



Narrative Review

Myofascial Pain Syndrome: A Narrative Review Identifying Inconsistencies in Nomenclature

Vy Phan, BS , Jay Shah, MD, Hannah Tandon, BA, John Srbely, DC, PhD, Secili DeStefano, DPT, Dinesh Kumbhare, MD, PhD, Siddhartha Sikdar, PhD, Allison Clouse, MSc, Amar Gandhi, Lynn Gerber, MD 

Abstract

There is currently confusion surrounding the phenotype of and diagnostic criteria for myofascial pain syndrome (MPS) in the published literature. This narrative literature review investigated whether there is consensus regarding the descriptive terminology used for MPS and the trend of MPS publications over time. The phrase “myofascial pain syndrome” was used to search PubMed and Web of Science, returning 923 articles. Of these, we included only full-text, primary research articles containing “myofascial pain syndrome” in the title, reducing the total articles reviewed to 167. We identified 116 descriptors and categorized them under one of five clusters that shared similar findings and are commonly associated with MPS: “trigger points,” “muscle,” “pain,” “nervous system,” and “fascia.” The frequency of the clinical criteria of Travell and Simons was tabulated. Terms pertaining to the clusters “trigger points,” “muscle,” or “pain” appeared in approximately 90% of the articles; “nervous system” in 46%; and “fascia” in 20%. Only 42% used the criteria of Travell and Simons. Most articles (122) included a combination of three or four clusters to describe MPS. In addition, MPS publications have doubled since 2010 compared to the prior decade. The publication patterns, determined by changes in which specialty journals articles on MPS have been published, have shifted from investigational to intervention studies. This may have been influenced by heterogeneity in the usage of MPS terminology. This underscores the lack of a reliable MPS diagnosis and limits human subjects research. Improved consistency in terminology is needed to establish consensus within the field and to inform future research studying the pathophysiology of MPS.

Introduction

Myofascial pain syndrome (MPS) is a common form of chronic musculoskeletal pain, affecting up to 85% of the population¹ and contributing to a significant financial burden and job-related disability in the United States. In fact, MPS is estimated to contribute over 50 billion dollars to the financial burden of illness in the United States.² MPS denotes a condition in which muscle and fascia present with pain at rest, so no provocative factors are needed to induce the pain. It is a descriptive term used and popularized by Travell and Simons to define an acute or chronic soft tissue musculoskeletal pain condition characterized by sensory, motor, and autonomic findings and is associated with myofascial trigger points (MTrPs).³ Travell and Rinzler coined the term “myofascial trigger point” in the 1950s on the basis of their observation that

palpable nodules may be present and refer pain to both muscle and overlying fascia.⁴ In these early descriptions, the pain and tenderness could be experienced locally at the MTrP site or remotely from the MTrP, following a well-defined referred pain pattern. Their early work stopped short of establishing firm criteria for diagnosis of the syndrome.

Despite its prevalence and impact on society, the syndrome remains poorly understood and, consequently, is frequently misdiagnosed and/or mismanaged.⁵ Several possible explanations exist including, most notably, that the mechanisms of MPS are still unknown. In fact, only recently has muscle been implicated^{6,7} and, even more recently, fascia.^{8,9} Many theories of the pathophysiology of MPS have been proposed, such as local tissue damage leading to decreased pH, tissue hypoxia, and release of histamines and bradykinin.^{10,11} These changes in the

biochemical milieu can cause an inflammatory cascade of cytokines, leukotrienes, and substance P, resulting in peripheral and/or central sensitization, at first peripherally and then centrally.¹¹ Despite this emerging body of research, MPS still lacks a distinguishing pathologic entity or biomarker. This makes MPS difficult to differentiate from other pain conditions including bursitis, radicular pain, complex regional pain syndrome, and fibromyalgia, which share some common clinical features with MPS.¹⁰

Another challenge to diagnosis is that the presence of pain, which is considered to be a feature that is unifying and requisite in all cases of MPS, requires self-report. The experience of pain varies by individual and is multidimensional, including sensory abnormalities, evidence of sensitization (peripheral and/or central), and abnormal movement patterns. For this reason, assessment of pain is largely based on patient self-reports, which are not objectively verifiable, posing challenges to the reliability of interpretation and etiology. Such self-reports oftentimes continue to direct treatment without a firm diagnosis or consistent constellation of objective signs. Furthermore, diagnostic criteria are based in clinical judgment without direct links to underlying mechanism(s). Some practitioners, including Travell and Simons,³ require MPS to be a local or regional pain syndrome, while others do not. Travell and Simons³ suggest that their criteria are mandatory for the diagnosis, but this is not universally accepted. Unlike Travell and Simons, Rivers et al have suggested a set of criteria that do not emphasize the presence of MTrPs or require a referred pain pattern upon palpation of a tender spot and considers stress in the worsening of pain.¹²

Our research team has published several studies highlighting the confusion among practicing clinicians on commonly applied diagnostic criteria,^{10,13} the lack of sensitivity of physical findings distinguishing those with and without pain,¹⁴ insufficient knowledge on the biochemical properties of muscles with and without active MTrPs,¹¹ the shear-wave and echo-textural properties of muscles in patients presenting with MPS before and after treatment,^{15,16} and clinical treatment responsiveness to dry needling.^{14,17} Our multidisciplinary experience in studying, reviewing, and reporting on the historical and scientific aspects of MPS¹⁰ has led us to question the uniformity and consistency of terminology applied across various disciplines.

The primary objective of this review was to investigate the terminology in peer-reviewed publications commonly used to describe MPS over the last 40 years. We specifically targeted labels, terms, and definitions routinely applied to define the syndrome and to establish inclusion criteria for entry of participants into study protocols. Our secondary objective was to investigate the evolving trends in publications among various specialties by investigating trends in the frequency of articles within the various journals publishing on MPS.

