

BACKGROUND

Prolonged pain tends to develop into a combination of physical, psychological, and social disabilities. Current lines of research are investigating the incorporation and integration of mindfulness, pain science education, and traditional physiotherapy in the treatment of chronic pain. Other studies have revealed conflicting results for multicomponent approaches to address chronic pain management. Still, there is enough published support for clinical guidelines to recommend multicomponent rehabilitative approaches, including a combination of movement or exercise, mindfulness, and pain neuroscience education, to improve chronic musculoskeletal pain (Chou et al 2007). One study found that patients with chronic low back pain can achieve positive outcomes with an intensive stretching, strengthening, and aerobic conditioning in a group environment exercise program (Ogston et. Al 2016). In a separate study, mindfulness was found to improve psychological distress, depressive symptoms and pain catastrophizing which in turn may aid in the improvement of chronic pain symptoms (Brooks et al. 2018). Pain Neuroscience Education (PNE) is a method of educating patients about the neurophysiology of pain that aims to reconceptualize pain from an indicator of damage to an interpretation of input signals by the brain and nervous system (Lane et al. 2018). In combining all three of these mentioned approaches, Samaritan Lebanon Community Hospital's Department of Physical Therapy has developed and are currently implementing an integrative pain rehabilitation program in a rural setting called the "Movement, Mindfulness, and Pain Science" program (MMaPS). The curriculum for a MMaPS program is designed through an integrative modality approach. The aim is to reduce the risk of injury, impairment, functional limitation and disability associated with chronic pain, and may include the improvement and maintenance of health, fitness, function and quality of life in all age populations.

OBJECTIVE

The objective of this observational, retrospective case series was to identify trends in physical function and pain-related outcome markers of the MMaPS program participants in order to determine whether a multimodal therapeutic approach could improve or worsen chronic pain in affected individuals.

