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Patient self-reported musculoskeletal symptoms before and after the interruption of chiropractic care during the COVID-19 lockdown in Ontario, Canada: a retrospective case series

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Purpose: *To describe characteristics and course of chiropractic patients' self-reported musculoskeletal (MSK) symptoms following interruption of chiropractic treatment during the COVID-19 lockdown.*

Methods: *Using a retrospective case series design, patient demographic, clinical and patient-reported clinical outcomes variables were abstracted from electronic health records of patients attending a chiropractic teaching clinic. We measured self-perceived changes in symptoms cross-sectionally at each of two time points: before and after the COVID-19 lockdown.*

Results: *133 of 184 patients were eligible. Most had comorbidities and treatment for multiple MSK diagnoses*

Les patients ont signalé eux-mêmes des symptômes musculo-squelettiques avant et après l'interruption des soins chiropratiques pendant le confinement lié à la COVID-19 en Ontario, Canada: une série de cas rétrospective.

But: *Décrire les caractéristiques et l'évolution des symptômes musculo-squelettiques (MSK) auto-rapportés des patients chiropratiques suite à l'interruption du traitement chiropratique pendant le confinement lié à la COVID-19.*

Méthodes: *En utilisant un design de série de cas rétrospective, les variables démographiques des patients, cliniques et les résultats cliniques rapportés par les patients ont été extraites des dossiers de santé électroniques des patients fréquentant une clinique d'enseignement chiropratique. Nous avons mesuré les changements auto-perçus des symptômes de manière transversale à deux moments : avant et après le confinement dû à la COVID-19.*

Résultats: Au total*133 des 184 patients étaient éligibles. La plupart avaient des comorbidités*

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pre-lockdown. Based on patients' self-perception, 17% improved (vs 77% pre-lockdown), 23% did not change (vs 17% pre-lockdown) and 43% worsened (vs 5% pre-lockdown) in MSK symptoms during lockdown. Those reporting worsening post-lockdown had more treatments, longer period of treatment time pre-lockdown, and more severe pain (mean: 7/10) post-lockdown. Upon clinic reopening, 47% of patients returned for care, more often reporting worsened MSK symptoms and higher average pain score (6.2/10) than non-returning patients (3.9/10).

Summary: *Some patients experiencing interruptions in chiropractic care during COVID-19 lockdown returned with worsened MSK symptoms, while others showed improvement and did not return to clinic. Our study helps generate future research hypotheses regarding the contribution of chiropractic treatment (e.g., during pandemics).*

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KEY WORDS: chiropractic, COVID-19, musculoskeletal pain, patient outcomes, treatment interruption, case series

et suivaient un traitement à la suite de plusieurs diagnostics musculo-squelettiques avant le confinement. Selon l'auto-perception des patients, 17 % se sont améliorés (contre 77 % avant le confinement), 23 % n'ont pas changé (contre 17 % avant le confinement) et 43 % se sont détériorés (contre 5 % avant le confinement) en ce qui concerne les symptômes musculo-squelettiques pendant le confinement. Ceux qui signalent une aggravation après le confinement avaient plus de traitements, une durée de traitement plus longue avant le confinement et une douleur plus sévère (moyenne : 7/10) après le confinement. À la réouverture de la clinique, 47 % des patients sont revenus pour des soins et ont le plus souvent signalé une aggravation des symptômes musculo-squelettiques et un score de douleur moyen plus élevé (6,2/10) que les patients qui ne sont pas revenus (3,9/10).

Résumé: *Certains patients ayant connu des interruptions dans les soins chiropratiques pendant le confinement lié à la COVID-19 sont revenus avec des symptômes musculo-squelettiques aggravés, tandis que d'autres ont présenté une amélioration et ne sont pas retournés à la clinique. Notre étude aide à élaborer de futures hypothèses de recherche en ce qui concerne la contribution du traitement chiropratique (par exemple, pendant les pandémies).*

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MOTS CLÉS : chiropratique, COVID-19, douleur musculosquelettique, résultats des patients, interruption de traitement, séries de cas

Introduction

Chiropractors manage a range of musculoskeletal (MSK) conditions, including musculoligamentous sprains and strains, joint dysfunctions, disc injury, radiculopathy and peripheral nerve entrapments.[1,2] MSK conditions constitute a significant burden on the global population, economy and health care resources.[3–5] These conditions are affected by various biopsychosocial factors that can contribute to disability and influence recovery, and thus such factors should be addressed in management plans.[6] The management of MSK conditions, especially in patients with multiple co-morbidities and chronicity, often involves multimodal interventions, including non-pharmacological treatments that may require in-person care, such as chiropractic care, with variable treatment outcomes.[6,7,8]

At a Canadian Memorial Chiropractic College (CMCC) chiropractic teaching clinic, which is part of the Academic Family Health Team in the Department of Family and Community Medicine (AFHT) at St. Michael's Hospital (SMH) in Toronto, Ontario (the Clinic), referred patients (from approximately 50,000 rostered

with the Department) receive multimodal treatments provided by supervised chiropractic interns, addressing symptoms ranging from vertigo to toe numbness. While the patient population represents a variety of socioeconomic backgrounds, the hospital's catchment area includes low socioeconomic districts; approximately 30% of patients are in the lowest income quintile.[9] The majority of patients present with comorbidities, which may[10–13] or may not[14] impact their pain experience and disabilities related to their MSK conditions. This population includes those likely to have had chronic conditions or disabilities with unmet rehabilitation needs attributed to the COVID-19 pandemic.[15,16]

During the COVID-19 pandemic of 2020, chiropractic care in Ontario was deemed a non-essential service by the government.[17] Thus, except for the provision of telehealth and "urgent care," chiropractic clinics were unable to open and remained in "lockdown" from March 16 until it was rescinded on May 26, 2020.[18] Patients who would have otherwise sought chiropractic treatment were left to manage with medications, exercise, and self-care strategies, which may have been part of a comprehensive plan of management even when clinics were open. The Clinic gradually resumed a hybrid of telehealth and in-person patient care on August 5, 2020. However, little is known about how chiropractic patients with MSK conditions managed during the lockdown period.

