Weight Loss in the Chiropractic Profession

By

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Abstract

Background: Excess weight places a significant burden on health. Clinical practice guidelines advise healthcare professionals to provide weight management interventions to patients with overweight and obesity. Chiropractic practice may provide a unique opportunity to deliver weight management interventions to those with overweight and obesity. However, little has been done to address overweight and obesity within the chiropractic profession. Identifying the extent of this evidence-practice gap in chiropractic practice is the first step in addressing this issue.

Objectives: This thesis was to assess the clinical practices of weight loss provided by chiropractors. The primary objectives were to 1) determine the prevalence of overweight and obesity in the adult patient population that sought chiropractic care, 2) describe the frequency and distribution of chiropractor directed weight management intervention, 3) identify associations between chiropractor directed weight management interventions and specific patient-level and chiropractor-level variables, and 4) examine the interaction between patient weight and comorbid conditions and whether chiropractors offered weight management interventions.

Methods: Data from the Ontario Chiropractic Observational and Analysis Study was used (N = 42 chiropractors, N = 3523 patient encounters). Multilevel logistic regression was performed. Patient-level as well as chiropractor-level variables were investigated and associations with weight management provided by chiropractors were identified.
Results: The majority of patients who sought chiropractic were overweight or obese (61.2%). Weight loss was provided to only 5.4% of patients. Chiropractors who graduated between 1995 and 2005 (OR: 0.02, 95% CI: 0.00 - 0.13) or prior to 1995 (OR: 0.08, 95% CI: 0.01 - 0.42) provided weight management significantly less than chiropractors who graduated between 2005 and 2014. No significant interaction was observed between patient adiposity and comorbid conditions with chiropractors directed weight loss.

Conclusion: The majority of patients who seek chiropractic care are overweight and obese. Chiropractors are in a unique position to help improve patient health through offering weight management. However, this opportunity has not been fully realized by the chiropractic profession.
Co-Authorship

This thesis presents the work of Dr. Peter Beliveau done in collaboration with supervisors Dr. Simon French and Dr. Michael McIsaac. The idea of assessing weight management in the chiropractic profession was developed collaboratively by Dr. Peter Beliveau and Dr. Simon French.

The data used in this thesis came from the Ontario Chiropractic Observation and Analysis STudy (O-COAST). O-COAST was coordinated by Dr. Jessica Wong. The principal investigators of O-COAST were Dr. Simon French, Dr. André Bussières, and Dr. Silvano Mior.

The manuscript entitled “Utilization of chiropractic services, reasons for seeking care, patient profiles, and treatment provided: A scoping review” is the original work of Dr. Peter Beliveau. Nir BenSimon acted as the second review author and Dr. Jessica Wong was the third review author (who resolved conflicts between Dr. Peter Beliveau and Nir BenSimon during the article screening process). Dr. Simon French, Dr. André Bussières, and Dr. Silvano Mior were consulted throughout the design and writing of the manuscript.

The manuscript entitled “Do Chiropractors Undertake Weight Loss Interventions?” is the original work of Dr. Peter Beliveau. Dr. Simon French and Dr. Michael McIsaac were consulted throughout the design and writing of the manuscript.

The statistical analyses, interpretation of the results, and writing of the thesis chapters were performed by Dr. Peter Beliveau, with guidance and feedback from Dr. French and Dr. McIsaac.
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List of Abbreviations

BEACH – Bettering the Evaluation and Care of Health

BMI – Body Mass Index

CCHS - Canadian Community Health Survey

CMCC – Canadian Memorial Chiropractic College

COAST – Chiropractic Observational and Analysis Study

GLMM – Generalized Linear Mixed Models

ICC – Intra-class Correlation

O-COAST – Ontario Chiropractic Observational and Analysis Study

WHO – World Health Organization
Chapter 1

Introduction

1.1 Thesis Rationale

Overweight and obesity are conditions in which excess body fat has accumulated to the extent that it has an adverse effect on a person’s physical, mental, and/or social health.[1] Body mass index (BMI), calculated as weight in kilograms divided by height in metres squared, describes the relation between body weight and stature in humans and is commonly used as a measure of adiposity.[2] BMI identifies adults as overweight if their BMI is between 25 and 29.9, and obese if their BMI is equal to or greater than 30.[3] Obesity is further divided into class I, II, and III for those with a BMI between 30 to 34.9, 35 to 39.9, and equal to or greater than 40, respectively. Data suggests that the rise in obesity could lead to a decline in life expectancy.[4] Concern about the health risks associated with rising obesity rates has become nearly universal: member states of the World Health Organization (WHO) introduced a voluntary target to stop the rise in obesity by 2025[5] and widespread calls have been made for regular monitoring of changes in the prevalence of overweight and obesity in all populations.[6–8]

Excess weight is widely recognized as a leading health concern and has recently been declared a global epidemic.[9–12] In 2013, Statistics Canada reported that 62.0% of men, 45.1% of women, and 20.7% of youths were either overweight or obese.[13, 14] Between 1985 and 2011, the prevalence of adult obesity in Canada increased from 6.1% to 18.3%, with the greatest increases occurring in the highest weight classes.[15] Obesity is a risk factor for many chronic diseases and musculoskeletal conditions.[16–23] The percentage of people with an increased risk of negative health related consequences due to their weight has tripled in Canada since 1981.[24]
The Obesity Society has recommended that obesity be considered a disease as a means of soliciting more resources into research, prevention, and treatment; encouraging more healthcare professionals to view treating the patient with obesity as a vocation worthy of effort and respect; and reducing the stigma and discrimination heaped upon many people with obesity.[25] A previously published literature review found that strategies to combat obesity and address obesogenic environments can be classified into three main categories: 1) health services and clinical interventions that target individuals; 2) community-level interventions that directly influence individuals and group behaviours; and 3) public policies that target broad social or environmental determinants.[26] It has been suggested that, like successful smoking cessation strategies, effective obesity prevention may require a multifaceted, long-term approach involving interventions that operate at multiple levels and in complementary ways.[26]

Overweight and obesity places a significant burden on health.[27] Numerous clinical practice guidelines advise healthcare professionals to recommend strategies, provide weight management counselling, and offer continued support to all patients who are overweight or obese.[28–41] Despite these recommendations and many stark statistics indicating the importance of their implementation, patients with overweight and obesity are not well managed by healthcare professionals.[9, 42–48] Chiropractic practice emphasizes a holistic and patient-centered paradigm of care and may provide a unique opportunity for weight management intervention to those patients with overweight or obesity. In the chiropractic profession, a profession that sees approximately 4.5 million Canadians annually, little has been done to address overweight and obesity.[49] Identifying the extent of this problem in chiropractic practice is the first step in addressing and closing this evidence-practice gap.
1.2 Prevalence of Overweight and Obesity

The simultaneous increases in obesity reported by almost all countries around the world has been described as a global epidemic.[9–12] Country trends in mean BMI between 1980 and 2008 were estimated using data from 369 national surveys and 591 subnational surveys.[50] Trends in childhood obesity and overweight from 1990 and projected to 2020 have been examined from 450 national surveys.[51] Data from these analyses suggest widespread increases in the number of people with overweight and obesity within the past three decades. In 2010, the health related consequences of overweight and obesity were estimated to have caused 3.4 million deaths, 4% of all years of life lost, and 4% of disability-adjusted life-years worldwide.[52] Worldwide, the proportion of adult men with BMI of 25 kg/m² or greater increased between 1980 and 2013 from 28.8% to 36.9% and of adult women from 29.8% to 38.0%.[53]

In 2013, Statistics Canada reported that 62.0% of men, 45.1% of women, and 20.7% of youths had either overweight or obesity.[13, 14] The prevalence of obesity, among Canadians ages 18 years and older, increased from 13.8% in 1979 to 25.4% in 2009.[54] Since 2003, the proportion of Canadians with obesity has increased by 17.5%.[55] Analyses of the 2007/2008 Canadian Community Health Survey (CCHS) showed that the prevalence of obesity increased with age up to age 65 for both men and women then decreased after age 65.[54] A similar trend of lower prevalence of obesity among the youngest and oldest age groups was also observed in the 2004 CCHS.[56] The proportion of overweight Canadians is higher in rural areas when compared to metropolitan areas with the lowest proportions of obesity in Canada’s three largest cities (Toronto, Montreal, and Vancouver) and the highest levels in Atlantic Canada, the Prairies, the Territories, and smaller cities in northern and southwestern Ontario.[55] [57, 58]
1.3 Lifestyle Change Effects on Overweight and Obesity

The regulation of body weight in humans is complex and involves physiological, genetic, and behavioural/environmental factors. Body weight is regulated primarily in the hypothalamus with hormonal signals that influence food intake and energy expenditure released from the gastrointestinal tract, pancreas, and adipose tissue.[59, 60] Identified modulators of appetite include: peptide YY$_{3-36}$,[61] ghrelin,[62] leptin,[63, 64] cholecystokinin,[65] insulin,[66] pancreatic polypeptide,[67] and glucagon-like peptide 1.[68] In addition, triiodothyronine has been shown to increase metabolic rate and energy expenditure.[69] By modulating appetite, energy intake, and energy expenditure, this system responds to changes in body fat and other energy stores to maintain a consistent body weight over time.[70] However, energy balance cannot be maintained with a large sustained energy surplus. The result is weight gain, which will continue until a new weight-to-energy expenditure equilibrium is reached. The same physiological mechanisms will maintain this new energy balance at the higher weight and defend against weight loss by increasing appetite and reducing energy expenditure if there is an energy deficit.[71, 72]

Thus a large intake of fat or sugar and high levels of sedentary behaviour will directly affect energy balance and lead to weight gain.

Human behaviour is affected by the environment. It is common for the surroundings or conditions in which a person lives and works to encourage energy imbalance and promote obesity, through changes in food supply, urban design discouraging physical activity and active travel, as well as longer working hours leading to less time to prepare food and to be physically active.[73–78] Individual behaviours relating to diet and physical activity can become habits and can be difficult to change. Eating and activity habits often result in increased energy intake, and as environments become more obesogenic these behaviours lead to increases in overweight and obesity.[79, 80] Psychosocial stress related to work, personal relationships, life constraints, and finances have been associated with weight gain.[81, 82]
Therefore behaviours that promote weight gain will have a significant effect on how the body regulates energy and stores fat.

1.4 Measures of Overweight and Obesity

The quantification of body fat (adipose tissue) mass and distribution in vivo is particularly difficult.[83] Techniques such as ultrasound or the measurement of skin-fold thickness by callipers have been shown to be accurate but cannot distinguish between visceral fat tissue and abdominal subcutaneous fat tissue.[84–87] Computer tomography, dual energy X-ray absorptiometry, and magnetic resonance imaging (MRI) enable investigation of subcutaneous, intraperitoneal, and visceral adipose tissue components.[88, 89] Yet, these methods are impractical for epidemiologic studies and for routine clinical practice.[90]

An alternative to the measurement of adipose tissue mass in the evaluation of overweight and obesity is the Quetelet’s index, described in 1832, and later termed body mass index in 1972.[91] As described previously, BMI estimates adiposity via weight and height measurements. However, due to the complex changes that occur during childhood and adolescence, BMI is interpreted differently for newborns through to those aged 18 years. Adiposity differs between sexes and changes with age prior to the age of 18. BMI among those less than 18 years old is plotted on sex specific growth curves and those who are within the 85th to 95th percentile are classified as overweight and those equal to or greater than the 95th percentile are classified as obese.

BMI as a measure of adiposity is imprecise because it does not distinguish lean body mass from fat mass.[92] Measures such as waist circumference and waist-hip ratio are among the many population-based methods suggested to better measure adiposity. Despite this BMI remains a widely used population
measure of adiposity in adults due to its convenience, safety, minimal cost, and correlation with body fat.[39, 92]

1.5 Overview of the Chiropractic Profession

Chiropractic encompasses the diagnosis, treatment, and prevention of disorders of the neuromusculoskeletal system and the effects of these disorders on general health.[93] Chiropractic, which arose as a separate health profession in the 1890s, has educational institutions in many countries with chiropractors in over 100 countries. The largest numbers of chiropractors are found in the United States of America (75,000), Canada (7,250), Australia (4,250), United Kingdom (3,000), Brazil (700), Norway (600), Denmark (550), France (450), Italy (400), Japan (400), New Zealand (400), and Spain (400).[93]

There is legislation to recognize and regulate the chiropractic profession in 48 countries. Different approaches to legislation include a state chiropractic act (Denmark, Hong Kong, China, Israel, Canada, and the USA), a chiropractic act under an umbrella law for various mainstream healthcare disciplines (Iran, Switzerland, Canada, Australia, and the USA), and a chiropractic act under an umbrella law for complementary and alternative health care disciplines (Belgium, France, the Philippines, and South Africa).[93] Regardless of the approach this legislation restricts the use of the title chiropractor to persons who meet specific educational requirements and who are licensed.[93] Chiropractic scope of practice generally allows for communication of a diagnosis identifying a disease or disorder, to perform or order diagnostic tests, and to move a joint beyond the usual physiological range of motion using a fast, low amplitude thrust.[94] Typical contact with chiropractors is directed by the patient without medical referral.
1.6 Chiropractic Clinical Practice

Clinical practice and chiropractic philosophy have been a contentious issue since the inception of the profession. Chiropractors continue to debate the merits of the legacy left by past chiropractic visionaries, the validity of chiropractic concepts and methods, the degree to which chiropractic represents an alternate form of health care, the treatment of non-musculoskeletal problems, and the scientific status of chiropractic knowledge.[95] The chiropractic profession has been plagued by internal ideologically-based strife throughout the profession’s history.[96, 97] As a result the chiropractic profession has deep rooted factions which are either research-informed or unorthodox and legacy-driven. These issues continue to have a significant impact on how chiropractors conduct their clinical practice.

It has been suggested that the differences in philosophical orientation among chiropractors are reflective of graduation from particular chiropractic teaching institutions.[95, 98, 99] There are currently 15 chiropractic colleges in the United States and many more internationally that span the spectrum of chiropractic ideology from conservative or more traditional beliefs to evidence-based approaches to clinical practice. There are only two chiropractic educational institutions in Canada: the Canadian Memorial Chiropractic College (CMCC) and the Université de Québec à Trois Rivières (UQTR), both of which teach from an evidence-based approach. The chiropractors who practice in Ontario have diverse backgrounds and training which have resulted in a multitude of intraprofessional ideologies and types of practice.

1.7 Chiropractic Professional Training in Managing Patients With Overweight and Obesity

International standards of chiropractic education have been recognized by the World Health Organization (WHO). These are considered the global standard for chiropractic education. Globally, entrance requirements are a minimum of three years of university credits in qualifying subjects. A typical
chiropractic educational program consists of a minimum of 4 full-time academic years (minimum of 4,465 total hours), followed by mandatory postgraduate clinical training and licensing exams as mandated by the WHO in 2005.[100] Subjects particularly relevant to the management of overweight and obesity include clinical biochemistry, physiology, nutrition, clinical nutrition, and community health.

There has been a growing awareness of the changing needs of society and that health care must evolve to address factors of disease such as lifestyle, behaviours, and social and economic differences.[101] In July 2000 the Surgeon General of the United States, Dr. David Satcher, declared a priority to improve the education of health professionals by building programs that are grounded in the principles of prevention.[102] A national agenda for the future of public health was published in early 2000 which supported the importance of improving the education of future health professionals in the areas of health promotion and disease prevention.[103]

The Chiropractic Health Care Section of the American Public Health Association formed the Public Health Curriculum Task Force with the goal of improving the quality of public health training for chiropractic students. A report, which detailed topics and resources for inclusion in public health courses, was created by this team of interdisciplinary researchers and was disseminated to all chiropractic colleges in 1999.[104] In 2000, the University of Bridgeport College of Chiropractic, the School of Public Health at Yale University, the Association of Schools of Public Health, and the Health Resources and Services Administration announced a collaborative project to address the issue of inconsistent health promotion within the chiropractic profession by developing a standardized public health curriculum.[105] This initiative resulted in the Council on Chiropractic Education issuing a new standard addressing wellness and health promotion in the chiropractic college curriculum.[106] By 2001, a model course for public
health education in chiropractic was implemented within the United States chiropractic public health education curriculum which promoted physical exercise and weight loss strategies.[107]

At the same time CMCC recognized the importance of patient education in the promotion of public health.[108] The institution implemented a new integrative curriculum to facilitate a variety of educational opportunities to promote effective patient education and to make course material clinically meaningful.[108, 109] Curricular content at CMCC was introduced to educate chiropractic students on planning and prescribing exercises as well as basic adult learning and teaching concepts in a practical clinical setting. In addition, exercise and nutrition education was implemented through clinician-directed, small group education sessions, as well as patient-directed education. The CMCC course in public health was reviewed and further developed in 2003, which led to improvements in the clinical application and relevance of the material.[109] A review of recent CMCC curriculum showed little change since 2003 in public health curriculum and that the core courses in public health, biochemistry (health and wellness), and clinical nutrition for chiropractic practice remained fundamental to chiropractic education in Canada.[110–115] It is the author’s opinion that chiropractors receive ample professional training in the management of patients with overweight and obesity and are well placed to provide such services to patients.