The purpose of this review is to contribute to the literature by deconstructing this heterogeneity through

identification of all the individual terms used to describe MPS and highlighting the variability in terminology among specialties. The findings, reported here, aim to shed light on the complexity of the syndrome and emphasize the potential need for standardization of the diagnostic criteria for MPS. Furthermore, this review may serve as a reference for establishing standard terminology in order to develop clinical practice guidelines specific for MPS as we measure the frequency of descriptive terms in each paper. Standardizing the terminology will enable efficient and reliable translation of findings between disciplines to inform future clinical studies and help identify factors that contribute to the mechanisms involved in MPS research.

Methods

PubMed and Web of Science were queried on 14th November 2017 using the search term “myofascial pain syndrome.” The phrase was queried in all fields, and no filters or additional search terms were used initially to ensure the broadest search results.

The first phase of the review involved evaluation of titles to determine relevance. Procedural reports for treatment modalities, book chapters, abstracts, literature reviews, and foreign language articles were excluded. Full-text primary articles that contained “myofascial pain syndrome” in the title were automatically included, whereas those that did not were excluded. This inclusion criterion gave a more feasible, focused, and narrow set of articles to analyze. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram detailing the review process is presented in Figure 1.

The second phase involved performing a qualitative key word analysis by dividing the 167 articles with “myofascial pain syndrome” in the title among five reviewers: two physicians, one physical therapist, and two college students. The three professionals have experience in evaluating and treating patients with chronic musculoskeletal pain and have previously published on the topic.^{10,11,14-22} The students served as unbiased reviewers with no prior work on musculoskeletal pain. Each article was double-checked by a physician and a research assistant for all terminology used to describe MPS in the methods section. Given that our focus was on the descriptive terminology, we did not look at the biopsychosocial aspects of MPS. All terms and phrases identified by each reader as part of an article’s inclusion criteria for MPS were recorded, generating a total 143 distinct descriptors. Appendix A in File S1 displays the terms identified along with the assessed articles.

After completing this evaluation, our interdisciplinary team of authors consolidated by consensus the overlapping and redundant terms to reduce the number to 116 distinct terms (Appendix B in File S1). Given the variability among the terms used to describe MPS, each

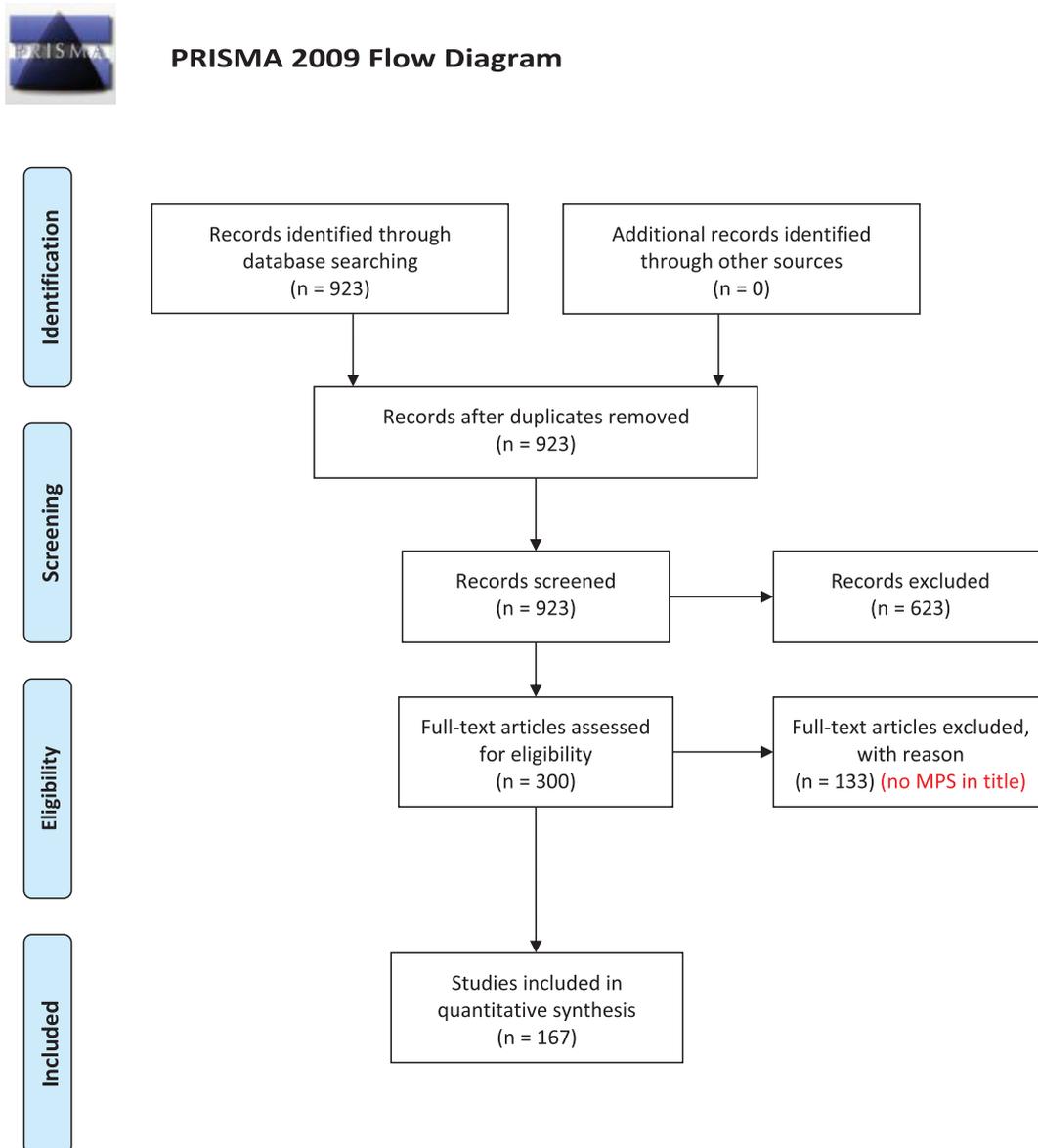


Figure 1. PRISMA flow diagram of narrative review process. PubMed and Web of Science were queried with the search term “myofascial pain syndrome,” which returned 923 articles. These articles were screened, generating 300 full-text articles. Only the full-text articles with “myofascial pain syndrome” in the title were included, generating 167 studies for review.

