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Change in young people's spine pain following chiropractic care at a publicly funded healthcare facility in Canada

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A B S T R A C T

Background: The presence of spinal pain in young people has been established as a risk factor for spinal pain later in life. Recent clinical practice guidelines recommend spinal manipulation (SM), soft tissue therapy, acupuncture, and other modalities that are common treatments provided by chiropractors, as interventions for spine pain. Less is known specifically on the response to chiropractic management in young people with spinal pain. The purpose of this manuscript was to describe the impact, through pain measures, of a pragmatic course of chiropractic management in young people's spinal pain at a publicly funded healthcare facility for a low-income population.

Methods: The study utilized a retrospective analysis of prospectively collected quality assurance data attained from the Mount Carmel Clinic (MCC) chiropractic program database. Formal permission to conduct the analysis of the database was acquired from the officer of records at the MCC. The University of Manitoba's Health Research Ethics Board approved all procedures.

Results: Young people (defined as 10–24 years of age) demonstrated statistically and clinically significant improvement on the numeric rating scale (NRS) in all four spinal regions following chiropractic management.

Conclusion: The findings of the present study provide evidence that a pragmatic course of chiropractic care, including SM, mobilization, soft tissue therapy, acupuncture, and other modalities within the chiropractic scope of practice are a viable conservative pain management treatment option for young people.

1. Introduction

Spinal pain, including neck and back pain [1,2], is a common health problem occurring in all age groups [3]. Cases of chronic non-cancerous spine pain are common in older Canadians with 60.2% reporting pain in the neck, thoracic, and lower back areas [4]. Costs associated with spine pain not only affects the health care system, but in addition, negatively impacts societal support systems [3].

On average, patients suffering from spine pain will incur 73% higher health care costs [5] with much of this costs going towards improper management [6] such as emergency services. Neck [7] and back pain are among the most commonly encountered complaints in the emergency room, with back pain being the most common musculoskeletal complaint in emergency medicine [8].

Recent clinical practice guidelines (CPGs) pertaining to management of patients suffering from spinal pain are encouraging non-pharmacological, non-surgical treatment options [9–11]. According to recent CPGs a trial of non-pharmacologic care should be considered as a first line treatment for those suffering from spine pain. Among the non-pharmacologic treatment suggestions is spinal manipulation (SM) [9–14]. Spinal manipulation, when delivered manually, involves a high-velocity low amplitude (HVLA) thrust delivered with therapeutic intent to a targeted spinal region. It involves bringing a spinal joint to the limit of the patients' elastic barrier and subsequently into the paraphysiologic space within the anatomical range of the joint. The goal of SM is restoration of normal range of motion and decreased pain [15]. Spinal manipulation is a cost-effective treatment option in the management of spinal pain [16].

Recent CPGs have aimed to improve knowledge translation in the clinical setting for patients suffering with spinal pain. For young people specifically, more research is warranted to develop a CPG for spinal pain. According to the World Health Organization, young people are those from ages 10–24 years old [17]. At present, a comprehensive picture of knowledge related to the management of spinal pain in young people is difficult to portray due to the heterogeneity in which spinal pain data are collected and reported on. Heterogeneity is also found in broad prevalence ranges that include point, period, and lifetime from 1% to 89% [18]. Etiology of spinal pain in young people is also unclear with varying directions for physical, psychological, and social factor

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associations [19]. Most studies note an increased prevalence with females [18,20–23], as well as increased prevalence as age increases [18,20,24,25]. Other spinal pain risk factors identified in both males and females were pubertal development and linear growth, which were found to be independent [26]. Spinal pain can limit physical activity for the aforementioned young populations, which has numerous long-term consequences; a focused effort is needed on the prevention and effective treatment strategies.

Currently, no "gold standard" exists for the treatment of spinal pain in young people [19,27,28]. A review on conservative interventions for low back pain in a young population only found 4 low-quality randomized clinical trials [29]. Of these, one included manual therapy, but the study may have had low statistical power having 45 participants, thus no conclusion for the intervention could be made. However, a recent high-quality randomized trial was conducted with individuals 12–18 years of age. This study found SM combined with exercise was more effective than exercise for chronic low back pain [30]. Spinal manipulation has been increasingly used for musculoskeletal pain, in spite of the lack of clear evidence that it is effective [31,32].

