The Role of Musculoskeletal Disorders in Chronic Disease: A Narrative Review

Masumi G. Asahi, DO; David Briganti, DO; Eric Cam, DO; Michael A. Seffinger, DO

From the College of Osteopathic Medicine of the Pacific at Western University of Health Sciences in Pomona, California.

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Address correspondence to Michael Seffinger, DO, College of Osteopathic Medicine of the Pacific at Western University of Health Sciences, 309 E 2nd St, Pomona, CA, 91766-1854.

Email: mseffinger@westernu.edu

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Chronic diseases and musculoskeletal conditions are responsible for a significant portion of the global disease burden and are frequently comorbid, such as with low back pain in patients who also have chronic organ disease. Low back pain is the leading cause of long-term disability and is the most common reason adults seek adjunctive treatment, including osteopathic manipulative treatment (OMT). OMT has been shown to be effective in relieving low back pain and improving back-specific functioning. In this narrative review, the authors summarize literature published in the last decade and analyze the relationship between musculoskeletal disorders and systemic medical conditions such as diabetes mellitus; they also discuss the efficacy and cost-effectiveness of OMT in managing somatic dysfunction in patients with chronic diseases.

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Chronic diseases typically have a long duration, progress slowly, and produce persistent and disabling effects.[1] They represent a broad group of complex health conditions such as diabetes, cardiovascular disease, chronic respiratory disease, and cancer, all of which are responsible for a significant portion of the global disease burden.[1-4] In 2012, 50% of all US adults had at least 1 chronic condition, and 25% had 2 or more chronic conditions.[3,5] In addition to representing a leading cause of mortality worldwide, chronic diseases have a considerable economic impact, with global economic losses between 2011 and 2025 projected to total $7 trillion.[6]

Musculoskeletal (MSK) conditions also contribute to the global disease burden.[4,7] Neck and back pain alone rank 4th among the leading causes of disability-adjusted life years, and elderly individuals with MSK conditions have been found to die earlier than those without them.[4,8] Low back pain (LBP) is the leading cause of long-term disability and the most common reason adults seek adjunctive treatment, including osteopathic manipulative treatment (OMT).[8] LBP often coexists with chronic organic or systemic disease. However, there is a paucity of clinical trials that evaluate the correlation between MSK dysfunction, pain, and chronic organic or systemic disease or the effectiveness of OMT in managing chronic disease. The significant burden of chronic disease and the rising prevalence of these conditions point to the need for innovative strategies for management and prevention.

Osteopathic philosophy was founded on the principle that the MSK system is an essential component to maintaining health.[10] It not only provides the means for movement but intimately interacts with most other organ systems to regulate and maintain health.

Alterations in the MSK system can have systemic consequences affecting health and well-being, and management of somatic dysfunction with OMT may help decrease the morbidity of chronic diseases and play a primary role in patient care. In this narrative review, the authors summarize the literature published in the last decade and analyze the relationship between musculoskeletal disorders and systemic medical conditions as well as the efficacy and cost-effectiveness of OMT in managing somatic dysfunction in patients with chronic diseases.

Literature Search

The authors searched PubMed and EBSCOhost for articles published between January 1, 2009, and December 31, 2018, using the following search terms: *chronic disease and MSK conditions/disorders or somatic dysfunction or low back pain* and *OMT and cost of care or risk or burden of disease*. The authors included randomized controlled trials, cross-sectional studies, and systematic reviews or meta-analysis of randomized controlled trials. The inclusion criteria were articles addressing MSK disorders or somatic dysfunction related to chronic diseases such as diabetes and cardiovascular disease, low back or neck pain, somatic dysfunction and OMT, cost of care, disease burden, and epidemiology. Articles were excluded if published before 2009; if they were about inflammatory, metabolic or endocrine disorders, or primary musculoskeletal diseases; if they did not address the relationship between the MSK system and organic or chronic disease; or if they were not clinical studies. A second search using MeSH terms of only musculoskeletal disorders and diabetes or cardiovascular disease or chronic disease was also performed. Key words were also used in combinations of 2 or 3 to increase article retrieval. A hand search for articles, some of which were cited in the selected articles, was also performed to identify pertinent articles missed in the original search that helped to interpret the findings of the selected articles from the search and facilitate the discussion of the points the authors felt pertinent to the research question and clinical practice.