Manhapra *et al*.[19] reported that, despite decreased utilization of healthcare services, including undescribed physical and rehabilitative therapies, respondents aged over 64 years enrolled in the American National Health Interview Survey reported no worsening of their usual pain. However, Bailly *et al*.[20] found that 41% of chronic low back pain patients reported worsening during the lockdown. Similarly, a systematic review investigating the impact of COVID-19 lockdown restrictions on MSK disorders found that, compared to pre-pandemic assessments, individuals with MSK disorders experienced reduced quality of life, increased pain, and a higher prevalence of MSK injuries.[21] Another systematic review of cross-sectional studies conducted worldwide found that overall, the prevalence and incidence of MSK disorders increased as a result of COVID-19 lockdowns.[22] However, none of these reviews included studies focused on chiropractic patients, nor were any of them conducted in Canada.

While these findings highlight the broader impact of the pandemic on MSK disorders, studies specifically examining chiropractic practices during the COVID-19 lockdowns have been limited. To our knowledge, COVID-19 related chiropractic research has primarily focused on changes to care delivery and practice processes.[23–25] In summary, about half of the surveyed chiropractic practices continued to offer in-person care, employing enhanced public health measures such as using personal protective equipment during patient encounters and disinfecting all contact surfaces. A smaller portion reported incorporating telehealth services for patients. However, the course of the patients' MSK conditions during the lockdown period was not reported.

Hence, little is known about how COVID-19 impacted individuals with MSK conditions living in Canada. In particular, it is unknown what effect, if any, the interruption of chiropractic treatment had on the course of MSK conditions during the COVID-19 lockdown. Documenting patients' self-management regimens during the untreated period caused by the pandemic and comparing their outcomes to those experienced previously while receiving treatment could help generate hypotheses regarding the contribution of passive chiropractic treatment (manual therapy, electrotherapy or thermal-based modalities) to their management.

Therefore, our study examined the course of chiropractic patients' self-reported MSK symptoms following prolonged withdrawal of passive chiropractic treatment during the lockdown of "non-essential" clinics. Specifically, our research objectives were to: 1) describe the course of MSK symptoms status (improved, no change, worsened) in patients post-lockdown; 2) compare demographics, comorbidities, self-management strategies during lockdown, and chiropractic treatment pre-lockdown (type, frequency, duration) among groups of patients who worsened, felt no change, or improved with regards to their pre-lockdown MSK diagnoses; and 3) compare demographics, comorbidities, diagnoses, chiropractic treatment pre-lockdown, self-management strategies, pain post-lockdown and course of symptoms during lockdown among groups of patients who chose to return for chiropractic treatment post-lockdown and those who did not. Given the paucity of literature about the course of MSK conditions during lockdown, we made no assumptions about which patient characteristics or outcomes

would impact course of symptoms. Instead, we took an exploratory approach to address the knowledge gap regarding the impact of COVID-19 lockdown on MSK disorders in chiropractic patients in Canada. The intent of our research is to inform future hypotheses regarding the course of MSK symptoms and role of chiropractic care during pandemics.

Methods

Study design

We conducted a retrospective case series study using patient files of the Clinic. This design allows for a detailed description of the characteristics and outcomes of the clinic patients who faced interruptions in their chiropractic care during the COVID-19 lockdown.[26]

Study setting

After the COVID-19 clinic lockdown (March 16 – August 5, 2020), it was necessary to implement a gradual re-opening of the Clinic. Patient volumes were restricted to accommodate for social distancing and sanitation procedures. Re-opening procedures were to initially assess patients virtually and then to engage in in-person visits. To determine which patients would be prioritized for return to the restricted (in terms of numbers of health care providers, support staff and patients attending at any given time) in-person services, a triage approach was utilized.

In late July 2020 prior to the Clinic reopening, chiropractic interns tried to contact the pre-lockdown patients and used a standard script (Appendix 1) for triaging those who were contacted, then arranged with the patient to conduct a re-assessment based on their reported MSK health status. Based on the information gathered from this initial contact, patients were categorized based on their self-reported MSK health status during the clinic closure period: those who worsened, felt no change, or improved in relation to their pre-lockdown MSK diagnoses. Any new symptoms arising during the lockdown were classified in one of two ways: if the symptom was related to a pre-lockdown condition (e.g., new radiation of low back pain to the buttock), it was considered a worsening of that pre-existing condition; otherwise, it was classified as a new symptom. Patients were also asked if they intended to return for treatment at the Clinic and their responses were recorded in their electronic health record (EHR).

Triaging was based upon the self-reported health status of the patient's MSK condition during the lockdown period. Those patients whose self-reported health status had worsened were categorized as "worsened" and offered a re-assessment appointment. Those whose self-reported health status had remained unchanged were categorized as "no change" and advised to continue with their self-management strategies, as their condition did not deteriorate despite a withdrawal of passive treatments. Finally, those with a self-reported health status that had improved were categorized as "improved" and advised to continue with their self-management strategies excluding passive clinic-based treatments. However, patients in the latter categories who requested return to clinical care were also given appointments for re-assessment, but appointments were prioritized for patients returning with worsened symptoms. Upon re-assessment, chiropractic interns followed a standard approach to examination of patients' MSK complaints and included specific questions related to their MSK health status during the pandemic lockdown (Appendix 2).

Study participants

We included all patients scheduled (whether for new assessments or subsequent treatments) at the Clinic between January 2, 2020, and March 16, 2020, and who were triaged upon the clinic's re-opening. We excluded patients lost to follow-up, patients discharged from the Clinic before March 16, 2020, patients presenting with different complaints than pre-lockdown, new patients (as of August 5, 2020), and existing patients who returned to the Clinic after October 31, 2020. In so doing, we aimed to follow the patients' pre-lockdown MSK conditions.

