Published in final edited form as:

J Manipulative Physiol Ther. 2011 November ; 34(9): 602–608. doi:10.1016/j.jmpt.2011.09.001.

IMMUNIZATION STATUS OF ADULT CHIROPRACTIC PATIENTS IN ANALYSES OF NATIONAL HEALTH INTERVIEW SURVEY

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Abstract

Objective—Two recent studies that examined National Health Interview Survey data reported divergent findings regarding the propensity of adult chiropractic users to receive seasonal influenza immunization. Although one study found a statistically significant negative association between chiropractic use and influenza vaccination, another found that chiropractic users were significantly more likely to be vaccinated. The purpose of this study is to extend previous works by delving more deeply into recent data to identify adult chiropractic users at high risk and high priority for vaccination against influenza and pneumococcal disease.

Methods—We used data from the 2007 National Health Interview Survey in an attempt to replicate previous methodologies and further examine vaccination among adult chiropractic users (age ≥ 18 years) who, according to the Center for Disease Control and Prevention guidelines, should receive influenza and/or pneumococcal vaccination. We used complex survey design methods to make national estimates and used logistic regression to determine if having used chiropractic care predicted vaccination.

Results—We found major methodological differences between the prior studies. In our analyses, we found that chiropractic users were significantly less likely than nonusers to have received the pneumococcal vaccine, and we found no significant difference between chiropractic users and nonusers relative to having received the seasonal flu vaccine.

Conclusions—Methodological differences in previous studies that investigated the association between chiropractic care and adult vaccination likely explain divergent findings reported in the literature. Future studies should consider these differences.

Key Indexing Terms

Chiropractic; Vaccination; Health Surveys; Preventive Health Services

The growing use of complementary and alternative medicine (CAM)^{1, 2} has spurred interest in the potential relationship between CAM use and specific health behaviors³ such as

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FUNDING SOURCES AND POTENTIAL CONFLICTS OF INTERESTS

The authors reported no conflicts of interest.

preventive vaccinations. Although some have focused on childhood vaccinations,⁴ most have examined adult influenza and pneumococcal vaccinations among adult CAM users.^{5–9}

Although numerous studies have explored the potential relationship between chiropractic care and adult vaccination, the association between chiropractic use and influenza vaccination remains unclear because of differences in study design. For instance, Stokley et al⁶ analyzed data from the 2002 National Health Interview Study (NHIS) and reported that adults who have ever used chiropractic had significantly higher adult vaccination coverage levels, when compared with those adults who have never used any CAM. However, Jones et al⁷ used 2007 NHIS data to examine influenza vaccination rates among current users of chiropractic and reported that individuals who sought chiropractic care within the past year were significantly less likely to have received the influenza vaccine (odds ratio [OR], 0.68; 95% confidence interval [CI], 0.55–0.83).⁷

Both studies^{6, 7} identified their study cohorts of interest based on the adult vaccine recommendations for prevention and control of influenza and pneumococcal disease from the Center for Disease Control and Prevention (CDC guidelines).^{10–13} The studies differed in how “chiropractic users” were defined, in the criteria used to identify high-priority adults, in analytic model design and selection of covariates, and in the selection of outcome measures (Table 1). For instance, to identify high-priority adults, Jones et al⁷ identified a study cohort of adults needing both influenza and pneumococcal vaccines based on the criteria in the CDC guidelines for adult vaccination (2007/2008 CDC criteria) and adjusted for poor health status (having one or more of select comorbidities) in their multivariable analysis, whereas Stokley et al⁶ stratified their analysis by “priority” adults (those adults meeting the 2002/1997 CDC criteria) and “nonpriority” adults.

Considering the popularity of chiropractic care in the United States,¹⁴ a potential association between using chiropractic care and lower influenza vaccination rates could have profound public health and economic impacts. Therefore, we sought to replicate the methodology used by Jones et al⁷ in their more recent study, to more closely examine the relationship between chiropractic care and the receipt of adult seasonal influenza and pneumococcal vaccination.

The purposes of this study are to (a) compare and contrast the methods used in the previous 2 studies and explore the extent to which methodological differences may explain these different findings reported in the literature (Table 1); (b) to report our attempt to reproduce the more recent Jones et al study⁷ cohort, based on replicating their study methods as published; and (c) to extend the work of Jones et al⁷ and Stokley et al⁶ by delving more deeply into recent data to identify adult chiropractic users at high risk and high priority for vaccination against influenza and pneumococcal disease.