distinct term was initially categorized under 18 headings based on related anatomy or symptomatology by consensus of the research team (Appendix B in File S1). To further reduce this variability, we grouped the headings under one of five clusters determined by our team to be commonly associated with the diagnosis of MPS: “trigger points” (eg, active or latent), “muscle,” “pain,” “central and peripheral nervous system,” and “fascia.” Terms unrelated to the five clusters were categorized under the cluster “other.” This iterative process of reducing the 18 headings into these six overarching clusters is illustrated in Figure 2. Categorization of the 116 terms under the six separate clusters was agreed for inclusion among our co-authors and indicated in Appendix C in File S1.

We also looked at pairwise and triplets of clusters for determining associations. This was done to analyze whether a combination of clusters (eg, pain/trigger points, muscle/pain, trigger points/muscle) were recognized as non-mutually exclusive. The number of articles that mentioned criteria in each cluster was recorded. The total number of clusters mentioned in each article was also noted. Inclusion of more than one cluster in the description of MPS additionally emphasizes the complexity of the syndrome.

Furthermore, the journals in which the articles were published were assessed and categorized by subject or specialty. For example, the *Journal of Musculoskeletal Pain*, *Pain Medicine*, and *Clinical Journal of Pain* were all classified under the category of pain-related journals.

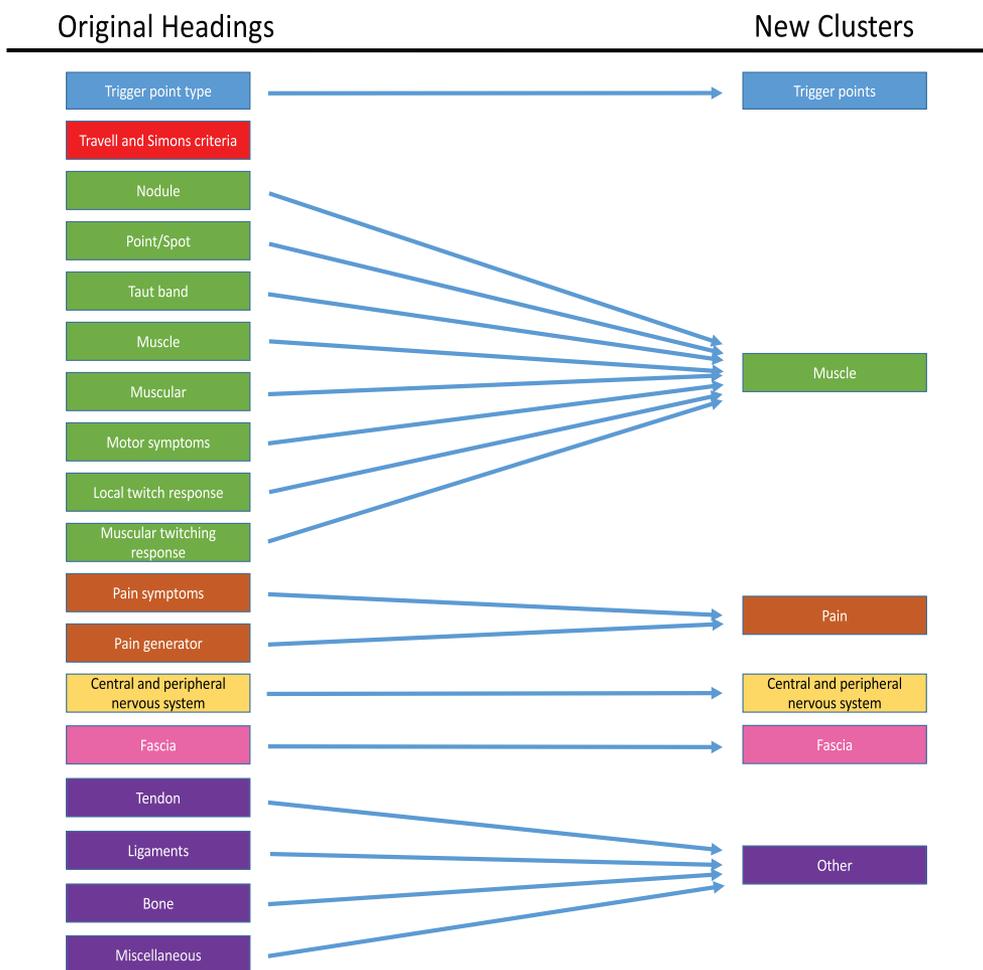


Figure 2. Process of reducing 18 headings, in which the terms were categorized based on related anatomy or symptomology, to 6 clusters. Five clusters (ie, “trigger points,” “muscle,” “pain,” “central and peripheral nervous system,” and “fascia” were determined to be commonly associated with the description of myofascial pain syndrome. Terms unrelated to the five clusters were categorized under the cluster “other.”

Altogether, there were eight categories under which the journals were classified: Pain, Rehabilitation/Physical Therapy, Rheumatology, Craniomandibular/Oral, Complementary Medicine, Neurology/Psychology, General Medicine, and Other (Appendix D in File S1). The frequency of MPS articles in each journal category was recorded to analyze which specialties were involved in the research on MPS.

Use of clusters within each journal category was also identified. The study design of each article was recorded and classified as either investigational research or intervention study (Appendix E in File S1). This will indicate how the nature of the study design may influence the types of terminology used in the description of MPS.