Data collection

We abstracted data directly from each eligible patient's electronic health record (EHR). Specifically, based on our defined objectives, we extracted and described related variables including demographic, clinical and patient-reported clinical outcomes characteristics (see Table 1). Data were recorded using specifically designed data collection forms that were pilot tested to ensure comprehension and ease of data abstraction by the research assistants.

Table 1.
Data collected from the patient electronic health record (EHR).

Variable	**Collected information from EHR**
Demographics	Age, sex
Pre-lockdown MSK diagnoses	Record the musculoskeletal diagnoses: • Mechanical neck pain (Cervicothoracic sprain/strain, WAD) • Mechanical back pain (Thoracolumbar sprain/strain, Lumbopelvic sprain/strain, SI dysfunction) • Cervicogenic headaches • Tension-type headaches • Migraines • Myofascial pain • Degenerative disc disease/Degenerative joint disease • Thoracic Outlet Syndrome • Spinal central/lateral recess stenosis • Shoulder strain • Radicular pain • Hip strain • Knee strain • Disc herniation/irritation • Temporomandibular joint disorder • Lower limb strain • Upper limb strain • Neurogenic claudication • Bursitis • Piriformis/Gluteal strain • Frozen shoulder • Costovertebral strain/sprain • Subacromial impingement/bursitis
Duration of symptoms	Calculate the number of days of symptoms
Date of initial visit	Enter the date of the patient's first visit
Number of treatments	Indicate how many treatments the patient received
Duration of treatment	Specify the total duration of treatment in days
Treatments received	Record the treatments the patient received at the Clinic (e.g., exercise, mobilization, manipulation, soft tissue therapy, modalities, etc.)
Outcomes of pre-lockdown treatment	Record the outcome of treatments received (no change, worsening, improving, resolved)
Comorbidities	Record the comorbidities categorized using the International Classification of Diseases 11th Revision.[29] We counted the types of comorbidities per patient, rather than the actual numbers of comorbidities (e.g., a patient could have more than one endocrine comorbidity).
Self-reported management during lockdown	Record how patients managed their conditions during lockdown (exercises, thermal applications, medications, emergency room visit, surgery, etc.), assumed to be for the same conditions diagnosed and treated at the Clinic pre-lockdown.

Variable	Collected information from EHR
Post-lockdown pain severity	Record the severity of pain that was reported verbally on an 11-point Numeric Pain Rating Scale (NPRS)[27]
Course of symptoms between closure and return to clinic	Record how symptoms changed during this period: improved, no change, worsened
Date of return to clinic	Record the date if the patient returned to the clinic
Change in diagnosis/plan/prognosis post-lockdown	Record any changes made post-lockdown
Reason for not returning to clinic post-lockdown	Collect reasons described in chart, if applicable

Two research assistants were trained in data abstraction by the senior investigators. To ensure consistency of data abstraction, 20% of the abstracted files were re-abstracted by the other assistant, reviewed and compared by the investigators for consistency. Any discrepancy in data abstraction was discussed between abstractors and the investigators so that a mutual approach could be applied during formal abstraction of the data.

Abstracted data were de-identified and stored on a secured SMH server accessible only to SMH registered personnel. The patient's file number was linked to a unique study identifier accessible by two of the investigators, stored in a separate file, and destroyed at the end of the study.

Data analysis

For Objective 1, we described patients' course of MSK symptoms during the COVID-19 lockdown and the characteristics of the overall sample by reporting frequencies and percentages for categorical variables, and means and standard deviations for continuous variables. In addressing Objective 2, we used select patient (sex, age) and clinical (diagnoses, symptom duration, treatment and outcomes) characteristics and compared them between groups defined by their reported course of MSK symptoms (worsened, no change, or improved) during the COVID-19 lockdown. For Objective 3, we compared the select patient characteristics by their clinic return status. We used contingency tables and chi-square tests to compare categorical characteristics, allowing for the possibility of nonlinear patterns in multi-category variables. We used analysis of variance (ANOVA) for characteristics measured on a continuous scale. A significance level of 0.05 was used to indicate statistically significant differences in proportions or means. We did not use imputation for missing data.

Ethical approvals were obtained from the Research Ethics Boards of St. Michael's Hospital (REB # 21-224) and Canadian Memorial Chiropractic College (REB #2112X02).

Results

Of 184 patients of the Clinic as of January 2020 (pre-COVID-19 lockdown), 12 patients' EHR had been inactivated (e.g., if a patient had passed away, moved away, were no longer patients of the AFHT), and of the remaining 172 patients, 39 did not meet inclusion criteria. (See Figure 1). Thus, a total 133 files were included in this study. We present summarized results for categories with cell sizes ≥5, with full data available (on request to the corresponding author) in a supplementary document.

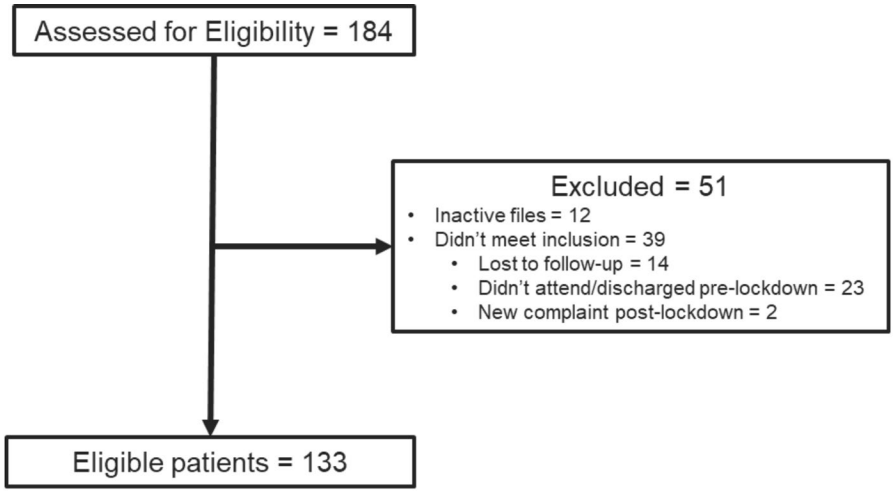

Figure 1.
Study patient flow.