1.8 Clinical Practice Guidelines for the Identification, Assessment, and Management of Overweight and Obesity

Numerous clinical practice guidelines on the identification, assessment, and management of overweight and obesity have been published. Many make recommendations based on systematic reviews of the best available evidence and include consensus statements by expert panels. Most guidelines base their recommendations on the 5A model (assess/ask, advise, agree, assist, arrange) of behavioural change,
adapted from tobacco cessation interventions in clinical care, to help patients modify their health
behaviour and promote physical activity.[116–118]

A review of these clinical practice guidelines is required to better understand what interventions should be
considered when analyzing the practice behaviours of Ontario chiropractors. For the purposes of this
thesis, a search of the literature was conducted June 2014 in OvidSP MEDLINE and EMBASE using
terms for obesity and terms for guidelines that yielded 233 results. Relevant guidelines were selected if
they were published in English and provided recommendations for primary healthcare practitioners to
identify, assess, and manage patients with overweight and obesity. A total of 15 guidelines were reviewed
and a comprehensive summary of the recommendation made by the clinical practice guidelines for the
management of patients with overweight and obesity is presented in Table 1.1. The guidelines
recommend a range of interventions including healthy eating plans, increased physical activity, and
behavioural modification to help patients manage their weight and promote health. These guideline
recommendations are within a chiropractor’s scope of practice and indicate that chiropractors should
intervene and provide weight management intervention to patients when needed.
Table 1.1: Summary of the primary healthcare practitioners clinical practice guideline recommendations for the identification, assessment, and management of persons with overweight and obesity

<table>
<thead>
<tr>
<th>Intervention Category</th>
<th>Recommendation</th>
</tr>
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| Role of health care team professionals in obesity counselling and management | 1. A comprehensive healthy lifestyle intervention for overweight and obese people where members of the health care team discuss weight management programs.[29, 31, 34]  
2. Primary care health professionals are encouraged to work with other health care team members as part of a multidisciplinary team to develop a comprehensive weight management program and to promote and maintain weight loss.[28, 29, 38, 71, 119, 120]  
3. Create a nonjudgmental atmosphere when discussing weight management and consider the barriers people might have concerning obesity and its management.[29, 31, 34, 38] |
| Lifestyle intervention | 1. The management and treatment of overweight and obesity should have a wider objective than weight loss and include risk reduction and health improvement. These may be achieved by modest weight loss (5-10% of initial body weight), improved nutritional content of the diet, and modest increases in physical activity and fitness.[28–39]  
2. Energy-reduced diet and regular physical activity as the first treatment option, especially for those with risk factors for type 2 diabetes and cardiovascular diseases, to achieve clinically important weight loss and reduce obesity-related symptoms.[29–31, 34]  
3. Provide education and support in behavior modification techniques as adjunct care for those willing to participate in weight management programs.[29, 31, 34, 35, 120]  
4. Prescribe on site, high intensity comprehensive weight loss interventions provided in individual or group sessions by a trained interventionist.[33, 35]  
5. Comprehensive lifestyle interventions (diet, physical activity, and behavior change) for all obese adults and family-oriented therapy in children.[29–31, 33–38] |
| Dietary intervention | 1. Optimal dietary plan for achieving health body weight be developed with a qualified and experienced health professional.[28, 29, 34, 38, 119, 120]  
2. Nutritionally balanced diet creating an energy deficit of ≥ 500 kcal per day (typically achieved with dietary intake of 1,200 kcal to 1,500 kcal per day) be combined with other supportive interventions.[29, 30, 34, 35, 37, 121]  
3. Establish a steady schedule of meals with minimal snacking in between.[28, 41]  
4. Greater adherence to the “Mediterranean” and/or vegetarian diets.[121]  
5. Restrict habitual intake of “fast food” to once a week.[121]  
6. Decrease the size of food portions.[28, 36, 121]  
7. Avoid all sweetened beverages.[41, 121]  
8. Appropriately control impact of alcohol calories on overall caloric intake.[30, 121]  
9. High-protein or a low-fat diet as a reasonable short-term (6-12 month) treatment option.[28–30, 34, 35, 37, 41]  
10. Establish a low calorie diet (between 800 kcal to 1,200 kcal per day) tailored to the individual’s food preferences, educate on nutritional labels to determine low calorie foods.[28, 39]  
11. Do not routinely use very low calorie diets (≤ 800 kcal per day) to manage obesity.[35, 38, 121]  
12. Meal replacements may be considered as a component of an energy-reduced diet for adults.[28, 29, 31, 121] |
| Physical activity | 1. All those considering initiating a vigorous exercise program are encouraged to consult their physician or health care team professionals.[29]  
2. Long-term, regular physical activity, which is associated with maintenance of body weight or a modest reduction in body weight for all who are overweight and obese.[28–30, 34]  
3. Physical activity and exercise is an integral part of weight-loss therapy and should be sustainable and tailored to the individual, with the total duration be increased gradually to maximize the weight-loss benefits.[29, 30, 39]  
4. Physical activity (30 minutes a day of moderate intensity, increasing, when appropriate, to 60 minutes a day) as part of the weight-loss program.[28–30, 34, 38, 39, 41]  
5. Endurance exercise training is recommended for postmenopausal women and for adults with an increased BMI.[29]  
6. Encourage children and adolescents to reduce sedentary pursuits and “screen time”.[28, 29, 38, 41]  
7. Physical activity prescribed for children should be fun and recreational pursuits tailored towards the strengths of the individual child and family.[29, 41] |
| Pharmacotherapy | 1. Pharmacotherapy is recommended as an adjunct to comprehensive lifestyle intervention to help achieve targeted weight loss and health goals for individuals with a BMI > 23 kg/m² with more than one obesity-associated comorbid condition or BMI > 25 kg/m².[30]  
2. Addition of a pharmacologic agent when appropriate (BMI ≥ 27 kg/m² with additional risk factors or BMI ≥ 30 kg/m²) for adults who a not attaining or who are unable to maintain clinically important weight loss with diet and exercise.[28, 29, 31, 33, 34, 36, 37, 39]  
3. Sibutramine (Meridia) be considered part of a program that includes diet, physical activity, and behavior therapy to aid in weight reduction.[39]  
4. Orlistat (Xenical) be considered to aid in weight reduction and weight maintenance when added to a regimen of lifestyle intervention among adolescents.[29–31, 37, 39]  
5. Due to a lack of data for prepubertal children, the use of pharmacologic agents in this group should be considered only within the context of a supervised clinical trial.[29, 38]  
6. Off-label use of drugs (such as phentermine) is not recommend for long-term use.[36] |
| Bariatric surgery | 1. Adults with clinically severe obesity (BMI $\geq 35$ kg/m² with severe comorbid disease or BMI $\geq 40$ kg/m²) may be considered for bariatric surgery when lifestyle intervention is inadequate to achieve healthy weight goals.[29–31, 33–39, 119]  
2. Surgery may be considered in patients with type 2 diabetes mellitus and a BMI of between 30-35 kg/m².[31, 119]  
3. Higher age (> 65 years) constitutes no contraindication in the presence of good general condition.[119]  
4. Bariatric surgery in adolescents be limited to exceptional cases and performed only by experienced teams.[29, 119] |
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<td>Alternative therapies</td>
<td>1. There is insufficient evidence to recommend in favor of or against the use of herbal remedies, dietary supplements or homeopathy for weight management in the obese person.[28, 29, 36]</td>
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1.9 The Role of Chiropractors in Managing Overweight and Obesity

Clinical practice guidelines are statements that include recommendations intended to optimize patient care that are typically informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options.[122] The clinical practice guidelines on the identification, assessment, and management of overweight and obesity are intended for use by health care professionals in everyday practice. Yet, data from the US Sample Adult Core component of the 2006 National Health Interview Survey (n = 24,275; 34.9% and 26.0% of survey respondents were overweight and obese respectively) indicated that only 30.5% of respondents who sought medical, chiropractic, and physiotherapy care reported receiving health promotion advice.[123] Of those who sought chiropractic care (n\textsubscript{DC} = 374) 11.5% received weight loss advice, 16.3% were advised to increase exercise, and 9.6% were given dietary advice.[123] Healthcare professionals reported a lack of time, resources, patient support, and knowledge limit their ability to manage patients with overweight and obesity.[124–132] However, considering the prevalence of those with overweight or obesity and the significant impact this has on health, more must be done by healthcare professionals to address this issue.

Chiropractors are trained to provide dietary, nutritional, lifestyle, and therapeutic exercise counselling to address specific patient complaints to enhance overall health.[133] As practitioners with a holistic approach to care, and experts in musculoskeletal health, chiropractors have the opportunity to play an important role in weight management. Evidence supports the use of weight management as a supportive treatment for musculoskeletal conditions.[134–144] Thus, chiropractors are in a valuable and opportunistic position to deliver weight management interventions to their patients. In addition, compliance by patients seeking chiropractic services may be greater when compared to the compliance observed by patients who receive weight management interventions from a medical doctor or other healthcare provider, since chiropractors may engage with their patients more frequently than medical doctors and other healthcare professionals.[145, 146]
1.10 Thesis Conceptual Framework

The decision to initiate or continue weight management interventions with a patient is a complex process that can be affected by multiple patient-level and chiropractor-level variables. This thesis will explore how often chiropractors provide weight management interventions to patients and will explore what factors play into this decision. The conceptual framework of this thesis is shown in Figure 1.1. It was hypothesized that, in accordance with clinical practice guideline recommendations, patient BMI would influence a chiropractor’s decision to initiate or continue weight management interventions with higher BMI increasing the likelihood of chiropractor-directed weight management. Additional patient-level variables that were anticipated to influence chiropractor-directed weight management were patient sex, smoking status, age, physical activity, diet, the presence of comorbidities (arthritis, diabetes, hypertension, and hyperlipidemia), and the duration of the chiropractor-patient encounter. Chiropractor-level variables that were anticipated to influence chiropractor-directed weight management were the chiropractors’ number of years since graduation and type of practice.

Figure 1.1: Conceptual Framework of Thesis
1.11 Patient Factors and Weight Management Intervention

Patients seek weight management infrequently from health professionals. A recent national survey of weight management experiences of Canadian adults with overweight and obesity found that only 15% of respondents asked their physician about weight loss in a 12 month period.[49] Slightly more women (17%) than men (13%) sought such interventions which is further supported by additional literature.[49, 147–149] There was a trend of patients requesting weight management with increased age, from 10% among those aged 18-24 years to 18% among those aged 55 years or more.[49] In addition, those with overweight and obesity requested weight loss management 24% and 56% more when compared to those who were of normal weight.[49, 147–150]

Smoking habits[148, 150], physical activity[149, 150], and fruit and vegetable consumption[149, 150] have been recognized among a plethora of potential patient lifestyle factors associated with healthcare professionals initiating or continuing weight management intervention. Chiropractors’ prevention services primarily focus on physical activity and exercise and may include correction of poor nutritional habits and smoking cessation.[150]

The greatest health risks for individuals with overweight and obesity are cardiovascular diseases and type 2 diabetes.[31] The association between BMI and cardiovascular risk factors (high blood pressure, high lipids, and type 2 diabetes) is well established and contributes to the increased health risks experienced by people with overweight or obesity.[151–153] Impaired mobility, due to arthritis or advanced age, can affect an individual’s capacity to adopt a healthy lifestyle and undertake physical activity. Yet, exercise combined with diet for weight loss are supported as the mainstays of rehabilitation for people with arthritis.[154] Therefore, when comorbidities are present, the need for weight management is heightened.
1.12 Chiropractor Factors and Weight Management Intervention

Several chiropractor-level variables have been associated with the initiation or continuation of weight management intervention including the chiropractic school of graduation[150], years since graduation[149, 150], and type of practice[148, 149]. The educational institution at which a chiropractor received training heavily influences their clinical practice.[95, 98, 99] This difference in training may impact the chiropractor’s attitude towards whether they consider weight management one of their professional duties as well as confidence in their own abilities to effectively offer weight management to patients. The years in which a chiropractor completed their training may impact a chiropractor’s decision to initiate or continue weight management interventions. Given the chiropractic public health educational reforms undertaken during the early 2000s it stands to reason that dissemination of the new model of public health curriculum[101–109] will affect newer graduates’ (between 2005-2015) decisions to initiate or continue weight management interventions. However, prior study has failed to observe this impact.[155] Ontario chiropractors differ in alignment with orthodox or unorthodox perspectives and this has a strong association with their treatment choices and type of practice.[98] Thus a chiropractor may choose to focus on sports injuries, motor vehicle accident rehabilitation, or general health and wellness. The type of care a chiropractor chooses to provide may affect whether they initiate or continue weight management with their patients.

1.13 Thesis Data - Ontario Chiropractic Observational and Analysis STudy (O-COAST)

This thesis used data from the Ontario Chiropractic Observational and Analysis STudy (O-COAST). O-COAST was a cross-sectional observational study of chiropractic practice in Ontario, Canada which aimed to investigate who seeks chiropractic care, for what reasons chiropractic care is sought, and what care is delivered. The study involved three inter-related data collections including relevant provider, patient, and care management information. The methods for O-COAST were based on the Bettering the
Evaluation and Care of Health (BEACH) study, and subsequently the Chiropractic Observational and Analysis STudy (COAST), both conducted in Australia.[156–158]

1.14 Thesis Objectives

1) determine the prevalence of overweight and obesity in the adult patient population that sought chiropractic care, 2) describe the frequency and distribution of chiropractor-directed weight management intervention, 3) identify associations between chiropractor-directed weight management interventions and specific patient-level and chiropractor-level variables, and 4) examine the interaction between patient weight and comorbid conditions and whether chiropractors offered weight management interventions.

1.15 Thesis Outline

This thesis is organized into four chapters. Chapter 1 is the introduction to weight management in the chiropractic profession. Chapter 2 is a manuscript presenting a scoping review of the utilization of chiropractic services, reasons for seeking care, patient profiles, and treatment provided. Chapter 3 is a manuscript presenting the findings of association between patient-level and chiropractor-level variables and whether chiropractors initiated or continued weight management intervention. Chapter 4 is the general discussion and conclusions.

1.16 References


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Chapter 2

Utilization of chiropractic services, reasons for seeking care, patient profiles, and treatment provided: A scoping review

2.1 Preface

The following chapter details the literature review conducted in conjunction with this thesis. The intent was to create a detailed overview of the chiropractic profession including utilization rates, reasons why patients seek chiropractic care, detailed demographic and health profiles of these patients, and what treatment was provided by chiropractors. By examining these critical components I intended to elucidate current chiropractic clinical practices to emphasize the extent of weight loss management interventions employed by chiropractors as reported in the literature. This literature review was the first within the chiropractic profession to examine all four factors simultaneous using a systematic and comprehensive approach. The findings of this review will update and inform the body of chiropractic literature and are presented within this thesis as a manuscript with the intention of publication. However, the search strategy presented within this manuscript was limited and not as inclusive as it could have been. A new search strategy was developed which yielded 12,289 citations and screening is underway. It is the authors’ intent to publish the completed manuscript within Chiropractic & Manual Therapies (CMT). The results of the original search are presented here and are formatted according to CMT specifications.

1 This chapter is formatted for submission to Chiropractic & Manual Therapies.

2 Preliminary findings of this chapter were presented at the Canadian Chiropractic Association’s National Convention and Tradeshow.
2.2 Abstract

**Background:** Each year, chiropractors provide care to millions of people worldwide. Previous research has investigated utilization rates, who sees chiropractors, for what reasons, and the type of care that chiropractors provide. However, to date these studies have not been synthesized comprehensively. The research question that guided this scoping review was: what is known about the utilization of chiropractic services, reasons for seeking care, patient profiles, and treatment provided?

**Methods:** A comprehensive approach to undertaking scoping reviews was used. Systematic searches were conducted in MEDLINE, CINAHL, and Index to Chiropractic Literature using keywords and subject headings (MeSH or ChiroSH terms) from database inception to August 2015. Eligible studies: 1) were published in English or French; 2) involved a cross-sectional, observational cohort, descriptive study design, or chart review; 3) targeted patients receiving chiropractic services; and 4) included the following outcomes: utilization rates of chiropractic services, reasons for attending chiropractic care, profiles of chiropractic patients, or types of chiropractic treatment or services provided. All citations were independently screened by paired review authors and eligible study outcomes were charted.

**Results:** The literature search retrieved 5213 articles; 46 studies (reported in 48 articles) were included. Median utilization of chiropractic services was 12.0% in the United States, Australia, Canada, and Norway. The utilization rate of chiropractic services remained constant over time. Most patients consulting chiropractors had a median age of 42.2 years and were female (55.5%). Many patients who sought chiropractic care were overweight (34.1%) and obese (23.5%). The most common reported reasons for people attending chiropractic care were (median): low back pain (48.5%), neck pain (22.5%), extremity problems (17.0%), nerve pain (8.7%), headache (6.2%), and wellness/maintenance care (6.0%). While none of the included studies specifically reported chiropractors giving weight loss interventions, it
is possible that patients who sought wellness care did so for weight loss interventions. The most common treatments provided by chiropractors included spinal manipulation (83.7%), nutritional supplements (52.0%), formal patient education (38.1%), heat (33.0%), soft-tissue therapy (28.1%), cold/ice (26.0%), electrical stimulation (25.0%), advice on medication (23.4%), mechanically assisted adjustments (22.6%), and exercise instruction or prescription (20.0%).

**Conclusions:** Findings of this scoping review support the diverse nature of chiropractic practice, although common trends emerged. Results may inform future research priorities in the chiropractic profession by addressing the most common presenting symptoms, plan workforce, establish professional norms, and guide quality improvement initiatives.
2.3 Introduction

The chiropractic profession provides care to millions of people around the world every year. Chiropractors practice in over 100 countries, in which 90 have established national chiropractic associations [1]. Chiropractic has become one of the most commonly used complementary therapies in the United States and Europe [2, 3]. Chiropractors provide a substantial portion of care for patients with many health conditions including low back and neck pain [4, 5]. In the United States, chiropractors provided 18.6 million clinical services under Medicare [6] and overall spending for chiropractic care was estimated at USD $12.5 billion in 2015 [7]. Moreover, chiropractors are a major stakeholder in the health care expenditures of many countries [8–10].

A number of studies have described the profile of chiropractic services and patients around the world [11–13]; however, few literature syntheses have summarized their results. Previous systematic reviews have only reported partial descriptions of chiropractic services and patients, utilization rates [14, 15] or reasons for attending chiropractic care [16]. Stakeholders of the profession could use a current synthesis of research that comprehensively describes the profile of chiropractic practice and services provided to help inform priorities in education, research and workforce development. These priorities can aim to address the most common presenting complaints, plan workforce, establish professional norms, and guide quality improvement and guideline initiatives.

