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Characteristics and treatment of geriatric patients in an osteopathic neuromusculoskeletal medicine clinic

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Abstract

Context: Osteopathic manipulative medicine (OMM) is an adjunctive treatment approach available to geriatric patients, but few studies provide details about presenting conditions, treatments, and response to osteopathic manipulative treatment (OMT) in that patient population.

Objectives: To provide descriptive data on the presentation and management of geriatric patients receiving OMT at an outpatient osteopathic neuromusculoskeletal medicine (ONMM) clinic.

Methods: Data were retrospectively collected from electronic health records (EHR) at a single outpatient clinic for clinical encounters with patients over 60 years of age who were treated with OMT between July 1, 2016, and June 30, 2019. Records were reviewed for demographic information, insurance type, presenting concerns, assessments, regions treated, OMT techniques used, and treatment response.

Results: There were 9,155 total clinical encounters with 1,238 unique patients found during the study period. More women than men were represented for overall encounters (6,910 [75.4%] vs. 2,254 [24.6%]) and unique patients (850 [68.7%] vs. 388 [31.3%]; both $p < 0.001$). The mean (standard deviation, SD) number of encounters per patient per year was 4.5 (4.0) and increased with increasing age by decade ($p < 0.001$). Medicare was the most common

primary insurance (7,246 [79.2%]), with private insurance the most common secondary insurance (8,440 [92.2%]). The total number of presenting concerns was 12,020, and back concerns were most common (6,406 [53.3%]). The total number of assessments was 18,290; most were neuromusculoskeletal (17,271 [94.5%]) and in the thoracolumbar region (7,109 [38.9%]). The mean (SD) number of somatic dysfunction assessments per encounter was 5 (1.7); the thoracic region was the most documented and treated (7,263 [15.8%]). With up to 19 technique types per encounter, the total number of OMT techniques documented across all encounters was 43,862, and muscle energy (7,203 [16.4%]) was the most documented. The use of high-velocity, low-amplitude (HVLA) declined as age increased ($p < 0.001$). The overall treatment response was documented in 7,316 (79.9%) encounters, and most indicated improvement (7,290 [99.6%]).

Conclusions: Our results showed that geriatric patients receiving OMT at our clinic were predominately presenting for neuromusculoskeletal concerns associated with back, neck, and extremity conditions, consistent with national epidemiological data for this population. The most common OMT techniques were also consistent with those used nationally by osteopathic medical students and practicing physicians. Future longitudinal studies are needed to determine the length of time improvement persists and the overall health impact experienced by geriatric patients receiving OMT.

Keywords: geriatric patients; OMM; OMT; osteopathic manipulative medicine.

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Osteopathic manipulative treatment (OMT) is the manual treatment aspect of osteopathic manipulative medicine (OMM) and is used by osteopathic physicians to improve structure-function relationships and promote the self regulatory and self healing capability of patients. It is also one of many adjunctive approaches accessed by geriatric patients [1–3]. Further, OMT can be used to treat somatic dysfunction associated with a wide range of

musculoskeletal conditions in older patients, such as postural dysfunction, neck, and back pain, as well as non-musculoskeletal conditions such as constipation, pneumonia, and Parkinson disease [4–13]. For instance, in a previous study [14] of 21 nursing home residents aged 74 years and older, twice monthly OMT resulted in significantly reduced hospitalizations ($p=0.04$) and medication usage ($p=0.02$). In another study [10] of 406 hospitalized patients aged 50 years and older with pneumonia, twice-daily OMT was associated with significantly reduced length of stay ($p=0.01$) and reduced in-hospital mortality rates ($p=0.008$). In conjunction with other manual therapies, OMT has been shown to improve psychological symptoms in geriatric patients by decreasing anxiety and anxiety-associated physical signs, such as elevated heart rate, respiratory rate, and blood pressure [8, 11, 15–18]. Likely because of symptom improvement, OMT and similar manual therapies have been shown to improve quality of life in elderly patients [6, 19–21].

