Somatic Dysfunction and Use of Osteopathic Manual Treatment Techniques During Ambulatory Medical Care Visits: A CONCORD-PBRN Study

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Context: Osteopathic manual treatment (OMT) of somatic dysfunction is a unique approach to medical care that may be studied within a practice-based research network.

Objective: To measure patient characteristics and osteopathic physician practice patterns within the Consortium for Collaborative Osteopathic Research Development–Practice-Based Research Network (CONCORD-PBRN).

Design: Cross-sectional card study.

Setting: Eleven member clinics within the CONCORD-PBRN coordinated by The Osteopathic Research Center.

Patients: A total of 668 patients seen between January and March 2013.

Main Study Measures: Patient age and sex; primary diagnoses; somatic dysfunction as manifested by tenderness, asymmetry, restricted motion, or tissue texture changes; and use of 14 OMT techniques. Results were stratified by anatomical region and adjusted for clustering within member clinics. Clustering was measured by the intracluster correlation coefficient.

Results: Patient ages ranged from 7 days to 87 years (adjusted mean age, 49.2 years; 95% confidence interval [CI], 43.3-55.1 years). There were 450 females (67.4%) and 508 patient visits (76.0%) involved a primary diagnosis of disease of the musculoskeletal system and connective tissue. Structural examination was performed during 657 patient visits (98.4%), and 649 visits (97.2%) involved OMT. Restricted motion and tenderness were the most and least common palpatory findings, respectively. Cranial (1070 [14.5%]), myofascial release (1009 [13.7%]), muscle energy (1001 [13.6%]), and counterstrain (980 [13.3%]) techniques were most commonly used, accounting for more than one-half of the OMT provided. Pediatric patients were more likely than adults to receive OMT within the head (adjusted odds ratio [OR], 9.53; 95% CI, 1.28-71.14). Geriatric patients were more likely than adults to receive a structural examination (adjusted OR, 1.83; 95% CI, 1.09-3.07) and OMT (adjusted OR, 1.62; 1.02-2.59) within the lower extremity. Females were more likely than males to receive a structural examination (adjusted OR, 2.44; 95% CI, 1.44-4.16) and OMT (adjusted OR, 2.11; 95% CI, 1.26-3.52) within the sacrum and OMT within the pelvis (adjusted OR, 1.79; 95% CI, 1.12-2.88). Intracluster correlation coefficients for the 4 most commonly used OMT techniques ranged from 0.34 to 0.72.

Conclusion: This study provides proof of concept of the feasibility of studying osteopathic medical practice on a national level by developing and growing the CONCORD-PBRN.

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Somatic dysfunction is defined as "impaired or altered function of related components of the somatic (body framework) system: skeletal, arthrodial, and myofascial structures, and related vascular, lymphatic, and neural elements."[1] Somatic dysfunction may be encountered in a variety of medical conditions, including musculoskeletal disorders and systemic diseases, that are managed by osteopathic physicians in primary care settings.[2] The structural examination for palpatory findings associated with somatic dysfunction represents a fundamental and uniquely osteopathic approach to clinical practice. Such findings guide osteopathic manual treatment (OMT), which is the therapeutic application of manually guided forces to improve physiologic function and/or support homeostasis that has been altered by somatic dysfunction.[1] Clinical trials using rigidly defined and executed protocols have studied the efficacy of OMT in treating patients with such medical conditions during the past 2 decades.[3] This research has demonstrated the efficacy of OMT in treating patients with chronic low back pain[4,5] and has contributed evidence to establish and support the American Osteopathic Association's clinical guidelines for OMT in patients with low back pain.[6]

There has been a recent move to assess clinical interventions such as OMT more pragmatically by determining their effectiveness and utility during actual patient encounters rather than in tightly controlled trials.[7] Such research is often conducted in medical practices wherein patients may not represent a homogeneous target population, and treatment delivery and adherence may vary across physicians and their patients. Along these lines, within the osteopathic medical profession, there have been calls for research involving the assembly of an inception cohort of patients to be followed longitudinally to study the natural history of somatic dysfunction and the effectiveness of OMT.[8,9] However, to date, only cross-sectional data on somatic dysfunction and OMT have been collected in clinical practice settings. A study of 1331 consecutive patient visits within 3 family practice clinics affiliated with a college of osteopathic medicine found that somatic dysfunction was documented in about one-third of patient visits and managed with OMT in one-fourth of visits.[10] Although the investigators reported impressive responses to OMT immediately after treatment, no follow-up data were collected.[10]

Practice-based research networks (PBRNs) represent another option for collecting potentially large volumes of clinical data on patient encounters. The strategies for planning and launching PBRN research involve consideration of clinic site selection, clinician and staff training, study feasibility, and budgeting issues.[11] Card studies are commonly implemented in PBRNs to collect cross-sectional data on the prevalence of patient conditions or other aspects of clinical care. Card studies engage clinicians and staff in the research process and are cost-effective in generating research data quickly.[12] More intensive research efforts, such as the development of longitudinal patient cohorts, may also be based within PBRNs.[13]

Initial planning for the Consortium for Collaborative Osteopathic Research Development–Practice-Based Research Network (CONCORD-PBRN) began in 2007 at The Osteopathic Research Center. The CONCORD-PBRN is an emerging national research network that focuses on the delivery of osteopathic medical care in ambulatory settings, including the integration of OMT within primary care. It presently consists of 16 member clinics and has been certified as a primary care research network by the Agency for Healthcare Research and Quality since 2011.[14] A unique aspect of the CONCORD-PBRN that distinguishes it from most other PBRNs is the research training received by member clinic physicians prior to their participating in any studies. The current article presents the results of the card study that was designed to initially measure patient characteristics and physician practice patterns relating to the structural examination for somatic dysfunction and the use of OMT within the CONCORD-PBRN.