In addition, the articles were analyzed for application of the clinical criteria of Travell and Simons to describe MPS. This was done to assess the frequency of use of an already popularized and defined set of descriptors. Usage was determined by whether the articles explicitly mentioned the Travell and Simons criteria

or had citations referring to the criteria when defining MPS in the methods section. The number of articles using the criteria of Travell and Simons was recorded along with the presence of the accepted clusters within these articles.

The raw counts regarding the frequency of the clusters, cluster combinations, use of Travell and Simons criteria, temporal changes in MPS literature, and the journals pertaining to the articles are displayed in Appendix E in File S1. These data were tabulated and graphed.

Results

Our search returned 923 results. After the exclusion criteria were applied, 167 papers were identified. Figure 2 summarizes the review process while Appendix A in File S1 lists the papers that met the inclusion criteria. Of the 167 articles assessed, 116 distinct words were found to describe MPS and were categorized under one of the six clusters (Appendix C in File S1).

Table 1
Percentage of articles that applied each cluster

Cluster	Percentage of Articles
Trigger point	88.6%
Muscle	92.8%
Pain	91.6%
Central and peripheral nervous system	46.1%
Fascia	19.8%
Other	8.9%

Frequency of an Accepted Cluster Used to Describe MPS

The percentage of articles that used each cluster to define MPS is reported in Table 1. Descriptive terms pertaining to “trigger points,” “muscle,” or “pain” were prevalent in 88.6%, 92.8%, and 91.6% of the articles, respectively. Terms related to the “nervous system” cluster appeared in 46.1% of the articles, whereas terms referring to “fascia” appeared in 19.8% of the articles (Table 1).

Frequency of Combinations of Clusters Used to Describe MPS

The frequency of any pairwise clusters used to describe MPS was assessed. The data demonstrated that any pairwise combinations of the three separate identifiers—“trigger points,” “muscle,” and “pain” (ie, pain/trigger points; muscle/pain; trigger points/muscle)—were present in over 80% of the articles. In addition, of the articles that included fascia in the description of MPS, 63.6% also included reference to the nervous system. The presence of multiple clusters was also assessed, indicating that 73.1% of the articles used three or four of the clusters to describe MPS. Specifically, 76.6% of the articles included terms related to “trigger points,” “muscle,” and “pain” in the descriptive terminology for MPS.

Application of Travell and Simons Criteria

Given the impact of the Travell and Simons criteria in characterizing MPS, we sought to identify the frequency of the criteria³ for describing MPS in the articles. Only 42% of the articles applied the Travell and Simons criteria. Within these articles, over 87% mentioned the clusters “trigger points,” “muscle,” or “pain” as part of the syndrome.

Frequency of Publications on MPS

Although Travell’s work on MPS dates back to the 1950s, research on muscle pain disorders was first documented as early as the 1500s.¹⁰ However, we observed that most of the articles with “myofascial pain syndrome” in the title have only been published in the last two decades (Figure 3). The number of articles published with MPS in the title since 2010 more than doubled from that of the prior decade, with 110 articles compared to 48, respectively. Consistent with this increase in the number of articles is the increase in use of our defined clusters. “Trigger points,” “muscle,” and “pain” were the most frequently referenced clusters (Figure 3).

MPS Publications among Journal Categories

Publications on MPS have been increasing consistently in each of the defined journal categories, except for Neurology/Psychology and Pain-related journals. Figure 4 illustrates the number of MPS publications in each journal category within a 5-year window between 1977 and 2017. In Pain-related journals, the frequency of MPS publications increased from 1977 to 2011, but decreased from 2012 to 2017. Although Pain-related journals had the most MPS publications from 2000 to 2011, Rehabilitation/Physical Therapy has published the most in recent years (2012 to 2017).

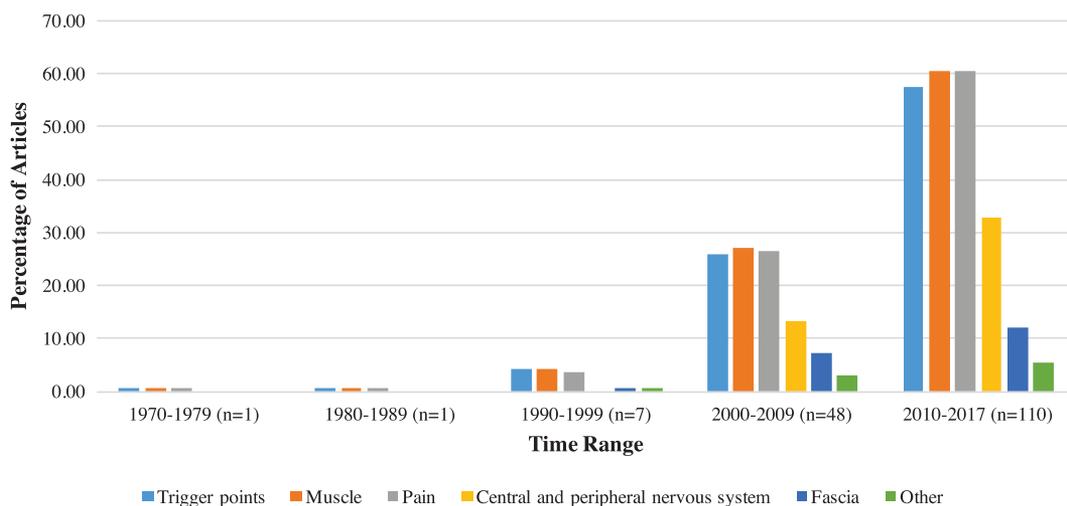


Figure 3. Percentage of articles using each cluster for the description of myofascial pain syndrome over time (1977-2017).