The objectives of this scoping review were to document the current state of knowledge on: 1) the utilization of chiropractic services, 2) reasons for attending chiropractic care, 3) demographic and health profiles of chiropractic patients, and 4) types of chiropractic treatment provided and to what extent this treatment included weight management interventions.
2.4 Methods

We used scoping review methodology to collect and organize relevant information to address our broad research question and provide a comprehensive examination of the existing body of literature [17]. We employed rigorous methods based on the recommended framework for scoping reviews by Arksey and O’Malley and Levac et al. [18, 19].

2.4.1 STEP 1: Identifying the Research Question

Our scoping review was guided by the following broad research question: What is known about the utilization of chiropractic services, reasons for seeking care, patient profiles, and treatment provided specifically if weight management interventions were provided?

2.4.2 STEP 2: Identifying Relevant Studies

Searches were conducted in MEDLINE, CINAHL, and the Index of Chiropractic Literature from database inception to August 2015 using a combination of keywords, subject headings (MeSH or ChiroSH terms) relevant to chiropractic care, utilization and health services. The search strategy was first developed in MEDLINE and subsequently adapted to the other databases (Appendix 2.1). In addition, the reference lists of the included studies were searched and personal sources of the authors were searched to identify any other appropriate studies from the literature. A Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) [20] flow chart was used to track the number of studies at each stage of the review.
2.4.3 STEP 3: Study Selection

Inclusion and Exclusion Criteria

We included studies: 1) published in English or French; 2) involved one of the following study designs: cross-sectional, observational cohorts, descriptive studies, or chart reviews; 3) targeted patients receiving chiropractic services; and 4) included at least one of the following outcomes: utilization rates of chiropractic services, reasons for attending chiropractic care, profiles of chiropractic patients, and types of chiropractic treatment interventions or services provided. Studies were excluded if the methods were not reported, if they were cadaveric or animal studies, or if they solely assessed clinical outcomes related to chiropractic care or profiles of chiropractors.

Screening and Agreement

Two trained review authors (PB and NB) independently screened the search results in two phases. All studies were screened using titles and abstracts during the first phase. Review authors then discussed their screening to reach consensus and a third review author (JW) was available to resolve discrepancies, if needed. In the second phase of screening, the same two review authors independently screened the full text of possibly relevant articles identified during phase one screening to determine eligibility. They then discussed their assessments to reach consensus and involved a third reviewer when needed to resolve discrepancies.

2.4.4 STEP 4: Data Charting

Data charting recorded the following information from each included study (when available): 1) description of the study (study design, number chiropractors and patients, chiropractic practice and setting, country); 2) description of the patient population, e.g. demographic information (age, sex,
occupation, income); 3) reasons for attending chiropractic services (e.g. clinical condition, symptom duration); 4) utilization rate of chiropractic services; 5) diagnosis or assessment procedures used by chiropractors; and 6) chiropractic treatment provided. The data were extracted by one review author and second checked by another review author to ensure relevance and minimize error.

2.4.5 STEP 5: Collating, Summarizing, and Reporting the Results

Analyzing the Data

A qualitative description of the charted data was summarized as follows:

*Descriptive numerical analysis:* The nature and distribution of the studies were analyzed with regards to the total number of studies, year of publication, study design, country where studies were conducted, study population, and area of chiropractic practice.

*Summary of included study findings:* We analysed the studies by categorising them into four primary themes: utilization rates, reasons for attending chiropractic care, profiles of chiropractic patients, and types of chiropractic treatment provided.

*Implication of the results:* Findings of the included studies were discussed according to the four primary themes to ensure that the results would have practical implications for future clinical chiropractic practice, research, and policy.
A quantitative description of the charted data was conducted. Data was pooled for each of the four primary themes to generate a range of rates. Reported rates from similar populations were grouped together within their respective primary theme. SAS 9.4 (SAS Inc., Cary, NC) was used for all analyses. The median value in this range was reported. Interquartile range (IQR) was calculated for the appropriate statistics presented to provide a measure of where the bulk of the reported values were within the reported range.

2.5 Results

2.5.1 Descriptive numerical analysis

The search conducted on August 10\textsuperscript{th}, 2015 yielded 5208 studies. An additional 5 studies were included from other sources; specifically from the personal sources of the authors. In total, 4484 titles and abstracts were screened after removal of duplicates. Phase I screening resulted in the exclusion of 4316 studies that did not meet our inclusion criteria. We excluded 120 studies following phase II full article screening. A total of 48 articles met the inclusion criteria and were included in this review [21–68] (Figure 2.1). In two separate instances, two different articles reported results from the same data source [26, 27, 55, 56]; thus the results of these two pairs of articles were combined. Table 2.1 summarizes the key aspects of each included study into primary themes.

We observed an increasing trend in the number of studies published over time, with 30 of the 46 studies (65%) published between 2005 and 2015 (Figure 2.2). The majority of studies (31 of 46) were cross-sectional, seven were retrospective cohort studies, seven were prospective cohort studies, and one was a chart review. Study country of origin included: United States (n=23), Australia (n=8), Canada (n=6), Denmark (n=4), United Kingdom (n=3), Italy (n=1), and Norway (n=1). Practice setting included: private
practice (n=24), not provided or not applicable (n=11), chiropractic teaching clinics (n=9), veterans’ affairs clinics (n=1), and a clinical research network (n=1).

2.5.2 Review findings

2.5.2.1 The utilization rates of chiropractic services

The utilization rate of chiropractic services was reported by one third (16/46) of studies (Table 2.2). Utilization rate was defined as the number of people who sought chiropractic care annually. Chiropractic utilization rates varied between studies. Eleven studies reported chiropractic utilization rates using national surveys of the general population, United States (n=5), Australia (n=3), Canada (n=2), and Norway (n=1), with a median utilization rate of 12.0% (IQR: 10.6% – 13.9%) [28, 34, 35, 40, 42, 49, 58, 66–68]. The utilization rates of chiropractic services does not seem to have changed between 1997 and 2015. However, a single study by Engel et al. included in this review reported a steady increase in the utilization of chiropractic services in Australia between 1998 and 2012 [32]. Higher utilization rates (median 15.1%) were reported by three studies that assessed the Midwestern United States and Midwestern Canada [25, 36, 49]. A national survey conducted in the United States reported that chiropractic utilization was 37% among complementary and alternative medicine (CAM) users [24]. For studies reporting only on those people with neck and back complaints, the reported median chiropractic utilization rate was 37.3% [43, 51, 67].
2.5.2.2 Profiles of chiropractic patients

Thirty-eight of the 46 included studies reported patient demographic information (Table 2.3). The majority of chiropractic patients were female (55.5%, IQR: 51.0% - 58.2%), had a median age of 42.2 years (IQR: 37.6 – 45.3, calculated as a median of reported means), 34.1% (IQR: 32.2 – 37.7) with overweight, 23.5% (IQR: 18.9 – 26.5) with obesity, and more than 80% were employed (full-time employment 56.0%, IQR: 48.2 - 60.4%; self-employed 14.5%, IQR: 13.7% - 15.0%; and part-time employment 11.3%, IQR: 9.7% - 14.5%) [21–25, 27–31, 33–41, 44–47, 50, 52–54, 56, 57, 59, 61–68].

2.5.2.3 Reasons for attending chiropractic care

Reasons for attending chiropractic care were reported in approximately two thirds (30/46) of included studies. Results of the five most frequently reported reasons for attending chiropractic care are shown in Table 2.4. Neuromusculoskeletal complaints were the predominant reason for attending chiropractic care. Of all the reported reasons to seek chiropractic care 48.5% (IQR: 41.0% - 58.1%) were due to low back/back complaints, 22.5% (IQR: 16.5% - 26.0%) were due to neck complaints, 17.0% (IQR: 10.0% - 20.0%) were due to extremity complaints, 8.7% (IQR: 1.5% - 16.0%) were due to nerve pain, and 6.2% (IQR: 4.6% - 9.3%) were due to headache. Seven studies reported a median of 4.6% (IQR: 1.3% – 6.6%) of chiropractic patients who attended chiropractic care for non-musculoskeletal complaints. [21, 27, 36, 37, 41, 45, 61].

2.5.2.4 Reasons for attending chiropractic care: weight management interventions

None of the 46 studies included in this review reported that patients sought chiropractic care specifically for weight loss interventions. However, 6.0% (3.0 – 10.1) of all people who sought chiropractic care did
so for wellness/maintenance care and it may be assumed that some of these people received weight loss interventions.

2.5.2.5 Reasons for attending chiropractic care: pediatric and adolescent population

Only two studies (Hestbaek et al. [39] and Marchand [48]) addressed the paediatric and adolescent population (patients age 0 to 18 years old) and reported many reasons for attending chiropractic care. These studies reported a median of 46.5% (IQR: 36.0% – 57.0%) of paediatric patients attending chiropractic care for musculoskeletal complaints [39, 48]. The remaining reasons for attending chiropractic care are summarized in Table 2.5.

2.5.2.6 Reasons for attending chiropractic care: type of injury

A study by Nyiendo and Haldeman reported the type of injury related reasons for attending chiropractic care [52]. The article reported the percentage of patients and reason for attending care as 47% missing/unknown, 18% due to other types of injury, 13% due to work related injury, 13% other, 5% auto accidents, and 3% illness [52].

2.5.2.7 Types of diagnostic assessment procedures used by chiropractors

Eight studies reported the different diagnostic assessment procedures used by chiropractors [35, 38, 50, 52, 54, 56, 60, 64], shown in Table 2.6. Static palpation was the most commonly used assessment procedure, reportedly used by 19 of every 20 chiropractors. Other commonly used assessment procedures included orthopedic tests, spinal examination, motion palpation, physical examination, and neurological examination.
2.5.2.8 Types of diagnostic assessment procedures used by chiropractors: X-ray utilization

Seven studies reported the utilization rate of x-rays by chiropractors [35, 50, 52, 54, 56, 60, 64], shown in Table 2.6. The median rate of x-ray use reported by all seven studies was 26.8% (IQR: 6.0% – 34.2%).

2.5.2.9 Types of chiropractic treatment provided

Fourteen studies reported the types of chiropractic treatment provided or chiropractic system used, where a chiropractic system was defined as a specific style of practice or treatment philosophy used by the chiropractor [27, 33, 35, 37, 38, 44–46, 50, 52, 54, 56, 63, 65] (Table 2.7). Spinal manipulation was the most common treatment provided, with more than four out of five patients visiting a chiropractor receiving this treatment. Other common treatments provided by chiropractors included prescription of nutritional supplements, patient education, the use of heat, and soft-tissue therapy. The Diversified chiropractic system was most commonly used with a median rate of use found to be 65.5% (IQR: 58.0% - 85.0%). Other prominent chiropractic systems used by chiropractors included Nimmo-Tonus (median 40.0%, IQR: 37.0% - 43.0%) and Activator (median 23.0%, IQR 17.0% - 35.0%).

2.6 Discussion

This scoping review of the chiropractic literature identified 46 studies from 48 articles related to the utilization of chiropractic services, reasons for attending chiropractic care, demographic and health profiles of chiropractic patients, and types of chiropractic treatment provided. The majority of these studies were published in the last decade (between 2005 and 2015), used a cross-sectional design,
originated in the United States, Australia, and Canada, with either current chiropractic patients or based on surveys of the general population.

National surveys conducted in the United States, Australia, Canada, and Norway reported that the median utilization rate of chiropractic services was 12.0%. Two previous systematic reviews by Lawrence and Meeker (2007) and Cooper et al. (2013) reported chiropractic utilization rates ranging between 6% and 12% [14, 15]. Chiropractic utilization rates were shown to vary at regional levels with a median rate of 15.1% reported in the Midwestern United States and in Midwestern Canada. Patients with neck and back complaints reported higher chiropractic utilization (median rate of 37.3%), when compared to that of the general population. This is consistent with findings from previous systematic reviews that assessed chiropractic utilization of those with neck and back pain [70, 71].

The literature reports many different reasons why patients seek chiropractic care. Yet common trends emerged within this review. Our review findings have shown that musculoskeletal complaints, specifically those of the back and neck, are the main reasons for patients of all ages to consult chiropractors. Hestbaek and Stochkendahl (2010) conducted a systematic review of the literature pertaining to the reasons why patients aged between 2-18 years attended chiropractic care. The authors concluded that musculoskeletal complaints, specifically spinal pain, were the main reasons for pediatric patients attending a chiropractor [16].

Our review found that chiropractors offer many different types of treatment to their patients, but spinal manipulation was the most common treatment provided. The National Center for Health Statistics found that manipulation was the most commonly used provider-based complementary and alternative therapy among adults and children [72]. Our findings suggest that chiropractors offer many additional treatments
or services including nutritional supplements, formal patient education, heat, soft-tissue therapy, cold/ice, electrical stimulation, medication advice, mechanically assisted adjustment, exercise instruction, as well as mobilization and manual traction. However, none of the included studies reported chiropractors providing treatment specifically for the management of overweight and obesity. Chiropractic care is diverse and should not be considered consisting of spinal manipulation exclusively.

Stakeholders of the chiropractic profession need to be cognisant of the current state of knowledge to help inform their decision-making processes. This review presents a comprehensive overview on the state of the chiropractic profession and has documented trends in the literature. Our review findings can be used by a wide range of chiropractic stakeholders, including the chiropractic profession and its organisations, chiropractic educational institutions, government, researchers, and industry. These results may facilitate the ability to set priorities in the chiropractic profession such that they address the most common presenting symptoms and guide future research initiatives.

2.6.1 Strengths and Limitations

A strength of our study was the process used to collect and summarize the available evidence from a large and diverse body of literature. The most appropriate method to collect and organize such diverse information and develop a picture of the existing evidence base was to conduct a scoping review [17]. A rigorous scoping review methodology can be used to bring theory to practice, and to reduce bias when informing stakeholders [73, 74]. Our scoping review was designed to include a greater range of study designs and methodologies than a systematic review [18]. We employed rigorous methods based on the recommended framework for scoping reviews by Arksey and O’Malley and Levac et al. [18, 19]. Moreover, we conducted systematic searches of the literature using multiple databases, a combination of key words and subject headings, and without restrictions on date. Study selection was based on a set of
clear inclusion and exclusion criteria to ensure that consensus between review authors was transparent and reproducible. Finally, we ensured that the charted data from each relevant study was accurate through a second check of the data.

Our review does have limitations. While a robust methodology was used, scoping reviews are a relatively new approach for which there is not yet a universal study definition or established methods [75]. However, the framework for scoping reviews published by Arksey and O’Malley in 2005 and expanded by Levac et al. in 2010 is being increasingly used across a broad range of disciplines and fields of study [76]. Despite conducting systematic searches of multiple databases to identify any other appropriate studies from the literature, our review may have missed relevant studies. Studies were excluded if not published in English or French, which may have resulted in missing relevant studies. However, we assumed that the large majority of chiropractic researchers graduated from accredited colleges of English or French language, thereby reducing this risk. Finally, the lack of critical appraisal of the methodology of the included studies may limit this review’s ability to report accurate results due to the inclusion of lower quality research. However, several authors of scoping reviews have argued that by not addressing the issue of quality appraisal, scoping reviews are able to deal with a greater range of study designs and methodologies [77, 78]. The emphasis of a scoping review is on comprehensive coverage rather than on a particular standard of evidence [77, 78].

2.6.2 Enhancing and Expanding this Review

We recently determined that the search strategy used to conduct this scoping review failed to identify a number of potentially relevant studies. Hence an expanded search strategy was developed with the aid of two librarians located at the Canadian Memorial Chiropractic College and McGill University to ensure that this scoping review captured all relevant articles and represented a complete review of the literature.
New searches were conducted in MEDLINE, CINAHL, and the Index of Chiropractic Literature from database inception to March 2016 using a combination of keywords, subject headings (MeSH or ChiroSH terms) relevant to chiropractic care, utilization, and health services. These new searches yielded 12,289 citations. I have been leading a team of six review authors who have completed Phase I screening and Phase II screening is underway. It is anticipated that this revised search strategy will enhance the manuscript presented by identifying studies missed by the original search strategy. The addition of newly identified relevant articles will aid in the completeness of this scoping review and will be completed before journal submission.

2.7 Conclusion

We employed rigorous methods based on the recommended framework for scoping reviews to document the current state of knowledge on the utilization of chiropractic services, demographic and health profiles of people receiving chiropractic care, and the treatments provided by chiropractors. Our findings reaffirm that the profile of chiropractic services and patients is diverse, yet common trends emerged from the body of literature. Across different countries, the average utilization rate of chiropractic services was 12.0% and was shown to have remained constant between 1997 and 2015. Neuromusculoskeletal complaints, such as back and neck pain were the predominant reason for people to attend chiropractic care. Typically, chiropractic patients were female, aged 42.2 years, and employed. Over 80% of patients who consulted a chiropractor received spinal manipulation; however, chiropractors also commonly provided nutritional supplements, formal patient education, heat, and soft-tissue therapy. Weight management interventions offered by chiropractors was not reported in the literature. Weight management was not reported as a reason people sought chiropractic care. These results will aid in setting future priorities in the chiropractic profession such that they address the most common presenting symptoms, plan workforce, establish professional norms, and guide quality improvement initiatives.
2.8 Competing Interests

The authors declare no competing interests.

2.9 Acknowledgements

The authors acknowledge the contributions of Kent Murnaghan at the Canadian Memorial Chiropractic College for his assistance with the search strategy. SF and AB are supported by Canadian Chiropractic Research Foundation Professorships. NB was supported by a Canadian Institutes of Health Research Health Professional Student Research Award while undertaking this study.