METHODS

This study was reviewed and was determined to be exempt from institutional board review by Dartmouth College's Committee for the Protection of Human Subjects.

Study Design and Data Source

We used data from the 2007 NHIS, a nationally representative survey of the civilian, noninstitutionalized US population. In 2007, the NHIS included a supplemental questionnaire about adult respondents' use of 18 different CAM modalities. Data for our study were acquired from the NHIS Adult Core, Family Core, and CAM questionnaires.

Study Sample

We examined the 23,393 adult (age ≥ 18 years) respondents to the Adult Core questionnaire in 2007 (response rate, 78%), of whom 22 783 (97%) answered at least 1 question on the CAM questionnaire. For each of the 18 different CAM modalities (including chiropractic care), respondents were asked whether they had ever used that modality and, if so, whether they had done so in the previous 12 months. We defined a CAM user as a respondent who reported using any of the 18 different CAM modalities (excluding prayer)¹⁵ in the previous 12 months.

Measures

Chiropractic Care—For each CAM therapy, the NHIS asks whether the person “ever used” the therapy and, if so, whether the therapy was used in the previous 12 months. Specifically, in 2007, the NHIS asked whether the respondent had used “spinal manipulative therapy” (SMT). Although this item could also include spinal manipulation performed by osteopaths, physical therapists, or others, this distinction cannot be made from the available NHIS data, and all available evidence indicates that chiropractors do provide the overwhelming majority of spinal manipulative therapy services in the US health care delivery system.¹⁶ Therefore, we made the reasonable assumption, as did previous investigators, that most NHIS respondents were probably reporting their use of spinal manipulation performed by chiropractors, and we also applied the Jones et al⁷ study protocol in defining a current user of chiropractic care as a respondent that reported using spinal manipulation within the previous 12 months.

Influenza and Pneumococcal Vaccination—The NHIS asks respondents if they had received a “flu shot” or “flu spray” in the previous 12 months and asks respondents if they “ever had” the pneumococcal vaccination. For comparison with Jones et al,⁷ we used the NHIS variables for having received a flu shot in the previous 12 months and the “ever had” a pneumococcal vaccination. Although using the NHIS variable flu shot vaccination neglects those that received the flu spray, this apparently captured most influenza vaccination (only 32 NHIS respondents received a flu spray, compared with 6988 who received the flu shot).

Identification of Respondents Who Should Receive Vaccination (Study Cohort) and Covariates—We used a number of items to identify respondents who should receive either the influenza and/or the pneumococcal vaccination based on age and specific cardiovascular, respiratory, and malignancy comorbidities. We selected these items according to the CDC 2007/2008 guidelines (Table 1),^{10–13} based on the identical selection criteria reported by Jones et al,⁷ which used the 2007–08 CDC criteria for both influenza and pneumococcal immunizations. We first attempted to reproduce the Jones et al⁷ study cohort (n = 7406) based solely on replicating their study methods as published. Our first attempt at replication yielded a study cohort size of n = 7460 and required us to make numerous assumptions about several of the data management protocols used by Jones et al in their study (for identification of their study cohort as well as in correctly setting up the variables as covariates to replicate their multivariable logistic regression models). After e-mail correspondences with the authors, we were able to very nearly replicate the Jones et al NHIS starting sample (n = 22 777) and their study cohort (n = 7406).

Our starting sample (n = 22 783) approximated Jones to within 1%, and our final study cohort of n = 7574 is within 2.3% of Jones et al. The small variation between our data and that of Jones et al could have been caused by additional minor data management steps used by Jones et al to drop cases, or such discrepancies might occur based simply on default settings in the statistical software that is used, such as listwise deletion of cases with missing

values on any variables (we used SPSS [SPSS Inc., Chicago, IL] for our analyses, and Jones et al used SAS [SAS Institute Inc., Cary, NC]).

Covariate Data—We replicated for all adult NHIS respondents the covariate variables used by Jones et al,⁷ for sociodemographic characteristics of age, sex, race/ethnicity, marital status, US region of residence, and education. We used the NHIS variables for “personal earnings” and “employment status” to create a single composite measure of “Income” and categorized race and ethnicity into the following categories: “Hispanic,” “non-Hispanic white,” “non-Hispanic black or African American,” and “other or multiple races.” We extracted NHIS data to be used as covariates on access and use of health services (physician office visits, health insurance coverage) and smoking status.