The included 133 patients had a mean age of 56 years and 54% were female. Pre-COVID, most patients had at least one comorbidity, most commonly disorders of the endocrine/nutritional/metabolic (55%) and mental/behavioural/neurodevelopmental (44%) systems (Table 2). They were mostly being treated for chronic conditions, with symptoms having a median duration of over two years, for up to seven MSK diagnoses; 29% had one diagnosis, 31% had two, 22% had three, and 15% had four diagnoses. The most common diagnoses were mechanical back pain (62%) and cervicothoracic sprain/strain (42%) or its variants (e.g., mechanical neck pain, Whiplash Associated Disorder 2 [WAD2]).

Pre-lockdown, the median number of patient visits was 14 and were provided over a median of 104 days (Table 2). The most common treatment modalities used

Table 2.
Characteristics of patients in case series (n=133)

Characteristics	Frequency (%)
Demographic	
Sex	
Female	72 (54%)
Age in years: mean (SD), median (IQR)	56 (17), 58 (23)
Pre-COVID Lockdown MSK Diagnosis	
Number of diagnoses	
1	39 (29%)
2	41 (31%)
3	29 (22%)
4	20 (15%)
5 – 7	4 (3%)
More common MSK diagnosis	
Mechanical neck pain (Cervicothoracic sprain/strain, WAD)	56 (42%)
Mechanical back pain (Thoracolumbar or lumbopelvic sprain/strain, SI dysfunction)	82 (62%)
Extremity Strain	58 (44%)
Headaches (cervicogenic, tension-type, migraines)	14 (11%)
Myofascial pain	24 (18%)
Degenerative disc disease/Degenerative joint disease	12 (9%)
Thoracic Outlet Syndrome	7 (5%)
Spinal central/lateral recess stenosis	11 (8%)
Shoulder pain (shoulder strain, subacromial pain, frozen shoulder)	24 (18%)
Radicular pain	8 (6%)
Other	15 (11%)
Duration of symptoms in days (N=130): mean (SD), median (IQR)	2449 (3445), 779.5 (2687)
Pre-COVID Lockdown - Comorbidity	
Certain infectious or parasitic diseases	28 (21%)
Neoplasms	26 (20%)
Diseases of the blood or blood-forming organs	20 (15%)
Endocrine, nutritional, or metabolic diseases	73 (55%)
Mental, behavioural or neurodevelopmental disorders	58 (44%)

Characteristics	Frequency (%)
Sleep-wake disorders	33 (25%)
Diseases of the nervous system	53 (40%)
Diseases of the visual system	25 (19%)
Diseases of the circulatory system	56 (42%)
Diseases of the respiratory system	35 (26%)
Diseases of the digestive system	68 (51%)
Diseases of the skin	27 (20%)
Diseases of the musculoskeletal system or connective tissue	82 (62%)
Diseases of the genitourinary system	37 (28%)
Other	29 (22%)
Pre-COVID Lockdown - Treatment Details	
Treatment/management	
Spinal Manipulation	94 (71%)
Spinal Mobilization	127 (95%)
Soft Tissue Therapy	132 (99%)
Thermal/Energy-Based Modalities	19 (14%)
Electrotherapy modalities	7 (5%)
Biomechanical support (e.g., brace, orthotics, etc.)	11 (8%)
Exercise	131 (98%)
Education	132 (99%)
Number of treatments: mean (SD), median (IQR)	41 (64), 14 (34)
Duration of treatment in days (N=132): mean (SD), median (IQR)	394 (644), 104 (369)
Outcomes of treatment pre-COVID lockdown	
No Change in Symptoms	22 (17%)
Symptoms Worsening	7 (5%)
Symptoms Improving	90 (68%)
Symptoms Resolved	12 (9%)
Not Applicable	2 (2%)
COVID-19 Lockdown – Self-Management	
Pharmacological treatments	32 (24%)
Other Manual Therapist	4 (3%)
Emergency Room Visit	1 (1%)
Naturopathy/Diet	2 (2%)
Home Electrical Modality	2 (2%)
Exercise	97 (76%)
Self-Massage	12 (9%)
Heat/cold	19 (14%)
Mindfulness/breathing	2 (2%)
Acupuncture	1 (1%)
Other treatments	38 (29%)

Characteristics	Frequency (%)
Post-COVID Lockdown	
Severity of pain post-COVID lockdown: mean (SD), median (IQR)	5.3 (3.2), 6 (3)
Return to clinic status	
Not returned	70 (53%)
Returned	63 (47%)
Reason for not returning to the clinic	
Discharged	4 (3%)
Resolved/improved	18 (14%)
Uncomfortable due to pandemic	7 (5%)
Moved away	3 (2%)
Self-managed	3 (2%)
Accessed private care	4 (3%)
Surgical intervention	2 (2%)
Late return	23 (17%)
Unknown	6 (5%)
Time between lockdown and return to treatment (days): mean (SD), median (IQR)	163 (21), 156 (30)
Change in diagnosis/plan of management/prognosis on return	(N=133)
Yes	29 (22%)
No	83 (62%)
Not Applicable	21 (16%)
Course of symptoms between lockdown and return to clinic	(N=133)
Improved	23 (17%)
No change	30 (23%)
Worsened	57 (43%)
Not Applicable	23 (17%)

were patient education (in 99% of treatments), exercise instruction (in 98%), soft tissue therapy (in 98%), spinal mobilization (in 95%), and spinal manipulation (in 71%). Exercise (76% of all patients), non-prescription analgesic medication (17% of all patients), and hot/cold compresses (14% of all patients) were the most frequently employed self-management strategies during the lockdown. The majority of patients reported improvement (68%) or resolution (9%) of symptoms, while a minority reported no change (17%) or worsening (5%) since starting treatment.