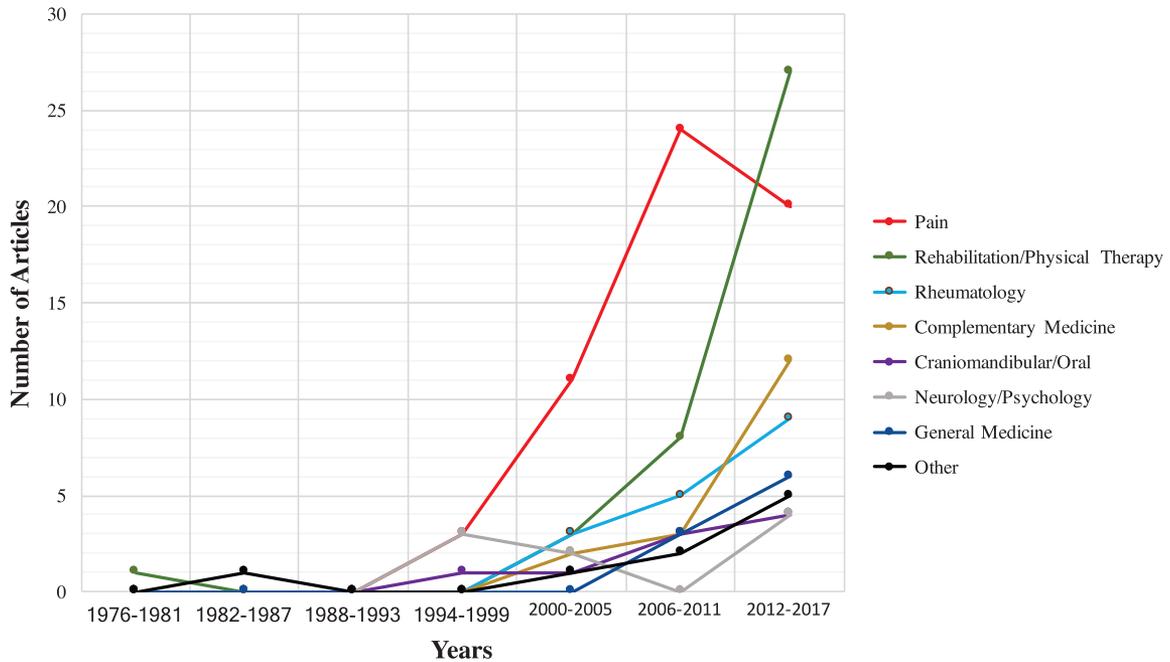


Figure 4. Number of articles published on myofascial pain syndrome in each journal category over time (1977-2017). The time frame was divided by 5-year increments.

Frequency of Clusters within Journal Categories

The percentage of articles in each journal category that applied the clusters as well as Travell and Simons were graphed (Figure 5). The cluster triad of “trigger points,” “muscle,” and “pain” was the most widely used among all the journal categories. The Travell and Simons diagnostic criteria were applied by over 50% of the articles in Rehabilitation/Physical Therapy and Rheumatology-related

journals, but by less than 50% in the other journals, including Pain-related.

Interventional versus Investigational Studies in Each Journal Category

In assessing the study design of each article, we found that nearly half of the articles in Pain-related journals were investigational, whereas Rehabilitation/Physical

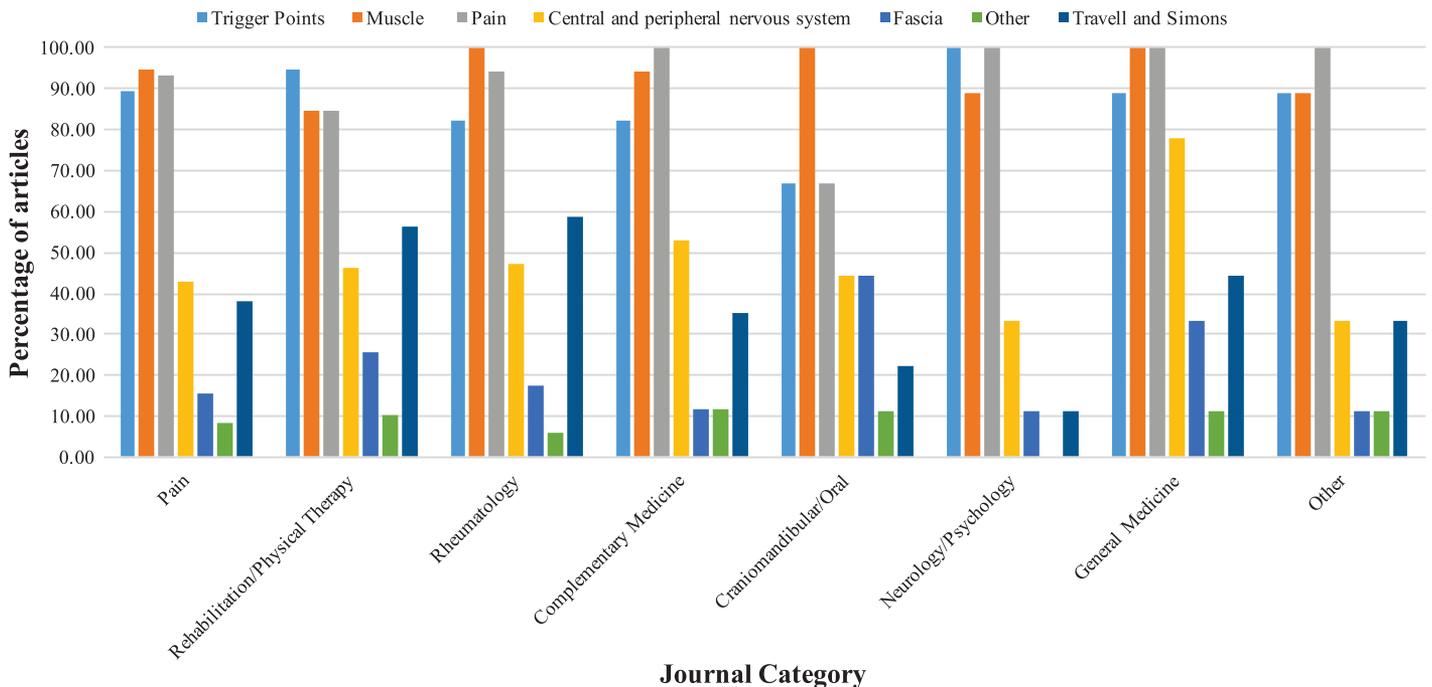


Figure 5. Percentage of articles by journal category that applied each cluster and Travell and Simons criteria for the description of myofascial pain syndrome.