Methods

The establishment of the CONCORD-PBRN has been previously described.[15] Planning for this study was initiated and coordinated by The Osteopathic Research Center at the University of North Texas Health Science Center at Fort Worth (UNTHSC). All study procedures were centrally reviewed and received exempt status from the Institutional Review Board at the UNTHSC. Additional exemptions or approvals were sought and acquired when required by the local institutional review boards overseeing the participating member clinics. The 11 (69%) of 16 CONCORD-PBRN member clinics that participated in the study were dispersed across the eastern, central, and western United States (*eFigure 1*). Of the 5 non-participating member clinics, 2 clinics were ineligible for the present study because their clinician investigators were not osteopathic physicians; 2 clinics could not participate because their osteopathic physician investigators were in the process of career relocations, and 1 clinic did not participate because of competing demands for the osteopathic physician investigator's time during the study period.

One osteopathic physician at each of the 11 participating member clinics contributed patient visit observations to the study. Each of these physicians completed 162-contact hours of instruction in research methodology at The Osteopathic Research Center during 2011 to ensure optimal study protocol implementation and fidelity in data collection.[15] These physicians included 9 patient-centered research fellows, a regional director, and the associate director of the CONCORD-PBRN. Each physician was asked to collect data on up to 100 consecutive patient visits during 4 weeks within the broader study period of January to March 2013 using preprinted cards supplied by The Osteopathic Research Center. The physicians were instructed to complete each card immediately after the visit without any involvement of the patient. The physicians were further instructed to aggregate cards in daily envelopes, place daily envelopes in a designated study receptacle, and return 5 daily envelopes to The Osteopathic Research Center in weekly prepaid envelopes.

The study cards were developed in 2011 by The Osteopathic Research Center in conjunction with its patient-centered research fellows and directors of its CONCORD-PBRN. The cards were designed to collect data on patient age and sex, as well as the primary, secondary, and tertiary diagnosis codes for the patient visit based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM).[16] Data collection also included the appropriate codes for region of somatic dysfunction on the structural examination and subsequent use of OMT.[16] The structural examination findings were recorded using the TART elements of somatic dysfunction (tenderness, asymmetry, restricted motion, tissue texture changes) within each of 9 anatomical regions (head, cervical, thoracic, lumbar, sacrum, pelvis, lower extremity, upper extremity, and ribs).[1] The use of 14 OMT techniques (in some cases also known as *osteopathic manipulative treatment systems*[1]) within each of these 9 anatomical regions was also measured. The OMT techniques used in other anatomical regions were recorded but not specifically assigned to any region.

Dual keyboard data entry was performed by 2 independent staff members at The Osteopathic Research Center. Each data set was compared, and discrepant entries were identified and assessed by a panel of 3 reviewers, including 2 of the authors (J.C.L. and C.M.K.). These discrepant data entries were resolved by consensus or majority opinion. Subsequently, 1 of the authors (J.C.L.) performed additional reviews and analyses to check for internal inconsistencies within each card (eg, reporting a structural examination finding within an anatomical region while also indicating that the relevant region was not examined). The rates of errors were <1 per 1000 for keyboard data entries and <1 per 16,000 for internal inconsistencies. Patient age and sex were not reported for 3 (0.4%) and 14 (2.1%) patient visits, respectively. Missing ages were estimated from the primary, secondary, and tertiary diagnosis codes; however, sex could not be inferred from these codes. Therefore, missing sex designations were subsequently imputed using a regression model based on patient age and member clinic.

Standard descriptive statistics were used to summarize the overall and member clinic–specific results. Patient age was also trichotomized as pediatric, 17 years or younger; adult, 18 to 64 years; or geriatric, 65 years or older. The diagnosis codes were aggregated and categorized at the organ system level prior to analysis. Results were subsequently adjusted for clustering according to member clinic using generalized mixed modeling methods. Results were not weighted by number of patient visits at each member clinic because there were no pre-existing network data to support the hypothesis of equality of patient volume across member clinics. Multiple logistic regression analysis was used to compute age- and sex-specific odds ratios (ORs) and 95% confidence intervals (CIs) for performance of a structural examination and use of OMT techniques within each anatomical region while simultaneously adjusting for member clinic. Clustering of patient characteristics and physician use of the various OMT techniques within member clinics was estimated by the intracluster correlation coefficient based on linear regression modeling with member clinic random effects.[17] The intracluster correlation coefficients were then used to compute the design effects for future research planning considerations.[18] The design effect represents the sample size inflation factor attributable to clustering of patient characteristics or physician use of the various OMT techniques within member clinics. Data entry and analyses were primarily performed with the SPSS version 19 software package (IBM Corporation) using 2-sided hypothesis tests at the .05 level of statistical significance.