2.10 References


Records identified through database searching (n = 5,208)

Additional records identified through other sources (n = 5)

Records after duplicates removed (n = 4,484)

Phase One
Records screened by title and abstract (n = 4,484)

Records excluded (n = 4,316)

Phase Two
Full-text articles assessed for eligibility (n = 168)

Full-text articles excluded, with reasons (n = 120)
- Ineligible study objectives = 37
- Results not stratified for chiropractic patients = 51
- Methods not reported = 3
- Patient data not reported = 8
- Ineligible study design = 5
- Ineligible language = 2
- Chiropractic services not reported = 4
- Ineligible population = 3
- Ineligible publication type = 7

Studies included in qualitative synthesis (n = 46 unique studies reported in 48 articles)
Figure 2.2: Studies by year of publication showing trend of number of publications (n=46)
Table 2.1: Characteristics of included studies and which of the four primary areas each study addressed

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Study design, number of chiropractors and number of patients</th>
<th>Practice setting, country</th>
<th>Patient population</th>
<th>Chiropractic utilization rate</th>
<th>Patient reason for encounter</th>
<th>Patient demographic information</th>
<th>Chiropractic treatment provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown et al., 2014, [21]</td>
<td>Cross-sectional survey; 486 patients</td>
<td>Private practice; Australia</td>
<td>Adult patients</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Cambron et al., 2007, [22]</td>
<td>Cross-sectional survey; 163 patients</td>
<td>Chiropractic teaching clinics; United States</td>
<td>Adult patients</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Cherkin et al., 2002, [23]</td>
<td>Cross-sectional survey; 1,349 Massachusetts patients, 1,201 Arizona patients</td>
<td>Private practice; United States</td>
<td>Current chiropractic patients</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Conboy et al., 2005, [24]</td>
<td>Cross-sectional survey; 2,055 patients</td>
<td>United States</td>
<td>Ever used chiropractic services</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Côté et al., 2001, [25]</td>
<td>Cross-sectional survey; 907 participants</td>
<td>Canada</td>
<td>Patients with neck pain, low back pain, or both in the previous six–months</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Coulter et al., 2002, [26] And *Coulter and Shekelle, 2005, [27]</td>
<td>Cross-sectional survey; 131 chiropractors; 1,275 patients</td>
<td>Private practice; United States and Canada</td>
<td>Current chiropractic patients</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Davis et al., 2010, [28]</td>
<td>Retrospective cohort; 1,082 patients</td>
<td>United States</td>
<td>Adult patients</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Setting</td>
<td>Population Description</td>
<td>US Veterans Affairs</td>
<td>Australia</td>
<td>United States</td>
<td>Denmark</td>
</tr>
<tr>
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</tr>
<tr>
<td>Dunn et al., 2006, [29]</td>
<td>Cross-sectional survey; 100 patients</td>
<td>Veterans affairs clinic; United States</td>
<td>United States veterans</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Ebrall et al., 1993, [30]</td>
<td>Cross-sectional survey; 25 chiropractors; 2,500 patients</td>
<td>Private practice; Australia</td>
<td>Current chiropractic patients</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Eirikstoft and Kongsted, 2014, [31]</td>
<td>Prospective cohort; 36 chiropractors; 951 patients</td>
<td>Clinical research network; Denmark</td>
<td>Patients with low back pain</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Engel et al., 2014, [32]</td>
<td>Retrospective cohort; 4,221 patients</td>
<td>Private practice; Australia</td>
<td>Patients with private health insurance</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>French et al., 2012, [33]</td>
<td>Cross-sectional survey; 52 chiropractors; 4,464 patients</td>
<td>Private practice; Australia</td>
<td>Current chiropractic patients</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>French et al., 2013, [34]</td>
<td>Cross-sectional survey; 7,519 patients</td>
<td>Private medical practice; Australia</td>
<td>Medical practice patients who reported chiropractic use in the last 12 months</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gaumer et al., 2006, [35]</td>
<td>Cross-sectional survey; 800 participants</td>
<td>United States</td>
<td>Ever used chiropractic services</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hawk and Long, 1999, [36]</td>
<td>Cross-sectional survey; 1,511 patients</td>
<td>Private practice; United States</td>
<td>Patients who reported chiropractic use for a physical problem in the last 12 months</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Hawk et al., 2000, [37]</td>
<td>Prospective cohort; 87 chiropractors; 805 patients</td>
<td>Private practice; United States and Canada</td>
<td>New patients aged 55 years and older</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Study</td>
<td>Methodology</td>
<td>Setting</td>
<td>Population Description</td>
<td>Presentations</td>
<td>Undergraduate</td>
<td>USA</td>
<td>Canada</td>
</tr>
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<tr>
<td>Hayden et al., 2003, [38]</td>
<td>Prospective cohort; 15 chiropractors; 54 patients</td>
<td>Private practice; Canada</td>
<td>Pediatric patients (aged 4 to 18 years) with low back pain</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hestbaek et al., 2009, [39]</td>
<td>Cross-sectional survey; 725 patients</td>
<td>Private practice; Denmark</td>
<td>Pediatric patients (aged 0 to 17 years)</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hurwitz and Chiang, 2006, [40]</td>
<td>Cross-sectional survey; 8,688 participants</td>
<td>United States and Canada</td>
<td>Adult patients</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kaeser et al., 2014, [41]</td>
<td>Cross-sectional survey; 224 patients</td>
<td>Chiropractic teaching clinics; United States</td>
<td>New patients</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kinge et al., 2015, [42]</td>
<td>Cross-sectional survey; 5,828 patients</td>
<td>Norway</td>
<td>Patients with chronic musculoskeletal disorders</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kozma et al., 2014, [43]</td>
<td>Retrospective cohort; 85,014 patients</td>
<td>United States</td>
<td>Patients with private insurance with a neck/back diagnosis or osteoarthritis</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Leboeuf-Yde et al., 2004, [44]</td>
<td>Prospective cohort; 115 chiropractors; 875 patients</td>
<td>Private practice; Norway</td>
<td>Patients with persistent low back pain</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Leboeuf-Yde et al., 2005, [45]</td>
<td>Cross-sectional survey; 385 chiropractors; 5,607 patients</td>
<td>Private practice; Canada, United States, Mexico, Hong-Kong, Japan, Australia, and South Africa</td>
<td>Current chiropractic patients</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lishchyna and Mior, 2012, [46]</td>
<td>Retrospective cohort; 580 patients</td>
<td>Chiropractic teaching clinic; Canada</td>
<td>New patients</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Study Authors</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Participants Description</td>
<td>Ever Used Chiropractic Services</td>
<td>Current Chiropractic Patients</td>
<td>New Patients</td>
<td>Pediatric Patients</td>
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<tr>
<td>MacPherson et al., 2015, [47]</td>
<td>Cross-sectional survey; 70 chiropractors; 544 patients</td>
<td>Private practice; United Kingdom</td>
<td>Ever used chiropractic services</td>
<td>×</td>
<td>×</td>
<td>✔</td>
<td>×</td>
</tr>
<tr>
<td>Marchand, 2012, [48]</td>
<td>Cross-sectional survey; 956 chiropractors; 19,821 patients</td>
<td>Private practice; 20 European countries</td>
<td>Pediatric patients (aged 0 to 18 years)</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Millar, 1997, [49]</td>
<td>Cross-sectional survey; 17,626 respondents</td>
<td>Canada</td>
<td>Ever used chiropractic services</td>
<td>✔</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Mootz et al., 2005, [50]</td>
<td>Cross-sectional survey; 205 chiropractors; 2,550 patients</td>
<td>Private practice; United States</td>
<td>Current chiropractic patients</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Murthy et al., 2014, [51]</td>
<td>Cross-sectional survey; 1,310 patients</td>
<td>Australia</td>
<td>Women aged 60 to 65 years with back pain</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Nyiendo and Haldeman, 1987, [52]</td>
<td>Cross-sectional survey; 2,000 patients</td>
<td>Chiropractic teaching clinic; United States</td>
<td>New patients</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Nyiendo et al., 1989, [53]</td>
<td>Cross-sectional survey; 1,865 patients</td>
<td>Chiropractic teaching clinics; United States</td>
<td>New patients</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Nyiendo et al., 2001, [54]</td>
<td>Prospective cohort; 60 chiropractors; 526 patients</td>
<td>Private practice; United States</td>
<td>Patients with low back pain</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Pedersen and Breen, 1994, [55]</td>
<td>Cross-sectional survey; 905 chiropractors; 1,014 patients</td>
<td>Private practice; Belgium, Denmark, Finland, France, Great Britain, Greece, Iceland, Ireland, Italy, Netherlands, Norway,</td>
<td>New patients</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Study</td>
<td>Design/Setting</td>
<td>Patients</td>
<td>Low Back Pain</td>
<td>New Patients</td>
<td>Adults Patients</td>
<td>Current Chiropractic Patients</td>
<td>Adults Patients</td>
</tr>
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</tr>
<tr>
<td>Phillips et al., 1992, [57]</td>
<td>Cross-sectional survey; 2,257 patients</td>
<td>Sweden, Switzerland</td>
<td>Chiropractic teaching clinics and private practice; United States</td>
<td>Patients with low back pain</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reinhard et al., 2014, [58]</td>
<td>Cross-sectional survey; 20,563 patients</td>
<td>United States</td>
<td>United States</td>
<td>United States veterans</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sharma et al., 2003, [59]</td>
<td>Prospective cohort; 1,414 patients</td>
<td>Private practice; United states</td>
<td>Patients with low back pain</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sorensen et al., 2006, [60]</td>
<td>Cross-sectional survey; 1,595 patients</td>
<td>Private practice; Denmark</td>
<td>New patients</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Stevans and Zodet, 2012, [61]</td>
<td>Retrospective cohort; 1,260 patients</td>
<td>Private practice; United States</td>
<td>Adults patients</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Stevens, 2007, [63]</td>
<td>Cross-sectional survey; 240 patients</td>
<td>Chiropractic teaching clinics; United States</td>
<td>New patients</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Stevens, 2007, [62]</td>
<td>Chart review; 256 patients</td>
<td>Chiropractic teaching clinic; United States</td>
<td>Adult patients</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Waalen et al., 1994, [64]</td>
<td>Prospective cohort; 15,174 patients</td>
<td>Chiropractic teaching clinics; Canada</td>
<td>New patients</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Waalen and Mior, 2005, [65]</td>
<td>Retrospective cohort; 692 chiropractors; 453,909 patients</td>
<td>Private practice; Canada</td>
<td>Current chiropractic patients</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Walker et al., 2004, [66]</td>
<td>Cross-sectional survey; 1,913 patients</td>
<td>Private practice; Australia</td>
<td>Patients with low back pain</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Study Reference</td>
<td>Design</td>
<td>Location</td>
<td>Population Details</td>
<td>Outcome</td>
<td>#1</td>
<td>#2</td>
<td>#3</td>
</tr>
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</tr>
<tr>
<td>Weigel et al., 2014, [67]</td>
<td>Retrospective cohort; 12,170 patients</td>
<td>United States</td>
<td>Community dwelling Medicare beneficiaries greater than 65 years of age</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Xue et al., 2008, [68]</td>
<td>Cross-sectional survey; 1,067 patients</td>
<td>Private practice; Australia</td>
<td>Adult patients</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>

*Citation used when the combined results are identified throughout this review.*
### Table 2.2: Chiropractic utilization rate by population

<table>
<thead>
<tr>
<th>Study population</th>
<th>Chiropractic utilization rate (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>National: United States, Australia, Canada, and Norway</td>
<td>12.0% (10.6 – 13.9)</td>
<td>[28, 34, 35, 40, 42, 49, 58, 66–68]</td>
</tr>
<tr>
<td>Regional: Midwestern United States and Midwestern Canada</td>
<td>15.1% (12.1 – 17.0)</td>
<td>[25, 36, 49]</td>
</tr>
<tr>
<td>CAM users in the United States</td>
<td>37.0%</td>
<td>[24]</td>
</tr>
<tr>
<td>Patients with neck/back diagnoses</td>
<td>37.3% (34.5 – 58.8)</td>
<td>[43, 51, 67]</td>
</tr>
</tbody>
</table>

IQR = inter quartile range; CAM = complementary and alternative medicine.
**Table 2.3: Chiropractic patient sex, age, adiposity, and employment**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Patient population</th>
<th>Percent female (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td></td>
<td>55.5% (51.0 – 58.2)</td>
<td>[40, 50, 27, 33, 35, 28, 68, 56, 23, 61, 36, 45, 24, 30, 47, 21, 65, 34, 37, 67, 52, 62, 22, 53, 63, 57, 41, 46, 64, 44, 66, 59, 25, 54, 31, 39, 38, 29]</td>
</tr>
<tr>
<td>General population</td>
<td></td>
<td>57.6% (53.9 – 61.0)</td>
<td>[40, 50, 27, 33, 35, 28, 68, 56, 23, 61, 36, 45, 24, 30, 47, 21, 65, 34, 37, 67]</td>
</tr>
<tr>
<td>Teaching clinic population</td>
<td></td>
<td>53.0% (49.3 – 58.0)</td>
<td>[52, 62, 22, 53, 63, 57, 41, 46, 64]</td>
</tr>
<tr>
<td>Low back pain population</td>
<td></td>
<td>52.0% (47.0 – 55.5)</td>
<td>[57, 44, 66, 59, 25, 54, 31]</td>
</tr>
<tr>
<td>Pediatric patient (&lt;18 years) population</td>
<td></td>
<td>44.5% (43.0 - 46.0)</td>
<td>[39, 38]</td>
</tr>
<tr>
<td>United States veterans population</td>
<td></td>
<td>12.0%</td>
<td>[29]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Patient population</th>
<th>Age in years (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td></td>
<td>42.2 (37.6 – 45.3)</td>
<td>[40, 50, 27, 33, 35, 28, 68, 56, 23, 61, 36, 45, 24, 30, 47, 21, 65, 34, 37, 67, 52, 62, 22, 53, 63, 57, 41, 46, 64, 44, 66, 59, 25, 54, 31]</td>
</tr>
<tr>
<td>General chiropractic population</td>
<td></td>
<td>44.9 (42.0 – 46.9)</td>
<td>[40, 50, 27, 33, 35, 28, 68, 56, 23, 61, 36, 45, 24, 30, 47, 21, 65, 34]</td>
</tr>
<tr>
<td>Teaching clinic population</td>
<td></td>
<td>36.9 (34.0 – 41.2)</td>
<td>[52, 62, 22, 53, 63, 57, 41, 46, 64]</td>
</tr>
<tr>
<td>Low back pain population</td>
<td></td>
<td>42.1 (40.7 – 43.0)</td>
<td>[57, 44, 66, 59, 25, 54, 31]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adiposity</th>
<th>Patient population</th>
<th>Overweight (median, IQR)</th>
<th>Obese (median, IQR)</th>
<th>Reporting Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td></td>
<td>34.1% (32.2 – 37.7)</td>
<td>23.5% (18.9 – 26.5)</td>
<td>[67, 41, 79]</td>
</tr>
<tr>
<td>General population</td>
<td></td>
<td>35.3% (32.9 – 40.0)</td>
<td>22.9% (14.8 – 24.0)</td>
<td>[67, 79]</td>
</tr>
<tr>
<td>Teaching clinic population</td>
<td></td>
<td>31.4%</td>
<td>29.0%</td>
<td>[41]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Employment (general population)</th>
<th>Employment type</th>
<th>Percent (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time employment</td>
<td>56.0% (48.2 – 60.4)</td>
<td>[56, 45, 24, 57, 66, 59, 25, 54]</td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>14.5% (13.7 – 15.0)</td>
<td>[56, 45, 59, 54]</td>
<td></td>
</tr>
<tr>
<td>Part-time employment</td>
<td>11.3% (9.7 – 14.5)</td>
<td>[56, 45, 24, 57, 66, 59, 25, 54]</td>
<td></td>
</tr>
<tr>
<td>Home duties</td>
<td>11.0% (6.9 – 13.7)</td>
<td>[33, 56, 36, 45, 24, 66, 25]</td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>10.6% (8.3 – 14.5)</td>
<td>[33, 56, 36, 45, 24, 21, 66, 25]</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>2.6% (2.0 – 9.1)</td>
<td>[33, 56, 36, 45, 24, 66, 25]</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>2.4% (2.0 – 4.1)</td>
<td>[33, 68, 56, 36, 24, 57, 66, 59, 25, 54]</td>
<td></td>
</tr>
<tr>
<td>Unable to work/disabled</td>
<td>2.2% (1.4- 3.7)</td>
<td>[56, 36, 24, 34]</td>
<td></td>
</tr>
</tbody>
</table>

IQR = inter quartile range, Overweight defined as those with body mass index between 25kg/m² and 29.9kg/m², Obese defined as those with body mass index ≥ 30kg/m².
Table 2.4: The ten most frequently reported reasons for attending chiropractic care and the percentage of patients who sought chiropractic care for each condition