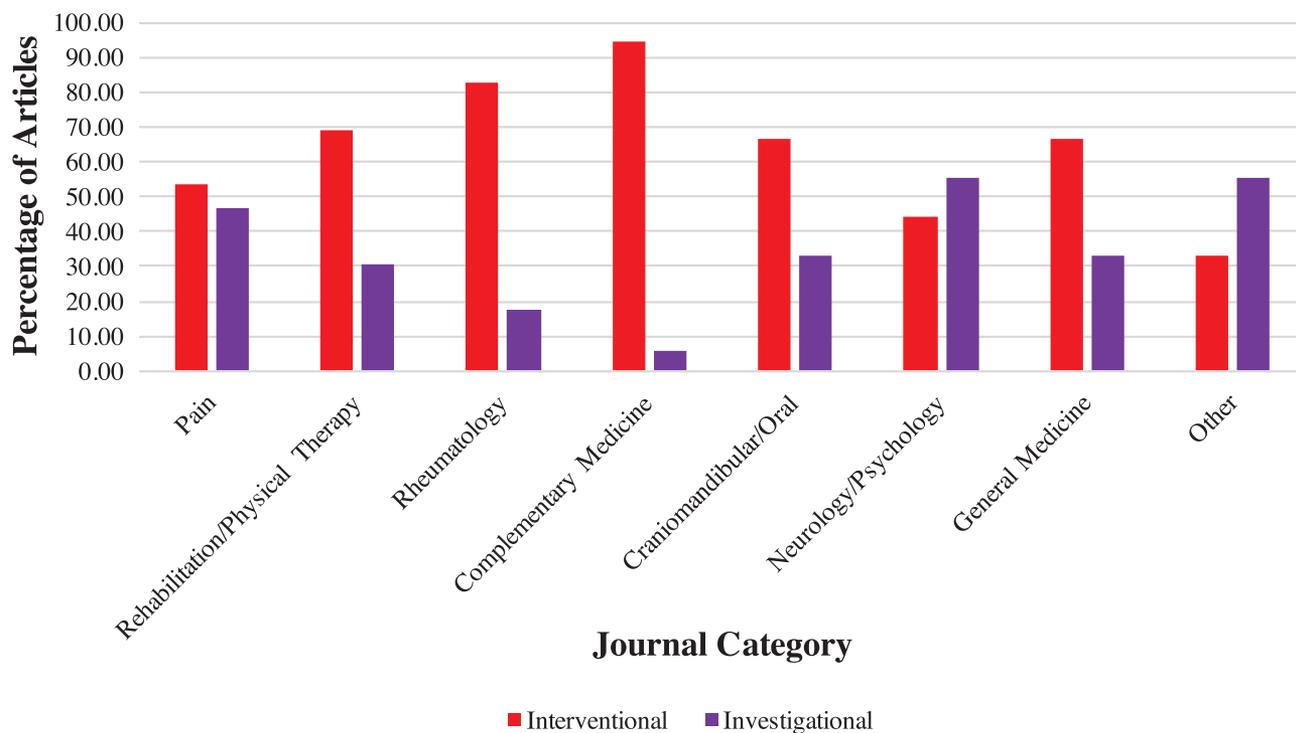


Figure 6. Percentage of interventional versus investigational studies in each journal category.

Therapy contained only 30.8% (Figure 6). The majority of the articles in Rehabilitation/Physical Therapy-related (69.2%) and Rheumatology-related journals (82.4%) were intervention studies.

Discussion

This review is the first to explore and characterize the terminology commonly used to describe the clinical presentation of MPS. Our goal was to determine the degree of heterogeneity in the descriptions and taxonomy for MPS in the literature. We sought to determine whether there were trends and/or consensus in terminology used to describe MPS. The narrative review we performed spanned a 40-year period (1977-2017), and our findings identify significant variance and lack of consensus in the terminology used within the MPS literature. Furthermore, we found changes in trends in MPS research.

The applied analytic strategy established word clusters referring to “muscle,” “pain,” and “trigger point,” which had been used frequently in the publications. Most of the articles used a variation of three or four clusters in their description of MPS and approximately 77% included all three clusters (ie, “trigger points,” “muscle,” and “pain”). Although this prevalence remained consistent over the years (Figure 3), this cluster triad was not used by all authors, providing further evidence for the lack of universal consensus and paucity of clinical practice guidelines for MPS.

It is notable that despite nearly 80% use of this cluster triad, the specificity of terms within these clusters differed widely (Appendix C in File S1). Within the cluster

“trigger point,” we observed inconsistency in the characterization of trigger points as *active* or *latent*. In the cluster “muscle,” frequently used terms were palpable nodules, which included *tender point*, *tender nodule*, *tender spot*, or *muscle knots*. Unfortunately, it is unclear whether these terms were used interchangeably. This heterogeneity leads to confusion, as these terms are not always considered to be synonymous by practitioners. Furthermore, standardization for terms used in the “pain” cluster is even more challenging because, unlike “trigger point” and “muscle,” descriptors of pain are entirely subjective, sensitive to change, and dependent on patient self-reports.¹⁴

The variance in terminology is further highlighted by the prevalence of nine words/phrases, such as *tendon*, *ligamentous junctions*, and *bone*, which are used in the description of MPS by certain articles. These terms were categorized as “other” because they were not commonly associated with MPS. Our reported heterogeneity in terminology is an important finding as it precludes meaningful comparisons between studies, given that different clusters may represent varying manifestations of the same underlying clinical condition.