Currently, the clinical indication for OMT is the presence of somatic dysfunction found during physical examination [22]. However, there is a need to better define the types of clinical conditions that prompt evaluation for somatic dysfunction and that may benefit from the use of OMT as part of the treatment plan. Therefore, we need to determine the presenting concerns of geriatric patients who are treated with OMM, the types of conditions that include OMM as part of patient management, and the OMT techniques used. A 2016 study of 197 osteopathic neuromusculoskeletal medicine (ONMM) specialists by Channell et al. [1] showed that OMM was used in all geriatric age groups as part of the management of musculoskeletal concerns and conditions. Although many types of OMT techniques were used in geriatric patients in that study, high-velocity, low-amplitude (HVLA) was used much less frequently in patients aged 65 years and older [1]. To our knowledge, no other studies with similar descriptive data exist.

Therefore, the purpose of the current study was to provide descriptive data on the presentation and management of geriatric patients receiving OMT at an outpatient ONMM clinic. We hypothesized that most geriatric patients would present with musculoskeletal concerns, such as back and neck concerns, and be treated with a variety of OMT techniques. Specific data regarding the current use of OMM in the treatment of geriatric patients may be beneficial to guide patient care decisions on when to integrate OMM into the treatment plan. Results of the current study may also identify clinical conditions to target in future outcome studies focusing on quality of life, pain management, and fall risk reduction; the results may also suggest areas for improved training, effectiveness, and establishment of guidelines for OMM in the geriatric population.

Methods

This study was deemed exempt by the institutional review board at A.T. Still University-Kirksville. Informed consent was not obtained for this retrospective chart review. This study had no grant or funding support.

For this study, we employed a retrospective, observational design. Electronic health records (EHR) of an ONMM specialty clinic were reviewed for outpatient geriatric clinical encounters involving patients aged 60 years and older treated with OMT between July 1, 2016, and June 30, 2019. The data was reviewed and analyzed by all authors between August 2019 and June 2020. We selected 60 years as the age cutoff instead of 65 years (when people become Medicare eligible in the United States) so we could compare decade cohorts and capture data from this transition period. Encounters of all geriatric patients seen by an attending physician, or a resident physician under the supervision of an attending physician, were included in the study. Participating physicians included seven attending physicians (including K.T.S.) and 17 resident physicians (including A.A.K.). The attending physicians were board certified or board eligible in NMM/OMM. The resident physicians included eight NMM/OMM residents, five family medicine/NMM residents, two internal medicine/NMM residents, and two family medicine residents (including A.A.K.).

The data were obtained from the clinic's EHR, NextGen Ambulatory EHR (Nextgen Healthcare Information Systems, Inc.). The query produced data files for demographic characteristics, presenting concerns, clinical assessments, and treatment information. The data were deidentified by removing the patient medical record number from the clinical encounter data before analysis and entered into a Microsoft Excel spreadsheet for tabulation and summary statistics. The demographic characteristics collected were age, sex, number of encounters per unique patient, and insurance type. Patient age was grouped by decade as 60–69, 70–79, 80–89, and 90 years and older. Primary and secondary insurance type were categorized as Medicaid, Medicare, private, or self-pay. The treatment information included the body regions of somatic dysfunction treated, OMT techniques used during the encounter, and the overall response to treatment. The 10 somatic dysfunction body regions included head, cervical, thoracic, lumbar, sacral, pelvic, lower extremity, upper extremity, rib, and abdomen. The EHR allowed 19 different types of OMT techniques to be documented. The OMT techniques used were recorded for each of the 10 body regions separately, but were counted only once per clinical encounter for the purposes of data analysis. Data from free-text narratives were excluded from the study.