The present study utilizes prospective quality assurance data attained from a publicly funded, non-profit, community health care facility with integrated chiropractic services, including SM delivered on-site to investigate changes in spinal pain in young people following conservative care. We hypothesize that young people's spinal pain will improve to an extent demarcated as both clinically, and statistically significant following a conservative trial of chiropractic care involving SM.

2. Methods

2.1. Study design

The study utilized a retrospective analysis of prospectively collected quality assurance data attained from the Mount Carmel Clinic (MCC) chiropractic program database. Formal permission to conduct the analysis of the database was acquired from the officer of records at the MCC. The University of Manitoba's Health Research Ethics Board approved all procedures.

2.2. Setting

Situated in Winnipeg, Manitoba, Canada, the MCC is one of the few health care centres in North America that is a publicly funded, non-profit, community-based healthcare clinic with chiropractic services on-site that provides services to a population with a full spectrum of age groups. This unique model eliminates a financial obstacle to accessing CPG recommended non-pharmacological treatment for spinal pain in a patient demographic with financial challenges. The model also eliminates any financial motivation for a clinician to see a patient more than is clinically warranted.

To qualify for treatment at the facility patients were financially disadvantaged and not covered by third party reimbursement, such as Manitoba Public Insurance or Workers Compensation Board. As a marginalized and underserved population complex comorbidities were frequent.

2.3. Participants and variables

The data were collected from January 2011 to August 2017. Inclusion into the study defined young people as 10–24 years of age, which is consistent with the World Health Organization definition for young people [17]. Patients were referred to the appropriate health care provider if chiropractic intervention was not clinically warranted, or underwent informed consent procedures to initiate care in the case chiropractic care was a viable treatment option. Descriptive data collected during the initial chiropractic consultation included a comprehensive amount of demographic data at baseline and entered into a prospective quality assurance database. One of the measures used was pain severity. Pain severity as measured using the pain numeric rating scale (NRS), which is an 11-point Likert scale with 0 representing "no pain" and 10 representing "worst pain imaginable" [33]. Pain scores were collected at baseline and follow-up visits.

In considering clinical populations the minimally clinically important difference (MCID) is an important concept and meaningful metric. According to Childs et al. (2005) a two point reduction (-2) in the NRS represents the MCID for musculoskeletal pain [34].

2.4. Data source

The data are maintained at the MCC chiropractic program by the treating clinician on site. Patient data were completely de-identified upon entry to the database prior to analysis and interpretation.

2.5. Chiropractic treatment methods and frequency

Patients reporting for chiropractic treatment underwent a trial of conservative, pragmatic care at the discretion of the treating chiropractor. Typical treatment visits consisted of: spinal or extremity joint manipulation and/or mobilization, soft tissue therapy, acupuncture, and other modalities, when clinically indicated all delivered by a licensed chiropractor. Re-evaluation visits were scheduled after every 4–6 treatment visits to assess treatment response, no response to care, or if the patient had reached a plateau in therapeutic response to care. New patient assessments were scheduled for 30–60 min, while treatment visits and re-evaluation visits were 15–30 min in duration.

2.6. Statistical analyses

Analysis of reported data consists of interpretation of raw numbers, and percentages of respondents to items from the database. Any discrepancies between the number of patients in the study, and the numbers used for comparison to derive percentages, is due to participants choosing to abstain from a question. Body mass index (BMI) categories were designated using those of the Centres for Disease Control and Prevention (CDC): underweight ($< 18.5\,kg/m^2$), normal ($18.5–24.9\,kg/m^2$), overweight ($25.0–29.9\,kg/m^2$), obese ($\geq 30.0\,kg/m^2$) [35].