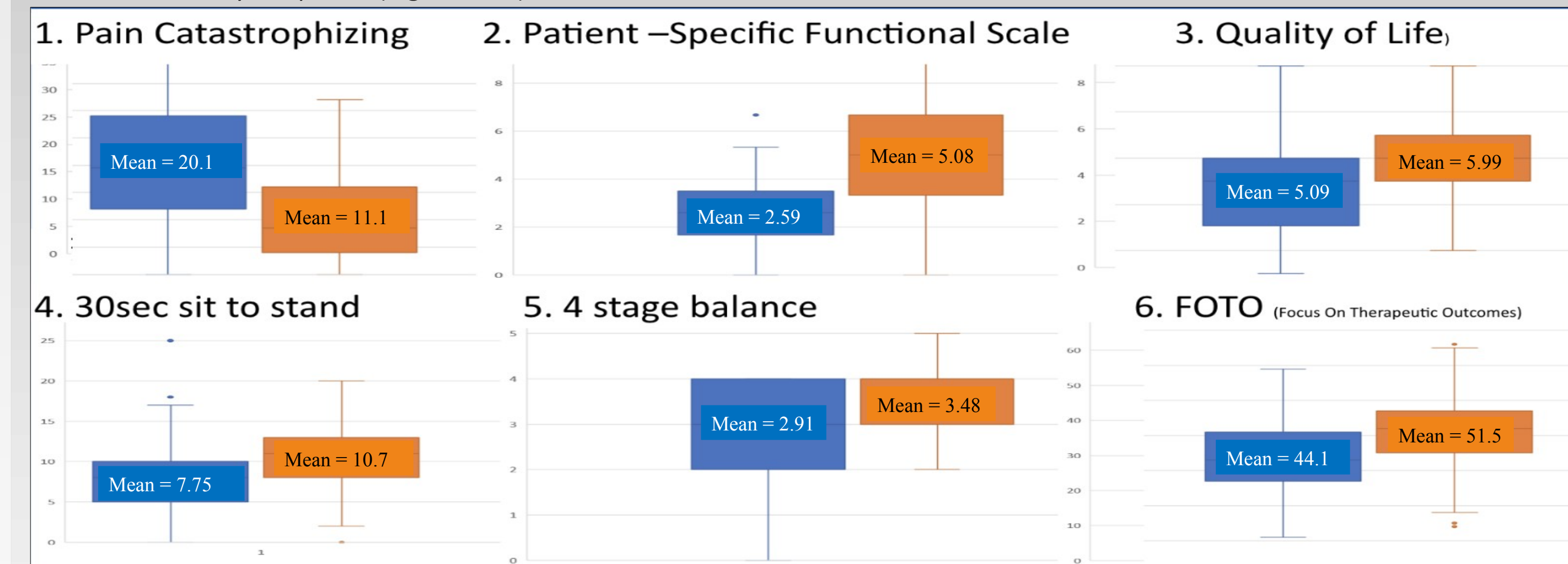


MATERIALS AND METHODS

The MMaPS Program occurred in 8-week intervals, with two sessions per week in the span 2-hours (4 hours total per week). Participants could enroll in the program twice per year, requiring at least a 2-month break in between each program. Each session included a movement, mindfulness, and pain science activity conducted and supervised by physical therapists (Table 1). Eligible participants included all adults over the age of 18 experiencing chronic pain with a physical therapy referral. Each accepted participant was individually evaluated prior to and after the program by physical therapists with measured outcome markers from various observational and survey diagnostic tests: the Pain Catastrophizing (PC) Scale, Quality of Life (QOL) Scale, 30 Second Sit to Stand Test, 4-stage Balance Test, Patient-Specific Functional Scale (PSFS), and Focus on Therapeutic Outcomes (FOTO). The Pre- and post- data of measured outcome markers were collected from 116 participants between May 2018 and Dec 2019, and were analyzed and compared retrospectively using the Wilcoxon Signed-Rank Test.

RESULTS

Regarding patient demographics, the average participant age was identified as 56 years, with 35 males, 80 females, and 1 unknown gender. Results showed statistically significant improvements for all outcome markers ($p < 0.001$): the average PC Scale decreased by 10 points, the average QOL Scale increased by 0.9 points, the average 30 Second Sit to Stand improved by 2.9 seconds, the average 4-stage Balance test score increased by 0.6 points, the average PSFS score increased by 2.5 points, and the average FOTO score increased by 7.4 points (Figures 1-6).



Figures 1-6 illustrate a significant decrease in Pain Catastrophizing and a significant increase in Patient Specific functional Scale, Quality of Life, 30s sit to stand, 4 stage balance, & FOTO

Outcome measures (N=116)	Pre-test Mean score (SD)	Post-test Mean score (SD)	p-value
Pain Catastrophizing Scale	20.1 (10.5)	11.1 (9.23)	<0.001
Quality of life scale	5.09 (2.01)	5.99 (1.98)	<0.001
Patient Specific Functional Scale	2.59 (1.45)	5.08 (2.16)	<0.001
30s Sit to Stand	7.75 (5.15)	10.7 (5.33)	<0.001
4 stage balance	2.91(1.09)	3.48 (0.77)	<0.001
FOTO score	44.1(10.5)	51.5 (11.5)	<0.001

MOVEMENT: Posture, pacing, DOMS, partner movements, tai chi, yoga, mindful walking, dancing, chair exercises, floor transfers, balance, ROM, stretching, strengthening, aerobics, HIIT, circuits.

MINDFULNESS: 5 facets of mindfulness (observe, describe, non-judging, non-reactive, & acting with awareness), ANTs, emotions, values & identity, radical acceptance, post traumatic growth, guided meditations, diaphragmatic breathing, setting intentions, media: Shauna Shapiro: the power of mindfulness: what you practice grows stronger.

PAIN SCIENCE: Pain triangle, SMART goals, central sensitization, pacing, graded exposure, polyvagal theory & titanic model, handful of health, contributing factors of pain, resiliency, drug cabinet of the brain, expressive writing, pain ≠ tissue damage, imaging statistics, DIMS and SIMs, cycle of change, fear avoidance cycle. Media: Lorimer Moseley: The Role of he Brain in Chronic Pain, Joe Dispenza: Neurons That Fire Together Wire Together, Michelle Pol-er: 100 Days Without Fear, Brené Brown: The Power of Vulnerability & Listening to Shame.

Table 1

CONCLUSIONS

The MMaPS program captured improvements in physical and pain-related markers for participants. All measured outcomes were found at statistically significant levels ($p < 0.001$), contributing to the growing evidence that an integrative pain management program may be an effective alternative in improving physical function and reducing pain for chronic pain patients. Furthermore, a multimodal group program approach may reduce costs for pain alleviation treatment in comparison to traditional therapies and improve health outcomes for outpatient settings. Inherent limitations of an observational case series exist without a control group. Thus, future studies should investigate and compare the efficacy of similar integrative and multimodal pain management programs with a standardization of outcome markers to improve predictive abilities of statistical models. Other experimental studies should also evaluate and compare group versus individual-based therapy settings in order to determine potential variation in outcomes due to program environment. Lastly, quality evidence is needed regarding the cost effectiveness of multidisciplinary programs, as they may require substantial staff and financial resources from the health care system.