Presenting concerns were grouped into neuromusculoskeletal or non-neuromusculoskeletal concerns. Neuromusculoskeletal concerns were then subclassified by body region, which included head, neck, thoracolumbar, hip/pelvis, lower extremity, upper extremity, rib/chest, abdomen, and nonspecific/generalized. These clinical assessments were grouped by International Classification of Diseases, Tenth Revision (ICD-10) category, body region, and clinical similarity as determined by three authors (K.T.S., A.A.K., J.C.) [23]. The assessments were categorized as neuromusculoskeletal and non-neuromusculoskeletal, and non-neuromusculoskeletal assessments were then subclassified by organ system. When the overall treatment response was documented, it was categorized as improved, unchanged, resolved, or worse.

Descriptive data were summarized using frequency and percentage for all encounters and for unique patients by age group. Mean and standard deviation (SD) values were calculated for

encounters per year by age and sex, somatic dysfunction per encounter by age, and number of different types of OMT techniques per encounter. A binomial test of proportions was used to compare proportions between groups. A two-sample t test was used to compare mean encounters per year between women and men. Mean encounters per year were calculated over the three years of the study. An analysis of variance was used to compare mean number of somatic dysfunctions per encounter among age groups. Tukey's adjustment to the p value was performed to control for type I error inflation due to multiple comparisons. A χ^2 test of proportions was performed to determine whether the proportion of patient encounters using HVLA decreased by age group. All analyses were conducted using SAS version 9.4 (SAS Inc., Cary, NC). A value of $p < 0.05$ was considered statistically significant.

Results

The EHR query identified 9,155 clinical encounters with 1,238 geriatric patients during the study period (Table 1). By age group, there were 3,674 (40.1%) encounters for patients aged 60–69 years, 3,213 (35.1%) for those aged 70–79 years, 1,845 (20.2%) for those aged 80–89 years, and 423 (4.6%) for those aged 90 years and older. The number of unique patients was 609 (49.2%) for those aged 60–69 years, 403 (32.6%) for those aged 70–79 years, 190 (15.4%) for those aged 80–89 years, and 36 (2.9%) for those aged 90 years and older. Women had a larger number of encounters than men (6,901 [75.4%] vs. 2,254 [24.6%], respectively; $p < 0.001$) and represented more

unique patients (850 [68.7%] vs. 388 [31.3%], respectively; $p < 0.001$). The mean (SD) number of encounters per year by age group was 4.2 (4.3) for those aged 60–69 years, 4.4 (3.4) for those aged 70–79 years, 5.4 (4.2) for those aged 80–89 years, and 5.6 (4.1) for those aged 90 years and older. The number of encounters per year increased with age ($p < 0.001$), and the mean (SD) number of encounters per year for women was larger than for men (4.8 [4.2] vs. 3.8 [3.5], respectively; $p < 0.001$).

The primary insurance types for patients were Medicare (7,246 [79.2%]), private insurance (1,770 [19.3%]), self-pay (108 [1.2%]), and Medicaid (31 [0.3%]). Secondary insurance types were private insurance (8,440 [92.2%]), Medicaid (643 [7.0%]), and Medicare (72 [0.8%]).

Each encounter recorded up to five presenting concerns, and 12,020 concerns were documented across all encounters (Table 2). Musculoskeletal concerns involving the back were the most frequent presenting concerns overall (6,406 [53.3%]) and for each age group. The next most common concerns were lower extremity (1,291 [10.7%]), neck (1,184 [9.9%]), upper extremity (1,175 [9.8%]), and hip/pelvic pain (862 [7.2%]).

Excluding somatic dysfunction, there were 18,285 documented clinical assessments, of which 17,271 (94.4%) were neuromusculoskeletal and 1,014 (5.6%) were non-neuromusculoskeletal (Table 3). For neuromusculoskeletal assessments, the most frequent regions assessed were the thoracolumbar (7,109 [38.9%]), cervical (3,299 [18.0%]), lower extremity (1,923 [10.5%]), and upper extremity (1,705 [9.3%]) regions. For non-neuromusculoskeletal assessments, the most common organ systems assessed were neuropsychiatry (216 [1.2%]); gastrointestinal (167 [0.9%]); and ear, nose, and throat (165 [0.9%]).