The initial search terms, when applied all together, yielded no results. Limiting combinations to only 2 or 3 terms at a time, however, produced pertinent articles that met the inclusion criteria and were used in this review. For example, using the phrase "low back pain and chronic diseases and OMT" yielded 6 results focused on chronic LBP. The terms "low back pain and diabetes and cardiovascular disease risk" yielded 70 results in EBSCOhost and 16 in PubMed.

MSK Conditions and Chronic Disease

A systematic review and meta-analysis of cohort studies by Williams et al[4] found that MSK conditions may increase the risk of chronic disease. Their analysis considered longitudinal cohort studies that estimated a direct association between baseline neck, back pain, or osteoarthritis (OA) of the knee or hip and subsequent diagnosis of chronic disease (cardiovascular disease, cancer, diabetes, chronic respiratory disease or obesity). The authors searched 7 databases for eligible studies with key terms including *neck or back pain*, *OA of the knee or hip*, *chronic diseases*, *cardiovascular disease*, *cancer*, diabetes, *chronic respiratory disease or obesity*, and terms for chronic disease and morbidity. Of 15,824 articles identified through a database search, 13 cohort studies following 3,086,612 people met the inclusion criteria. The authors included longitudinal cohort studies to assess temporal relationships and prioritized adjusted estimates over crude estimates to account for potential confounding. Data from 11 studies (2,686,113 patients) were used for meta-analysis. Pooled adjusted estimates showed that patients with an MSK condition had a 17% increase in the rate of developing chronic disease compared with patients without an MSK condition (hazard ratio [HR], 1.17; 95% confidence interval [CI], 1.13-1.22). Having back pain increased patients' risk of having cardiovascular disease (HR 2.13; 95% CI, 1.32-3.44) and cancer (HR 1.25; 95% CI, 1.19-1.32) compared with patients

without back pain. Patients with neck pain had an increased risk of having cancer (HR 1.20; 95% CI, 1.09-1.31) compared with individuals without neck pain. Combining all MSK conditions as the exposure and cardiovascular disease as the outcome revealed a statistically significant increase in risk of cardiovascular disease (HR 1.16; 95% CI, 1.12-1.19; 8 studies). The researchers could not determine a causal mechanism between the relationship of MSK conditions and the increased risk of chronic disease.

DM and MSK Disorders

Diabetes mellitus (DM) is widely recognized as a major public health concern worldwide, causing significant morbidity and mortality.[11,12] DM has also been associated with several MSK disorders such as Dupuytren contractures, frozen shoulder (adhesive capsulitis), and carpal tunnel syndrome, many of which are associated with the severity and duration of the disease.[11-13] The musculoskeletal manifestations of diabetes can be overlooked and may not be managed until later into the disease course. A previous systematic review and meta-analysis assessed the prevalence of MSK disorders in patients with DM.[13] It included 21 studies and used a meta-analysis of proportion to calculate pooled estimates; it found the prevalence of all types of MSK disorders among patients with diabetes to be 58.15% (95% CI, 41.4%-73.9%),[13] compared with global prevalence estimated to be 17.1%.[14] A cross-sectional study analyzed data of 5106 adults from the National Health and Nutrition Examination Survey (NHANES) from 2009 to 2010 and found that adults with DM also had a higher prevalence of known chronic LBP (CLBP) risk factors (sex, race, education level, income, smoking, physical activity status, body mass index), and a higher prevalence of CLBP independent of those same risk factors (OR 1.39; 95% CI, 1.02-1.92; P=.041).[15] The pathophysiological mechanism leading to the MSK disorders in patients with DM is not well understood, but is thought to be a result of chronic hyperglycemia affecting cell function and altering extracellular matrix components of the connective tissues resulting in damage.[11,16]