<table>
<thead>
<tr>
<th>Reason for attending care</th>
<th>Percentage of patients (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low back/back pain</td>
<td>48.5% (41.0 – 58.1)</td>
<td>[23, 27, 29, 30, 33, 35–37, 41, 45, 46, 50, 53, 56, 60, 61, 63–65, 68]</td>
</tr>
<tr>
<td>Neck pain</td>
<td>22.5% (16.5 – 26.0)</td>
<td>[23, 27, 29, 30, 33, 36, 37, 41, 45, 46, 50, 53, 61–65, 68]</td>
</tr>
<tr>
<td>Extremity problem</td>
<td>17.0% (10.0 – 20.0)</td>
<td>[27, 29, 37, 41, 45, 46, 50, 53, 56, 61–63]</td>
</tr>
<tr>
<td>Nerve pain(^1)</td>
<td>8.7% (1.5 – 16.0)</td>
<td>[33, 45]</td>
</tr>
<tr>
<td>Headache</td>
<td>6.2% (4.6 – 9.3)</td>
<td>[21, 23, 27, 30, 33, 41, 45, 50, 62, 63, 68]</td>
</tr>
<tr>
<td>Wellness/maintenance</td>
<td>6.0% (3.0 – 10.1)</td>
<td>[23, 33, 36, 41, 45, 50, 62, 63, 68]</td>
</tr>
<tr>
<td>Hip pain</td>
<td>5.6% (0.8 – 23.0)</td>
<td>[33, 37, 45]</td>
</tr>
<tr>
<td>Unspecified/miscellaneous/other</td>
<td>5.5% (4.0 – 10.0)</td>
<td>[27, 33, 36, 37, 50, 53, 56, 61–65, 68]</td>
</tr>
<tr>
<td>Knee pain</td>
<td>5.0%</td>
<td>[62]</td>
</tr>
<tr>
<td>Shoulder/arm pain</td>
<td>4.0% (3.3 – 6.7)</td>
<td>[23, 30, 33, 37, 45, 62, 68]</td>
</tr>
</tbody>
</table>

IQR = inter quartile range.
\(^1\)Nerve pain consisted of nerve cord, nerve root, and peripheral neural conditions.
Table 2.5: Reasons for attending chiropractic care reported by the pediatric population

<table>
<thead>
<tr>
<th>Reason for attending chiropractic care</th>
<th>Percentage of patients (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musculoskeletal conditions</td>
<td>46.5% (36.0 – 57.0)</td>
<td>[39, 48]</td>
</tr>
<tr>
<td>Neurologic conditions</td>
<td>23.7%</td>
<td>[48]</td>
</tr>
<tr>
<td>Gastrointestinal conditions</td>
<td>12.4%</td>
<td>[48]</td>
</tr>
<tr>
<td>Excessive crying</td>
<td>10.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Stomach</td>
<td>8.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Abnormal movement</td>
<td>7.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Headache</td>
<td>7.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Prophylactic examination</td>
<td>7.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Asymmetry</td>
<td>5.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Other</td>
<td>5.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Motor development</td>
<td>4.0%</td>
<td>[39]</td>
</tr>
<tr>
<td>Infection</td>
<td>3.5%</td>
<td>[48]</td>
</tr>
<tr>
<td>Disturbed sleep</td>
<td>3.0%</td>
<td>[39]</td>
</tr>
</tbody>
</table>

IQR = inter quartile range.
<table>
<thead>
<tr>
<th>Assessment procedure</th>
<th>Rate of use (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static palpation</td>
<td>95.0% (89.9 – 100.0)</td>
<td>[52, 56]</td>
</tr>
<tr>
<td>Orthopedic examination</td>
<td>83.1% (41.0 – 85.2)</td>
<td>[38, 50, 52, 56]</td>
</tr>
<tr>
<td>Spinal examination</td>
<td>79.5% (79.0 – 80.0)</td>
<td>[50]</td>
</tr>
<tr>
<td>Motion palpation</td>
<td>79.3% (71.0 – 87.9)</td>
<td>[38, 52, 56]</td>
</tr>
<tr>
<td>General physical examination</td>
<td>67.5% (35.0 – 100.0)</td>
<td>[35, 52]</td>
</tr>
<tr>
<td>Neurological examination</td>
<td>62.7% (30.0 – 78.3)</td>
<td>[50, 52, 56]</td>
</tr>
<tr>
<td>Soft tissue examination</td>
<td>56.0%</td>
<td>[50]</td>
</tr>
<tr>
<td>Postural analysis</td>
<td>48.0% (38.0 – 70.8)</td>
<td>[38, 50, 52, 56]</td>
</tr>
<tr>
<td>Complete history</td>
<td>27.0% (16.0 – 65.5)</td>
<td>[35, 50, 52]</td>
</tr>
<tr>
<td>X-rays</td>
<td>26.8% (6.0 – 34.2)</td>
<td>[35, 50, 52, 54, 56, 60, 64]</td>
</tr>
<tr>
<td>Examination abdomen</td>
<td>21.3%</td>
<td>[56]</td>
</tr>
<tr>
<td>Extremity examination</td>
<td>20.5% (16.0 – 25.0)</td>
<td>[50]</td>
</tr>
<tr>
<td>Examination heart</td>
<td>16.4%</td>
<td>[56]</td>
</tr>
<tr>
<td>Vital signs</td>
<td>15.9% (10.0 – 30.9)</td>
<td>[50, 56]</td>
</tr>
<tr>
<td>Examination lungs</td>
<td>15.8%</td>
<td>[56]</td>
</tr>
<tr>
<td>Examination mouth</td>
<td>13.0%</td>
<td>[56]</td>
</tr>
<tr>
<td>Laboratory tests/referral</td>
<td>5.6% (5.0 – 100.0)</td>
<td>[35, 52, 56]</td>
</tr>
<tr>
<td>MRI</td>
<td>1.0% (1.0 – 1.5)</td>
<td>[50, 54]</td>
</tr>
</tbody>
</table>

IQR = inter quartile range; MRI = magnetic resonance imaging.
Table 2.7: Chiropractic treatment provided and rate of use

<table>
<thead>
<tr>
<th>Chiropractic treatment provided</th>
<th>Percentage of chiropractors who reported using the treatment provided (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal manipulation</td>
<td>83.7% (78.0 – 91.3)</td>
<td>[33, 35, 38, 44–46, 50, 52, 54, 56]</td>
</tr>
<tr>
<td>Nutritional supplements</td>
<td>52.0% (10.6 – 84.0)</td>
<td>[27, 37, 54]</td>
</tr>
<tr>
<td>Formal patient education</td>
<td>38.1% (24.5 – 62.0)</td>
<td>[27, 35, 37, 50, 52, 54, 56]</td>
</tr>
<tr>
<td>Heat</td>
<td>33.0% (20.0 – 49.0)</td>
<td>[27, 50, 52, 63]</td>
</tr>
<tr>
<td>Soft-tissue therapy(^1)</td>
<td>28.1% (15.5 – 51.0)</td>
<td>[27, 33, 38, 45, 46, 50, 52, 65]</td>
</tr>
<tr>
<td>Cold/ice</td>
<td>26.0% (20.0 – 33.0)</td>
<td>[27, 50, 52, 63]</td>
</tr>
<tr>
<td>Electrical stimulation</td>
<td>25.0% (15.0 – 51.0)</td>
<td>[27, 38, 50]</td>
</tr>
<tr>
<td>Medication advice</td>
<td>23.4% (4.7 – 42.0)</td>
<td>[56, 63]</td>
</tr>
<tr>
<td>Mechanically assisted adjustment(^2)</td>
<td>22.6% (22.0 – 28.8)</td>
<td>[33, 45, 56]</td>
</tr>
<tr>
<td>Exercise instruction/prescription</td>
<td>20.0% (15.0 – 29.8)</td>
<td>[27, 38, 46, 50, 52, 54, 63, 65]</td>
</tr>
<tr>
<td>Mobilization/Manual traction(^3)</td>
<td>14.2% (9.0 – 17.0)</td>
<td>[27, 33, 44, 50, 65]</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>13.0% (12.0 – 15.0)</td>
<td>[27, 33, 50, 52]</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>4.2% (1.2 – 7.5)</td>
<td>[33, 50, 65]</td>
</tr>
<tr>
<td>Orthopedic supports</td>
<td>4.1% (3.0 – 5.2)</td>
<td>[52, 56]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chiropractic system used</th>
<th>Rate of use (median, IQR)</th>
<th>Reporting studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversified</td>
<td>65.5% (58.0 – 85.0)</td>
<td>[27, 37, 50, 56, 65]</td>
</tr>
<tr>
<td>Nimmo-Tonus</td>
<td>40.0% (37.0 – 43.0)</td>
<td>[27, 56]</td>
</tr>
<tr>
<td>Activator</td>
<td>23.0% (17.0 – 35.0)</td>
<td>[27, 37, 50, 56, 65]</td>
</tr>
<tr>
<td>HIO</td>
<td>16.6%</td>
<td>[56]</td>
</tr>
<tr>
<td>Gonstead</td>
<td>14.0% (7.0 – 36.0)</td>
<td>[27, 37, 50, 56, 65]</td>
</tr>
<tr>
<td>Applied kinesiology</td>
<td>10.8% (2.0 – 19.5)</td>
<td>[56, 65]</td>
</tr>
<tr>
<td>Cox</td>
<td>10.0% (4.0 – 39.0)</td>
<td>[27, 50]</td>
</tr>
<tr>
<td>Thompson</td>
<td>7.0% (2.7 – 14.0)</td>
<td>[50, 65]</td>
</tr>
<tr>
<td>Cranial/SOT</td>
<td>6.0% (5.0 – 18.0)</td>
<td>[50, 56]</td>
</tr>
</tbody>
</table>

IQR = inter quartile range; HIO = hole in one technique; SOT = sacro-occipital technique.

1 Soft-tissue therapy included the use of massage techniques, trigger-point release, ischemic compression, and other manual therapies typically used with the intent to treat connective tissue, muscles, and other soft tissue structures.

2 Mechanically assisted adjustment included the use of hand-held instruments (Activator), toggle boards, and drop pieces.

3 Mobilization/Manual traction included any manual therapy typically directed at the joint complex with varying speeds and amplitudes with the intent to restore optimal motion, function, and to reduce pain.
Chapter 3

Do Chiropractors Undertake Weight Loss Interventions?

3.1 Abstract

**Background:** Overweight and obesity are conditions in which an excess of fat has accumulated to the extent that it impacts health. It has long been recognized that overweight and obesity are a significant risk to health. Numerous clinical practice guidelines advise healthcare professionals, such as chiropractors, to provide weight management interventions to patients with overweight and obesity. Yet these patients are poorly managed by healthcare professionals and little has been done to address this problem by the chiropractic profession in Canada. Identifying the extent of this problem in chiropractic practice is the first step in addressing this issue and closing the evidence-practice gap.

**Methods:** Data from the Ontario Chiropractic Observational and Analysis STudy (O-COAST) were used ($N_c = 42$ chiropractors, $N_p = 3523$ patient encounters). Multilevel logistic regression was performed to assess the odds of chiropractors initiating or continuing weight management interventions with patients. Eight patient-level variables and two chiropractor-level variables were investigated for influence on chiropractor-directed weight management. In addition, the interaction between adiposity and comorbidity was assessed on whether weight management interventions were initiated or continued by chiropractors.

**Results:** The majority (61.2%) of patients who sought chiropractic care were either overweight or obese. Weight management was initiated or continued by Ontario chiropractors for all patients with BMI equal
to or greater than 18.5 kg/m² (including those who were of normal weight, overweight, and obese) during 5.4% of encounters. Weight management interventions were not offered at significantly different rates between patients who were of normal weight, overweight, and obese (p-value = 0.2319). Patients who did not meet Canadian guideline diet recommendations were significantly (OR: 0.52, 95% CI: 0.29 - 0.93) less likely to receive weight management interventions from chiropractors. The amount of time spent with the patient was not significantly associated with whether weight management interventions were offered by the chiropractor. Chiropractors who graduated between 1995 and 2005 (OR: 0.02, 95% CI: 0.00 - 0.13) and prior to 1995 (OR: 0.08, 95% CI: 0.01 - 0.42) offered weight management significantly less than chiropractors who graduated between 2005 and 2014. No significant interaction was found between patient adiposity and comorbid conditions with whether chiropractors initiated or continued weight management interventions.

**Conclusion:** The prevalence of weight management interventions offered to patients by Ontario chiropractors is very low. However, chiropractors who received public health education following the chiropractic educational reforms of the early 2000s did provide weight management interventions significantly more often than chiropractors who did not receive this public health education, albeit at low levels. The chiropractic profession must continue to emphasize the importance of public health in order to reduce the impact overweight and obesity has on the health of Canadians. Chiropractors may have an important role to play in the battle against overweight and obesity yet this aspect of chiropractic practice has not yet been fully realized.
3.2 Introduction

Overweight and obesity are conditions in which an excess of body fat has accumulated to the extent that it impairs physical, mental, and spiritual health.[1] Body mass index (BMI) describes the relationship between body weight and height in humans.[2] Adults are classified as overweight if their BMI is between 25 and 29.9 and obese if their BMI is equal to or greater than 30.[3] Obesity is further divided into class I, II, and III for those with a BMI between 30 to 34.9, 35 to 39.9, and equal to or greater than 40 respectively. Prior to 1980 fewer than one in ten people were obese, however, in the following decades rates have doubled or tripled as more than one in three adults in Mexico, New Zealand, and the United States, and more than one in four in Australia, Canada, Chile, and Hungary were obese.[4]

The burden overweight and obesity places on Canadians and the Canadian health care system is immense. In 2014, 9 million Canadians aged 18 years or over were overweight and 5.3 million were obese. Altogether, 61.8% of men (8.2 million) and 46.2% of women (6.1 million) were at risk of having poor health due to excess weight.[5] The obesity epidemic continues to spread and with it, significant risks to health.[6–10] The total direct costs attributed to overweight and obesity in Canada are an estimated $6.0 billion, or 4.1% of total Canadian health care expenditures.[11]

Numerous clinical practice guidelines advise healthcare professionals to recommend strategies, provide weight management counselling, and offer continued support to all patients with overweight and obesity.[12–25] Despite these recommendations and the importance of their implementation, patients with overweight and obesity are not well managed by their healthcare professionals.[26–33]
Chiropractors and the patients who seek their care represent an important segment of Canadian society. The chiropractic profession sees approximately 4.5 million Canadians annually.[34] Obesity is a factor associated with seeking chiropractic care because chiropractors treat many conditions prevalent among those with overweight and obesity.[35] An estimated 71% of men and 53% women who seek chiropractic care were overweight and obese.[36] Weight management interventions have been shown to be of benefit.[37–47] Patients want substantially more help with weight management, with most seeking dietary advice, exercise recommendations, and help setting realistic weight goals.[48] Chiropractors are trained to provide dietary, nutritional, lifestyle advice, and therapeutic exercise to address specific patient complaints and enhance overall health.[49] As practitioners with a holistic approach to care, the chiropractic profession has a unique opportunity to significantly contribute to the treatment of overweight and obesity.

Little is known about chiropractor-directed weight loss management. A 2011 online survey found that 45% of chiropractors focused on weight loss for patients in need.[50] Yet this survey had a response rate of 1% and was not representative of the chiropractic profession. Within a chiropractic college population, 84% of survey participants felt it was very important for doctors of chiropractic to educate their patients regarding healthy behaviours.[51] Past investigation has shown that chiropractors are willing to undertake weight management interventions with patients but were more likely to provide health information brochures than to offer tailored interventions.[52] While chiropractors regard themselves as wellness professionals, one study found that only 48% of patients seeking chiropractic care were asked about their weight.[53] Data from the US Sample Adult Core component of the 2006 National Health Interview Survey (n = 24,275) indicated that only 11.5% of respondents reported receiving weight loss advice from their chiropractor.[54]
Clinical practice guidelines on the identification, assessment, and management of overweight and obesity are intended for use in everyday practice. Yet the decision to initiate or continue weight management interventions with patients is complex. Lack of time, resources, patient support, and knowledge are commonly reported reasons not to manage overweight and obesity.[55–63] However, the factors that are positively associated with chiropractors initiating or continuing weight loss interventions are unknown. Past investigations have focused extensively on the patient and the factors that drive weight management.[64–69] Within the medical profession the interaction between physician and patient has been investigated. It has been shown that when physicians tell their patients that the patient is overweight or obese the patients’ desire to lose weight increased as did the number of attempts to lose weight.[70] It is not known what factors influence the healthcare provider to acknowledge patient weight and offer weight management interventions. In addition, the interaction between patient weight and comorbid conditions on whether weight loss interventions are initiated or continued by chiropractors has not been investigated.

This study was designed to address these gaps in the literature by conducting a comprehensive assessment of weight loss initiated or continued by chiropractors in clinical practice using data from a cross-sectional observational study that described the profiles of chiropractic practices and their patients in Ontario. The study focus was on weight loss interventions offered to adults. The objectives were to 1) determine the prevalence of overweight and obesity in the adult patient population that sought care from Ontario chiropractors, 2) describe the frequency and distribution of chiropractor directed weight management intervention, 3) identify associations between chiropractor directed weight management interventions and specific patient-level and chiropractor-level variables, and 4) examine the interaction between patient weight and comorbid conditions and whether chiropractors offered weight loss interventions.
3.3 Methods

**Data Source**

3.3.1 The *Ontario Chiropractic Observational and Analysis STudy* (O-COAST)

The O-COAST was a cross-sectional observational study of chiropractic practice in Ontario, Canada. O-COAST, aimed to investigate who seeks chiropractic care, for what reasons chiropractic care is sought, and what care was delivered. The study involved three inter-related data collections including relevant provider, patient, and management information. The methods for this study are based on the Bettering the Evaluation and Care of Health (BEACH) study, and subsequently the Chiropractic Observational and Analysis STudy (COAST), both conducted in Australia.[71–73] The research within this study involved analysis of data from O-COAST.

3.3.2 O-COAST Population and Data Collection

A random sample of 135 chiropractors was selected from the 4,528 licensed chiropractors in Ontario. Random selection was done using Microsoft Excel by uniquely coding each chiropractor in the publicly accessible directory from the College of Chiropractors of Ontario and recruitment was initiated on July 11, 2014. These 135 chiropractors were then invited to participate in O-COAST via a formal letter of invitation sent by regular mail. Follow-up letters to non-responders were mailed out four and eight weeks after initial mailing. At 12-15 weeks, phone calls were made to introduce the study to non-responders and invite them to participate. A final mailing was simultaneously sent to the non-responders.