Corresponding with body regions treated with OMT, up to 10 somatic dysfunction body region assessments could be documented per encounter. Across all encounters, 46,100 somatic dysfunction assessments were documented, and the mean (SD) number of somatic dysfunction assessments per encounter was 5 (1.7) (Table 4). No difference was found in mean (SD) number of somatic dysfunctions per encounter between age groups ($p = 0.25$): 5.1 (1.8) for those aged 60–69 years, 5 (1.7) for those aged 70–79 years, 5.1 (1.7) for those aged 80–89 years, and 5 (1.7) for those aged 90 years and older. Across all age groups, the most common body region treated with OMT was the thoracic region (7,263 [79.3% of all encounters and 15.8% of all somatic dysfunction assessments]).

Up to 19 different types of OMT techniques could be documented in the EHR per clinical encounter (Table 5). Cumulatively in 9,155 encounters, the total number of OMT techniques documented was 43,862 and the mean (SD)

Table 1: Demographic characteristics of geriatric patients from an outpatient osteopathic neuromusculoskeletal medicine clinic.

Characteristic	Age group			
	60–69 years	70–79 years	80–89 years	≥90 years
Encounters (N=9,155), ^a n (%)				
Total	3,674 (40.1)	3,213 (35.1)	1,845 (20.2)	423 (4.6)
Women	2,722 (74.1)	2,459 (76.5)	1,374 (74.5)	346 (81.8)
Men	952 (25.9)	754 (23.5)	471 (25.5)	77 (18.2)
Patients (N=1,238), ^b n (%)				
Total	609 (49.2)	403 (32.6)	190 (15.4)	36 (2.9)
Women	404 (66.3)	281 (69.7)	139 (73.2)	26 (72.2)
Men	205 (33.7)	122 (30.3)	51 (26.8)	10 (27.8)
Encounters per patient per year, ^c mean (SD)				
Total	4.2 (4.3)	4.4 (3.4)	5.4 (4.2)	5.6 (4.1)
Women	4.6 (4.7)	4.6 (3.4)	5.4 (4.0)	6.3 (4.3)
Men	3.5 (3.1)	3.8 (3.3)	5.2 (4.9)	3.7 (2.8)

^aThere were 6,901 (75.4%) encounters with women and 2,254 (24.6%) with men. ^bThere were 850 (68.7%) women patients and 388 (31.3%) men. ^cMean (standard deviation, SD) encounters per patient averaged over the three years of the study was 7.4 (9.1); mean (SD) number of encounters per patient per year was 4.5 (4.0).

Table 2: Presenting concerns of geriatric patients from an outpatient osteopathic neuromusculoskeletal medicine clinic treated with osteopathic manipulative treatment by age groups (N=12,020).

Presenting concern ^a	Overall, n (%)	Concerns by age group, n (%)			
		60–69 years	70–79 years	80–89 years	≥90 years
Back	6,406 (53.3)	2,477 (49.6)	2,307 (55.9)	1,324 (55.7)	298 (57.6)
Lower extremity	1,291 (10.7)	561 (11.2)	424 (10.3)	271 (11.4)	35 (6.8)
Neck	1,184 (9.9)	523 (10.5)	378 (9.2)	215 (9.0)	68 (13.2)
Upper extremity	1,175 (9.8)	513 (10.3)	425 (10.3)	189 (8.0)	48 (9.3)
Hip/pelvis	862 (7.2)	357 (7.2)	271 (6.6)	192 (8.1)	42 (8.1)
Head	337 (2.8)	200 (4.0)	85 (2.1)	45 (1.9)	7 (1.4)
Rib	275 (2.3)	138 (2.8)	86 (2.1)	48 (2.0)	3 (0.6)
Musculoskeletal (nonspecific)	21 (0.2)	14 (0.3)	2 (0.1)	5 (0.2)	0 (0)
Non-musculoskeletal	469 (3.9)	212 (4.2)	152 (3.7)	89 (3.7)	16 (3.1)

^aEach of the total 9,155 patient encounters could list up to five presenting concerns.