Table 3 describes characteristics organized by patient-reported course of their MSK symptoms post-lockdown. Post-lockdown, 43% of the 133 patients reported worsening, 23% no change, and 17% improvement in symptoms, while 17% were unknown. The patients' ages and numbers of diagnoses and co-morbidities were similar between all groups. However, patients that were diagnosed with cervicogenic headache ($p = 0.03$) or mechanical back pain ($p = 0.04$) pre-COVID lockdown reported worsening of symptoms compared to the other groups, whereas those who improved post-lockdown had more often been diagnosed with spinal stenosis ($p = 0.03$). Exercise was most frequently utilized by those who reported improvement post-lockdown (95% of this group), compared to those who reported no change (75% of this group) or worsening (77% of this group) of their symptoms ($p = 0.01$). Overall, those who reported worsening

of symptoms post-lockdown received more treatments ($p = 0.012$) at the Clinic over a longer period of time pre-lockdown ($p = 0.017$), and reported more severe pain post-lockdown ($p < 0.001$) (mean of 7/10 on the 11-point Numeric Pain Rating Scale [NPRS][27]). In contrast, those who reported improvement in their symptoms post-lockdown experienced lower pain severity (mean of 2.1/10 on the 11-point NPRS), and were treated less frequently with spinal manipulative therapy (SMT) (57% of this group) compared to those reporting no change (70%) or worsening (88%) of symptoms ($p < 0.001$). Comorbidities did not differ significantly between groups.

Table 3.
Characteristics of patients by MSK symptom course post-COVID lockdown.

Characteristics	**Musculoskeletal symptom course post-COVID lockdown**				**Independence Test**
	Improved (n=23)	**No change (n=30)**	**Worsened (n=57)**	**Unknown (n=23)**	p-value[§]
Demographic					
Sex					0.217
Female	11 (48%)	15 (50%)	29 (51%)	17 (74%)	
Age (mean [years], SD)	59 (19)	57 (16)	54 (16)	54 (17)	0.702
Pre-COVID Lockdown - MSK Diagnosis					
Number of diagnoses					NA
1	9 (39%)	9 (30%)	11 (19%)	10 (43%)	
2	7 (30%)	13 (43%)	12 (21%)	9 (39%)	
3	1 (4%)	6 (20%)	19 (33%)	3 (13%)	
4	4 (17%)	2 (7%)	13 (23%)	1 (4%)	
5 – 7	2 (9%)	0 (0%)	2 (4%)	0 (0%)	
MSK diagnosis					
Mechanical neck pain					0.099*
Yes	7 (30%)	10 (33%)	31 (54%)	8 (35%)	
Mechanical back pain					0.038**
Yes	12 (52%)	24 (80%)	36 (63%)	10 (43%)	
Cervicogenic headaches					0.032**
Yes	1 (4%)	0 (0%)	8 (14%)	0 (0%)	
Myofascial pain					0.601
Yes	6 (26%)	4 (13%)	9 (16%)	5 (22%)	
Degenerative disc/joint Disease					0.131
Yes	5 (22%)	2 (7%)	4 (7%)	1 (4%)	
Spinal central/lateral stenosis					0.034**
Yes	5 (22%)	0 (0%)	5 (9%)	1 (4%)	
Shoulder strain					0.193
Yes	6 (26%)	2 (7%)	9 (16%)	2 (9%)	

Characteristics	Musculoskeletal symptom course post-COVID lockdown				Independence Test
	Improved (n=23)	No change (n=30)	Worsened (n=57)	Unknown (n=23)	p-value§
Radicular pain					0.922
Yes	1 (4%)	2 (7%)	3 (5%)	2 (9%)	
Lower limb strain					0.533
Yes	2 (9%)	6 (20%)	12 (21%)	3 (13%)	
Upper limb strain					0.551
Yes	2 (9%)	2 (7%)	9 (16%)	2 (9%)	
Duration of symptoms, No (days), SD	2784 (3329)	2092 (3454)	2703 (3547)	1983 (3436)	0.744
Pre-COVID Lockdown - Treatment Details					
Treatment/management					
Spinal Manipulative Therapy					<0.001***
Yes	13 (57%)	21 (70%)	50 (88%)	10 (43%)	
Spinal Mobilization					0.519
Yes	22 (96%)	28 (93%)	56 (98%)	21 (91%)	
Soft Tissue Therapy					0.368
Yes	23 (100%)	29 (97%)	57 (100%)	22 (96%)	
Laser					0.792
Yes	2 (9%)	4 (13%)	6 (11%)	4 (17%)	
Exercise					0.073*
Yes	23 (100%)	28 (93%)	57 (100%)	23 (100%)	
Education					0.326
Yes	23 (100%)	29 (97%)	57 (100%)	23 (100%)	
Number of treatments pre-COVID lockdown (No, SD)	18 (27)	30 (57)	61 (70)	26 (71)	0.012**
Duration (days) of treatment pre-COVID lockdown (No, SD)	165 (262)	303 (600)	594 (724)	255 (654)	0.017**
Outcomes of treatment pre-COVID lockdown					0.345
No Change	4 (17%)	4 (13%)	9 (16%)	5 (22%)	
Worsening	0 (0%)	3 (10%)	3 (5%)	1 (4%)	
Improving	17 (74%)	20 (67%)	40 (70%)	13 (57%)	
Resolved	2 (9%)	3 (10%)	5 (9%)	2 (9%)	
Not Applicable	0 (0%)	0 (0%)	0 (0%)	2 (9%)	
COVID-19 Lockdown – Self-Management					
OTC Pain Medications					0.114
Yes	4 (17%)	5 (17%)	13 (23%)	0 (0%)	