Patient NRS data was categorized as acute pain ($<$ 3 months in duration) or chronic pain ($>$ 3 months in duration). The NRS data was further analyzed by categorizing "minimal pain" (NRS 0–3), "moderate pain" (NRS 4–6), and "severe pain" (NRS 7–10).

Paired t-tests were calculated by IBM SPSS statistics (Version 25.0) assuming an alpha of 0.05, a power of 0.80, and a medium effect size ($p = 0.5$) for a 2-tailed test. Paired-sample t-tests were utilized to compare baseline pain NRS to discharge NRS scores for each spinal and extremity regions. Clinical significance was assessed using a MCID of 2-point or greater change from baseline to discharge for NRS scores. A 2-point reduction in NRS scores represents an MCID for musculoskeletal pain, and represents improvement beyond measurement error [34].

3. Results

3.1. Participant demographics

Unique patients between 10 and 24 years of age ($N = 51$) visited the clinic on multiple occasions, with 1 patient never engaging in care due to contraindications, and 5 patients receiving only a single treatment on the day of their initial evaluation. As illustrated in Table 1, female patients represented the majority (80%) of the patient treatment visits for young people at the MCC chiropractic clinic. The mean age of patients was 19.98 ($SD = 3.01$) years old. The average body mass index was 28.1 ($SD = 7.00$) based on 50 unique respondents, which is considered overweight. Comorbidities to musculoskeletal pain included but were not limited to: anxiety disorder ($n = 6$), depression ($n = 6$), pregnancy ($n = 4$), and fetal alcohol syndrome ($n = 2$).

Referral by other healthcare providers on-site within the MCC made up the majority of new patient visits for chiropractic care (29 out of 34 respondents or 85.3%). The remaining 14.7% (5 out of 34 respondents) were referred to the MCC by an outside source. Patients who received HVLA joint manipulation, mobilization, and soft tissue intervention, had those interventions directed most often toward the thoracic and lumbar spinal regions followed by the cervical and sacroiliac regions in equal proportion (Table 2). Acupuncture was used minimally for all regions (cervical spine 2/9 or 22.2%; thoracic spine 1/9 or 11.1%; lumbar spine 1/9 or 11.1%; sacroiliac region 1/9 or 11.1%; & extremity regions 4/9 or 44.4%). Soft tissue therapies within a course of chiropractic management were more frequently directed towards the thoracic (30.5%) and lumbar regions (32.6%).

The average course of care consisted of 8.67 (SD = 8.22) chiropractic visits, with the average course of care for acute conditions as 9.38 (SD = 7.94) and 8.31 (SD = 8.47) for chronic conditions. When young people receiving chiropractic care were asked if their "initial chiropractic visit saved them from making an additional primary care physician visit", 95.0% (38/40) stated "yes" it did. Following chiropractic care/consultation 2 out of 51 (3.93%) patient respondents required referral to another healthcare provider for additional care.

There were more young patients seeking care for chronic pain (symptoms > 3 months in duration) as shown in Table 3, than acute pain (< 3 months in duration). For those seeking acute pain treatment, there was relatively even distribution of complaints by spinal region. Conversely, for patients with chronic pain seeking management, the greatest proportion of patients sought care for pain in the thoracic (30.2%) and lumbar (32.6%) regions.

Statistically, all five regions assessed by the NRS demonstrated significant improvement when comparing baseline and evaluation scores for a completed course of chiropractic management (Table 4). From the NRS data collected all four spinal regions (cervical, thoracic, lumbar and sacral) and the extremity regions reported improvement beyond measurement error in accordance with the MCID. Patients demonstrated on average a point change of −3.3, or −47.5% NRS reduction in all four spinal regions and extremities, following chiropractic management, which exceeds a clinically meaningful reduction.

This analysis revealed patients seeking care for acute conditions experienced the greatest decrease in NRS point change (Table 5). Patients seeking care for acute conditions experienced an average point change of – 4.12 or – 59.2% NRS reduction in all four spinal regions and extremities, following chiropractic management. Chronic conditions had an average point change of – 2.86 or – 40.9% NRS reduction following care (Table 6).