Table 3: Categories of clinical assessments of geriatric patients from an outpatient osteopathic neuromusculoskeletal medicine clinic treated with osteopathic manipulative treatment by age group (N=18,290).

Assessment categories	Assessments between categories ^a , n (%)	Assessments by age groups ^b , n (%)			
		60–69 years	70–79 years	80–89 years	≥90 years
Neuromusculoskeletal	17,271 (94.5)	6,995 (40.5)	5,916 (34.3)	3,515 (20.4)	845 (4.9)
Thoracolumbar region	7,109 (38.9)	2,708 (38.1)	2,560 (36.0)	1,511 (21.3)	330 (4.6)
Cervical region	3,299 (18.0)	1,317 (39.9)	1,038 (31.5)	712 (21.6)	232 (18.0)
Lower extremity region	1,923 (10.5)	813 (42.3)	658 (34.2)	406 (21.1)	46 (2.4)
Upper extremity region	1,705 (9.3)	731 (42.9)	613 (40.0)	281 (16.5)	80 (4.7)
Hip/pelvis region	1,238 (6.8)	518 (41.8)	389 (31.4)	254 (20.5)	77 (6.2)
Head region	530 (2.9)	309 (58.3)	148 (27.9)	64 (12.1)	9 (1.7)
Rib/chest wall	405 (2.2)	213 (52.6)	127 (31.4)	54 (13.3)	11 (2.7)
Abdomen	11 (0.1)	7 (63.6)	4 (36.4)	0 (0)	0 (0)
Nonspecific/generalized	1,051 (5.8)	379 (36.1)	379 (36.1)	233 (22.2)	60 (5.7)
Non-neuromusculoskeletal	1,014 (5.6)	423 (41.7)	360 (35.5)	191 (18.8)	40 (3.9)
Neuropsychiatric	216 (1.2)	63 (29.2)	94 (43.5)	54 (25.0)	5 (2.3)
Gastrointestinal	167 (0.9)	76 (45.5)	40 (24.0)	38 (22.8)	13 (7.8)
Ear, nose, throat	165 (0.9)	83 (50.3)	45 (27.3)	29 (17.6)	8 (4.9)
Other, uncategorized	159 (0.9)	92 (57.9)	51 (32.1)	15 (9.4)	1 (0.6)
Pulmonary	83 (0.5)	15 (18.1)	55 (66.3)	9 (10.8)	4 (4.8)
Integumentary	41 (0.2)	15 (36.6)	13 (31.7)	10 (24.4)	3 (7.3)
Cardiac	49 (0.3)	10 (20.4)	21 (31.7)	10 (24.4)	3 (7.3)
Hematology/oncology	63 (0.3)	28 (44.4)	21 (33.3)	9 (14.3)	5 (7.9)
Genitourinary	31 (0.2)	10 (32.3)	15 (48.4)	6 (19.4)	0 (0)
Endocrine	40 (0.2)	31 (77.5)	5 (12.5)	4 (10)	0 (0)

^aAssessments between categories represents the percentage distribution of each assessment between all assessment categories.

^bAssessments by age groups represents the percentage distribution of each assessment category between the four age groups.

number of different types of techniques documented per encounter was 4.8 (1.8) (Table 5). The most frequently documented technique was muscle energy both overall (7,203 [16.4%]) and for most age groups; myofascial release was most commonly used for those aged 90 years and older (270 [19.8%]). In an analysis by age group, the use of HVLA decreased with increasing age group ($p < 0.001$).

Overall treatment response was documented in 7,316 (79.9%) of 9,155 encounters. Of encounters with a treatment

response, 7,290 (99.6%) were improved, 15 (0.2%) were unchanged, 10 (0.1%) were resolved, and one (0.01%) was worse.

Discussion

As is the trend with the geriatric population of the United States [24], the current study found the percentage of

Table 4: Documented somatic dysfunction assessments of geriatric patients from an outpatient osteopathic neuromusculoskeletal medicine clinic treated with osteopathic manipulative treatment by age group (N=46,100).