Characteristics	Musculoskeletal symptom course post-COVID lockdown				Independence Test
	Improved (n=23)	No change (n=30)	Worsened (n=57)	Unknown (n=23)	p-value[§]
Exercise					0.012**
Yes	21 (95%)	21 (75%)	44 (77%)	11 (52%)	
Self-Massage					0.366
Yes	1 (4%)	2 (7%)	8 (14%)	1 (4%)	
Heat/cold					0.082*
Yes	2 (9%)	7 (23%)	10 (18%)	0 (0%)	
Other treatments					<0.001***
Yes	3 (13%)	8 (27%)	21 (37%)	6 (26%)	
Not Applicable	0 (0%)	1 (3%)	2 (4%)	12 (52%)	
Post-COVID Lockdown					
Severity of pain post-COVID lockdown (SD)	2.1 (3.4)	4.8 (2.6)	7.0 (2.0)	3.0 (0.0)	<0.001***
Return to clinic status					<0.001***
Did not return to clinic	12 (52%)	9 (30%)	4 (7%)	22 (96%)	
Returned to clinic	8 (35%)	16 (53%)	38 (67%)	1 (4%)	
Late return to clinic (after Oct. 31, 2020)	3 (13%)	5 (17%)	15 (26%)	0 (0%)	
Reason for not returning to the clinic					NA
Discharged	1 (4%)	0 (0%)	0 (0%)	3 (13%)	
Resolved/improved	10 (43%)	5 (17%)	0 (0%)	3 (13%)	
Uncomfortable due to pandemic	0 (0%)	2 (7%)	1 (2%)	4 (17%)	
Moved away	1 (4%)	0 (0%)	0 (0%)	2 (9%)	
Self-managed	0 (0%)	0 (0%)	0 (0%)	3 (13%)	
Accessed private care	0 (0%)	0 (0%)	1 (2%)	3 (13%)	
Surgical intervention	0 (0%)	1 (3%)	1 (2%)	0 (0%)	
Late return (after Oct. 31, 2020)	3 (13%)	5 (17%)	15 (26%)	0 (0%)	
Unknown	0 (0%)	1 (3%)	1 (2%)	4 (17%)	
Time between closure and return to treatment (days, SD)	158 (16)	174 (21)	160 (22)	162 (NA)	0.119
Change in diagnosis, plan of management, prognosis					<0.001***
Yes	4 (17%)	6 (20%)	18 (32%)	1 (4%)	
No	18 (78%)	21 (70%)	35 (61%)	9 (39%)	
Not Applicable	1 (4%)	3 (10%)	4 (7%)	13 (57%)	

[§]Chi-square or Fisher's exact test for categorical variables, ANOVA for continuous variable.
* p<0.1; ** p<0.05; *** p<0.01; No, Number; SD, standard deviation; NA, not applicable

Once the Clinic resumed patient care, 70 (53%) patients had not returned by November 2020. More commonly reported reasons for not returning to the Clinic included resolved or improved symptoms (26% of non-returners) and aversion to attending in-person treatment during the ongoing pandemic (10%). Of the 63 patients who returned to the Clinic, they did so after a mean absence of about five months. There were no differences between the age, sex, number of diagnoses and comorbidities, and the nature of the diagnosis between those returning and not returning for care, excepting that those returning were more often diagnosed with mechanical back pain ($p = 0.017$). Patients who returned for treatment more often had a higher number of pre-lockdown treatments ($p = 0.035$), a longer treatment duration ($p = 0.037$), and treatment with SMT ($p = 0.008$) (Table 4). Returning patients had higher mean pain score after the lockdown (6.2/10) compared those who did not return (3.9/10). They reported worsening of symptoms, and had their original diagnoses and plans of management changed at the Clinic post-lockdown ($p < 0.001$).

Table 4.
Characteristics of patients by return-to-clinic post-COVID lockdown.

Characteristics	**Return status post-COVID lock down**		**Independence test**
	Did not return (n=70)	**Returned (n=63)**	**p-value**
Demographic			
Sex			0.576
Female	40 (57%)	32 (51%)	
Age (mean [years], SD)	55 (18)	56 (16)	0.727
Pre-COVID Lockdown - MSK Diagnosis			
Number of diagnoses			0.436
1	25 (36%)	14 (22%)	
2	21 (30%)	20 (32%)	
3	13 (19%)	16 (25%)	
4	8 (11%)	12 (19%)	
5 – 7	3 (4%)	1 (2%)	
MSK Diagnoses			
Mechanical neck pain			0.296
Yes	26 (37%)	30 (48%)	
Mechanical back pain			0.017**
Yes	36 (51%)	46 (73%)	
Spinal central/lateral stenosis			0.087*
Yes	9 (13%)	2 (3%)	
Duration of symptoms (days, SD)	2159 (3112)	2777 (3786)	0.309
Pre-COVID lockdown - Treatment Details			
Treatment/Management			
Spinal Manipulative Therapy			0.008***
Yes	42 (60%)	52 (83%)	