Medical Comorbidities—Based on our direct e-mail correspondences with Jones et al, we used identical NHIS variables for constructing a count of comorbid medical health conditions as our covariate measure of health status during our logistic regressions that replicated the logistic regression models used by Jones et al for their hypothesis tests. We also used this same constructed comorbidities variable to specifically identify those chiropractic users with one or more of the underlying medical conditions of hypertension, heart disease, stroke, emphysema, and/or cancer. The CDC 2007/2008 guidelines identified persons with these medical comorbidities as “high priority” for receiving vaccination to prevent influenza and pneumococcal disease.

Analyses—We constructed our dataset as close as possible to that used by Jones et al.⁷ To generate national estimates, we used complex survey design procedures that account for a respondent's probability of selection and for NHIS sampling methodology. Statistical analyses were conducted using SPSS complex survey procedures to apply the NHIS sampling strata, primary sampling units, and weights. We used logistic regressions to examine the association between having used chiropractic care in the previous 12 months, with receiving either the influenza and/or pneumococcal vaccine, and adjusted for sociodemographic, health service use and access, health behavior (smoking), and health status covariates as used by Jones et al.⁷

RESULTS

We were able to very nearly reproduce the findings of Jones et al⁷ that are reported in Table 1, using weighted data and adjusting for the complex sampling frame of the NHIS. Based on our replication of the Jones et al⁷ methods and analyses, we found that chiropractic users were significantly less likely than nonusers to have received the pneumococcal vaccine, and we found no significant difference between the 2 groups in having received both flu and pneumococcal vaccines (OR, 0.91; 95% CI, 0.68–1.21). However, we found no significant difference between chiropractic users and nonusers relative to having received the seasonal flu vaccine.

For our study cohort, we replicated the Jones et al⁷ methods to identify adults who needed both influenza and pneumococcal vaccines based on the 2007/2008 CDC criteria. We determined that 74% of chiropractic users in our study cohort had one or more of the underlying medical conditions of hypertension, heart disease, stroke, emphysema, or cancer, which made them high priority for vaccination according to 2007/2008 CDC criteria. For this “high-priority” group, in particular, we wanted to gauge their compliance with CDC recommendations for seasonal influenza and/or pneumococcal vaccination and to speculate on the potential impact of a concerted chiropractic professional effort to successfully achieve universal immunization compliance among current chiropractic users with those medical comorbidities.

Among our subcohort of chiropractic users considered “high priority” because of having one or more of the above medical comorbidities, we identified those who do not receive flu vaccine or pneumococcal vaccine or both vaccines (unadjusted percentages): 44% of high-priority comorbid chiropractic users do not get vaccinated against flu, 53% of comorbid chiropractic users do not get vaccinated against pneumococcal disease, and 61% do not receive both vaccines (ie, these may get one or the other vaccine, or neither vaccine).

For speculation, we posed the following question: Presuming that the chiropractic profession was successful in achieving universal immunization compliance among this particular group of chiropractic users with medical comorbidities, how might that have potentially changed the outcome of the analyses conducted by Jones et al⁷ (and replicated by ourselves)? Our sensitivity analyses based on this speculative premise indicate profound and highly significant potential effects within the population represented by the Jones et al study cohort. Presuming universal immunization compliance just among the “highest priority” group of chiropractic users with medical comorbidities, it would have changed the overall outcomes of the Jones et al study comparing chiropractic users to nonusers to show that chiropractic users 8 times more likely to have received flu vaccine (OR, 8.0; 95% CI, 5.7–11.2), 9 times more likely to have pneumococcal vaccine (OR, 9.4; 95% CI, 6.9–12.7), and 19 times more likely to have both vaccines (OR, 19.0; 95% CI, 13.9–26).

DISCUSSION

From our analyses, it is apparent that methodological differences likely account for the previous divergent findings from 2 prior analyses^{6, 7} that used NHIS data to look at the potential relationship between chiropractic care use and preventive vaccination (Table 1). The 2 studies^{6, 7} used different CDC criteria and different years of NHIS source data and differed in their selection of comparison groups, in their operationalization of covariate variables, and in their design of regression models. The study by Stokley et al⁶ used 2002 CDC criteria and selected CAM users based on the NHIS variable “ever used chiropractic care,” whereas Jones et al⁷ used 2007 CDC criteria and selected users based on whether the modality had been used within the previous 12 months. In addition, the categorization between these 2 studies different in their model design (Stokley et al aggregated all nonchiropractic CAM users as a comparison group, whereas Jones et al compared chiropractic user with nonusers). Although both approaches appear reasonable, the differences clearly impact the results of the logistic models and offer different insights toward understanding the relationship between vaccination and use of CAM or chiropractic services.