As shown in Table 7, patients in the "severe pain" (n = 31) category experienced an average point change of – 4.02 or – 50.0% NRS reduction in all four spinal regions and extremities, following chiropractic care. Patients (n = 17) in the "moderate pain" category (Table 8) experienced an average point change of – 2.15 or – 40.0% NRS reduction when all four spinal regions are collapsed. However, in the cervical spine region a point change of (−1.4) was observed, which failed to reach statistical (p = 0.08) or clinical significance (defined as a 2-point NRS change). There was insufficient data to statistically analyze the response to chiropractic care in the extremity region for the "moderate pain" category. Statistical analysis for the "minimal pain" category was also not possible due to the insufficient power (n = 4).

No adverse events were reported throughout the study duration as a result of SM.

4. Discussion

Spine pain is common health problem [3] and afflicts many Canadians [4]. According to a cross-sectional survey performed in the province of Saskatchewan, patients suffering with spine pain commonly seek care from a medical doctor (31.6%), a chiropractor (28.8%), or both (7.9%) [36].

The present study provides evidence that young people with spinal pain responded favorably to chiropractic management. The course of care between acute and chronic cases was similar; 9.38 visits (SD = 7.94) and 8.31 visits (SD = 8.47), respectively. Throughout the course of chiropractic care patients demonstrated a point change of – 3.3 NRS reduction on average. These findings were statistically significant and clinically meaningful in all five regions and provides support that chiropractic management may be a useful treatment option for young people suffering with spinal pain of musculoskeletal etiology in socioeconomically disadvantaged communities.

The results revealed that young people responded more favorably to chiropractic management in acute cases as evidenced by the greater decrease in average NRS point change. Patients experiencing "severe pain" experienced greater benefit (- 50.0% NRS reduction) from chiropractic management when compared to patients experiencing "moderate pain" (- 40.0% NRS reduction). A similar study investigating spinal pain in older adults was conducted at MCC by Passmore, Toth, Kanovsky, & Olin in 2015. The researchers found that the average course of care was 12.7 (SD = 14.3) visits, with an average NRS point reduction of – 2.04 or – 29.3% in patients who were on average 51 years old or older [37]. Patient were also found to have a BMI > 30 on average categorizing patients as obese in the 2015 study [37]. Whereas, the current study on young people found the average BMI to be 28.1 categorizing patients as overweight. Psychosocial comorbidities, which were present in a modest number of the population tested included anxiety and depression, may be challenges to responding favorably to a course of care. A larger cohort of individuals specifically with psychosocial comorbidities would be an area requiring future study using a team approach including clinical psychologists [11]. Potentially addressing musculoskeletal complaints, such as spinal pain, at a younger age and lower BMI, prior to the development of other psychosocial comorbidities is an upstream solution.

Adverse events following SM, a treatment frequently delivered during a course of chiropractic management, in younger populations are rare [38,39]. The practitioner should be cognizant of the patients' age, and development of the spine in younger populations and the necessity to modulate SM force [38]. The safety profile of SM in the adult population is similar to that of younger populations and SM for adults is generally regarded as safe. The current evidence suggests that adverse events following SM in all populations are very rare [38–44]. From the inception of chiropractic integration into the MCC in January 2011 to the end of the study period August 2017, no minor or serious adverse event were reported as a result of SM or other chiropractic intervention on young people.

In the presence of limited evidence practitioners must remain vigilant and rely on the best available evidence to help guide their clinical decisions. The present findings provide support for chiropractic management for young people suffering with spinal pain of musculoskeletal etiology in socioeconomically disadvantaged communities as a viable treatment option.

5. Limitations

Several limitations should be considered based on the inherent nature of the retrospective study design. Data collected were limited to the patient demographic headings and outcome measures utilized in the database, and the sample size of young people was modest. The authors also acknowledge that treatment outcomes reflect a pragmatic course of chiropractic care, which inherently included variations in frequency of clinic visits. The pragmatic treatment approach is compliant with recent clinical practice guidelines, which are multimodal in nature. While certain instances of spinal pain may be self-limiting, there may be a risk of developing chronicity if spinal pain in young people is left untreated [45]. Without a control group we are not able to comment on whether the population in the present study would have had their symptoms spontaneously resolve if untreated, or if their symptoms would have

become chronic if left untreated. Future clinical trials are warranted to resolve the aforementioned issue, in the present study we observed that young people responded favorably to a brief course of chiropractic management.