Results

A total of 668 patient visits were recorded and summarized using the study cards. The patient ages ranged from 7 days to 87 years (adjusted mean age, 49.2 years; 95% CI, 43.3-55.1 years). There were 20 pediatric patients (3.0%), 477 adult patients (71.4%), and 171 geriatric patients (25.6%). There were 450 females (67.4%; adjusted mean percentage, 67.1%; 95% CI, 59.2%-74.9%). Patient age and sex are summarized according to member clinic in *Table 1*. The primary diagnoses are summarized in *eTable 1*. A total of 508 patient visits (76.0%) involved a primary diagnosis of disease of the musculoskeletal system and connective tissue (adjusted mean percentage, 74.9%; 95% CI, 62.6%-87.2%).

Table 1.
Patient Age and Sex According to Member Clinic

Member Clinic	n	Age, y, Mean (95% CI)	Female, Mean % (95% CI)
A	33	50.2 (44.5-56.6)	48.5 (30.5-66.5)
B	100	49.9 (46.3-53.4)	61.0 (51.3-70.7)
C	54	49.6 (43.6-55.6)	68.5 (55.7-81.3)
D	62	54.4 (50.3-58.5)	66.1 (54.0-78.2)
E	100	47.5 (44.8-50.3)	70.0 (60.9-79.1)
F	67	46.7 (41.3-52.2)	89.6 (82.0-97.1)
G	59	55.4 (52.0-58.9)	71.2 (59.3-83.1)
H	60	27.6 (25.9-29.3)	53.3 (40.3-66.3)
I	93	62.1 (59.5-64.8)	67.7 (58.1-77.4)
J	21	44.1 (36.9-51.4)	57.1 (34.1-80.2)
K	19	53.1 (42.4-63.7)	84.2 (66.2-100.0)
Overall (unadjusted)	**668**	**49.7 (48.3-51.1)**	**67.4 (63.8-70.9)**
Overall (adjusted)[a]	**668**	**49.2 (43.3-55.1)**	**67.1 (59.2-74.9)**

[a] Adjusted for clustering of patient age and sex within each member clinic.

Abbreviation: CI, confidence interval.

A structural examination was performed during 657 patient visits (98.4%), and 649 visits (97.2%) involved OMT. The adjusted results for performance of a structural examination and use of OMT according to anatomical region are summarized in *Figure 1*. The thoracic region was most often examined (633 [94.8%]) and treated (614 [91.9%]), whereas the upper extremity was least often examined (367 [54.9%]) and treated (345 [51.6%]). The adjusted results for presence of TART findings according to anatomical region are summarized in *Figure 2*. These ranged from restricted motion in the cervical region (572 [94.5%]) to tenderness in the sacrum (314 [58.5%]). Restricted motion and tenderness were consistently the most and least common TART findings, respectively, across all anatomical regions.

A total of 7387 OMT techniques were delivered across all anatomical regions during the 668 patient visits (mean number of OMT techniques per patient visit, 11.1). The overall frequency of use of each technique is presented in *Figure 3*. Cranial (1070 [14.5%]), myofascial release (1009 [13.7%]), muscle energy (1001 [13.6%]), and counterstrain (980 [13.3%]) techniques were most commonly used, accounting for more than half of the OMT provided. High-velocity, low-amplitude thrusts (227 [3.1%]) and the other remaining techniques were less frequently used. The use of cranial, myofascial release, muscle energy, and counterstrain techniques according to anatomical region is displayed in *Figure 4*. Cranial techniques were predominantly used in the head and sacrum, whereas myofascial release and muscle energy techniques were predominantly used in the cervical, thoracic, and lumbar regions.

The adjusted patient age-specific results for performance of a structural examination and use of OMT techniques according to anatomical region are presented in *Table 2*. Relatively few statistically significant associations were observed within the pediatric age group, and those that were observed were imprecise because of the small number of observations therein. Pediatric patients were more likely than adults to receive OMT within the head (adjusted OR, 9.53; 95% CI, 1.28-71.14). Pediatric patients were also less likely to receive a structural examination (adjusted OR, 0.20; 95% CI, 0.06-0.64) and OMT (adjusted OR, 0.17; 95% CI, 0.05-0.58) within the ribs and were less likely to receive lumbar OMT (adjusted OR, 0.12; 95% CI, 0.02-0.99). Geriatric patients

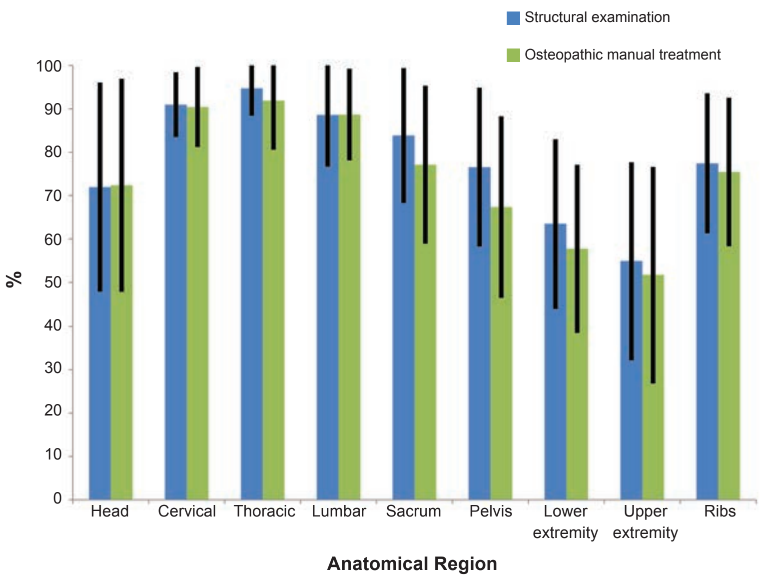

Figure 1. Percentage of ambulatory medical care visits that included a structural examination for somatic dysfunction or osteopathic manual treatment according to anatomical region (N=668). The mean percentages and 95% confidence intervals (represented by the error bars) were adjusted for clustering within each member clinic.