REFERENCES

- Chou, R., Huffman, L. H., American Pain Society, & American College of Physicians. (2007). Nonpharmacologic therapies for acute and chronic low back pain: A review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Annals of Internal Medicine*, 147(7), 492-504.
- Brooks, J. M., Iwanaga, K., Cotton, B. P., Deiches, J., Blake, J., Chiu, C., Morrison, B., & Chan, F. (2018, Apr-Jun). Perceived Mindfulness and Depressive Symptoms Among People with Chronic Pain. *Journal of rehabilitation*, 84(2), 33-39.
- Lane, E., Fritz, J. M., Greene, T., & Maddox, D. (2018). The effectiveness of training physical therapists in pain neuroscience education on patient reported outcomes for patients with chronic spinal pain: a study protocol for a cluster randomized controlled trial. *BMC musculoskeletal disorders*, 19(1), 386. <https://doi.org/10.1186/s12891-018-2269-2>
- Ogston, J. B., Crowell, R. D., & Konowalchuk, B. K. (2016). Graded group exercise and fear avoidance behavior modification in the treatment of chronic low back pain. *Journal of back and musculoskeletal rehabilitation*, 29(4), 673-684. <https://doi.org/10.3233/BMR-160669>

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1.0 Introduction:

Current lines of research are integrating mindfulness, patient education, exercise, and traditional physiotherapy in the treatment of chronic pain. These studies often monitor holistic factors including physical, mental, emotional and self-appraisal metrics in patients with chronic pain. Curriculum for a “Pain education, Mindfulness, and Movement” program works to alleviate impairments and functional limitations associated with chronic pain by designing, implementing, and administering multifaceted interventions. The aim is to help patient regain their confidence in their function, restore self-care, self –compassion, physical fitness and health. Hence lead a better quality of life with empowerment.

Some studies have revealed conflicting results for multi-faceted approaches to address chronic pain management. Still, there is enough published support for clinical guidelines to recommend multi-faceted approaches, including a combination of movement or exercise, mindfulness, and pain neuroscience education, to improve chronic musculoskeletal pain.

More recently, there have been studies researching the benefits of specific types of exercise on improvement of chronic pain and decreased opioid use. Studies have not only found that exercise creates a reduction in pain and pain medication usage, but also improves flexibility, range of motion and physical function (Ogston et. al, 2016). For example, Saper et al. discovered a yoga intervention designed specifically for chronic low back pain that is similar in efficacy to physical therapy for improving physical function, and reducing chronic low back pain and pain medication usage (Saper et al. 2017).

In addition to movement training, mindfulness has also shown benefits in addressing chronic pain when used in addition to other existing treatments. Mindfulness was found to

improve psychological distress, depressive symptoms, and pain catastrophizing which in turn may aid in the improvement of chronic pain symptoms (Brooks et al. 2018).

Furthermore, educating patients on the neurobiology and neurophysiology of pain has shown results with decreased pain and improved physical performance. Pain Neuroscience Education (PNE) is a method of educating patients about the neurophysiology of pain that aims to reconceptualize pain from an indicator of damage to an interpretation of input signals by the brain and nervous system (Lane et al. 2018). Improving patient knowledge of pain has the ability to reduce pain by improving function, lowering disability, reducing psychosocial factors, enhancing movement, and minimizing healthcare utilization (Louw et al. 2016).

Finally, multiple studies have sought to combine these various treatment protocols into a single treatment plan (Kääpä et al 2006, Jay et al 2016, Still & Björnsdóttir 2015). Unfortunately, these groups had mixed results due to the lack of consistency between studies in the methods of treatment, as well as the methods of measuring outcomes. Still, current clinical guidelines suggest overall interdisciplinary rehab has supporting evidence of moderate efficacy (Chou et al 2017).

Building on this research, this study seeks to identify trends in outcome data accumulated in a novel interdisciplinary group rehabilitation program at Samaritan Lebanon Community Hospital’s Department of Physical Therapy. Physical therapists in this department developed and are implementing a unique program called MMAPS: Movement, Mindfulness, and Pain Science. The purpose is (1) to empower individuals by giving them pain concepts, helping them accept their pain, increasing function, and improving quality of life; (2) to provide consistent content presented across classes, locations, and terms of the program for continuity of care and standardization for research; (3) to structure the program so that it is reproducible at multiple locations.

The format of the program is 8 weeks, twice per week for two hours per session (with a (10 min break), to include the following in any order:

- Meditation x5 mins
- Movement x25 mins
- Pain Science x50 mins
- Mindfulness x30 mins

The sessions are taught by two therapists, Veronica Moresi being one of them in each case as the Lead MMAPS PT.

The following schedule is an example of how the topics (movement, mindfulness, and pain science) might be covered in an entire 8-week course. They are in the recommended order, but it is up to the MMAPS therapists, subject to the unique dynamic of each MMAPS group, and dependent on timing in each group (for example, in some groups certain topics take longer to cover) to determine the actual order.