Data does not necessarily reflect the general population as the sample studied was from a socioeconomically disadvantaged, underserved community with complex comorbidities.

6. Conclusion

Young people from a socioeconomically disadvantaged, underserved community with spinal pain experienced both statistically and clinically significant improvements in pain severity. A pragmatic course of chiropractic management, that was multimodal in nature, was found to have a favorable outcome as a treatment option for young people suffering with spinal pain of musculoskeletal etiology from a socioeconomically disadvantaged community. Further prospective research is warranted to explore the response of young people with specific diagnoses as the etiology of their spinal pain, and the changes in their functionality and disability, in response to chiropractic management.

Conflicts of interest

The authors report no conflict of interest. The authors alone are responsible for the content and composition of the manuscript.

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Appendix

Table 1
Patient Demographics – Chiropractic patient demographic data of young people's visits at the Mount Carmel Clinic from 2011 to August 2017.

Age Range for Inclusion into Study: 10 years old to 24 years old		
Mean age	19.98 years of age	
Standard Deviation	3.0	
Body Mass Index (BMI)		
Mean	28.1	
Standard Deviation	7.0	
Gender (total clinic visits) – 385		
Male	67	17.4%
Female	303	78.7%
Transitioning	15	3.9%

Table 2
Treatment Intervention – Type of treatment intervention, by region, delivered by the Mount Carmel Clinic chiropractor. Data reflects the number of unique patients receiving intervention per region (% receiving the respective intervention).

	HVLA SM		Mobilization		Soft Tissue Therapy		Acupuncture	
CS	20	(13.6%)	19	(13.9%)	17	(12.1%)	2	(22.2%)
TS	45	(30.6%)	41	(29.9%)	43	(30.5%)	1	(11.1%)
LS	47	(32.0%)	45	(32.8%)	46	(32.6%)	1	(11.1%)
SI	28	(19.0%)	27	(19.7%)	27	(19.1%)	1	(11.1%)
Ext	7	(4.8%)	5	(3.6%)	8	(5.7%)	4	(44.4%)

Legend: HVLA is high-velocity low-amplitude; SM is spinal manipulation; CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity.

Table 3
Duration of Complaint – Duration of complaint from new patients (N = 51), some with multiple regions, at the Mount Carmel Clinic receiving chiropractic care.

	Acute Pain Patients (% of Acute)		Chronic [> 3 months] Pain Patients (% of Chronic)		Ratio (acute: chronic)
CS	6	(13.6%)	10	(11.6%)	1 : 1.67
TS	11	(25.0%)	26	(30.2%)	1 : 2.36
LS	14	(31.8%)	28	(32.6%)	1 : 2
SI	8	(18.2%)	16	(18.6%)	1 : 2
Ext	5	(11.4%)	6	(7.0%)	1 : 1.2

Legend: CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity.

Table 4
Patient Outcomes – Patient outcomes by region for the Pain Numeric Rating Scale (NRS): M (SD).

	Baseline		Discharge		Point Change	% Change	t-score	P-value
CS	6.5	(1.9)	3.6	(2.2)	- 2.9	- 44.6	4.415	0.001
TS	6.9	(1.5)	4.2	(2.3)	- 2.7	- 39.1	6.758	0.000
LS	6.8	(1.9)	3.8	(2.4)	- 3.0	- 44.1	6.901	0.000
SI	7.2	(1.8)	3.6	(2.4)	- 3.6	- 50.0	6.699	0.000
Ext	7.4	(1.6)	3.0	(2.6)	- 4.4	- 59.5	5.231	0.000

Legend: MCID for chronic musculoskeletal pain for NRS is – 2 point from baseline [34]; p-values are derived from 2 tailed paired T-tests, significant differences are $p < 0.05$. CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity. MCID is minimally clinically important difference.