ICD-10 region (code)	Overall, n (%)	Somatic dysfunction assessments by age groups, n (%)			
		60–69 years (n=21,104)	70–79 years (n=14,582)	80–89 years (n=9,005)	≥90 years (n=1,409)
Head (M99.00)	3,878 (8.4)	1,973 (9.3)	1,047 (7.2)	720 (8.0)	138 (9.8)
Cervical (M99.01)	6,327 (13.7)	2,948 (14.0)	1,967 (13.5)	1,191 (13.2)	221 (15.7)
Thoracic (M99.02)	7,263 (15.8)	3,331 (15.8)	2,343 (16.1)	1,340 (14.9)	249 (17.7)
Lumbar (M99.03)	6,487 (14.1)	2,801 (13.3)	2,175 (14.9)	1,336 (14.8)	175 (12.4)
Sacral (M99.04)	4,774 (10.4)	1,996 (9.5)	1,647 (11.3)	1,029 (11.4)	102 (7.2)
Pelvic (M99.05)	4,915 (10.7)	2,250 (10.7)	1,651 (11.3)	917 (10.2)	97 (6.9)
Lower extremity (M99.06)	3,536 (7.7)	1,566 (7.4)	1,086 (7.4)	788 (8.8)	96 (6.8)
Upper extremity (M99.07)	2,197 (4.8)	1,107 (5.2)	602 (4.1)	392 (4.4)	96 (6.8)
Rib (M99.08)	6,123 (13.3)	2,839 (13.5)	1,905 (13.1)	1,160 (12.9)	219 (15.5)
Abdomen (M99.09)	600 (1.3)	293 (1.4)	159 (1.1)	132 (1.5)	16 (1.1)

ICD-10, International Classification of Diseases, Tenth Revision.

Table 5: Osteopathic manipulative treatment techniques used in the treatment of geriatric patients at an outpatient osteopathic neuromusculoskeletal medicine clinic (N=43,862).

Technique	Overall, n (%)	Age groups, n (%)			
		60–69 years	70–79 years	80–89 years	≥90 years
Muscle energy	7,203 (16.4)	3,286 (16.1)	2,362 (17.3)	1,370 (16.4)	185 (13.5)
Myofascial release	6,540 (14.9)	2,961 (14.5)	2,000 (14.6)	1,309 (15.7)	270 (19.8)
Articular	6,023 (13.7)	2,674 (13.1)	1,942 (14.2)	1,235 (14.8)	172 (12.6)
Soft tissue	4,687 (10.7)	2,144 (10.5)	1,551 (11.4)	846 (10.1)	146 (10.7)
Still technique	3,685 (8.4)	1,722 (8.4)	1,138 (8.3)	720 (8.6)	105 (7.7)
Percussion hammer	3,163 (7.2)	1,278 (6.2)	1,062 (7.8)	703 (8.4)	120 (8.8)
Balanced ligamentous tension	2,902 (6.6)	1,286 (6.3)	910 (6.7)	570 (6.8)	136 (10.0)
Counterstrain	2,247 (5.1)	1,180 (5.8)	642 (4.7)	361 (4.3)	64 (4.7)
HVLA	1,684 (3.8)	1,031 (5.0)	497 (3.6)	153 (1.8)	3 (0.2)
Cranial	1,356 (3.1)	744 (3.6)	363 (2.7)	213 (2.6)	36 (2.6)
Ligamentous articular strain	1,127 (2.6)	565 (2.8)	352 (2.6)	196 (2.4)	14 (1.0)
Facilitated positional release	888 (2.0)	423 (2.1)	244 (1.8)	173 (2.1)	48 (3.5)
Progressive neuromuscular inhibition	840 (1.9)	405 (2.0)	219 (1.6)	185 (2.2)	31 (2.3)
Functional	457 (1.0)	227 (1.1)	114 (0.8)	103 (1.2)	13 (1.0)
Other	429 (1.0)	219 (1.1)	114 (0.8)	90 (1.1)	6 (0.4)
Visceral manipulation	289 (0.7)	149 (0.7)	65 (0.5)	66 (0.8)	9 (0.7)
Neurofascial release	160 (0.4)	78 (0.4)	48 (0.4)	29 (0.4)	5 (0.4)
Lymphatic	113 (0.3)	63 (0.3)	25 (0.2)	22 (0.3)	3 (0.2)
Integrated neuromuscular release	69 (0.2)	39 (0.2)	17 (0.1)	13 (0.2)	0 (0)