Wk	#	Movement Topics	Mindfulness Topics	Key Concepts
1	1	Diaphragmatic	Opening meditation setting intention 3-5 min	Pain triangle

		Breathing Posture	Into to meditation & One min mini meditation Introduction to course & binder Introductions & setting group rules	
	2	Pacing & DOMS Seated gentle whole-body ROM	Opening meditation setting intention 3-5 min Review group rules & introductions Mindfulness definition & intro to 5 facets Mindfulness as a stage analogy	Understanding pain in 5 min media Pain triangle SMART goals
2	3	chair yoga Pacing & DOMS review	Opening meditation setting intention 3-5 min Observe & describe facets – external guided senses meditation	Central sensitization & fight/flight vs rest/digest Handful of health
	4	Partner movements	Opening meditation setting intention 3-5 min Observe & describe facets – internal (thoughts, ANTs, emotions & Music meditation (<5min))	Lorimer snake bite media Neurons that fire together wire together
3	5	Tai chi	Opening meditation setting intention 3-5 min Observe & describe facets – internal (values, identity, true self)	Resiliency Levels of energy – titanic model
	6	Chi walking/mindful walking	Opening meditation setting intention 3-5 min Non-judgement facet (ANTs & mindfulness is choosing)	Drug cabinet in the brain Expressive writing DIMs & SIMs
4	7	Floor transfers	Opening meditation setting intention 3-5 min Non-judgement facet (Radical acceptance)	Cycle of change, fear avoidance cycle, 100 days of fear media
	8	Balance	Opening meditation setting intention 3-5 min Non-reactivity (prompting events) & act with awareness (Wise advocate & Wise mind)	Tissue damage ≠ pain, Imaging facts, Tissue vs function vs experience
5	9	Aerobic exercise basics HIIT	Opening meditation setting intention 3-5 min Post traumatic growth Review of 5 facets	Brene Brown – The Power of Vulnerability Group process & review
	10	How many exercises can you do with a chair Physiology & guidelines of stretching & strengthening	Opening meditation setting intention 3-5 min Guided meditation – self esteem	Brene Brown – Listening to Shame Group process & review
6	11	Yoga	Opening meditation setting intention 3-5 min Guided meditation – true self	Review: pain triangle, central sensitization
	12	Tai chi	Opening meditation setting intention 3-5 min Guided meditation	Review: handful of health
7	13	Movement stations	Opening meditation setting intention 3-5 min Guided meditation	Review: pacing, neurons that fire together wire together
	14	HIIT	Opening meditation setting intention 3-5 min	Review: drug cabinet in

			Guided meditation	brain, DIMs & SIMs, expressive writing
8	15	30" chair stand 4 stage balance	Opening meditation setting intention 3-5 min Shauna Shapiro media	Paperwork day Review
	16	Dancing	Opening meditation setting intention 3-5 min Guided meditation	Overall review: list all possible tools

2.0 Study Aims (Research Question/Hypotheses):

1. How does Samaritan Lebanon Hospital's current transdisciplinary chronic pain program compare to current literature on chronic pain management?
2. Is there an observable trend in outcome measures in patients who have participated in Samaritan Lebanon's group multidisciplinary chronic pain program?
 - a. Outcome measures are as follows: (see Appendix B for copies of all measures).
 - Pain Catastrophizing scale
 - Quality of Life scale (QOL)
 - Patient-Specific Functional Scale (PSFS)
 - 30 sec sit to stand test
 - 4-stage balance test
 - Focus on Therapeutic Outcomes (FOTO)
 - Adverse Childhood Experience (ACE) Questionnaire

3.0 Methods:

Study design: Program Evaluation

Study subjects: Individuals of any age, race, ethnicity, or gender, with any physical diagnosis, who report pain and are referred to physical therapy by their primary care physician or a physician specialist.

Inclusion and/or exclusion criteria:

- Inclusion:
 - Individuals with any diagnosis who report pain and are referred to physical therapy by their primary care physician or a physician specialist (not necessarily for MMaPS).
 - 18 years of age or more.
 - Individuals must be able to participate in all aspects of the sessions, though they are allowed to opt out of certain sections.
 - Individuals must be able to arrange transportation to and from sessions.
 - Individuals must be available for the session's scheduled times.
 - Individuals must be able to understand and speak English.
 - Individuals must score greater or equal to 21 on the Mini-Mental State Exam. The MMSE is not part of a standard PT evaluation but is performed in patients

with potential cognitive issues, including those with a history of brain tumors, brain cancer, stroke, traumatic brain injury, dementia, Parkinson's, Multiple Sclerosis, serious psychiatric diagnosis, and other neurological conditions that may have cognitive effects.

- Patients must be done with 1:1 PT sessions, if they have been participating in them, before beginning MMaPS.
- New potential patients must complete a 1:1 evaluation with a MMaPS therapist prior to beginning the program; participation in the program is a joint decision between the therapist and the patient.
- Exclusion:
 - Individuals who did not attend at least 11 sessions out of 16.
 - Individuals for whom outcome measure data is missing or incomplete.
 - Individuals lacking a referral from their PCP or other physician.