Table 2.
Performance of Structural Examination and Use of OMT According to Patient Age Group[a] and Anatomical Region

Anatomical Region	Adult (n=477), No. (%)	Pediatric (n=20)		Geriatric (n=171)	
		No. (%)	OR (95% CI)[b]	No. (%)	OR (95% CI)[b]
Structural Examination Performed					
Head	326 (68.3)	16 (80.0)	1.83 (0.29-11.64)	132 (77.2)	0.33 (0.15-0.73)[c]
Cervical	429 (89.9)	19 (95.0)	0.90 (0.10-8.51)	157 (91.8)	0.63 (0.30-1.30)
Thoracic	444 (93.1)	19 (95.0)	0.58 (0.06-5.81)	161 (94.2)	0.58 (0.24-1.41)
Lumbar	399 (83.6)	18 (90.0)	0.39 (0.05-2.99)	159 (93.0)	1.63 (0.77-3.45)
Sacrum	372 (78.0)	16 (80.0)	0.21 (0.04-1.12)	149 (87.1)	1.19 (0.62-2.29)
Pelvis	341 (71.5)	15 (75.0)	0.95 (0.26-3.50)	135 (78.9)	1.23 (0.71-2.13)
Lower extremity	272 (57.0)	12 (60.0)	1.16 (0.36-3.71)	127 (74.3)	1.83 (1.09-3.07)[c]
Upper extremity	264 (55.3)	10 (50.0)	0.95 (0.27-3.42)	106 (62.0)	0.63 (0.37-1.07)
Ribs	355 (74.4)	10 (50.0)	0.20 (0.06-0.64)[c]	144 (84.2)	0.96 (0.55-1.68)
OMT Used					
Head	325 (68.1)	18 (90.0)	9.53 (1.28-71.14)[c]	138 (80.7)	0.68 (0.29-1.57)
Cervical	425 (89.1)	18 (90.0)	0.33 (0.05-2.30)	159 (93.0)	0.70 (0.32-1.53)
Thoracic	425 (89.1)	18 (90.0)	0.26 (0.03-2.27)	162 (94.7)	0.58 (0.22-1.48)
Lumbar	406 (85.1)	17 (85.0)	0.12 (0.02-0.99)[c]	158 (92.4)	1.33 (0.64-2.78)
Sacrum	355 (74.4)	16 (80.0)	0.13 (0.02-1.02)	146 (85.4)	1.13 (0.61-2.10)
Pelvis	317 (66.5)	12 (60.0)	0.43 (0.11-1.76)	126 (73.7)	1.09 (0.64-1.87)
Lower extremity	253 (53.0)	8 (40.0)	0.27 (0.07-1.12)	113 (66.1)	1.62 (1.02-2.59)[c]
Upper extremity	256 (53.7)	8 (40.0)	0.35 (0.08-1.58)	106 (62.0)	0.73 (0.42-1.29)
Ribs	357 (74.8)	10 (50.0)	0.17 (0.05-0.58)[c]	144 (84.2)	0.97 (0.54-1.73)

[a] Age was trichotomized as pediatric, ≤17 years; adult, 18-64 years; or geriatric, ≥65 years.
[b] Odds ratios (ORs) and 95% confidence intervals (CIs) were adjusted for member clinic.
[c] $P<.05$.

Abbreviation: OMT, osteopathic manual treatment.

were less likely than adults to receive a structural examination of the head (adjusted OR, 0.33; 95% CI, 0.15-0.73). However, geriatric patients were more likely to receive a structural examination (adjusted OR, 1.83; 95% CI, 1.09-3.07) and OMT (adjusted OR, 1.62; 95% CI, 1.02-2.59) within the lower extremity.

The adjusted patient sex-specific results for performance of a structural examination and use of OMT techniques according to anatomical region are presented in *Table 3*. Females were more likely than males to receive a structural examination (adjusted OR, 2.44; 95% CI, 1.44-4.16) and OMT (adjusted OR, 2.11; 95% CI, 1.26-

Table 3.
Performance of Structural Examination and Use of OMT According to Patient Sex and Anatomical Region