LBP, DM, and OMT

Several studies have demonstrated the role of OMT in various musculoskeletal disorders. The largest trial on OMT for patients with LBP with a subpopulation of diabetic patients was called the OSTEOPATHIC trial.[9] It was a randomized, double-blind, sham-controlled 2 × 2 factorial designed study with a sample size of 455. The trial showed a large effect size for OMT in providing significant LBP improvement in patients with high baseline pain severity (RR, 2.04; 95% CI, 1.36-3.05; P<.001). The trial also found clinically important improvement in back-specific functioning (RR, 1.80; 95% CI, 1.08-3.01; P=.02), decreased use of prescription medication for LBP (RR, 0.64; 95% CI, 0.36-1.13; P<.12), and greater patient satisfaction with back care (RR, 1.30; 95% CI, 1.13-1.49; P<.001). Subgroup results from the OSTEOPATHIC trial also found that severe somatic dysfunction was present significantly more often in patients with DM than in patients without DM.[17] The subgroup of diabetic patients had a clinically relevant reduction not only in LBP but also in TNF-α serum concentration in those who received OMT compared with those who received sham OMT (mean between-group difference, −0.6pg/mL; 95% CI, −12.4 to −0.8pg/mL; P= .03), suggesting that decreased circulating TNF-α may represent a possible mechanism for OMT effects in patients with diabetes mellitus.[17] TNF-α is a pro-inflammatory cytokine involved in the development of diabetic neuropathy.[18] Although diabetic patients with LBP responded favorably to OMT to reduce their LBP, no long-term follow-up with blood sugar assessments were performed, so the overall effect of the LBP reduction on diabetes was not determined.

Discussion

MSK conditions are currently largely ignored in the context of current management strategies addressing

chronic disease prevention by modifying lifestyle risk factors such as poor diet, physical inactivity, alcohol consumption, and smoking.[4,5] Considering their high global burden, addressing MSK conditions via public health strategies may significantly reduce the morbidity of other chronic diseases such as cardiovascular disease and diabetes.

Osteopathic physicians carry a unique philosophy through which knowledge is organized to all aspects of health: physical, mental, emotional, and spiritual.[10] This unique patient-centered focus that uses health-oriented principles of patient care and skills, including hands-on manual diagnosis and management, may aid in reducing the burden of MSK conditions and the associated sequelae of chronic disease.

Back pain is linked to increased risk of cardiovascular disease and highly associated with DM.[4,15,16] Chronic LBP is often managed with costly or invasive interventions including opioid analgesics, epidural corticosteroid injections, and spinal surgery, particularly in patients with higher pain severity. LBP can be debilitating and can contribute to decreased physical activity, increased weight gain, and increased use of analgesics, all of which increase the risk of cardiovascular disease (**Figure**).[4,19,20] OMT is a safe, adjunctive strategy for treating chronic LBP.[9,21]

Osteopathic care could also reduce the global financial burden caused by MSK conditions and chronic disease. The OSTEOPATHIC trial[9] demonstrated positive results with 6 OMT sessions over 12 weeks, fewer office visits than initial chiropractic care, which typically entails 6 to 12 treatment sessions every 2 to 4 weeks.[9] In Belgium, when compared with usual care, osteopathic manipulative therapy (manipulative care performed by non–US trained osteopaths) has also been found to be a dominant and cost-effective strategy for managing LBP and neck pain, respectively.[7]

Within the United States, OMT as a specialty has been shown to be a more cost-effective adjunctive treatment for improving physical function and quality of life in patients with LBP and joint pain when compared with other specialties such as orthopedics, neurology, physical therapy, or acupuncture.[22] OMT and osteopathic manipulative therapy have also been shown to be cost-effective in other conditions such as migraine headaches[23] and for preterm infants.[24]

Physicians are often the first line of support when patients have a chronic disease diagnosis. In addition to providing care, physicians should aim to develop knowledge and skills that improve patients' ability to manage their diseases. A study[25] evaluating *The Other 45*, an educational curriculum, suggested that a patient-education approach was effective in improving patients' self-reported outcomes and improving future physicians' ability to relate to and educate their patients who have chronic disease. Patient education should also focus on the overall health of the patient.

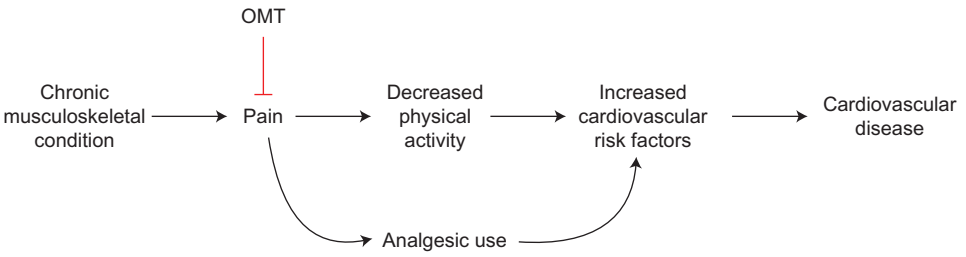

Figure.
Flowchart showing a cascade of events (black arrows) starting with a chronic musculoskeletal condition and resulting in pain, subsequent analgesic use, and decreased physical activity, the latter of 2 of which contribute to increased cardiovascular risk factors, ultimately resulting in cardiovascular disease. OMT (red line) modulates pain and the resultant cascade of events.

