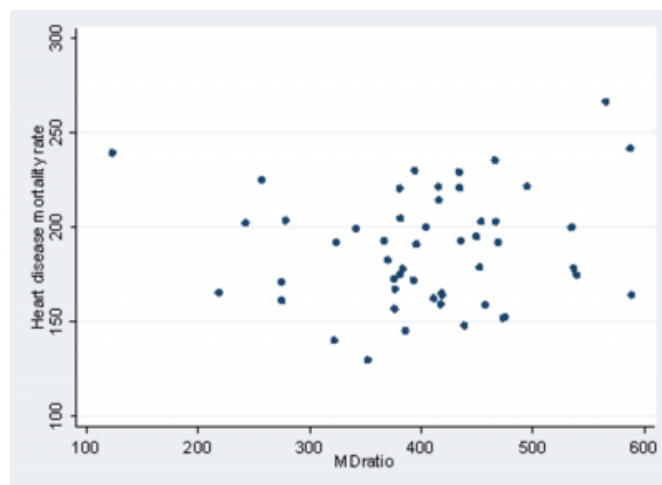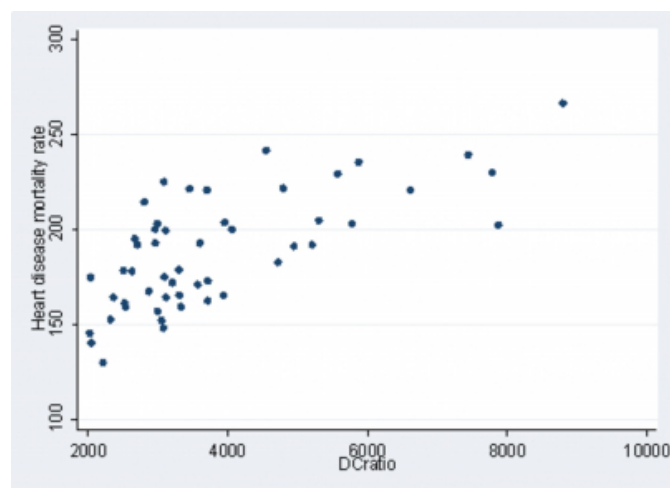
Figure 2

Figure 2. DC ratios and HDMR. Although the variance is a bit uneven, no influential observations are considered to be present. As the ratio of population-to-DCs increases (less concentration of DCs), HDMR tends to increase. DC ratio = number of people in the general population per one DC.

DISCUSSION

A surprising finding in this study is the stronger relationship with HDMR observed for DC ratios compared to MD ratios. One possible explanation is the services that many chiropractors provide such as dietary services [15] may not be provided by MDs in general. Another possible explanation is that spinal adjustment / manipulation may have a beneficial effect on visceral health by way of neurological pathways. [16-19]

Explanation of the correlations coefficients is possible with their squared values. For DC ratios, approximately 49% (0.703^2) of the variation in HDMR is explained by the variation in DC ratios compared to approximately 5% (0.215^2) for MD ratios (without outliers). For MLR coefficients, a larger coefficient corresponds to higher mortality rates. The regression equation with outliers is: HDMR = 120.3 + β(x) where 120.3 is the intercept, β is the coefficient and x is the ratio (e.g., 5873.7 for DC ratio in Alabama). As an example of applying the equation, when keeping x constant at, say, 1000, the two equations would be as follows:

DC ratios: HDMR = 120.3 + (0.01*1000) = 130.3

MD ratios: HDMR = 120.3 + (0.04*1000) = 160.3

Consequently, DC ratios are more strongly related with lower HDMR according to the regression equation.

Limitations to the study include its design (ecological). It is assumed that states having, for example, higher MD ratios have more of their population receiving MD services. Although the ecological design tends to be weaker compared to other designs such as case control, one of its strengths is the sheer numbers involved, namely, the entire population. Validity of the ecological design is exemplified where efficacy of vaccines is communicated, that is, where charts are shown with population rates of a disease before and after introduction of the vaccine without indications that anybody in the population actually received the vaccine, though the inference is that many or most did receive it. [20]

It could be said that another limitation of the study is that it did not include other confounding variables such as socioeconomic factors. However, as indicated in the purpose statement of the article, the study was not to show what the causes or cures are for HDMR, but rather, to simply compare the associations of HDMR with DC ratios versus MD ratios.

CONCLUSION

DC ratios showed stronger relationships with lower heart disease mortality rates compared to MD ratios. Since this is an observational study, causal inference is not claimed.

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