Table 5
Acute Patient Outcomes – Patient outcomes by region for the Pain Numeric Rating Scale (NRS): M (SD).

	Baseline	Discharge	Point Change	% Change	t-score	P-value
CS	5.8 (1.7)	2.7 (2.2)	- 3.1	- 53.4	4.974	.006
TS	7.0 (1.3)	3.1 (2.1)	- 3.9	- 55.7	5.723	.001
LS	6.6 (1.5)	2.9 (2.1)	- 3.7	- 56.1	5.344	.000
SI	7.0 (1.5)	2.1 (1.4)	- 4.9	- 70.0	6.895	.001
Ext	8.2 (0.6)	3.2 (0.6)	- 5.0	- 61.0	9.023	.026

Legend: MCID for chronic musculoskeletal pain for NRS is – 2 point from baseline [34]; p-values are derived from 2 tailed paired T-tests, significant differences are $p < 0.05$. CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity. MCID is minimally clinically important difference.

Table 6
Chronic Patient Outcomes – Patient outcomes by region for the Pain Numeric Rating Scale (NRS): M (SD).

	Baseline	Discharge	Point Change	% Change	t-score	P-value
CS	7.0 (1.8)	4.4 (2.3)	- 2.6	- 37.1	2.594	.029
TS	7.0 (1.6)	4.7 (2.2)	- 2.3	- 32.9	5.374	.000
LS	7.0 (2.1)	4.3 (2.4)	- 2.7	- 38.6	5.016	.000
SI	7.4 (2.0)	4.6 (2.6)	- 2.8	- 37.8	4.582	.000
Ext	6.7 (1.9)	2.8 (2.8)	- 3.9	- 58.2	3.781	.013

Legend: MCID for chronic musculoskeletal pain for NRS is −2 point from baseline [34]; p-values are derived from 2 tailed paired T-tests, significant differences are $p < 0.05$. CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity. MCID is minimally clinically important difference.

Table 7
Patient Outcomes of “Severe Pain” – Patient outcomes by region for the Pain Numeric Rating Scale (NRS): M (SD).

	Baseline		Discharge		Point Change	% Change	t-score	P-value
CS	8.0	(1.1)	4.0	(2.2)	- 4.0	- 50.0	3.802	0.007
TS	7.9	(0.8)	4.6	(2.4)	- 3.3	- 41.8	6.292	0.000
LS	8.2	(1.1)	4.3	(2.5)	- 3.9	- 47.6	6.515	0.000
SI	8.1	(1.2)	4.4	(2.6)	- 3.7	- 45.7	5.155	0.000
Ext	8.0	(0.9)	2.8	(2.6)	- 5.2	- 65.0	4.324	0.008

Legend: MCID for chronic musculoskeletal pain for NRS is −2 point from baseline [34]; p-values are derived from 2 tailed paired T-tests, significant differences are $p < 0.05$. CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity. MCID is minimally clinically important difference.

Table 8
Patient Outcomes “Moderate Pain”– Patient outcomes by region for the Pain Numeric Rating Scale (NRS): M (SD).

	Baseline		Discharge		Point Change	% Change	t-score	P-value
CS	5.4	(0.8)	4.0	(2.3)	- 1.4	- 25.9	2.085	0.082
TS	5.5	(0.7)	3.5	(2.0)	- 2.0	- 36.4	3.708	0.004
LS	5.1	(0.9)	2.9	(2.1)	- 2.2	- 43.1	4.702	0.000
SI	5 .5	(0.8)	2.5	(1.4)	- 3.0	- 54.5	8.216	0.000
Ext	–		–		–	–	–	–

Legend: MCID for chronic musculoskeletal pain for NRS is −2 point from baseline [34]; p-values are derived from 2 tailed paired T-tests, significant differences are $p < 0.05$. CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region; Ext is extremity. MCID is minimally clinically important difference.

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