Anatomical Region	Male (n=218), No. (%)	Female (n=450)	
		No. (%)	OR (95% CI)[a]
Structural Examination Performed			
Head	141 (64.7)	333 (74.0)	0.90 (0.50-1.64)
Cervical	194 (89.0)	411 (91.3)	1.19 (0.65-2.18)
Thoracic	201 (92.2)	423 (94.0)	0.94 (0.47-1.88)
Lumbar	182 (83.5)	394 (87.6)	1.08 (0.62-1.87)
Sacrum	158 (72.5)	379 (84.2)	2.44 (1.44-4.16)[b]
Pelvis	150 (68.8)	341 (75.8)	1.52 (0.94-2.46)
Lower extremity	121 (55.5)	290 (64.4)	1.22 (0.79-1.90)
Upper extremity	117 (53.7)	263 (58.4)	0.90 (0.57-1.43)
Ribs	152 (69.7)	357 (79.3)	1.25 (0.80-1.95)
OMT Used			
Head	143 (65.6)	338 (75.1)	0.87 (0.46-1.65)
Cervical	195 (89.4)	407 (90.4)	0.93 (0.50-1.75)
Thoracic	193 (88.5)	412 (91.6)	0.82 (0.43-1.57)
Lumbar	184 (84.4)	397 (88.2)	1.11 (0.64-1.94)
Sacrum	151 (69.3)	366 (81.3)	2.11 (1.26-3.52)[b]
Pelvis	134 (61.5)	321 (71.3)	1.79 (1.12-2.88)[b]
Lower extremity	110 (50.5)	264 (58.7)	1.22 (0.81-1.84)
Upper extremity	119 (54.6)	251 (55.8)	0.73 (0.45-1.17)
Ribs	155 (71.1)	356 (79.1)	1.10 (0.70-1.72)

[a] Odds ratios (ORs) and 95% confidence intervals (CIs) were adjusted for member clinic.
[b] $P<.05$.

Abbreviation: OMT, osteopathic manual treatment.

3.52) within the sacrum. Females were also more likely to receive OMT within the pelvis (adjusted OR, 1.79; 95% CI, 1.12-2.88).

The intracluster correlation coefficients and design effects are presented in *Table 4*. These results indicate that there was more clustering within member clinics by age or age category than by sex. Generally, there was also more clustering within member clinics for physician use of the various OMT techniques than for patient demographic characteristics. Clustering was generally greatest for the most commonly used OMT techniques. Overall, *Table 4* demonstrates that even relatively low levels of clustering (eg, as reflected by intracluster correlation coefficients <0.10) will substantially inflate the sample size needed to test research hypotheses.

Comment

The mean patient age and percentages of pediatric, adult, and geriatric patients reported herein suggest that the CONCORD-PBRN generally reflects geriatric patient visits but overrepresents adult patient visits relative to pediatric patient visits when compared with national estimates.[19] The CONCORD-PBRN also appears to overrepresent female patient visits relative to male patient visits.[19] Nevertheless, these national estimates[19] are approximated by the lower ends of our member clinic–adjusted 95% CIs for patient age and female sex (*Table 1*). We cannot determine the impact, if any, of the 5 nonparticipating member clinics on the patient age and sex parameters of the CONCORD-PBRN.

About three-fourths of patient visits involved primary diagnoses of diseases of the musculoskeletal system and connective tissue. Although this distribution of diagnoses may help explain the almost universal performance of structural examinations and use of OMT in this study, it does not appear to be representative of primary care. Nevertheless, our study provides insight on the structural examination findings and use of OMT techniques that may be observed if a more strictly osteopathic approach was implemented in the treatment of patients with musculoskeletal disorders and related conditions that may be encountered in primary care.

Our study generally found a similar pattern of somatic dysfunction across anatomical regions, most often manifested by restricted motion, less often by asymmetry and tissue texture changes, and least often by tenderness.

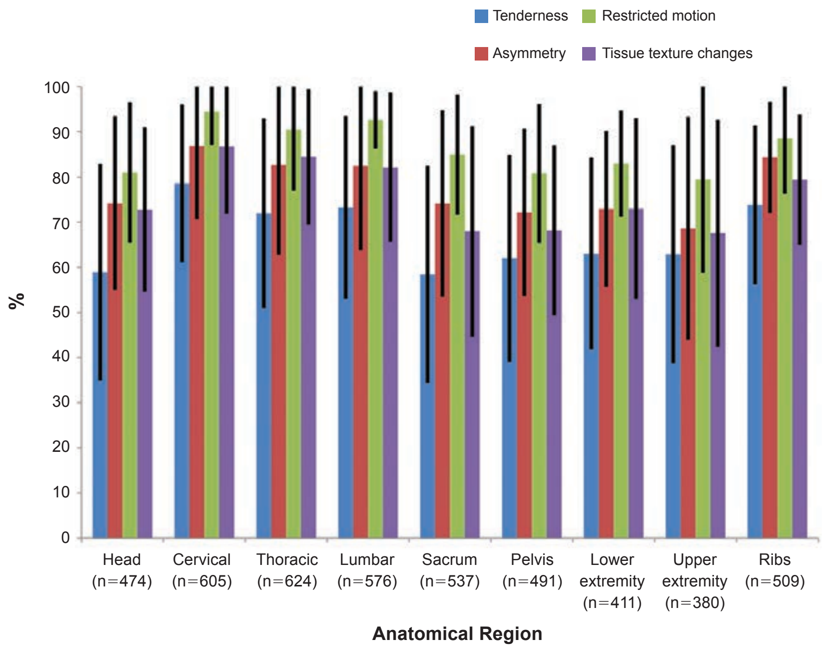

Figure 2.
Presence of TART (tenderness, asymmetry, restricted motion, tissue texture changes) findings according to anatomical region. The numbers indicate the frequency of structural examination of each anatomical region during the 668 patient visits. Structural examination of an anatomical region was considered to have been performed if any of the TART elements was assessed. The mean percentages and 95% confidence intervals (represented by the error bars) were adjusted for clustering within each member clinic.