We presented a “thought experiment” based on our replicating the methods of the Jones et al study⁷ and presuming universal vaccination compliance among adult chiropractic users with comorbid medical conditions of hypertension, heart disease, stroke, emphysema, or cancer. For our speculative “sensitivity analysis,” we were particularly interested in the group of chiropractic users with medical comorbidities for a number of reasons. First, these generally sicker individuals are at higher risk for developing serious complications from influenza or pneumococcal disease; therefore, they are identified as a very high-priority population for receiving the pneumococcal and seasonal influenza vaccines (by CDC,^{10–13} Stokley et al,⁶ and Jones et al⁷). Second, older or sicker individuals are more likely than their younger, healthier counterparts to report having a usual source of medical care.^{17–22} Because adult chiropractic users with medical comorbidities are more likely to already have an established relationship with a medical provider as their “usual source of care,” then they may also more readily follow through with their chiropractor's recommendation or their chiropractor's directed referral, for receiving adult vaccination from their regular medical provider. Third, because the risks of sicker comorbid patients developing serious complications from

influenza far outweigh the small potential risk of their receiving the vaccine, then chiropractic patients with comorbidity may be more readily convinced that preventive vaccination will benefit them directly, immediately, and profoundly. Younger or healthier individuals may perceive that they are less likely to get the flu or that they are less likely to get seriously ill if they do get the flu. In contrast to their elders, younger adults have not directly experienced past American pandemics such as polio and tuberculosis and perhaps may also be less inclined to appreciate the importance of collective benefits such as “herd immunity.” Such perceptions could partly explain why younger people are significantly and substantially less likely to be vaccinated against influenza than their older counterparts.²³ If perceptions differ between older, sicker patients vs younger, healthier patients, then effective strategies for encouraging vaccination compliance may also need to be “individualized” to specifically appeal to different types of patients with varying perceptions and motivations. For instance, younger, healthier individuals may be more responsive to information that is tailored to their particular lifestyle risk, such as reminding students and members of the active workforce of their inherent risk of exposure to vaccine-preventable disease, because of the global nature of modern commerce, education, and travel.

More research is needed to better understand underlying perceptions, motivations, and experiences that may help to explain vaccination attitudes and behaviors of both patients and their health care providers. For instance, Rose and Ayad²⁴ found interesting differences among chiropractic students in their baseline attitudes before taking a public health course, in that older chiropractic students with poorer self-reported health status were already more likely to have positive attitudes toward vaccination, compared with younger students in better health. After completion of the public health course, the younger, healthier students also demonstrated significant and more substantial positive changes in their attitudes about public health. Chiropractors and chiropractic users have historically been perceived as having “antivaccination” tendencies; however, evidence is accruing of changes over time in the personal and professional attitudes of chiropractors toward vaccination,^{24–30} and more research should be directed toward better understanding vaccination attitudes and behaviors of all health care providers,³⁰ their patients, and the general public. More research is needed as well to better understand the challenges and implications of changing recommendations for preventive vaccinations, especially because the most recent CDC guidelines for seasonal influenza recommend that all US adults should be considered “high priority” for receiving vaccination.³¹

Study Limitations

There are several limitations of this study that must be acknowledged. First, the NHIS data are self-reported and collected retrospectively. Therefore, errors may exist especially in cases where respondents were asked to recall their use of health care services up to 12 months ago; nevertheless, previous studies have shown that adult self-reported influenza vaccination is a reliable measure.^{32, 33} Second, nonresponse is a potential limitation of the data used for our study. However, in 2007, the adult response rate was excellent (78% for the Adult Core), and of these adult respondents, 97% completed the CAM supplemental questionnaire. Third, because our study was a cross-sectional design as were previous reports, we cannot establish a cause-effect relationship between using chiropractic care and adult immunization.