Measurements: Outcome measures are as follows: Pain Catastrophizing scale, Quality of Life scale, Patient-Specific Functional Scale (PSFS), 30 sec sit to stand test, 4-stage balance test, Adverse Childhood Experience (ACE) Questionnaire, and Focus on Therapeutic Outcomes score (see end of document for copies of all measures).

Implementation plan: Outcome measures have been collected on patients (with the exception of drop-outs) beginning in 2017 in MMaPS. They are in a spreadsheet at the front desk, and the data is entered by one of the office admins on a rolling basis.

Veronica Moresi, PT, DPT, Sharna Prasad, PT, DPT, Rachel Harvey, PT, DPT, and Peter Smith, PT, are the physical therapists employed by Samaritan Lebanon Hospital who have taught the 8-week sessions. Veronica Moresi is the Lead MMaPS PT.

Edie Sperling, PT, DPT is the faculty partner from Western University of Health Sciences, and PI, who is responsible for research design, protocol completion, IRB requirements, and student oversight.

Arman Jahangiri, Chai Subramanyam, John Henderson, Lauren Glasner, and Sierra Hawthorne are first-year osteopathic medical students at Western University of Health Sciences. They performed the literature review and background section of the IRB.

Completed data will be transferred to Samaritan's Research Development Office to complete statistical analysis.

Buy-in and approval: Buy-in and approval for the 8-week sessions themselves is already in place within Samaritan Lebanon Hospital administration. The physical therapists who have collected the data now wish to analyze it. The administrative support staff has been collecting the data with approval of management.

4.0 Statistical Considerations:

Approach to statistical analyses: For patients who have both pre and post data available, we will compare responses/performance on all outcome measures (Catastrophizing scale, Quality of Life scale, Patient-Specific Functional Scale, 30 sec sit to stand test, 4-stage balance test, and Focus on

Therapeutic Outcomes score) using paired t-tests or non-parametric alternatives. We will summarize participant's demographics and responses to the ACE questionnaire.

Hypotheses, sample size, and power: There are approximately 115 individual charts available to be reviewed. If all 115 participants have both pre and post data available, this study will be adequately powered to detect a small to medium effect size difference between groups (Cohen's $d=0.3$, power = 80%, $\alpha=0.05$).

Limitations and issues: Missing data in the form of missing outcome measures is a likely issue. For example, did someone begin the program and complete all the initial baseline forms, but then never return, or fail to complete one or more of the post-intervention measures for whatever reason? These data points will need to be excluded. A smaller sample size will impact the power of our analyses.

The population will need to be described and compared to other chronic pain multidisciplinary studies to evaluate similarities, including age, sex, etc.

It is not feasible to have a control group at this time due to the hospital needing to see patients in a timely manner for profit margins. Because there is no control group, it will not be known if MMAPS is better than no treatment or other forms of treatment (such as 1:1 PT). Therefore the literature will be used to make a comparison and draw broad conclusions. The research will not be generalizable.

As this is a retrospective study, new and potentially better outcome measures cannot be chosen.

5.0 Subject Safety:

Potential risks to subjects: The outcome measures have already been pulled from the patient charts by the office admin personnel at Samaritan Lebanon Hospital. The identifying data on the spreadsheet is a number given to each patient, with their age and sex. There is no other identifying health information. Therefore there is little risk in reviewing this data. There is a potential risk for a breach of confidentiality, but this will be limited through proper data management.

Potential benefits to subjects: In this retrospective chart review, there is no direct benefit to the individuals beyond their potential benefit in participating in the sessions. However, if this study shows significant improvements in their outcomes after MMAPS, many other patients could benefit from attending this program. In addition, this study could add to the medical literature on management of chronic pain and spur further studies. Ideas for future projects related to MMAPS include a RCT. If enough of a benefit is found, further dissemination of these results to insurance companies and other hospital systems could be of enormous benefit to a large number of people.

6.0 Data management:

Access to study data will be limited to study investigators and the Research Development Office. All data will be saved on secure network drives. All results will be reported on an aggregate level and in a manner such that no individuals can be identified. Study data will be kept for a minimum of 3 years and a maximum of 7 years, at which point it will be permanently destroyed.

7.0 Ethical considerations:

There are no known conflicts of interest. Affiliations are as follows:

Sharna Prasad, Veronica Moresi, Rachel Harvey, and Peter Smith, Samaritan Lebanon Hospital.

Edie Sperling, PT, DPT; Arman Jahangiri, Chai Subramanyam, John Henderson, Lauren Glasner, and

Sierra Hawthorne, Western University of Health Sciences.