Cranial, myofascial release, muscle energy, and counterstrain were the most commonly used OMT techniques, accounting for more than one-half of the OMT provided. Use of the various OMT techniques in our study, particularly high use of cranial techniques and low use of high-velocity, low-amplitude thrusts, was discordant with reported results from a national survey of osteopathic physicians in 1998.[20] It is unclear to what degree, if any, these differences are attributable to evolving curricular content at colleges of osteopathic medicine and osteopathic postdoctoral training institutions or to clinical practice patterns. Alternatively, our results may simply reflect the unique OMT technique preferences of osteopathic physicians in the CONCORD-PBRN. For example, 4 of the 11 osteopathic physicians used cranial OMT techniques in 85% or more of patient visits.

The finding of increased OMT use within the head in pediatric patients is consistent with osteopathic philosophy relating to detection and management of somatic dysfunction in the developmental stages of infancy. It is

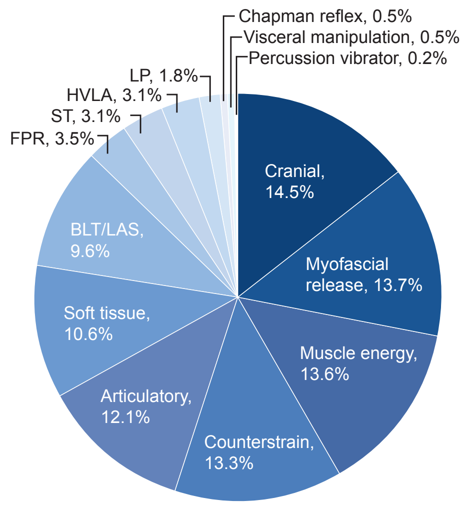

Figure 3.
Frequency of use of osteopathic manual treatment (OMT) techniques. The frequencies are based on the 7387 OMT techniques that were delivered across all anatomical regions during the 668 patient visits. *Abbreviations:* BLT/LAS, balanced ligamentous tension/ligamentous articular strain; FPR, facilitated positional release; HVLA, high-velocity, low-amplitude thrust; LP, lymphatic pump; ST, Still technique.

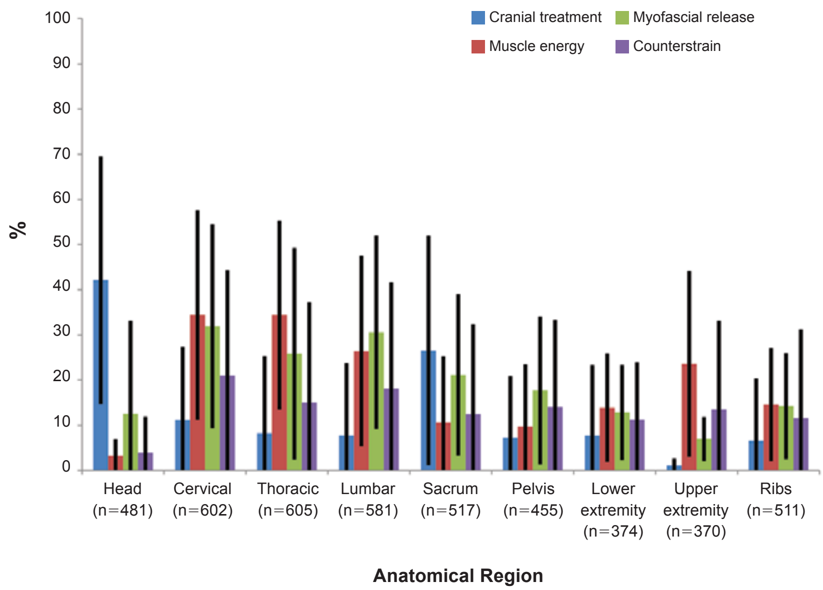

Figure 4. Use of common osteopathic manual treatment (OMT) techniques according to anatomical region. The numbers indicate the frequency of OMT use within each anatomical region during the 668 patient visits. Osteopathic manual treatment was considered to have been used if any of the 14 studied techniques was provided. The mean percentages and 95% confidence intervals (represented by the error bars) were adjusted for clustering within each member clinic.

unclear if the findings of decreased examination of and treatment applied to the ribs and decreased treatment applied to the lumbar region among pediatric patients are coincidental because of the small sample size of this group or if they represent a differential approach to the examination and treatment of pediatric patients. The increased OMT use within the lower extremity in geriatric patients may reflect the treatment of patients with musculoskeletal disorders, including falls or other injuries. Additionally, this increased OMT use may represent a uniquely osteopathic approach to the management of complications of such common chronic diseases as diabetes mellitus, atherosclerosis and other circulatory diseases, and congestive heart failure. There is no apparent clinical explanation for decreased structural examination of the head in geriatric patients, although the latter may have been attributable to some degree to statistical adjustment for member clinics. Increased structural examination and OMT of the sacrum and increased OMT of the pelvis in females likely reflects treatment of patients with common conditions such as low back pain and possibly a uniquely osteopathic approach to management of reproductive health issues or gynecologic conditions.