Characteristics	Return status post-COVID lock down		Independence test
	Did not return (n=70)	Returned (n=63)	p-value
Spinal Mobilization			0.582
Yes	68 (97%)	59 (94%)	
Soft Tissue Therapy			1
Yes	69 (99%)	62 (98%)	
Exercise			1
Yes	69 (99%)	62 (98%)	
Education			0.958
Yes	70 (100%)	62 (98%)	
Number of treatments pre-COVID lockdown (No, SD)	30 (58)	53 (69)	0.035**
Duration of treatment pre-COVID lockdown (days, SD)	284 (532)	518 (735)	0.037**
Outcomes of treatment pre-COVID lockdown			0.331
No Change in Symptoms	14 (20%)	8 (13%)	
Symptoms Worsening	3 (4%)	4 (6%)	
Symptoms Improving	43 (61%)	47 (75%)	
Symptoms Resolved	9 (13%)	3 (5%)	
Not Applicable	1 (1%)	1 (2%)	
COVID-19 Lockdown – Self-Management			
Over-The-Counter (OTC)Topicals			0.165
Yes	1 (1%)	5 (8%)	
OTC Pain Medications			0.161
Yes	8 (12%)	14 (22%)	
Exercise			0.078*
Yes	46 (69%)	51 (84%)	
Self-Massage			0.621
Yes	5 (7%)	7 (11%)	
Heat/cold			0.227
Yes	7 (10%)	12 (19%)	
Other treatments			0.017**
Yes	17 (24%)	21 (33%)	
Not Applicable	13 (19%)	2 (3%)	
Post-COVID Lockdown			
Severity of pain post COVID closure (SD)	3.9 (3.4)	6.2 (2.7)	0.001***
Change in diagnosis, plan of management, prognosis			<0.001***
Yes	9 (13%)	20 (32%)	
No	43 (61%)	40 (63%)	
Not Applicable	18 (26%)	3 (5%)	

Characteristics	Return status post-COVID lock down		Independence test
	Did not return (n=70)	Returned (n=63)	p-value
Course of symptoms between closure and return to clinic			<0.001***
Improved	15 (21%)	8 (13%)	
No change	14 (20%)	16 (25%)	
Worsened	19 (27%)	38 (60%)	

§ Chi-square or Fisher's exact test for categorical variables, ANOVA for continuous variable.
* p<0.1; ** p<0.05; *** p<0.01; SD, standard deviation

Discussion

Our case series adds to studies assessing the impact of COVID-19 and clinic closure on patients with MSK conditions.[19-22] To our knowledge, this is the first study of the outcomes of chiropractic patients following the interruption of passive chiropractic treatment. Our findings describe the patient characteristics that may be associated with the course of symptoms during interruption of care and may inform future pandemic protocols.

Pre-lockdown, the majority of patients reported improvement (68%) or resolution (9%) of symptoms, while a minority reported no change (17%) or worsening (5%) since starting treatment. Post-lockdown, 17% of patients reported to be improved, 23% did not change and 43% worsened in MSK symptoms during lockdown. It appears that, in general, patients worsened during the lockdown. Those reporting worsening post-lockdown had more treatments, longer period of treatment time pre-lockdown, and more severe pain (mean: 7/10) post-lockdown. Upon clinic reopening, 47% of patients returned for care, more often reporting worsened MSK symptoms and higher average pain score (6.2/10) than non-returning patients (3.9/10) during the lockdown. Our findings support Fatoye et al's [21] systematic review reporting increase in patients' MSK pain during COVID-19 lockdown.

Although the percentage of our patients' sex (54% female) was similar, their mean age (56 years) was older than patients in non-hospital-based chiropractic clinics ([1,2]). Additionally, as about 30% of the patients rostered with our AFHT, from which all Clinic patients are referred, are in the lowest income quintile,[9] we were unable to assess individual patients' socioeconomic status, which has been shown to affect clinical outcomes.[4] Most of our patients had at least one comorbidity in addition to their MSK diagnoses, a finding that aligns with other reports of populations with similar patient demographics.[12,13] Unlike previous studies,[10–13] we did not find any significant difference between our patient demographics or comorbidities and their clinical outcomes post-lockdown. Our findings are consistent with those reported by Bailly *et al.*,[20] who found no significant correlation between patient age, sex or basal metabolic index with the course of low back pain.

Consistent with studies of chiropractic practice in the community,[1,2] the most common MSK diagnoses among patients in our case series were synonymous with mechanical back pain (62% of all patients) and mechanical neck pain (42% of all patients). Diagnoses of mechanical back pain and cervicogenic headache were more often found among patients reporting worsening post-lockdown, whereas those diagnosed with spinal stenosis were associated with reporting improvement. However, the small number of patients with stenosis makes it difficult to draw definitive conclusions on why this was seen. Pre-lockdown, the median duration of treatment was 104 days, and the median number of treatments received was 14. Most patients reported self-managing their pain during lockdown with exercise, use of over-the-counter medication and application of hot/cold compresses.

Upon the Clinic reopening, 47% of patients returned for care. The most common reasons for not returning to the clinic included improvement of symptoms and aversion to in-person care during the pandemic. Patients who received more chiropractic treatments and who were treated with SMT pre-lockdown, and those who reported more severe pain post-lockdown, were among those who

returned for treatment post-lockdown. Patients' perceptions of whether and how their conditions changed during the lockdown may have been influenced (for the worse) by the anxiety and depression experienced by people in general during the pandemic.[16,20] However, it is important to consider that when the Clinic re-opened, an initial triage protocol was implemented, which likely accounts for the differences observed between groups. It was expected that patients returning for care would have worsened symptoms and higher pain scores.

Patients in our study received multimodal treatments for their MSK diagnoses, similar to those reported by the Canadian Chiropractic Guideline Initiative.[7] Given that these patients were receiving guideline-based care in the Clinic pre-lockdown, it is possible that chiropractic treatment, including education and prescription of exercises, played a role in limiting further worsening of symptoms during the lockdown.[28] It is not surprising that patients in our case series who reported improvement post-lockdown used exercise for self-management during the lockdown more so than those who did not improve, consistent with the observations of Bailly et al.[20] This beneficial form of self-management, unlike passive treatments, is amenable to be prescribed, monitored and progressed via telehealth; and would thus be a suitable, valid modality of chiropractic management of patients, especially during periods of interruption of passive care[25].

Limitations

Our study has several limitations. First, as a descriptive retrospective review of patients' EHR, it does not allow for conclusions regarding causation. Additionally, because the study involved patients from a hospital-based chiropractic teaching clinic, the findings may not be generalizable to those in private practice settings. Second, chiropractic interns (pre-licensure learners) obtained and recorded the data in the patients' EHRs under clinician supervision, as well as assessed and treated patients and documented their histories, examinations and treatment notes. Similarly, despite the training and supervision of research assistants, and regular review of abstracted files, some variability in data recording may have persisted, resulting in inconsistencies in the recording. These factors could introduce measurement bias due to inconsistencies and incomplete or inaccurate data recording.