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Appendices:

a. Bibliography for references cited

Aloraibi, S., & Ranjeeta, A. (2011). Physiotherapy Management of Chronic Back Pain: Systematic Literature Review. *Indian Journal of Physiotherapy and Occupational Therapy - An International Journal*, 5, 167–170.

Baer, R. A. (2003). Mindfulness Training as a Clinical Intervention: A Conceptual and Empirical Review. *Clinical Psychology: Science and Practice*, 10(2), 125–143.

<https://doi.org/10.1093/clipsy.bpg015>

Baer, R. A., Smith, G.T., Hopkins, J., Krietemeyer, J., Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, 13, 27-45.

Bawa, F. L. M., Mercer, S. W., Atherton, R. J., Clague, F., Keen, A., Scott, N. W., & Bond, C. M. (2015). Does mindfulness improve outcomes in patients with chronic pain? Systematic review and meta-analysis. *The British Journal of General Practice: The Journal of the Royal College of General Practitioners*, 65(635), e387-400. <https://doi.org/10.3399/bjgp15X685297>

Bertozzi, L., Gardenghi, I., Turoni, F., Villafañe, J. H., Capra, F., Guccione, A. A., & Pillastrini, P. (2013). Effect of therapeutic exercise on pain and disability in the management of chronic nonspecific neck pain: Systematic review and meta-analysis of randomized trials. *Physical Therapy*, 93(8), 1026–1036. <https://doi.org/10.2522/ptj.20120412>

Björnsdóttir, S. V., Arnljótsdóttir, M., Tómasson, G., Triebel, J., & Valdimarsdóttir, U. A. (2015). Neuroscience patient education and mindfulness added to multidisciplinary rehabilitation for women with chronic musculoskeletal pain. *Physiotherapy*, 101, e157–e158.

<https://doi.org/10.1016/j.physio.2015.03.308>

- Blickenstaff, C., & Pearson, N. (2016). Reconciling movement and exercise with pain neuroscience education: A case for consistent education. *Physiotherapy Theory and Practice*, 32(5), 396–407. <https://doi.org/10.1080/09593985.2016.1194653>
- Brooks, J. M., Iwanaga, K., Cotton, B. P., Deiches, J., Blake, J., Chiu, C., Morrison, B., & Chan, F. (2018). Perceived Mindfulness and Depressive Symptoms Among People with Chronic Pain. *Journal of Rehabilitation*, 84(2), 33–39.
- Carnes, D., Mars, T., Plunkett, A., Nanke, L., & Abbey, H. (2017). A mixed methods evaluation of a third wave cognitive behavioural therapy and osteopathic treatment programme for chronic pain in primary care (OsteoMAP). *International Journal of Osteopathic Medicine*, 24, 12–17. <https://doi.org/10.1016/j.ijosm.2017.03.005>
- Carnes et al. - 2017—A mixed methods evaluation of a third wave cogniti.pdf. (n.d.). Retrieved February 5, 2020, from https://www.uco.ac.uk/sites/default/files/research_supporting_docs/Carnes.pdf
- Carvalho, S. A., Gillanders, D., Palmeira, L., Pinto-Gouveia, J., & Castilho, P. (2018). Mindfulness, selfcompassion, and depressive symptoms in chronic pain: The role of pain acceptance. *Journal of Clinical Psychology*, 74(12), 2094–2106. <https://doi.org/10.1002/jclp.22689>
- Chou, R., Huffman, L. H., American Pain Society, & American College of Physicians. (2007). Nonpharmacologic therapies for acute and chronic low back pain: A review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Annals of Internal Medicine*, 147(7), 492–504. <https://doi.org/10.7326/0003-4819-147-7-200710020-00007>
- Crawford, C., Lee, C., & May, T. (2014). Physically Oriented Therapies for the Self-Management of Chronic Pain Symptoms. *Pain Medicine*, 15(S1), S54–S65. <https://doi.org/10.1111/pme.12410>