The present study represents an initial attempt to describe the patient characteristics and physician practice patterns of the CONCORD-PBRN. This study provides proof of concept of the feasibility of studying osteopathic medical practice on a national level by further developing and growing the CONCORD-PBRN. The results reported herein relating to patient age and sex indicate that larger studies are needed to counter the clustering within member clinics. They also seriously bring into question the feasibility of conducting pediatric research within the CONCORD-PBRN. Future studies that focus on particular OMT techniques may need substantially greater numbers of patients based on the observed intracluster correlations and design effects. However, it is important to note that much of the clustering within member clinics (particularly relating to use of OMT techniques) was probably self-imposed by our research protocol, which limited data collection at each member clinic to a lone trained physician. The next step in advancing research within the CONCORD-PBRN will involve increasing the number of member clinics and the number of investigators within each member clinic, thereby increasing the number and representativeness of

Table 4.
Intracluster Correlation Coefficients and Design Effects for Patient Demographic and Physician Practice Characteristics

Characteristic	ICC	D
Age, y	0.22	14
Age Group	0.10	7
Sex	0.04	3
Use of OMT Techniques[a]		
Cranial treatment	0.72	44
Myofascial release	0.41	25
Muscle energy	0.34	21
Counterstrain	0.54	33
Articulatory	0.69	42
Soft tissue	0.45	28
BLT/LAS	0.54	33
Facilitated positional release	0.47	29
Still technique	0.36	23
HVLA thrust	0.24	16
Lymphatic pump	0.31	19
Chapman reflex	0.10	7
Visceral manipulation	0.13	9
Percussion vibrator	0.00	1

[a] Based on a dichotomous variable measuring whether or not the technique was used during a patient visit.

Abbreviations: BLT/LAS, balanced ligamentous tension/ligamentous articular strain; D, design effect; HVLA, high-velocity, low-amplitude; ICC, intracluster correlation coefficient; OMT, osteopathic manual treatment.

patients. The Osteopathic Research Center has proposed a hub-and-spoke model for growth of the CONCORD-PBRN wherein the member clinics housing its patient-centered research fellows, including most investigators in this study, are designated Level 1 clinics.[15] These fellows will establish and develop secondary hubs by building research relationships with other clinician investigators within their geographical spheres and by providing local oversight and coordination of these investigators. This strategy will promote physician specialty diversification within primary care and exponential growth of the CONCORD-PBRN patient base, thereby enabling it to develop a more representative population of patients and to achieve much larger sample sizes. Achievement of these objectives will facilitate the performance of substantive longitudinal research within the CONCORD-PBRN.

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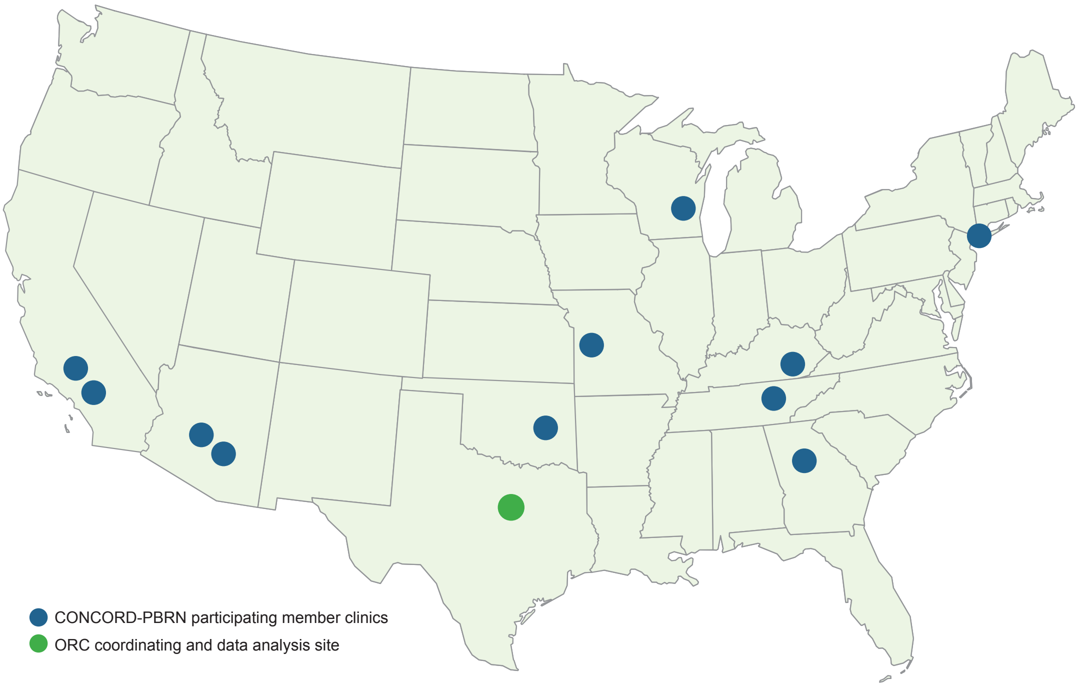
References