HVLA, high-velocity, low-amplitude.

geriatric patients in each age group decreased with increasing age and the majority of patients in each age group were women. We also found a gradual but significant increase in the number of encounters per year with increasing age decade and that women had a higher mean number of encounters per year than men in all age groups. This finding is consistent with existing data showing that healthcare costs [25–27] and utilization [26, 27] increase with increasing age and that women tend to have higher utilization of healthcare than men [25–27].

Geriatric patients commonly present to our outpatient ONMM clinic with acute and chronic pain symptoms; somatic dysfunction that may be contributing to the patient's specific symptoms is typically found on physical examination. As such, OMT is provided using a variety of techniques that are directed toward the specific physical findings, and patients commonly report improvement after treatment at the time of the visit. Our results showed that OMM was predominately used at our clinic as part of the management of neuromusculoskeletal concerns and

conditions. Back pain was the most common presenting concern for all age groups, and thoracolumbar conditions were most frequently assessed. This finding is consistent with low back pain as a common condition and as the global leading cause of years lived with disability [28]. The incidence of low back pain peaks at 80–89 years and then begins to decline in those aged 90 years and older [28].

Neuromusculoskeletal conditions of the cervical region were the second most frequent type of assessment in geriatric patients treated with OMT in our current study. In previous studies [29, 30], neck pain was more common among individuals aged 60 years and older than in younger individuals. Neck pain in the elderly population is associated with degenerative changes in the cervical spine and with osteoporosis [31]. Further, OMT has been shown as a cost-effective approach that can provide benefit to adults with back and neck pain [32–37]. Studies have also shown that OMT improves low back pain and quality of life in older patients [19–21]. However, a search of the literature revealed a deficit of studies investigating the use of OMT for neck pain, specifically in geriatric patients, which highlights a need for additional study in this area.

Other frequently documented concerns in our study included lower extremity, upper extremity, and hip/pelvis pain. Our patients' common concerns and conditions are consistent with results from a previous meta-analysis that found back and lower extremity pain were prevalent in older people and were correlated with increasing incidence of osteoarthritic conditions as people age [38]. In a survey of 44.8 million people aged 65 and older, 49.6% reported at least one doctor-diagnosed arthritic condition [39]. Women represented a larger proportion of our patient population and encounters. This finding is consistent with a higher prevalence of age-adjusted, arthritis-attributable activity limitations in women [39].

Non-neuromusculoskeletal assessments accounted for 5.6% of documented assessments in our results. Of these, the most frequent were neuropsychiatric assessments (1.2%), including dizziness, hemiplegia, and tremor. The next most frequent non-neuromusculoskeletal assessments were gastrointestinal (0.9%), including acute gastritis, gastroesophageal reflux, abdominal pain, and constipation; and ear, nose, and throat assessments (0.9%), including sinusitis, upper respiratory tract infection, and tinnitus. Because somatic dysfunction is the clinical indication for OMT, many of these conditions may be underreported as assessments. For example, treatment of the abdomen was reported in 600 encounters and the use of visceral manipulation was reported in 289 encounters, but gastrointestinal assessments were included in only 167 encounters. Future studies should investigate review of systems, past

medical history, and free-text narratives to determine how often OMM is provided as adjunctive treatment of non-neuromusculoskeletal concerns. Given the large evidence base of manual therapies for conditions such as constipation [40–44], the documentation and use of OMM for non-neuromusculoskeletal conditions may be an appropriate topic for continuing medical education. Our findings prompted in-service training for physicians at the institution of the current study aimed to ensure more comprehensive encounter documentation.