- Crofford, L. J. (2015). Psychological aspects of chronic musculoskeletal pain. *Best Practice & Research. Clinical Rheumatology*, 29(1), 147–155. <https://doi.org/10.1016/j.berh.2015.04.027>
- Curtin, K. B., & Norris, D. (2017). The relationship between chronic musculoskeletal pain, anxiety and mindfulness: Adjustments to the Fear-Avoidance Model of Chronic Pain. *Scandinavian Journal of Pain*, 17, 156–166. <https://doi.org/10.1016/j.sjpain.2017.08.006>
- Evans, D. R., Eisenlohr-Moul, T. A., Button, D. F., Baer, R. A., & Segerstrom, S. C. (2014). Self-Regulatory Deficits Associated with Unpracticed Mindfulness Strategies for Coping with Acute Pain. *Journal of Applied Social Psychology*, 44(1), 23–30. <https://doi.org/10.1111/jasp.12196>
- Foster, N. E., & Delitto, A. (2011). Embedding psychosocial perspectives within clinical management of low back pain: Integration of psychosocially informed management principles into physical therapist practice--challenges and opportunities. *Physical Therapy*, 91(5), 790–803. <https://doi.org/10.2522/ptj.20100326>
- Garcia, A. N., Costa, L. da C. M., da Silva, T. M., Gondo, F. L. B., Cyrillo, F. N., Costa, R. A., & Costa, L. O. P. (2013). Effectiveness of back school versus McKenzie exercises in patients with chronic nonspecific low back pain: A randomized controlled trial. *Physical Therapy*, 93(6), 729–747. <https://doi.org/10.2522/ptj.20120414>
- Haugmark, T., Hagen, K. B., Provan, S. A., Bærheim, E., & Zangi, H. A. (2018). Effects of a community-based multicomponent rehabilitation programme for patients with fibromyalgia: Protocol for a randomised controlled trial. *BMJ Open*, 8(6). <https://doi.org/10.1136/bmjopen-2017-021004>
- Jay, K., Brandt, M., Jakobsen, M. D., Sundstrup, E., Berthelsen, K. G., Schraefel, M., Sjøgaard, G., & Andersen, L. L. (2016). Ten weeks of physical-cognitive-mindfulness training reduces fear-avoidance beliefs about work-related activity: Randomized controlled trial. *Medicine*, 95(34), e3945. <https://doi.org/10.1097/MD.0000000000003945>

- Jay, K., Brandt, M., Schraefel, mc, Jakobsen, M. D., Sundstrup, E., Sjøgaard, G., Vinstrup, J., & Andersen, L. L. (2016). Neurocognitive performance and physical function do not change with physical-cognitive-mindfulness training in female laboratory technicians with chronic musculoskeletal pain. *Medicine*, *95*(50). <https://doi.org/10.1097/MD.0000000000005554>
- Kääpä, E. H., Frantsi, K., Sarna, S., & Malmivaara, A. (2006). Multidisciplinary group rehabilitation versus individual physiotherapy for chronic nonspecific low back pain: A randomized trial. *Spine*, *31*(4), 371–376. <https://doi.org/10.1097/01.brs.0000200104.90759.8c>
- Karjalainen, K., Malmivaara, A., van Tulder, M., Roine, R., Jauhiainen, M., Hurri, H., & Koes, B. (2000). Multidisciplinary rehabilitation for fibromyalgia and musculoskeletal pain in working age adults. *The Cochrane Database of Systematic Reviews*, *2*, CD001984. <https://doi.org/10.1002/14651858.CD001984>
- Khan, M., Akhter, S., Soomro, R. R., & Ali, S. S. (2014). The effectiveness of Cognitive Behavioral Therapy (CBT) with general exercises versus general exercises alone in the management of chronic low back pain. *Pakistan Journal of Pharmaceutical Sciences*, *27*(4 Suppl), 1113–1116.
- Knoerl, R., Lavoie Smith, E. M., & Weisberg, J. (2016). Chronic Pain and Cognitive Behavioral Therapy: An Integrative Review. *Western Journal of Nursing Research*, *38*(5), 596–628. <https://doi.org/10.1177/0193945915615869>
- Lane, E., Fritz, J. M., Greene, T., & Maddox, D. (2018). The effectiveness of training physical therapists in pain neuroscience education on patient reported outcomes for patients with chronic spinal pain: A study protocol for a cluster randomized controlled trial. *BMC Musculoskeletal Disorders*, *19*(1), 386. <https://doi.org/10.1186/s12891-018-2269-2>
- Lang, E., Liebig, K., Kastner, S., Neundörfer, B., & Heuschmann, P. (2003). Multidisciplinary rehabilitation versus usual care for chronic low back pain in the community: Effects on quality

of life. *The Spine Journal: Official Journal of the North American Spine Society*, 3(4), 270–276.

[https://doi.org/10.1016/s1529-9430\(03\)00028-7](https://doi.org/10.1016/s1529-9430(03)00028-7)

Louw, A., Puentedura, E. J., Zimney, K., & Schmidt, S. (2016). Know Pain, Know Gain? A Perspective on Pain Neuroscience Education in Physical Therapy. *The Journal of Orthopaedic and Sports Physical Therapy*, 46(3), 131–134. <https://doi.org/10.2519/jospt.2016.0602>

Louw, A., Zimney, K., O’Hotto, C., & Hilton, S. (2016). The clinical application of teaching people about pain. *Physiotherapy Theory and Practice*, 32(5), 385–395.