Chiropractors were eligible if they currently practiced in Ontario. Of the 135 chiropractors invited to participate in the study, 14 were ineligible (2 were no longer practicing in Ontario and 12 were no longer in practice). Of the 121 eligible chiropractors, 42 chiropractors agreed to participate in the study (35%
response rate) and each recorded up to 100 consecutive patient encounters. The participating chiropractors recorded, by hand on one-page paper encounter forms, anonymous patient demographic data, clinical information, patient characteristics, treatment provided, and recommendations given (encounter form shown in Appendix B). Specifically, patient sex, height, weight, and comorbidities were recorded on every encounter form.

Questions about health and lifestyle behaviours were included on the encounter forms, with questions changing on alternating forms. Form 1 included questions regarding amount of fruit and vegetables usually consumed each day, weekly moderate to vigorous intensity aerobic and muscle strengthening physical activity, smoking habits, and daily alcohol consumption over the past 7 days. Form 2 recorded perceived general health, quality of life, life satisfaction, limitations due to discomfort, and feelings about life as a whole.

Data were entered by trained coders. Coders classified terms recorded by patients and chiropractors according to the International classification of primary care, 2nd edition (ICPC-2) using the Australian ICPC-2 PLUS general practice terminology.[74]

3.3.3 Ethical Approval of the Study

The O-COAST protocol was approved by the Queen’s University Research Ethics Board as well as the Canadian Memorial Chiropractic College Research Ethics Board. The approved protocol included consideration of inconvenience, participant withdrawal, confidentiality, storage of data, and use of data for other purposes. During the informed consent process, both practitioners and patients agreed that their de-identified data may be used for other purposes in the future. Furthermore, confidentiality agreements
were made ensuring that all the information collected in the research study was confidential. No information that could lead to the identification of any individuals was disclosed in any reports or to any other party.

3.3.4 Study Design Overview

Secondary data analysis of all chiropractors and their patients who participated in the O-COAST was conducted between August 1st, 2014 and November 10th 2015. Unique patient data, excluding the data from repeat visits, was used to calculate the prevalence of overweight and obesity within the patient population aged 18 years or older. Frequency and distribution of chiropractor-directed weight management intervention, the associations between chiropractor-directed weight management interventions and specific patient-level and chiropractor-level variables, and the interaction between patient weight and comorbid conditions and whether chiropractors offered weight loss interventions were examined for all unique adult (aged 18 to 80 years) patients who were of normal weight, overweight, and obese. Patients were classified as normal weight (BMI 18.5 kg/m$^2$ to 24.9 kg/m$^2$), overweight (BMI 25 kg/m$^2$ to 29.9 kg/m$^2$), or obese (BMI $\geq$ 30 kg/m$^2$) by BMI calculated from self-reported height and weight. Study population selection is shown in Figure 3.1.

Research assessing the relationship between chiropractor directed weight loss and patient-level as well as chiropractor-level variables is limited. This study was an exploratory investigation of these relationships. It was hypothesized that, in accordance with clinical practice guideline recommendations, patient BMI would influence a chiropractor’s decision to initiate or continue weight management interventions with higher BMI increasing the likelihood of chiropractor-directed weight management. Additional patient-level variables that were anticipated to influence chiropractor-directed weight management were patient sex, smoking status, age, physical activity, diet, the presence of comorbidities (arthritis, diabetes,
hypertension, and hyperlipidemia), and the length of the chiropractor-patient encounter. Chiropractor-level variables that were anticipated to influence chiropractor-directed weight management were the chiropractors’ number of years since graduation and type of practice. Due to the lack of previous research and given the exploratory nature of the study confounders the relationship under investigation was not considered. However, the interaction between patient BMI and comorbid conditions is well established in the literature.[75–77] The clinical practice guidelines for the management of those with overweight and obesity state that more aggressive weight loss intervention is required among those with lower BMI if they have one or more comorbid conditions when compared to those without a comorbid condition.[78] Therefore, the interaction between patient BMI and comorbid conditions with chiropractor-directed weight management was included in this study.

3.3.5 Chiropractor Level Study Variables

Chiropractors who participated in O-COAST completed a chiropractic baseline questionnaire in which they provided demographic and clinical information. Two chiropractor-level variables were considered in the analysis. These variables included years since graduation[79, 80] and type of practice[80, 81].

*Years since Graduation*

Public health education reforms occurred within the chiropractic profession that would have affected graduates following the 2004-2005 school year. The years since graduation variable was therefore grouped into three categories: chiropractors who graduated between 2005 and 2014, who graduated between 1995 and 2004, and who graduated prior to 1995.
**Type of Practice**

Chiropractors reported their practice type and these data were used to create a dichotomous variable. The categories included sports/rehabilitation practice and other (including: general, family, lifestyle counselling, and wellness practice).

**3.3.6 Patient Level Study Variables**

Patient characteristics, demographic data, and treatment provided or recommendations made were recorded during each encounter by the participating chiropractor. Eight patient level variables were identified in the literature as relevant for this analysis. The patient level variables of interest were as follows: BMI[12–14, 18, 34, 79–84], sex[34, 80, 81, 84], age[34], smoking habits[79, 81], physical activity[79, 80], diet[79, 80], the presence of a comorbid condition (including arthritis[85], diabetes[15, 86–88], hypertension[86–88], and hyperlipidemia[86–88]), and time spent with the patient.

**Body Mass Index**

Patients were asked by the treating chiropractor to provide their height and weight. BMI was calculated using patient-reported height and weight. Patients were categorized as normal weight (BMI 18.5 kg/m² to 24.9 kg/m²), overweight (BMI 25 kg/m² to 29.9 kg/m²), and obese (BMI ≥ 30 kg/m²).

**Sex**

Patient sex was recorded and used as a dichotomous variable (‘male’ and ‘female’).
**Age**

Self-reported date of birth was used to calculate patient age. The age variable was created, as described in the literature [34], with three categories which included those aged 18-24 years, those aged 25-54 years, and those aged 55-80 years. A cut point of 80 years of age was used as evidence suggests that an increased BMI is protective against poor health among persons over the age of 80 years thereby yielding weight loss interventions initiated or continued by chiropractors noncompliant with the purpose of this investigation.[89–93]

**Smoking**

During the patient encounter, participants were asked several questions by the participating chiropractor relating to lifestyle and health behaviours. Patients were asked which of the following categories best described their smoking: never smoked, used to smoke, now smoke occasionally, and now smoke regularly. A dichotomous variable (‘non-smoker’ and ‘smoker’) was created in which ‘never smoked’ and ‘used to smoke’ responses were combined as ‘non-smoker’ and ‘now smoke occasionally’ and ‘now smoke regularly’ responses were combined as ‘smoker’.

**Physical Activity**

Patient physical activity was assessed by asking the patient two questions. The first asked patients how many times they engaged in moderate to vigorous intensity aerobic physical activity lasting 30 minutes or more and the second asked how many times they engaged in muscle and bone strengthening activities using major muscle groups. Both were categorized as follows: never; once a week; 2-3 times per week; 4, 5 or 6 times per week; once every day; or more than once every day. A dichotomous variable (‘met recommended physical activity level’ and ‘did not meet recommended physical activity level’) was
created in accordance with current Canadian guideline recommendations[94–96] by grouping those who answered ‘4, 5, or 6 times per week’, ‘once every day’, and ‘more than once every day’ as ‘met recommended physical activity level’ for one or both questions and those who did not as ‘did not meet recommended physical activity level’.

**Diet and Eating Habits**

Evidence suggests that adequate fruit and vegetable consumption (5 or more servings of fruit and vegetables combined per day) is a reasonable proxy for a healthy diet and good eating habits.[97, 98] Study participants were asked how many servings of vegetables and fruit they usually ate each day. A dichotomous variable (‘5 or more servings of fruit and vegetables per day’ and ‘less than 5 servings of fruit and vegetables per day’) was created using these data.

**Comorbidities**

Patients were asked to list other conditions which they were afflicted by that the chiropractor was not treating. Comorbid conditions including arthritis, diabetes, hypertension, and hyperlipidemia were coded using ICPC-2 PLUS codes. A dichotomous variable was created to indicate the presence of any one or more patient reported comorbid conditions or the absence of all of the comorbid conditions above.

**Time Spent with the Patient**

Chiropractors reported when the patient encounter started and finished. These data were used to calculate the time the chiropractor spent with the patient during the encounter. A categorical variable was created using quartiles as the division points. These quartile categories were 0-9 minutes, 10-15 minutes, 16-20 minutes, and greater than 20 minutes spent with the patient. Patients who sought care from a participating
chiropractor for the first time were excluded from this analysis because these encounters typically are
longer in duration to provide a detailed work-up of the patient and therefore not representative of
subsequent appointments.

3.3.7 Outcome Variable

Chiropractors recorded the treatments delivered at the time of the patient encounter, recommendations
made relating to the conditions treated (musculoskeletal condition treated as well as other conditions), and
interventions initiated or continued for those conditions identified. ICPC-2 PLUS codes were used to
identify weight management interventions made by the chiropractor. The three specific forms of
chiropractor-directed weight management considered were 1) education or advice pertaining to weight
management or counseling; 2) education or advice pertaining to exercise or sedentary lifestyle; and 3)
education or advice pertaining to diet and nutrition specific to weight loss. The dichotomous response
variable was ‘weight management initiated or continued by the chiropractor’.

3.3.8 Missing Data

By design this study considered only unique patients, not all patient encounters. Repeat visits were
identified by matching date of birth, sex, and postcode. Outcome information was determined using only
the first encounter form for patients with repeat visits during the recording period. Only complete cases
(those that had complete data for patient BMI, sex, age, smoking status, physical activity, diet,
comorbidities, chiropractor time spent with the patient, years since graduation, and chiropractor practice
type) were used in the analysis.
3.3.9 Multi-level Modeling

Data collection employed by O-COAST necessitated the need to account for clustering as the patients seen by one chiropractor were more likely to be similar to each other than those seen by another chiropractor. Descriptive analyses were performed to profile the patient study population by age, gender, and adiposity class. A multi-level logistic regression model was employed to determine which variables were associated with chiropractors initiating or continuing weight management intervention with their patients. The multi-level model included the a priori defined patient and chiropractor covariates described above. The first level controlled for any variation between patients. The second level considered clustering that may occur within patients treated by the same chiropractor. Chiropractors may have provided services to patients with similar backgrounds and this may impact the findings due to patients under the care of one chiropractor being more similar than those under the care of other chiropractors. A model was used to identify significant covariates. The independent variable of BMI category (normal weight, overweight, and obese) with the addition of significant covariates was used to analyze the binary dependent variable ‘weight management initiated or continued by the chiropractor’.

Patient level data (level-1) and chiropractor data (level-2) were used to build the two-level hierarchical models used to investigate the relationship between weight management interventions initiated or continued by the chiropractor and predictor variables at both levels. The COVTEST statement was used in SAS as a mechanism to obtain statistical inferences for the covariance parameters. Significance tests were based on the ratio of residual likelihoods or pseudo-likelihoods. Confidence limits and bounds were computed as Wald intervals.
### 3.3.10 Statistical Analysis

SAS 9.4 (SAS Inc., Cary, NC) was used for all analyses. The major statistical method used in this thesis was multi-level logistic regression analysis. A hierarchical generalized linear model using PROC GLIMMIX was used in this analysis as described in the literature by Ene, Leighton, Blue, and Bell.[99] All estimates of association were calculated using multi-level logistic regression which provided odds ratio estimates. The Full maximum likelihood with Laplace approximation was used to fit the model. The -2 Log Likelihood and Akaike’s Information Criteria (AIC) fit indices were used to assess model fit.

### 3.3.11 Statistical Power

The size of this study was predetermined, so the power calculations focus on identifying power and minimum detectable effect sizes for this set sample size. Bootstrapping, which is case resampling of the data using simple random sampling with replacement from the original sample was conducted based on similar simulations presented in the literature.[100, 101] The methods described by Cassell[102, 103] were used to generate 500 independent samples. The effect size for the BMI (OR 1.3, 1.65, and 2.0) and type of practice (OR 10, 15, and 20) variables were fixed at three different odds ratios. The remaining model estimates were computed from the study sample data. Together these bootstrap sample estimates were used to calculate power.

### 3.4 Results

Characteristics of the 42 chiropractors who participated in O-COAST are shown in Table 3.1. Compared with all registered chiropractors in Ontario, those who participated in O-COAST had similar mean age (43.5 years compared with 44.9 years of age) and proportion of women (14/52 [33.3%] compared with 1365/3625 [37.7%] based on Statistics Canada Employment Income Statistics in 2010). Similarly,
compared with all Canadian chiropractors, those who participated in O-COAST were of similar age (43.5 years compared with 45.0 years of age) and proportion of women (14/52 [33.3%] compared with 2500/7135 [35.0%] based on Statistics Canada Employment Income Statistics in 2010). The distribution of participating chiropractors between the three ‘years since graduation’ categories was observed to be 35.7% less than 10 years, 33.3% between 10 to 20 years, and 31.0% greater than 20 years. Participating chiropractors received their chiropractic education in Canada (34), the United States (6), and Australia (2). Participating chiropractors described their type of practice as general/family (34), sports (3), rehabilitation (3), lifestyle counseling (1), and wellness (1).

Of all patient encounters 91% recorded patient weight and height. When recording the patient encounter 40 of 42 chiropractors completed sections related to “Other recommendations/actions” that would have contained any weight management provided (O-COAST encounter forms are shown in Appendix B). Table 3.2 shows the demographic details of all unique adult (aged 18 to 80 years) chiropractic patients who were normal weight, with overweight, and with obesity (n = 2,162) in encounters recorded by participating chiropractors. 58.1% of patients who sought care from participating chiropractors were female. Of all patients who were normal weight, two thirds were female. The distribution of sexes among patients with overweight and obesity was 52.1% male compared to 47.9% female for those with overweight and 44.7% male compared to 55.3% female among those with obesity. In most chiropractor-patient encounters patients were aged 25-54 years (55.5%) or aged 55-80 years (39.0%). In only 5.5% of encounters were patients between 18 and 24 years of age.

The majority of patients were non-smokers (95.4%), did not meet the Canadian guideline recommendation for physical activity (95.3%), and did not meet diet recommendations (85.9%). The distribution of smokers to non-smokers between the BMI categories was similar (95.0%, 95.7%, and
95.5% smokers vs. 5.0%, 4.3%, and 4.5% non-smokers for normal weight, overweight, and obese respectively). The majority of patients did not meet the physical activity (95.3%) and diet (85.9%) recommendations. 12.2% of patients reported being afflicted by at least one comorbid condition including arthritis, diabetes, hypertension, and hyperlipidemia. The distribution of comorbid conditions differed across BMI categories: 6.4% of patients of normal weight reported at least one comorbid condition, 12.6% of patients with overweight reported at least one comorbid condition, and 20.9% of patients with obesity reported at least one comorbid condition. After excluding new patient encounters the mean duration of patient encounter was 17.7 minutes.

3.4.1 Prevalence and Distribution of Weight Management Initiated or Continued by Chiropractors

The prevalence of overweight and obesity within the study sample was 37.8% and 23.5% respectively, as shown in Table 3.2. Only 5.4% of patient encounters included weight management initiated or continued by chiropractors. There was no significant difference in chiropractors undertaking weight management across the different BMI categories (p-value = 0.2319).

3.4.2 Probability of Chiropractors Initiating or Continuing Weight Management

The SAS PROC GLIMMIX syntax generated the fixed effects estimates shown in Table 3.3. The intraclass correlation (ICC) was 0.26794 and the design effect was 14.5247 (Appendix 3.1). Therefore, approximately 26.8% of the variability in the decision to initiate or continue weight management intervention was accounted for by the chiropractor-level variables in the study.
3.4.3 Assessing Model Fit

Table 3.3 displays the model building process. Model 2, Model 3, and Model 4 were created by including patient-level variables, chiropractor-level variables, and patient-level variable interaction as fixed effects respectively. Model fit statistics and the log likelihood test demonstrated that Model 3, which included both patient-level and chiropractor-level variables, fit the data best and at a statistically significant amount when compared to the previous model (Model 2) in the model building sequence described above. The addition of the interaction term between patient BMI and comorbid conditions as a fixed effect (Model 4) was not statistically significant when compared to Model 3. Furthermore, the interaction term between patient BMI and comorbid conditions did not produce statistically significant log odds estimates and the model fit statistic was worse for Model 4 (AIC = 702.62) compared to Model 3 (AIC = 702.42). Therefore the parameter estimates generated by Model 3 were used to answer the remaining research questions. Odds ratios were reported when describing the relationship between predictors and the outcome, shown in Table 3.4.

3.4.4 Relationship between Patient-Level Variables and the Likelihood of Receiving Chiropractor Directed Weight Management

The parameter estimates for patient level variables are shown in Table 3.3 and the odds ratios with level of significance and power in Table 3.4. Diet, specifically daily fruit and vegetable consumption, was the only patient-level variable which showed a significant association with chiropractor-directed weight management intervention. The relationship (b = -0.64, p < 0.05) indicated that the odds of chiropractor-directed weight management intervention was about half (OR: 0.52, 95% CI: 0.29 - 0.93) as large for those who did not meet dietary recommendations when compared to those who did meet the diet recommendations. The odds that patients received weight management interventions from their chiropractor differed between the four categories of time the chiropractor spent with the patient, however,
these associations were not statistically significant (OR: 1.53, 95% CI: 0.85 – 2.73, OR: 1.17, 95% CI: 0.52 – 2.67, and OR: 1.36, 95% CI: 0.68 – 2.73 comparing the 0 - 9 minutes with 10 - 15 minutes, 16 - 20 minutes, and > 20 minutes respectively).