Although the Travell and Simons criteria for MPS have been referenced in the literature, we found that less than half of the authors actually utilized the criteria by name. It is uncertain whether these authors used all the criteria and/or a subset of their descriptors, such as taut band, trigger point, and painful/tender nodule. We also observed that there were significant variations in references to trigger points, as applied in the Travell and Simons writings. This finding emphasizes the need for

standard taxonomy as well as diagnostic criteria for MPS. Despite Travell and Simons being widely recognized, our findings suggest that their descriptive criteria were not uniformly used.

The secondary aim of this review was to shed light on whether there are new trends in investigations or interventional research in MPS, and whether this has evolved over the last 40 years. We were able to identify some new trends in publication during this time. A variety of specialties have contributed to the MPS literature, including Pain-related journals, Complementary Medicine, Rehabilitation/Physical Therapy, and Rheumatology (Appendix D in File S1). For the first three decades, Pain-related journals dominated the literature on MPS. Nearly half of the articles in these journals were investigational (Figure 6), which implies a focus on the role of pain (eg, sensitization and neurogenic inflammation). However, in recent years, MPS publications have decreased in Pain-related journals and increased in not only Rehabilitation/Physical Therapy-related journals but also in other journal categories. This change in trend suggests that the interest has shifted toward interventional, clinical research. The greater usage of the Travell and Simons diagnostic criteria for MPS in Rehabilitation/Physical Therapy-related journals than in Pain-related journals further supports its interventional focus (Figure 5). However, of the intervention studies in Rehabilitation/Physical Therapy-related journals, only 56% applied a pre-defined set of descriptive criteria (ie, Travell and Simons) for inclusion. This lack of uniformity challenges the comparability among studies and their effectiveness for treating MPS, hence the infrequency with which clinical practice guidelines appear in the literature.

The heterogeneity in the descriptive terms for MPS over the 40-year review period makes it difficult to align the descriptors in all the publications we examined. However, there were no significant differences in the frequency of clusters among the journal specialties. In addition, the prevalence of the three clusters (ie, “trigger points,” “muscle,” and “pain”) has not changed (Figure 3) and no universally adopted diagnostic criteria have been established, suggesting that the profile of MPS research has not evolved significantly. Furthermore, it appears that the prevalence of the cluster triad in 90% or more of the articles in Pain-related journals (Figure 5), the dominance of this journal specialty in the initial three decades, and its investigational focus may have influenced the types of terminologies used in other fields and in subsequent research on MPS. It is our belief that if researchers and clinicians could agree upon using the three clusters for diagnostic and inclusion criteria, this would introduce a more uniform taxonomy and enable meaningful comparisons in studies pertaining to MPS.

This review has several strengths. Co-authors of this review included a team of health-care providers and investigators with over 100 years of combined experience evaluating and treating musculoskeletal pain, as well as

publishing extensively on various topics related to MPS.^{10,11,14-22} The 116 terms categorized under each cluster were the original terms used in the assessed articles and common terms were selected based on their use in the articles, so no bias was introduced upon identifying them. The authors, while familiar with the work of Travell and Simons, were committed to identifying the frequency of terms used in MPS publications and not in demonstrating that the Travell and Simons criteria were superior or more desirable for future research and clinical practice in MPS.

The main limitation of this review is that we included only articles with “myofascial pain syndrome” in the title for our final analysis. We chose this to reflect only those articles whose primary focus was myofascial pain, as many studies investigating other forms of chronic pain (eg, low back, neck) also discuss myofascial pain as secondary epiphenomena. We believe that the potential bias of this limitation is adequately mitigated by the fact that we employed a large number of articles (167) for our final analysis, which is sufficient to adequately represent the greater body of research in MPS. The 2-year lag time between which the database query was performed, in 2017, and the time of our manuscript submission, in 2019, may also be explained and mitigated by the number of articles we analyzed. The depth and specificity of our analysis of each article required a large time commitment that extended into 2 years. However, again, we feel that the quantity of articles over the 40-year timespan provides an adequate representation of MPS research despite this 2-year delay. Moreover, the 116 terms were clustered based on consensus among our team. We utilized the aforementioned clusters instead of individual terms so that comparisons could be made among the descriptors of MPS across all articles.

Our findings highlight the heterogeneity of terminology within the literature, underscoring the urgent need for development and standardization of diagnostic criteria for MPS. This heterogeneity has the potential to adversely affect clinical advances in the field by limiting the external validity of clinical trials, reliability of disease biomarkers, and selection of treatment beginning and/or endpoints. In addition, mechanistic research is difficult to do because consensus about what constitutes the MPS diagnosis has not yet been reached. There is clearly continued and growing interest in MPS and an increasing body of research being published by investigators from multiple specialties.

We suggest that the international community of interested investigators (eg, basic scientists, clinical researchers, epidemiologists, and academic and community-based healthcare practitioners) come to a consensus on the cluster definition approach to taxonomy and diagnostic criteria for MPS. Given the decrease in publications in Pain-related journals and the paucity of terminology reflecting the central and peripheral nervous system, there may be insufficient research on pain

mechanisms in this syndrome. Opportunities for investigation would include studies evaluating sensitization, neurogenic inflammation, biomechanical abnormalities, and inclusion of other soft tissues to examine biochemical contributors to the syndrome.