For example, physical activity is an attractive treatment for patients with cardiovascular disease or diabetes, given its low cost, nonpharmacological nature, and aerobic and cardiovascular benefits. Managing somatic dysfunction with OMT may help patients increase physical activity, which has been shown to result in reduction of risk factors for the development of cardiovascular disease and diabetes mellitus type 2.[26] In light of the ongoing COVID-19 pandemic and the decrease in use of manual treatment by mandates for social distancing,[27] physicians can educate and encourage their patients to increase their physical activity levels.

Our results are limited because they are not based on a thorough and comprehensive systematic review of the literature on the topic. There is also a scarcity of prospective clinical trials that evaluate the hypothesis that OMT is effective at reducing the burden of chronic disease. Future studies should aim to document MSK symptoms and physical examination findings in clinical trials studying patients with chronic organ disease to further elucidate the relationship between the MSK system and total health of the patient. Additionally, they should assess whether OMT vs sham OMT is effective in improving chronic diseases with long-term follow-up.

Conclusion

Patients are increasingly burdened with multiple comorbid diseases and symptoms. MSK conditions, including somatic dysfunction, are associated with chronic disease. OMT is effective at alleviating common MSK conditions such as LBP and may have a beneficial effect on the prevention and management of chronic disease. As research continues to elucidate the relationship between MSK conditions and their potential bidirectional role in systemic disease processes, osteopathic physicians should continue to offer patient-centered and health-focused medical care, including addressing dysfunctions found in the MSK system.

Author Contributions

All authors provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Flanagan S, Damery S, Combes G. The effectiveness of integrated care interventions in improving patient quality of life (QoL) for patients with chronic conditions: an overview of the systematic review evidence. *Health Qual Life Outcomes*. 2017;15(1):188. doi:10.1186/s12955-017-0765-y
2. GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016 [published correction appears in Lancet. 2017 Oct 28;390(10106):e38]. *Lancet*. 2017;390(10100):1211-1259. doi:10.1016/S0140-6736(17)32154-2
3. National Center for Chronic Disease Prevention and Health Promotion: about chronic diseases. Centers for Disease Control and Prevention website. https://www.cdc.gov/chronicdisease/about/index.htm. Accessed February 7, 2019.
4. Williams A, Kamper SJ, Wiggers JH, et al. Musculoskeletal conditions may increase the risk of chronic disease: a systematic review and meta-analysis of cohort studies. *BMC Med*. 2018;16(1):167. doi:10.1186/s12916-018-1151-2
5. Chapel JM, Ritchey MD, Zhang D, Wang G. Prevalence and medical costs of chronic diseases among adult medicaid beneficiaries. *Am J Prev Med*. 2017;53(6S2):S143-S154. doi:10.1016/j.amepre.2017.07.019
6. Leach MJ, Eaton H, Agnew T, et al. The effectiveness of integrative health care for chronic disease: a systematic review. *Int J Clin Pract*. 2019;73(4):e13321. doi:10.1111/ijcp.13321
7. Verhaeghe N, Schepers J, van Dun P, Annemans L. Osteopathic care for low back pain and neck pain: a cost-utility analysis. *Complement Ther Med*. 2018;40:207-213. doi:10.1016/j.ctim.2018.06.001
8. Hurwitz EL, Carragee EJ, Velde G, et al. Treatment of neck pain: noninvasive interventions: results of the Bone and Joint Decade 2000-2010 Task Force on neck pain and its associated disorders. *J Manipulative Physiol Ther*. 2009;32(2 suppl):S141-75. doi:doi:10.1016/j.jmpt.2008.11.017
9. 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. *Man Ther*. 2013;18(6):533-40. doi:10.1016/j.math.2013.05.006
10. Seffinger M, Hruby RJ, Rogers FJ, et al. Philosophy of osteopathic medicine. In: Seffinger MA, ex ed, *Foundations of Osteopathic Medicine*. Wolters Kluwer Health/Lippincott Williams & Wilkins; 2018:2-17.
11. Majjad A, Errahali Y, Toufik H, et al. Musculoskeletal disorders in patients with diabetes mellitus: a cross-sectional study. *Int J Rheumatol*. 2018;2018:3839872. doi:10.1155/2018/3839872