3.4.5 Relationship between Chiropractor-Level Variables and the Likelihood of Providing Chiropractor Directed Weight Management

The relationship between chiropractor-level variables and the likelihood of the chiropractor providing weight management interventions to their patients was assessed. Parameter estimates and odds ratios are provided in Table 3.3 and Table 3.4 respectively. While still infrequently offered, chiropractors who graduated between 2005 and 2014 initiated or continued weight management intervention significantly more often than chiropractors who graduated between 1995 and 2005 as well as chiropractors who graduated before 1995 (12.9%, 1.0%, and 5.7% of patients received weight management interventions from chiropractors who graduated between 2005 – 2014, 1995 – 2004, and prior to 1995 respectively). Chiropractors who graduated between 1995 and 2004 and chiropractors who graduated prior to 1995 were significantly less likely to initiate or continue weight management interventions with patients when compared to chiropractors who graduated between 2005 and 2014 (OR: 0.02, 95% CI: 0.00 – 0.13 and OR: 0.08, 95% CI: 0.01 – 0.42 respectively).

The chiropractor’s type of practice appeared to be important in whether chiropractors provided weight management interventions to patients. Appendix 3.2, Table A.1 shows that the distribution of patients between BMI categories were nearly equal (5.7% normal weight, 6.7% overweight, and 6.3% obese) among patients who sought care from sports or rehabilitation type practices. When compared to other types of practice, patients who received care from chiropractors who adopted either a sports or
rehabilitation type of practice were less likely to have received chiropractor directed weight management interventions (OR 0.04 95% CI 0.00 – 0.59).

3.4.6 Study Power

Power calculations are shown in the thesis Appendix C, Table C.1. Overall the patient-level variables had much greater statistical power when compared to the chiropractor-level variables. Our study had 94.5% power and 81.8% power to detect an odds ratio of 1.65 between overweight vs. normal weight and obese vs. normal weight when the effect size of the chiropractor-level variable ‘type of practice’ was fixed at 15. The power was 87.3% for an odds ratio of 15 between other vs. sports/rehabilitation types of practice when the effect size of BMI was fixed at 1.65. When the effect size of BMI was fixed at 1.3, analyses for BMI had 11.8%, 20.9%, and 22.7% power for the relationship between overweight and normal weight and 6.4%, 22.7%, and 32.7% power for the relationship between obese and normal weight when the effect size of type of practice was set to 10, 15, and 20 respectively. It was found that when the effect size of type of practice was fixed at 10 the power was 52.7%, 65.5%, and 66.4% as the effect size of BMI increased from 1.3 to 1.65 and 2.0 respectively.

3.5 Discussion

Key Findings

The main goal of this study was to provide a preliminary description of weight loss management offered to patients by chiropractors. The majority of people who sought chiropractic care had overweight or obesity. Yet, chiropractors rarely offered weight management interventions to their patients. Two commonly cited reasons for not providing weight management to patients are insufficient time and lack of knowledge. It was found that time spent with the patient was not significantly associated with whether
weight management was initiated or continued by chiropractors. The duration of the chiropractor-patient encounter varied and may have limited our ability to detect a significant relationship in terms of there being enough time to effectively provide weight loss intervention. However, the years since graduation did yield significant results, in that chiropractors who graduated between 2005 and 2014 were significantly more likely to offer weight management to their patients than were chiropractors who graduated between 1995 and 2005 as well as chiropractors who graduated prior to 1995. Changes in chiropractic public health education may have contributed to this observed trend.

In Canadian chiropractic education, attempts have been made to improve the education of future chiropractors in health promotion and disease prevention in order to better prepare them for their expanded role in society and in health care. A preliminary study in 1995 indicated that there were significant inconsistencies in what was being taught in public health courses in chiropractic colleges across the United States.[104] The Chiropractic Health Care Section of the American Public Health Association formed the Public Health Curriculum Task Force with the goal of improving the quality of public health training for chiropractic students. A report, which detailed topics and resources for inclusion in public health courses, was created by this team of interdisciplinary researchers and was disseminated to all chiropractic colleges in 1999.[105] In 2000, the University of Bridgeport College of Chiropractic, the School of Public Health at Yale University, the Association of Schools of Public Health, and the Health Resources and Services Administration, announced a collaborative project to address the issue of inconsistent health promotion within the chiropractic profession by developing a standardized public health curriculum.[106] This initiative resulted in the Council on Chiropractic Education issuing a new standard addressing wellness and health promotion in the chiropractic college curriculum.[107] By 2001, a model course for public health education in chiropractic was implemented which promoted physical exercise and weight loss strategies.[108]
At the same time the Canadian Memorial Chiropractic College (CMCC) recognized the importance of patient education in the promotion of public health.[109] The institution implemented a new integrative curriculum to facilitate a variety of educational opportunities to promote effective patient education and to make course material clinically meaningful.[109, 110] Curricular content at CMCC was introduced to educate chiropractic students on planning and prescribing exercises as well as basic adult learning and teaching concepts in a practical clinical setting. In addition, exercise and nutrition education was implemented through clinician-directed, small group education sessions, as well as patient-directed education. The CMCC course in public health was reviewed and further developed in 2003, which led to improvements in the clinical application and relevance of the material.[110]

It is possible that the public health educational reforms of the early 2000s within the chiropractic profession[106–110] resulted in an increased awareness in the importance of public health initiatives as well as an increased confidence in providing such services to patients. It was found that courses in public health, biochemistry (health and wellness), and clinical nutrition for chiropractic practice changed within Canadian chiropractic education as a result of the reforms in the early 2000s. However, a review of recent CMCC curriculum showed little change in public health curriculum after 2005.[111–116] A previous study failed to show statistically significant results of the impact the introduction of the new public health education had on chiropractor clinical behaviour.[117] It is believed that our study may demonstrate that the reforms to public health education offered to chiropractors has significantly impacted clinical behaviour since the chiropractors who received this new model of education offered significantly more weight management interventions when compared to chiropractors who did not receive this public health education. However, direct examination of the public health education reforms in Canadian chiropractic education could not be assessed within our study design. In addition, many other consideration must be accounted for such as general public health awareness of overweight and obesity as a health concern which could have influenced chiropractor clinical behaviour.
Ontario chiropractors who described their practice type as sport or rehabilitation were significantly less likely to offer weight management interventions to patients. The relationship between other chiropractic types of practice and weight management interventions would be beneficial as chiropractors also reported general/family, lifestyle counseling, and wellness types of practice. The chiropractic literature suggests that chiropractors of lifestyle counseling and wellness types of practice would offer weight management interventions more frequently.[79, 118, 119] Unfortunately, the O-COAST study did not have an adequate representation of such chiropractors to accurately assess the relationship between these types of practice and chiropractor-directed weight management intervention.

Patients who did not meet the recommended daily fruit and vegetable consumption guideline (5 or more servings of fruit and vegetables combined)[97, 98] were significantly less likely than those who did consume this recommended daily intake of fruits and vegetables to receive chiropractor-directed weight management interventions. It is possible that patients who consumed the recommended daily amount of fruits and vegetables did so because they were trying to improve their diet. This concerted effort to improve diet may have been the result of prior dietary advice provided by the chiropractor as part of continued weight management intervention. Alternatively, chiropractic patients who had healthy diets may also be more concerned with their health than patients who did not have a healthy diet. This increase in patient concern for health may have led to an increase in patients requesting that their chiropractor provide weight management intervention. However, this relationship could not be explicitly assessed in this study and should be examined in future research.
3.5.1 Strengths and Limitations

This study is an important first step in examining the clinical practices of weight management initiated or continued by chiropractors. This study had several strengths. This study used the O-COAST dataset which is the largest dataset of chiropractors’ clinical practice in Canada. For age and sex, participating chiropractors were similar to all other practising chiropractors in Ontario and across Canada. In addition, the chiropractors selected to participate in O-COAST were randomly selected.

This study relied upon the chiropractors accurately recording their patient encounters, and it is possible that the participating chiropractors did not record all that occurred during the patient encounter such as providing weight management recommendations. Chiropractic encounter forms were based on encounter forms used in similar studies[73, 120] with an established reliable and valid data collection process.[72]

The data collection and coding process used in this study was robust. Data collection occurred during each chiropractor-patient encounter, thereby reducing errors in recall bias. The cut points used to determine if someone met the physical activity and diet recommendations within this study were based on national recommendations that are commonly cited in the literature.[94–98] The outcome variable was created using multiple international clinical practice guideline recommendations to ensure the most up-to-date definition of ‘weight management intervention’ was used. The Australian ICPC-2 PLUS general practice terminology system was used to classify the patient encounter which has been validated within the chiropractic profession.[121]

The O-COAST had a response rate of 35% of the eligible chiropractors approached. Selection bias may have resulted in chiropractors who were more evidence-based to have participated in O-COAST.
However, it was not possible to compare the study sample to the Ontario population in this way. Although participating chiropractors appeared to be representative of the Ontario and Canadian chiropractic profession for age and sex there remains uncertainty of the representativeness of the participating chiropractors. Data describing the Ontario and Canadian chiropractic professions is limited and additional comparisons between the study sample and the Ontario or Canadian populations is required. Currently there are no representative Canadian chiropractic patient data available. However, the O-COAST data was collected on consecutive patient encounters in an attempt to capture a representative sample of chiropractic patients. Patient data collected in the O-COAST was similar to findings of international chiropractic patient populations. Sex distribution was similar between O-COAST (58.1% of patients were female) and the global chiropractic patient population (57.6% of patients within the general chiropractic patient population within the literature were female) [35, 73, 122–139]. The prevalence of overweight and obesity within the study sample was 37.8% and 23.5% respectively which was similar to that reported in the sample populations of several other chiropractic studies 35.3% overweight and 22.9% obese. [139, 140]

The measure of adiposity (self-reported height and weight to calculate BMI) used in this study was imprecise as it does not distinguish lean body mass from fat mass.[141] Measures such as waist circumference and waist-hip ratio are among the many population-based methods suggested to better measure adiposity. Despite this, BMI remains the most commonly used population measure of adiposity in adults due to its convenience, safety, minimal cost, and correlation with body fat.[23, 141] BMI used for analysis was calculated from patient reported data that may have resulted in information bias. Self-reported data are easier and less expensive to collect in population-based surveys but tend to underestimate the prevalence of obesity when compared with measured data.[142] One study has suggested that self-reporting bias, with regards to weight, has increased since the early 1990s.[143] The sensitivity and specificity of self-reported height and weight used to calculate BMI is between 74%–80%
and 92%-99% respectively with people of higher BMI being more likely to under report.[144–146] Nine percent of all patient encounters did not report weight and it is not known if patients with higher BMI were less likely to provide their weight during their chiropractor-patient encounters. This may have resulted in an under estimation of patients with overweight and obesity in the study sample. An underestimate of BMI would have biased our results towards intervention being offered to patients of lower BMI. Specifically, some of the weight management interventions initiated or continued by chiropractors to normal weight patients may have actually been to patients with overweight or obesity and intervention directed to patients with overweight actually been to patients with obesity.

This study included all consecutive unique adult patients who were normal weight and with overweight or obesity. Patients who attended their chiropractor more frequently during the study period were more likely to be sampled. A patient who is in acute pain is more likely to seek care more often, and in response to their patient’s immediate needs, the treating chiropractor may not offer weight management interventions instead focussing on pain management. Thus, the analysis conducted within this study missed the opportunity to determine if weight management interventions were initiated or continued by the chiropractor in later encounters once the patient’s acute symptoms had subsided.

Socioeconomic status (SES) is important with regard to the sociocultural context of obesity.[147] In Canada there is an increased risk of obesity among groups with low SES.[148] Ideally, SES would have been considered as an important covariate within the analysis presented. SES data were not collected in O-COAST. Future research in this area should consider SES.

While some significant relationships were found at the chiropractor-level (those of chiropractor years since graduation and type of practice), it is recognized that the power to detect meaningful effect sizes at
the chiropractor-level was lacking in this study. Non-significant findings, such as the findings for time spent with the patient, may likely be due to a lack of power. Future research is required with a larger sample of participating chiropractors to determine if such non-significant findings continue to be observed.

### 3.5.2 Implications

People do not typically attend chiropractors for weight loss interventions alone, but chiropractors are well placed to deal with this major public health issue due to training and general lifestyle approach to care. There are a number of important implications that stem from this study. First, the strong association between chiropractors’ years-since-graduation and whether chiropractors offered weight loss interventions to patients may have important implications for the chiropractic profession. One of the known barriers that clinicians cite to offering weight management interventions is a lack of knowledge.[55–63] These findings indicate that the change in the structure of chiropractic public health education may have resulted in more chiropractors who graduated after 2005 offering weight management to their patients; however, the amount of weight management interventions offered by chiropractors is still very low. In addition, the amount of time spent with the patient and type of practice were not significant barriers to whether weight management interventions were initiated or continued with the patient. Following the clinical practice guideline recommendations on weight management, interventions may be employed by all chiropractors regardless of how they practice. The challenge is changing the behaviour of chiropractors who are not providing weight management interventions to their patients. An education campaign from the Ontario Chiropractic Association about this issue may help raise awareness among chiropractors of how they can assist to improve the general health of their patients.
3.6 Conclusion

This study provides valuable information in an under-researched area of Canadian health care. While infrequently, chiropractors do provide weight management interventions to their patients. However, the need for weight management intervention among the patients who seek chiropractic care far exceeds what the chiropractic profession currently offers. Positive trends have been observed. Chiropractors who graduated after 2005 and were educated following public health chiropractic education reforms do offer weight management interventions more often to their patients. In addition, chiropractor-directed weight management interventions do not seem to be inhibited by the amount of time spent with the patient. Health care policy and continued chiropractic educational reforms can be guided to ensure that the needs of the patients who seek chiropractic care are met. Future research relevant to chiropractor-directed weight management intervention can be guided to ensure it is directed appropriately and in accordance with recommendations made by clinical practice guidelines on the treatment of overweight and obesity. Reducing the burden that overweight and obesity place on health will significantly enhance the well-being of Canadians. Chiropractors may have an important role as part of the healthcare movement to aid those with overweight and obesity.

3.7 Competing Interests

The authors declare no competing interests.

3.8 Acknowledgements

The authors would like to thank the O-COAST team pursuing the project and for granting access to the O-COAST dataset. They would also like to thank the chiropractors and patients who participated in O-COAST. Without their contributions this study would not have been possible.
3.9 References


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Figure 3.1: Detailed study sample selection

Chiropractors Registered in Ontario
(n=3,978)

Chiropractors Randomly Invited to Participate (n=135)

- Ineligible Chiropractors (n=13)
  - Not currently in practice (n=13)
  - Not practicing in Ontario (n=2)

Chiropractors Eligible to Participate
(n=120)

- Declined Participation (n=44)
  - No reason given (n=52)
  - Too busy (n=4)
  - Personal reasons (n=3)
  - Study involves too much work (n=3)
  - Clinic did not give permission (n=2)

  - Could Not Reach (n=33)

Chiropractors Agreed to Participate
(n=45)

- Drop Out (n=1)

Completed Data Entry and Coding
(n=42 chiropractors, 5,523 encounters)

- Multiple Encounters Removed (n=806)

Unique Patients
(n=2,717)

- Ineligible Patients (n=555)
  - BMI < 18.5 (n=224)
  - Age < 18 years (n=242)
  - Age > 80 years (n=89)

Unique Adult Patients with BMI ≥ 18.5
(n=2,162)
Table 3.1: Characteristics of the 42 participating chiropractors

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Chiropractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age in years (range, SD)(^{b,c})</td>
<td>43.5 (25 – 71; 11.4)</td>
</tr>
<tr>
<td>Mean years in practice (range, SD)</td>
<td>15.6 (2 – 45; 11.0)</td>
</tr>
<tr>
<td>Years since graduation (% of participating chiropractors)</td>
<td></td>
</tr>
<tr>
<td>Less than 10 years (2005 or sooner)</td>
<td>15 (35.7%)</td>
</tr>
<tr>
<td>Between 10 to 20 years (1995 to 2005)</td>
<td>14 (33.3%)</td>
</tr>
<tr>
<td>Greater than 20 years (1995 or later)</td>
<td>13 (31.0%)</td>
</tr>
<tr>
<td>Female (% of participating chiropractors)(^{a,b,c})</td>
<td>14 (33.3%)</td>
</tr>
<tr>
<td>Practice in languages other than English</td>
<td>11</td>
</tr>
<tr>
<td>Country of chiropractic education</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>34</td>
</tr>
<tr>
<td>United States</td>
<td>6</td>
</tr>
<tr>
<td>Australia</td>
<td>2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Practice characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of practice(^d)</td>
<td></td>
</tr>
<tr>
<td>General/Family</td>
<td>34</td>
</tr>
<tr>
<td>Sports</td>
<td>3</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>3</td>
</tr>
<tr>
<td>Lifestyle counseling</td>
<td>1</td>
</tr>
<tr>
<td>Wellness</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^a\) Mean age and sex of all chiropractors registered to practice in Ontario was 44.9 years and proportion of women 37.7% respectively (Statistics Canada Employment Income Statistics 2010).

\(^b\) 52.7% and 41.4% of all Canadian chiropractors were between the ages of 25-44 years and 45-64 years respectively with a mean age of 45.0 years (Statistics Canada 2011 National Household Survey).

\(^c\) Proportion of all Chiropractors who were women was 35.0% (Statistics Canada Employment Income Statistics 2010).