Conclusion

MPS is frequently misdiagnosed and/or mismanaged.⁷ Our review highlights the lack of uniformity in descriptors for MPS across a 40-year period. In the view of the authors, this limits the ability to compare clinical interventions and to study possible mechanisms of MPS. We recommend that a clustering of frequently used terms be used to advance the field and improve clinical trial outcomes, which we believe may help develop practice guidelines for MPS. Standardized, mechanistic-based terminology, objective definitions of findings, and evidence-based interventions are needed to properly compare patients, trials, and endpoints.

Acknowledgments

Erika Caldwell from the University of Guelph for her help with reviewing the data.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

References

1. Simons D. Clinical and etiological update of myofascial pain from trigger points. *J Musculoskelet Pain*. 1996;4:93-122.
2. Bourgaize S, Newton G, Kumbhare D, Srbely J. A comparison of the clinical manifestation and pathophysiology of myofascial pain syndrome and fibromyalgia: implications for differential diagnosis and management. *J Can Chiropr Assoc*. 2018;62(1):26-41.
3. Simons D, Travell JG, Simons LS. *Myofascial Pain and Dysfunction: The Trigger Point Manual*. Vol 1. Baltimore, MD: Williams & Wilkins; 1999.
4. Travell J, Rinzler S. The myofascial genesis of pain. *Postgrad Med*. 1952;11:425-434.
5. Hendler N, Kozikowski J. Overlooked physical diagnoses in chronic pain patients involved in litigation. *Psychosomatics*. 1993;34:494-501.
6. Mense S. Muscle pain: mechanisms and clinical significance. *Dtsch Arztebl Int*. 2008;105(12):214-219.
7. Mense S. Algesic agents exciting muscle nociceptors. *Exp Brain Res*. 2009;196(1):89-100.
8. Stecco C, Stern R, Porzionato A, et al. Hyaluronan within fascia in the etiology of myofascial pain. *Surg Radiol Anat*. 2011;33(10):891-896.
9. Stecco A, Gesi M, Stecco C, Stern R. Fascial components of the myofascial pain syndrome. *Curr Pain Headache Rep*. 2013;17(8):352.
10. Shah JP, Thaker N, Heimur J, Aredo JV, Sikdar S, Gerber L. Myofascial trigger points then and now: a historical and scientific perspective. *PM R*. 2015;7(7):746-761.
11. Shah JP, Gilliams EA. Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. *J Bodyw Mov Ther*. 2008;12(4):371-384.
12. Rivers WE, Garrigues D, Graciosa J, Harden RN. Signs and symptoms of myofascial pain: an international survey of pain management providers and proposed preliminary set of diagnostic criteria. *Pain Med*. 2015;16(9):1794-1805.
13. Nasirzadeh Y, Ahmed S, Monteiro S, Grosman-Rimon L, Srbely J, Kumbhare D. A survey of healthcare practitioners on myofascial pain criteria. *Pain Pract*. 2018;18(5):631-640.
14. Gerber LH, Sikdar S, Armstrong K, et al. A systematic comparison between subjects with no pain and pain associated with active myofascial trigger points. *PM R*. 2013;5(11):931-938.
15. Ballyns JJ, Turo D, Otto P, et al. Office-based elastographic technique for quantifying mechanical properties of skeletal muscle. *J Ultrasound Med*. 2012;31:1209-1219.
16. Turo D, Otto P, Shah JP, et al. Ultrasonic characterization of the upper trapezius muscle in patients with chronic neck pain. *Ultrasound Imaging*. 2013;35:173-187.
17. Gerber LH, Shah J, Rosenberger W, et al. Dry needling alters trigger points in the upper trapezius muscle and reduces pain in subjects with chronic myofascial pain. *PM R*. 2015;7(7):711-718.
18. Aredo JV, Heyrana KJ, Karp BI, Shah JP, Stratton P. Relating chronic pelvic pain and endometriosis to signs of sensitization and myofascial pain and dysfunction. *Semin Reprod Med*. 2017;35(1):88-97.
19. Dommerholt J, Shah J. Myofascial pain syndrome. In: Ballantyne J, Fishman S, Rathmell J, eds. *Bonica's Management of Pain*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2018.
20. Gerber LH, Sikdar S, Aredo JV, et al. Beneficial effects of dry needling for treatment of chronic myofascial pain persist for 6 weeks after treatment completion. *PM R*. 2017;9(2):105-112.
21. Srbely J, Vadasz B, Shah J, Gerber NL, Sikdar S, Kumbhare D. Central sensitization: a clinical conundrum. *Clin J Pain*. 2016;32:1011-1013.
22. Stratton P, Khachikyan I, Sinaii N, Ortiz R, Shah J. Association of chronic pelvic pain and endometriosis with signs of sensitization and myofascial pain. *Obstet Gynecol*. 2015;125(3):719-728.

Disclosure

V.P., J.S., H.T. Rehabilitation Medicine Department, Clinical Center, National Institutes of Health, Bethesda, MD. Address correspondence to: V.P.; e-mail: vy.phan@nih.gov

J.S. Department of Human Health and Nutritional Sciences, University of Guelph, Guelph, Canada

S.D. Department of Health Administration and Policy, College of Health and Human Services, George Mason University, Fairfax, VA

D.K. Department of Medicine, Division of Physical Medicine and Rehabilitation, University of Toronto, Toronto, Canada

S.S. Department of Bioengineering, Center for Adaptive Systems of Brain-Body Interactions, George Mason University, Fairfax, VA

A.C. Department of Human Health and Nutritional Sciences, University of Guelph, Guelph, Canada

A.G. Department of Health Administration and Policy, College of Health and Human Services, George Mason University, Fairfax, VA

L.G. Department of Health Administration and Policy, Center for the Study of Chronic Illness and Disability, College of Health and Human Services, Center

for Adaptive Systems of Brain-Body Interactions, George Mason University, Fairfax, VA
Disclosure: None

Submitted for publication August 2, 2019; accepted November 4, 2019.