<https://doi.org/10.1080/09593985.2016.1194652>

Louw, A., Zimney, K., Puentedura, E. J., & Diener, I. (2016). The efficacy of pain neuroscience education on musculoskeletal pain: A systematic review of the literature. *Physiotherapy Theory and Practice*, 32(5), 332–355. <https://doi.org/10.1080/09593985.2016.1194646>

Mehta, P., Claydon, L. S., Hendrick, P., Cook, C., & Baxter, D. G. (2016). Pain and Physical Functioning in Neuropathic Pain: A Systematic Review of Psychometric Properties of Various Outcome Measures. *Pain Practice: The Official Journal of World Institute of Pain*, 16(4), 495–508. <https://doi.org/10.1111/papr.12293>

Mihalov, S. A., Bouffard, K. J., & Cara, J. R. (2018). Successful Treatment of Multifactorial Chronic Daily Headaches at an Interdisciplinary Chronic Pain Program: A Case Study. *PM & R: The Journal of Injury, Function, and Rehabilitation*, 10(4), 446–451.

<https://doi.org/10.1016/j.pmrj.2017.10.006>

Ogston, J. B., Crowell, R. D., & Konowalchuk, B. K. (2016). Graded group exercise and fear avoidance behavior modification in the treatment of chronic low back pain. *Journal of Back and Musculoskeletal Rehabilitation*, 29(4), 673–684. <https://doi.org/10.3233/BMR-160669>

- Polaski, A. M., Phelps, A. L., Kostek, M. C., Szucs, K. A., & Kolber, B. J. (2019). Exercise-induced hypoalgesia: A meta-analysis of exercise dosing for the treatment of chronic pain. *PLoS One*, *14*(1), e0210418. <https://doi.org/10.1371/journal.pone.0210418>
- Puentedura, E. J., & Flynn, T. (2016). Combining manual therapy with pain neuroscience education in the treatment of chronic low back pain: A narrative review of the literature. *Physiotherapy Theory and Practice*, *32*(5), 408–414. <https://doi.org/10.1080/09593985.2016.1194663>
- Ravn, S., Vang, M., Vaegter, H., & Andersen, T. (2017). Pain-Related Acceptance as a Mediator in the Fear Avoidance Model of Chronic Pain: A Preliminary Study. *Pain Medicine*, *19*.
<https://doi.org/10.1093/pm/pnx223>
- Saper, R. B., Lemaster, C., Delitto, A., Sherman, K. J., Herman, P. M., Sadikova, E., Stevans, J., Keosaian, J. E., Cerrada, C. J., Femia, A. L., Roseen, E. J., Gardiner, P., Gergen Barnett, K., Faulkner, C., & Weinberg, J. (2017). Yoga, Physical Therapy, or Education for Chronic Low Back Pain: A Randomized Noninferiority Trial. *Annals of Internal Medicine*, *167*(2), 85–94.
<https://doi.org/10.7326/M16-2579>
- Schütze, R., Rees, C., Preece, M., & Schütze, M. (2010). Low mindfulness predicts pain catastrophizing in a fear-avoidance model of chronic pain. *Pain*, *148*(1), 120–127.
<https://doi.org/10.1016/j.pain.2009.10.030>
- Tick, H., Nielsen, A., Pelletier, K. R., Bonakdar, R., Simmons, S., Glick, R., Ratner, E., Lemmon, R. L., Wayne, P., Zador, V., & Pain Task Force of the Academic Consortium for Integrative Medicine and Health. (2018). Evidence-Based Nonpharmacologic Strategies for Comprehensive Pain Care: The Consortium Pain Task Force White Paper. *Explore (New York, N.Y.)*, *14*(3), 177–211.
<https://doi.org/10.1016/j.explore.2018.02.001>
- Wijma, A. J., van Wilgen, C. P., Meeus, M., & Nijs, J. (2016). Clinical biopsychosocial physiotherapy assessment of patients with chronic pain: The first step in pain neuroscience education.

Physiotherapy Theory and Practice, 32(5), 368–384.

<https://doi.org/10.1080/09593985.2016.1194651>

Zangi, H. A., & Haugli, L. (2017). Vitality training-A mindfulness- and acceptance-based intervention for chronic pain. *Patient Education and Counseling*, 100(11), 2095–2097.

<https://doi.org/10.1016/j.pec.2017.05.032>

Zangi, H. A., Mowinckel, P., Finset, A., Eriksson, L. R., Høystad, T. Ø., Lunde, A. K., & Hagen, K. B.

(2012). A mindfulness-based group intervention to reduce psychological distress and fatigue in patients with inflammatory rheumatic joint diseases: A randomised controlled trial. *Annals of the Rheumatic Diseases*, 71(6), 911–917.

<https://doi.org/10.1136/annrheumdis-2011-200351>

Appendix b: See attached outcome measures.