In addition to the aforementioned limitations inherent to survey studies, our analyses (as did those of Jones et al) relied on identifying current chiropractic users as those adults who reported using “spinal manipulation” in the previous 12 months. Therefore, these include users of osteopathic spinal manipulation. Lastly, although we were able to very nearly replicate the findings of previous reports, because of subtle differences in operational

definitions, data management strategies, and other methodological considerations, small differences may still exist.

CONCLUSION

We used the 2007 NHIS to further explore the relationship between having used chiropractic care and adult immunization, more specifically, adult influenza immunization. Our study finds that methodological differences vary widely in the literature among previous studies that have explored this relationship. These differences likely explain the divergent findings reported. In addition, the CDC's criteria used to identify adults that are “high priority” for immunization has changed considerably over the last 10 years.

Unless more universal methods are used by future studies, differences in study methodology among reports in the literature will continue to compromise our ability to draw meaningful inferences regarding this hypothesized relationship. In addition, other study designs may be better equipped to explore important aspects of this relationship in more depth. Longitudinal prospective studies are a more appropriate design for determining whether a causal relationship exists, and surveys of chiropractic patients' attitudes toward immunization would also add more relevant information to inform future research and health policy decisions.

Acknowledgments

Smith was supported by Award Number 1K01AT002391 from the National Center for Complementary and Alternative Medicine. Davis was supported by Award Number 1K01AT006162 from the National Center for Complementary and Alternative Medicine.

The views expressed herein do not necessarily represent the views of the National Center for Complementary and Alternative Medicine or the National Institutes of Health.

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Practical Applications

- Methodological differences likely account for the previous divergent findings from prior analyses that used NHIS data to look at the potential relationship between chiropractic care use and preventive vaccinations.
- Chiropractic users with medical comorbidities such as hypertension, heart disease, stroke, emphysema, or cancer are a high priority for vaccination against influenza and pneumococcal disease.

Table 1

Comparison of Stokley et al and Jones et al: disparate findings for patterns of adult vaccination in adult chiropractic users, based on analyses of NHIS data

	Stokley et al	Jones et al
NHIS data year	2002	2007
CDC high priority criteria		
Influenza	2002	2007
Pneumococcal	1997	2008
Study cohort for comparison of CAM users vs CAM nonusers	High priority Nonpriority	Need <i>both</i> vaccines (influenza and pneumococcal)
NHIS variables used to identify high-priority adults based on CDC criteria		
Age as CDC criteria for Needs FLU (<i>age</i> 50), PNEUMO (<i>age</i> 65)	Yes	Yes
Cardiovascular (coronary artery disease, myocardial infarction, other)	Yes: cardio (ever)	Yes: cardio (ever)
Stroke	No	Yes: Stroke (Ever)
Respiratory		
Flu, pneumonia:	Yes for influenza and for pneumococcal	Yes for <i>both</i> influenza and pneumococcal
History of emphysema	Emphysema (ever)	Emphysema (ever)
Chronic bronchitis	Chronic bronchitis (ever)	Chronic bronchitis (past 12 mo)
Asthma (influenza)	Yes for influenza: asthma (past 12 mo)	Yes for influenza: asthma (past 12 mo)
Cancer	Any cancer (diagnosed past 12 mo)	Leukemia, lymphoma (ever)
Kidney disease	Yes for pneumococcal	Yes for <i>both</i> influenza and pneumococcal
Liver disease	Yes for pneumococcal	Yes for pneumococcal
Diabetes	Yes for <i>both</i> influenza and pneumococcal	Yes for <i>both</i> influenza and pneumococcal
Currently pregnant	No	Yes for influenza
HIV/AIDS	No	No
Chiropractic user status	“Ever”	Past 12 mo
Other covariates		
Sociodemographics	Sex, age, race, region, education, poverty	Sex, age, race, region, education, income, marital status
Utilization/access	No. of physician visits, usual source of care, insurance	Office visits, insurance
Health behaviors	Smoking	Smoking
Health status		Comorbidities
Main findings chiropractic users		
Influenza	Priority: chiro user higher (41.7% vs 38.3%) Nonpriority: chiro user higher (15.8% vs 12.0%)	Chiro user lower; OR, 0.68 (95% CI, 0.55–0.83)
Pneumococcal	Priority: chiro user higher (40.3% vs 32.6%) Nonpriority: chiro user higher (6.9% vs 4.5%)	Chiro user lower; OR, 0.76 (95% CI, 0.61–0.95)

HIV indicates human immunodeficiency syndrome; AIDS, acquired immunodeficiency syndrome.