The most frequently used OMT technique in the current study was muscle energy, except in patients aged 90 years and older, where myofascial release was used more often. The types of OMT techniques used in our study are similar to reported OMT use among practicing osteopathic physicians and students taking the Comprehensive Osteopathic Medical Licensing Examination of the United States Performance Evaluation [2, 19, 45]. In a recent study of 10,150 OMM practice treatments performed by third-year and fourth-year osteopathic medical students [46], patients aged 60 years and older accounted for approximately 14% of the OMT documented by the students, and muscle energy was the most commonly used. These findings suggest OMT training provided in osteopathic medical schools is consistent with OMT use patterns by practicing osteopathic physicians [1, 2, 45] and, therefore, is appropriate preparation for the clinical integration of OMM into the management of common geriatric conditions.

In our study, HVLA techniques accounted for only 3.8% of all OMT techniques used and progressively declined from 5% in the 60–69 age group to 0.2% in the 90 years and older group. This finding, along with reduced use of muscle energy in the >90 age group, likely reflects the tendency to use more indirect and gentle techniques with older patients. Further, HVLA and other direct techniques are relatively contraindicated in the presence of conditions associated with musculoskeletal fragility, such as osteoporosis, where prevalence increases with advancing age [47, 48]. Our results are also consistent with those from a survey-based study by Channel et al. of 197 physicians specializing in ONMM [1], which found lower utilization of rate of HVLA in geriatric patients.

Of the encounters in our study with a documented treatment response, 99.6% reported improvement with less than 0.2% reporting unchanged or worse symptoms. The reported improvement in our results was greater than the 92% of encounters reporting improvement from a practice-based research network study of 2,569 encounters involving OMT in adults aged 18–93 years [49]. The immediate benefit of manual therapies has been well documented. For instance, manual therapies have been shown to increase

soft tissue pressure pain thresholds, resulting in immediate pain reduction [50–53]. A systematic review [54] found evidence that geriatric patients may be more sensitive to mechanically evoked pain than younger patients, which suggests older patients may be more likely to experience an immediate benefit from OMT. The annual direct medical cost of arthritis is \$81 billion in the United States [39]. Nearly 80% of patients in the current study had Medicare as their primary insurance. If OMM can provide cost-effective, adjunctive treatment of arthritis conditions in older patients with minimal treatment-associated morbidity and mortality, then long-term studies of the cost, outcomes, and potential contraindications of OMM are justified and should be prioritized in research funding.

The primary limitation of the current study was that our data was from a single specialty ONMM clinic, which may limit the generalizability of the findings to other specialties and ONMM clinics. Another limitation was the exclusion of data from free-text narratives in the EHR encounters notes. The free-text narratives typically describe quality of life information, fall histories, and medication and lifestyle interventions; they may also include information about patient symptoms that were not documented as presenting concerns or clinical assessments. Inclusion of that information may have better described treatment plans for non-neuromusculoskeletal conditions and outcomes in our patient population.

Conclusions

The current study investigated the presentation and management of geriatric patients receiving OMT at an outpatient ONMM clinic. Our results indicated that geriatric patients primarily presented with musculoskeletal concerns common for their age group, such as back, neck, and lower extremity concerns. Future studies are needed to determine whether these findings are generalizable to OMM provided by other ONMM clinics or by other specialty provider types. Given the reported immediate improvement in presenting symptoms after OMM in our patient population, longitudinal studies should be conducted to determine the length of time the improvement persists and the overall health impact to the patients receiving OMM. Our findings also identified common musculoskeletal concerns and conditions with a sufficient incidence for the pursuit of future prospective, randomized studies focusing on long-term outcomes, such as quality of life and fall risk reduction, as well as contraindications. Results from such studies could be used to establish treatment guidelines for geriatric patients with musculoskeletal pain. Given the high prevalence of musculoskeletal concerns in the

geriatric population, clinicians should consider including OMM as part of the management of pain conditions in this population.

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