1. Education Council on Osteopathic Principles. *Glossary of Osteopathic Terminology*. Chevy Chase, MD: American Association of Colleges of Osteopathic Medicine; 2009.
2. Nelson KE, ed; Glonek T, associate ed. *Somatic Dysfunction in Osteopathic Family Medicine*. Baltimore, MD: Lippincott Williams & Wilkins; 2007.
3. Licciardone JC. Responding to the challenge of clinically relevant osteopathic research: efficacy and beyond. *Int J Osteopath Med*. 2007;10(1):3-7.
4. Licciardone JC, Minotti DE, Gatchel RJ, Kearns CM, Singh KP. Osteopathic manual treatment and ultrasound therapy for chronic low back pain: a randomized controlled trial. *Ann Fam Med*. 2013;11(2):122-129. doi:10.1370/afm.1468.
5. Licciardone JC, Kearns CM, Minotti DE. Outcomes of osteopathic manual treatment for chronic low back pain according to baseline pain severity: results from the OSTEOPATHIC Trial [published online June 10, 2013]. *Man Ther*. 2013;18(6):533-540. doi:10.1016/j.math.2013.05.006.
6. Clinical Guideline Subcommittee on Low Back Pain. American Osteopathic Association guidelines for osteopathic manipulative treatment (OMT) for patients with low back pain. *J Am Osteopath Assoc*. 2010;110(11):653-666.
7. National Center for Complementary and Alternative Medicine. *Exploring the Science of Complementary and Alternative Medicine: Third Strategic Plan, 2011-2015*. Bethesda, MD: National Institutes of Health; 2011.
8. Licciardone JC. Osteopathic research: elephants, enigmas, and evidence. *Osteopath Med Prim Care*. 2007;1:7.
9. Licciardone JC. Time for the osteopathic profession to take the lead in musculoskeletal research. *Osteopath Med Prim Care*. 2009;3(1):6. doi:10.1186/1750-4732-3-6.
10. Licciardone JC, Nelson KE, Glonek T, Sleszynski SL, Cruser dA. Osteopathic manipulative treatment of somatic dysfunction among patients in the family practice clinic setting: a retrospective analysis. *J Am Osteopath Assoc*. 2005;105(12):537-544.
11. Graham DG, Spano MS, Stewart TV, Staton EW, Meers A, Pace WD. Strategies for planning and launching PBRN research studies: a project of the Academy of Family Physicians National Research Network (AAFP NRN). *J Am Board Fam Med*. 2007;20(2):220-228.
12. Westfall JM, Zittleman L, Staton EW, et al. Card studies for observational research in practice. *Ann Fam Med*. 2011;9(1):63-68. doi:10.1370/afm.1199.
13. Sloane PD, Callahan L, Kahwati L, Mitchell CM. Development of a practice-based patient cohort for primary care research. *Fam Med*. 2006;38(1):50-57.
14. Consortium for Collaborative Osteopathic Research Development Practice-Based Research Network. Agency for Healthcare Research and Quality website. http://pbrn.ahrq.gov/pbrn-registry/consortium-collaborative-osteopathic-research-development-practice-based-research. Accessed July 1, 2013.
15. Licciardone JC, Kearns CM. A new triadic paradigm for osteopathic research in real-world settings. *J Am Osteopath Assoc*. 2012;112(7):447-456.
16. Snider KT, Jorgensen DJ. Billing and coding for osteopathic manipulative treatment. *J Am Osteopath Assoc*. 2009;109(8):409-413.
17. Dickinson LM, Basu A. Multilevel modeling and practice-based research. *Ann Fam Med*. 2005;3 suppl 1:S52-S60.
18. Campbell MK, Mollison J, Steen N, Grimshaw JM, Eccles M. Analysis of cluster randomized trials in primary care: a practical approach. *Fam Pract*. 2000;17(2):192-196.
19. National Center for Health Statistics. *2010 NAMCS Micro-Data File Documentation*. Atlanta, GA: Centers for Disease Control and Prevention. ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NAMCS/doc2010.pdf. Accessed July 1, 2013.
20. Johnson SM, Kurtz ME. Osteopathic manipulative treatment techniques preferred by contemporary osteopathic physicians. *J Am Osteopath Assoc*. 2003;103(5):219-224.

Editor's Note: In this article, the authors use the term *osteopathic manual treatment* to describe the techniques used to treat patients with somatic dysfunction. The style guidelines of *The Journal of the American Osteopathic Association* and AOA policy prefer the term *osteopathic manipulative treatment*. Given the context of this article, the authors believe that the term *osteopathic manual treatment* is more appropriate because it is more encompassing than *osteopathic manipulative treatment*.



eFigure 1.
Geographical distribution of the 11 Consortium for Collaborative Osteopathic Research Development–Practice-Based Research Network (CONCORD-PBRN) member clinics that participated in the study. *Abbreviation:* ORC, The Osteopathic Research Center.

eTable 1.
Primary Diagnoses During Patient Visits

ICD-9-CM Code	No. (%)
Diseases of the musculoskeletal system and connective tissue	508 (76.0)[a]
Diseases of the nervous system and sense organs	43 (6.4)
Symptoms, signs, and ill-defined conditions	27 (4.0)
Injury and poisoning	24 (3.6)
Mental disorders	13 (1.9)
Diseases of the digestive system	10 (1.5)
Diseases of the circulatory system	9 (1.3)
Diseases of the respiratory system	7 (1.0)
Congenital anomalies	7 (1.0)
Diseases of the skin and subcutaneous tissue	2 (0.3)
Endocrine, nutritional and metabolic diseases, and immunity disorders	8 (1.2)
Neoplasms	5 (0.7)
Diseases of the genitourinary system	3 (0.4)
Complications of pregnancy, childbirth, and the puerperium	2 (0.3)
Total	**668 (100.0)**

[a] The mean percentage (95% confidence interval) for diseases of the musculoskeletal system and connective tissue was 74.9% (62.6%-87.2%) after adjusting for clustering within each member clinic.

Abbreviation: ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.