12. Merashli M, Chowdhury TA, Jawad AS. Musculoskeletal manifestations of diabetes mellitus. *QJM*. 2015;108(11):853-7. doi:10.1093/qjmed/hcv106

13. Kaka B, Maharaj S, Fatoye F. Prevalence of musculoskeletal disorders in patients with diabetes mellitus: a systematic review and meta-analysis. *J Back Musculoskelet Rehabil*. 2019;32(2):223-235. doi:10.3233/BMR-171086

14. Cho NH, Shaw E, Karuranga S, et al. IDF Diabetes Atlas: global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract*. 2018;138:271-281. doi:10.1016/j.diabres.2018.02.023

15. Hassoon A, Bydon M, Kerezoudis P, et al. Chronic low-back pain in adult with diabetes: NHANES 2009-2010. *J Diabetes Complications*. 2017;31(1):38-42. doi:10.1016/j.jdiacomp.2016.10.025.

16. Mueller MJ. Musculoskeletal impairments are often unrecognized and underappreciated complications from diabetes. *Phys Ther*. 2016;96(12):1861-1864.

17. Licciardone JC, Kearns CM, Hodge LM, Minotti DE. Osteopathic manual treatment in patients with diabetes mellitus and comorbid chronic low back pain: subgroup results from the OSTEOPATHIC Trial. *J Am Osteopath Assoc*. 2013;113(6):468-478.

18. Rosenberger DC, Blechschmidt V, Timmerman H, et al. Challenges of neuropathic pain: focus on diabetic neuropathy. *J Neural Tansm* (Vienna). 2020;127(4):589-624. doi:10.1007/s00702-020-02145-7

19. Zhu K, Devine A, Dick IM, Prince RL. Association of back pain frequency with mortality, coronary heart events, mobility, and quality of life in elderly women. *Spine*. 2007;32:2012-2018.

20. Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *Lancet*. 2018;391(10137):2356-2367. doi:10.1016/S0140-6736(18)30480-X

21. Licciardone J. Research methods and evidence relating to osteopathic manipulative treatment. In: Seffinger MA, ex ed, *Foundations of Osteopathic Medicine*. 4th ed. Wolters Kluwer Health/Lippincott Williams & Wilkins, 2018:1518-1530.

22. Wilson FA, Licciardone JC, Kearns CM, Akuoko M. Analysis of provider specialties in the treatment of patients with clinically diagnosed back and joint problems. *J Eval Clin Pract*. 2015;21(5):952-957.

23. Schabert E, Crow WT. Impact of osteopathic manipulative treatment on cost of care for patients with migraine headache: a retrospective review of patient records. *J Am Osteopath Assoc*. 2009;109(8):403-407.

24. Lanaro D, Ruffini N, Manzotti A, Lista G. Osteopathic manipulative treatment showed reduction of length of stay and costs in preterm infants: a systematic review and meta-analysis. *Medicine (Baltimore)*. 2017;96(12):e6408. doi:10.1097/MD.0000000000006408

25. Stoner AM, Cannon M, Shan L, et al. The other 45: improving patients' chronic disease self-management and medical students' communication skills. *J Am Osteopath Assoc*. 2018;118(11):703-712. doi:10.7556/jaoa.2018.155

26. Wahid A, Manek N, Nichols M, et al. Quantifying the association between physical activity and cardiovascular disease and diabetes: a systematic review and meta-analysis. *J Am Heart Assoc*. 2016;5(9):e002495. doi:10.1161/JAHA.115.002495

27. Licciardone JC. Demographic characteristics associated with utilization of noninvasive treatments for chronic low back pain and related clinical outcomes during the COVID-19 pandemic in the United States. https://www.jabfm.org/content/covid-19-ahead-print-subject-collection#25. Accessed August 8, 2020.