Third, the data were obtained verbally from patients, thus responses were dependent on the accuracy of their recall, possibly introducing recall bias, and upon each patient's comprehension of "improved," "no change" or "worsened," introducing possible variability in their responses and consequent categorization. However, the patients served as their own controls, with information about variables possibly impacting their clinical outcomes. Furthermore, there is a possibility of selection bias, as data pertaining to patients' post-lockdown status was only obtained from those we were able to contact. Consequently, we have no data on others, which could have impacted our findings. For example, it is possible that patients with "unknown" status represent those less likely to seek follow-up care or with milder symptoms, potentially underestimating or overestimating the observed trends in symptom trajectory. Additionally, our sample of cases was relatively small; however, adequate information was available and recorded for most of the patients under study. The data from the 133 patients in this case series may not be representative of the total active cases at the Clinic, nor of patients in chiropractic clinics within the community. Furthermore, we may not have considered prognostic factors that could have influenced outcomes, such as socioeconomic status.[16] Finally, to identify any trends in this sample, the authors grouped various presentations into categories rather than analyzing them as individual diagnoses, introducing the possibility of misclassification bias. Specifically, grouping conditions could result in the loss of important nuances, potentially affecting the accuracy of the findings. There may also be some inaccuracies in categorizing outcomes as better, worse, or no change, which could affect the reliability of the reported trends.

Summary

Our Clinic patients whose chiropractic treatment was interrupted by the COVID-19 lockdown experienced various outcomes but, in contrast to the pre-lockdown trend, the majority reported no change or worsening of their pre-lockdown MSK symptoms. Patients who did return for treatment upon Clinic reopening had more often been diagnosed with mechanical back pain, received more chiropractic treatments and were more often (than non-returners) treated with SMT pre-lockdown, experienced no improvement or worsening during the lockdown, and reported higher pain intensity post-lockdown

compared to those who did not return. Additionally, those who self-managed with exercises during the lockdown more commonly reported improvement post-lockdown. This observation suggests that supervised exercise therapy could be an effective form of management amenable to telehealth during interruption of in-person chiropractic care. These findings can help inform future research investigating the course of symptoms and the contribution of chiropractic treatment for MSK disorders, as observed during this pandemic.

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Appendix 1.
Check-in Call Script

Hello, this is Intern_____ from the St. Michael's chiropractic team. Could I please speak with _____? I am calling to provide you with an update to our chiropractic services. Could I please verify that I am speaking with the correct person? Could you inform me of your birthdate and postal code/ address? Thank you.

We are calling to let you know that we will be commencing chiropractic services at the beginning of August. Would you be interested in returning for chiropractic treatments?

[If "No":]

Is that because you feel alright? We hope you'll be well. Should you feel the need for chiropractic treatment in the future, please have your family doctor or nurse practitioner email us a new referral. [Intern discusses discharging patient with clinician.]

[If "Yes":]

As we return, we will be following our public health initiative and gradually bringing people back into our clinic, starting with those that are in most need of our services. Could you please tell me how your _____pain has been over the past 4 months since stopping your treatments?

Thank you for the update. As part of the ministry plan for re-opening our services, we need to keep a few things in mind and we have developed a few strategies to help keep you safe throughout this pandemic. First, we are making our best efforts at keeping consistent with social distancing. In order to do this, we will be conducting our history interviews as well as much of our intake process through telehealth services.

Do you have a computer with a camera in it? Do you have access to email and internet services? [If has email:] Could you please tell me your email address? Is it alright for us to communicate with you by email?

Our second method of keeping you safe will be to implement active and passive screening measures. Although this may seem tedious, it is very important that we ensure that any symptoms related to the COVID-19 virus are routinely monitored and screened. You can expect that we will be calling ahead of your appointments to ask you these screening questions. We also have a screener at the entrance to the clinic and we will be asking at the beginning of every appointment.

And finally, when you arrive at the clinic, it will not look

the same as it did before. Our entire team will now be wearing scrubs, gloves, masks and face shields. In addition to this we ask that you wear a mask throughout your appointment as well. Will this be a problem for you?

What you can expect next would be that Julinne, our clerical support, will be contacting you to schedule our telehealth history examination. Following this, we will coordinate a Zoom [or telephone, as applicable] call where we will conduct our interview.

[If Zoom:] Attached to the invitation to the Zoom meeting will be an information sheet about telehealth, a form for your informed consent to have a virtual session, and your intake forms. We ask that you complete the consent and intake forms ahead of our meeting and that you send them back to us by replying to the email link.

We would like you to think back on the most recent treatment here. We'll be asking you to complete a brief survey about your experience at the end of our first virtual session. The session should take about an hour.

We look forward to starting your care very soon!

Appendix 2.
Post- COVID-19 Re-evaluation

Re-evaluation History (After introducing yourself & obtaining consent, including for exam)

1. How were you feeling with respect to Complaint #1, Complaint #2, etc. on March 16, 2020? (**per Complaint**: intensity, frequency, duration, effect on ADLs & function)
2. Between the last time you were treated at this clinic and now, how has Complaint #1 (etc.) behaved? (**per Complaint**, change in intensity, frequency, duration, effect on ADLs & function)
3. What have you done between your last treatment at this clinic and today for Complaint #1, etc.? (**per Complaint**: describe rest, exercise, thermal applications, ergonomic changes, medications, any lab/imaging assessments, any treatments in a clinic/hospital, any virtual treatment)
4. How is your Complaint #1, etc. now?

Re-evaluation Physical Exam

Per Complaint: observation, ROMs, & repeat past neuro, ortho, palpation

Re-evaluation Diagnosis

Indicate if changed

Plan of Management

Indicate if changed

Prognosis