\(^d\) Note study analysis grouped Sports and Rehabilitation types of practice together and all other reported types of practice were grouped together as the ‘other’ category.
Table 3.2: Characteristics of chiropractic patients aged 18 to 80 years old who were of normal weight, overweight, and obese

<table>
<thead>
<tr>
<th>Descriptors</th>
<th>Total sample size (%)</th>
<th>No. (%) of recorded encounters</th>
<th>No. (%) of recorded encounters</th>
<th>No. (%) of recorded encounters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal Weight (BMI 18.5-24.9 kg/m²)</td>
<td>Overweight (BMI 25-29.9 kg/m²)</td>
<td>Obese (BMI ≥ 30 kg/m²)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nₙₑₙ=837</td>
<td>nₙₑₙ=817</td>
<td>nₙₑₙ=508</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>906 (41.9)</td>
<td>253 (30.2)</td>
<td>426 (52.1)</td>
<td>227 (44.7)</td>
</tr>
<tr>
<td>Female</td>
<td>1,256 (58.1)</td>
<td>584 (69.8)</td>
<td>391 (47.9)</td>
<td>281 (55.3)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24 years</td>
<td>118 (5.5)</td>
<td>75 (9.0)</td>
<td>32 (3.9)</td>
<td>11 (2.2)</td>
</tr>
<tr>
<td>25-54 years</td>
<td>1,201 (55.5)</td>
<td>502 (60.0)</td>
<td>414 (50.7)</td>
<td>285 (56.1)</td>
</tr>
<tr>
<td>55-80 years</td>
<td>843 (39.0)</td>
<td>260 (31.0)</td>
<td>371 (45.4)</td>
<td>212 (41.7)</td>
</tr>
<tr>
<td><strong>Smoking Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-smoker</td>
<td>2,062 (95.4)</td>
<td>795 (95.0)</td>
<td>782 (95.7)</td>
<td>485 (95.5)</td>
</tr>
<tr>
<td>Smoker</td>
<td>100 (4.6)</td>
<td>42 (5.0)</td>
<td>35 (4.3)</td>
<td>23 (4.5)</td>
</tr>
<tr>
<td><strong>Physical Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendation</td>
<td>101 (4.7)</td>
<td>48 (5.7)</td>
<td>38 (4.7)</td>
<td>15 (3.0)</td>
</tr>
<tr>
<td>Did not meet recommendation</td>
<td>2,061 (95.3)</td>
<td>789 (94.3)</td>
<td>779 (95.3)</td>
<td>493 (97.0)</td>
</tr>
<tr>
<td><strong>Diet</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendation</td>
<td>304 (14.1)</td>
<td>157 (18.8)</td>
<td>89 (10.9)</td>
<td>58 (11.4)</td>
</tr>
<tr>
<td>Did not meet recommendation</td>
<td>1,858 (85.9)</td>
<td>680 (81.2)</td>
<td>728 (89.1)</td>
<td>450 (88.3)</td>
</tr>
<tr>
<td><strong>Comorbid Conditions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>263 (12.2)</td>
<td>54 (6.4)</td>
<td>103 (12.6)</td>
<td>106 (20.9)</td>
</tr>
<tr>
<td>Absent</td>
<td>1,899 (87.8)</td>
<td>783 (93.6)</td>
<td>714 (87.4)</td>
<td>402 (79.1)</td>
</tr>
<tr>
<td><strong>Time with the Patient</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 9 minutes</td>
<td>783 (36.2)</td>
<td>306 (36.6)</td>
<td>290 (35.5)</td>
<td>187 (36.8)</td>
</tr>
<tr>
<td>10 – 15 minutes</td>
<td>603 (27.9)</td>
<td>252 (30.1)</td>
<td>218 (26.7)</td>
<td>133 (26.2)</td>
</tr>
<tr>
<td>16 – 20 minutes</td>
<td>258 (11.9)</td>
<td>75 (9.0)</td>
<td>108 (13.2)</td>
<td>75 (14.8)</td>
</tr>
<tr>
<td>&gt; 20 minutes</td>
<td>518 (24.0)</td>
<td>204 (24.3)</td>
<td>201 (24.6)</td>
<td>113 (22.2)</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Weight management initiated or continued by chiropractor*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>116 (5.4)</td>
<td>41 (4.9)</td>
<td>40 (4.9)</td>
<td>35 (6.9)</td>
</tr>
<tr>
<td>No</td>
<td>2,046 (94.5)</td>
<td>796 (95.1)</td>
<td>777 (95.1)</td>
<td>473 (93.1)</td>
</tr>
</tbody>
</table>

* Fisher’s Exact test p-value = 0.2319 comparing the distribution of weight management initiated or continued by chiropractors between BMI groups.
Table 3.3: Multilevel model log odds estimates for the two-level generalized linear dichotomous models of weight management intervention initiated or continued by chiropractors

<table>
<thead>
<tr>
<th>Estimates</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Model 4</th>
</tr>
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<tbody>
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<td><strong>Fixed Effects Patient Level Variables</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Intercept</td>
<td>-4.41 (0.54)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-5.15 (0.82)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.40 (0.90)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-2.45 (0.90)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>18.5 - 24.9</td>
<td></td>
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<tr>
<td>25.0 - 29.9</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>≥ 30.0</td>
<td>Ref</td>
<td>0.12 (0.26)</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>0.33 (0.29)</td>
<td>0.11 (0.27)</td>
<td>0.32 (0.29)</td>
<td>0.52 (0.31)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Ref</td>
<td>0.11 (0.24)</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>18 - 24</td>
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<tr>
<td>25 - 54</td>
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<td>55 - 80</td>
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<td>0.11 (0.25)</td>
<td>Ref</td>
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<tr>
<td>Smoker</td>
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<td>-0.83 (0.57)</td>
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<td>Physical Activity</td>
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</tr>
<tr>
<td>Met recommendation</td>
<td>Ref</td>
<td>0.83 (0.59)</td>
<td>Ref</td>
<td>Ref</td>
</tr>
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<td>Did not meet recommendation</td>
<td></td>
<td>0.88 (0.59)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet</td>
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<tr>
<td>Met recommendation</td>
<td>Ref</td>
<td>-0.64 (0.30)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
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<td>-0.65 (0.30)&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Comorbid condition</td>
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<tr>
<td>Absent</td>
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<td></td>
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</tr>
<tr>
<td>Present</td>
<td>Ref</td>
<td>0.18 (0.32)</td>
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<td>Ref</td>
</tr>
<tr>
<td>Time with Patient (minutes)</td>
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<td></td>
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<tr>
<td>0 - 9</td>
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<tr>
<td>10 - 15</td>
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<td>16 - 20</td>
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<tr>
<td>&gt; 20</td>
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<tr>
<td></td>
<td>0.47 (0.30)</td>
<td>0.42 (0.30)</td>
<td>0.42 (0.30)</td>
<td>0.30 (0.35)</td>
</tr>
<tr>
<td></td>
<td>0.21 (0.42)</td>
<td>0.16 (0.42)</td>
<td>0.13 (0.42)</td>
<td>0.30 (0.35)</td>
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<tr>
<td></td>
<td>0.31 (0.35)</td>
<td>0.30 (0.35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI x Comorbid condition</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>25.0 - 29.9 x present</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 30.0 x present</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>0.36 (0.70)</td>
<td>0.36 (0.70)</td>
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<td>-0.88 (0.75)</td>
<td>-0.88 (0.75)</td>
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<tr>
<td><strong>Fixed Effects Chiropractor Level Variables</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years Since Graduation (years)</td>
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<td></td>
</tr>
<tr>
<td>&lt; 10 (2005 – 2014)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 20 (prior to 1995)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-3.88 (0.95)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-2.59 (0.88)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-3.91 (0.95)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Style of Practice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports/Rehabilitation</td>
<td>Ref</td>
<td>-3.24 (1.38)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td><strong>Model Fit</strong></td>
<td></td>
<td></td>
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<tr>
<td>-2 Log Likelihood</td>
<td>700.02</td>
<td>684.82&lt;sup&gt;c&lt;/sup&gt;</td>
<td>668.42&lt;sup&gt;c&lt;/sup&gt;</td>
<td>664.62</td>
</tr>
<tr>
<td>AIC</td>
<td>704.02</td>
<td>712.82</td>
<td>702.42</td>
<td>702.62</td>
</tr>
</tbody>
</table>

Note: *p < 0.05; <sup>b</sup>p<0.01; <sup>c</sup>likelihood ratio test significant; ICC = 0.26794; Values based on SAS PROC GLIMMIX. Entries show parameter estimates with standard errors in parentheses; Estimation method = Laplace. <sup>d</sup>Best fitting model.
Table 3.4: Multilevel model 3 odds ratio estimates of predictor and outcome

<table>
<thead>
<tr>
<th>Odds ratios of weight management initiated or continued by chiropractor</th>
<th>Comparison</th>
<th>Estimate</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient level variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.5 - &lt; 25</td>
<td>Ref</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 - &lt; 30</td>
<td>1.12</td>
<td>0.66 – 1.88</td>
<td></td>
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<tr>
<td>≥ 30</td>
<td>1.38</td>
<td>0.78 – 2.42</td>
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<tr>
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<td>Ref</td>
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<tr>
<td>Male</td>
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<td>0.71 - 1.79</td>
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<td>18 - 24</td>
<td>0.93</td>
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<tr>
<td>25 - 54</td>
<td>Ref</td>
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<tr>
<td>55 - 80</td>
<td>1.11</td>
<td>0.68 - 1.81</td>
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<tr>
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<td>Physical Activity</td>
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<tr>
<td>Met recommendation</td>
<td>Ref</td>
<td></td>
<td></td>
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<tr>
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<td>0.75 - 7.72</td>
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<tr>
<td>Met recommendation</td>
<td>Ref</td>
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<tr>
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<tr>
<td>Present</td>
<td>1.21</td>
<td>0.65 - 2.26</td>
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<tr>
<td>Time Spent with Patient (minutes)</td>
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<td></td>
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<tr>
<td>0 - 9</td>
<td>Ref</td>
<td></td>
<td></td>
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<tr>
<td>10 - 15</td>
<td>1.53</td>
<td>0.85 - 2.73</td>
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<tr>
<td>16 - 20</td>
<td>1.17</td>
<td>0.52 - 2.67</td>
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<tr>
<td>&gt; 20</td>
<td>1.36</td>
<td>0.68 - 2.73</td>
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<td><strong>Chiropractor level variables</strong></td>
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<tr>
<td>Years Since Graduation (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10 (2005 - 2014)</td>
<td>Ref</td>
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<td>10 - 20 (1995 - 2004)</td>
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<td>0.00 - 0.13</td>
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<td>&gt; 20 (prior to 1995)</td>
<td>0.08</td>
<td>0.01 - 0.42</td>
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<tr>
<td>Type of Practice</td>
<td></td>
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<tr>
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<td>Ref</td>
<td></td>
<td></td>
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<td>Sports/Rehabilitation</td>
<td>0.04(^a)</td>
<td>0.00 - 0.59</td>
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\(^a\)Because of a high level of variation due to small cell size, estimates may be unreliable.
Chapter 4
Discussion

4.1 Summary of Findings

Chiropractors are well placed to provide weight management interventions to people with overweight and obesity. Yet little is known about current chiropractic practice and those who seek chiropractic care. The purpose of this thesis was to investigate weight management practices within the chiropractic profession. I have conducted a detailed review of the chiropractic profession in which utilization rates, reasons why patients sought chiropractic care, health profiles, and what treatment was provided by chiropractors were reported. Through a comprehensive analysis of cross-sectional survey data, I was able to measure the prevalence of weight management interventions initiated or continued by chiropractors. In addition, I demonstrated that specific patient and chiropractor characteristics were important in whether weight management interventions were offered to patients by chiropractors.

While not directly addressing the thesis objectives the first manuscript synthesised the chiropractic literature about chiropractic patient characteristics, reasons for attending care, and services provided by attending chiropractors. In this scoping review, searches were conducted in MEDLINE, CINAHL, and Index to Chiropractic Literature from database inception to August 2015. In total, 5213 articles were screened, which lead to 46 studies (reported in 48 articles) being included in the scoping review. The majority of these studies were published between 2005 and 2015, used a cross-sectional design, and originated in the United States, Australia, or Canada. The findings of chiropractic utilization were consistent with previous reviews which indicated that chiropractic utilization has remained relatively constant over time at 12% [1, 2]. However, chiropractic utilization rates were shown to vary at regional
levels (median rate of 15.1% in the Midwestern United States and in Midwestern Canada). The majority of people who sought chiropractic care were female (55.5%) and the median age of the chiropractic patient population was 42.2 years. The majority of patients who sought chiropractic care were overweight (34.1%) or obese (23.5%). Previous authors concluded that musculoskeletal complaints, specifically spinal pain, were the main reasons for patients attending a chiropractor [3–5]. The scoping review found that the most common reported reasons for people attending chiropractic care were low back pain (48.5%), neck pain (22.5%), and extremity problems (17.0%). This review found that chiropractors offer many different types of treatment to their patients with the most common being spinal manipulation (83.7%), nutritional supplements (52.0%), formal patient education (38.1%), heat (33.0%), soft-tissue therapy (28.1%), cold/ice (26.0%), electrical stimulation (25.0%), advice on medication (23.4%), mechanically assisted adjustments (22.6%), and exercise instruction or prescription (20.0%). The National Center for Health Statistics found that manipulation was the most commonly used provider-based complementary and alternative therapy among adults and children [6]. Although reported less frequently, the findings suggest that chiropractors offer many additional treatments or services including: nutritional supplements, formal patient education, medication advice, and exercise instruction as part of wellness care. Chiropractic care should not be considered consisting of spinal manipulation exclusively as chiropractors provided many additional services, some of which are consistent with weight management interventions.

The second manuscript focused on how often chiropractors initiated or continued weight management interventions with patients. In addition, the study examined the association between both patient-level and chiropractor-level variables and whether weight management intervention was provided by the chiropractor. Data from a large sample was used for the analysis. The key findings established that while chiropractors did initiate and continue weight management interventions with patients, the need for weight management among those who sought chiropractic care far exceeded what was offered by the
profession. Time constraints are commonly cited by healthcare professionals as a barrier to offering weight management to patients. Yet, the amount of time spent with the patient was not a significant factor in whether weight management was offered to patients by chiropractors. However, the years in which the chiropractor was educated was significantly associated with whether chiropractors initiated or continued weight management with patients. This finding supports claims that knowledge was a barrier to offering weight management interventions by healthcare professionals: chiropractors who received their education following chiropractic public health education reforms (those who graduated after 2005) were significantly more likely to offer weight management to patients. In addition, the type of practice (sports/rehabilitation vs. other) was indicated as a significant factor towards chiropractors offering weight management interventions to patients.

4.2 Study Design

Data used for analysis were from O-COAST, which employed a cross-sectional observational design. Information from cross-sectional studies is collected at a single point in time. While the O-COAST did allow for the capture of data from the same patient during multiple encounters these data were only used in a true cross-sectional manner as both risk factors and health conditions were obtained at the same time-point. Furthermore, analysis only considered a single encounter for each unique patient. This study design was ideal to estimate the prevalence of the outcome, weight management interventions initiated or continued by chiropractors within the chiropractic patient sample. O-COAST presented a unique platform to investigate associations between patient-level as well as chiropractor-level factors and whether weight management interventions were initiated or continued by the chiropractor. However, because the data were collected at one time point they gave no indication of the sequence of events - whether chiropractors engaged in weight management interventions with the patient following, during, or prior to exposure to the various factors of interest. Thus, in general it was not possible to infer causality.
4.2.1 My Involvement with O-COAST

I have had the honour of working with the O-COAST team since June 2014. I first became involved with the project during development of the encounter forms used in O-COAST. I participated in the meeting where the primary investigators and stakeholders finalized the questions and templates to be used for data collection. I was part of the O-COAST recruitment team and was responsible for contacting chiropractors by telephone. I provided information about the O-COAST and invited the chiropractors who did not respond to the mailed invitations to participate in the study.

Between November 2014 and June 2015, I was one of two trained coders who created the O-COAST dataset, the largest database of chiropractic patient encounter data of its kind in Canada. I entered and coded data from 1,678 encounter forms. In addition, I classified terms recorded by patients and chiropractors according to the *International classification of primary care, 2nd edition* (ICPC-2) using the Australian ICPC-2 PLUS general practice terminology.[7] I was also responsible for cleaning and processing all O-COAST data used for analysis within this thesis.

My ongoing involvement with the O-COAST team has given me the opportunity to present at the Canadian Chiropractic Association’s national conference. In addition, I was the project manager of a smaller project that used the O-COAST encounter forms to collect data about chiropractic practice among members of the Queen’s University Chiropractic Practice Based Research Network. This project was conducted using the same protocol as the O-COAST.
4.3 Internal Validity

Rothman et al. define the estimation process, the process leading to an epidemiologic estimate, as the end product of the study design, the study conduct, and the data analysis [8]. The goal of this process is to obtain a valid and precise estimate of the effect of an exposure on the occurrence of a disease in the source population of study. The validity of inferences drawn with regard to the members of the source population is referred to as internal validity which can be classified into three general categories: selection bias, information bias, and confounding. This section will include a discussion of internal validity and the biases that may have affected the results of this thesis.

4.3.1 Selection Bias

Selection biases arise from procedures used to select participants and from factors that influence study participation. In such biases the relationship between exposure and outcome is different for those who participate and for all those who should have been eligible for study [8]. When selecting the O-COAST sample, the research team attempted to reduce selection bias. The College of Chiropractors of Ontario (CCO) is the governing body that regulates the chiropractic profession in Ontario. Every practising chiropractor in Ontario must be a registered member of the CCO. When selecting eligible study participants the research team had access to this full list of registered chiropractors in Ontario. Random selection from all practicing chiropractors in Ontario was conducted to generate a list of 135 chiropractors who were approached for participation. However, the O-COAST had only 35% of eligible chiropractors participate. Thus the study sample may not have been representative of the entire population of chiropractors in Ontario and this may have resulted in selection bias. Without more information on the Ontario chiropractor population it is difficult to assess how representative the O-COAST sample was to the Ontario chiropractor population. The effect of selection bias on the study results is therefore difficult to infer.
4.3.2 Information Bias

Much of the O-COAST data used for analysis of this thesis were obtained directly from the chiropractor-patient encounter. Participating chiropractors were instructed to ask patients to answer questions regarding diet, exercise, and smoking status. Care must be taken in interpreting and drawing conclusions on such information, because there is a tendency for respondents to provide what they believe to be socially acceptable answers rather than the truth. For example, BMI was calculated using self-reported height and weight. The nature of this self-reported data may have resulted in an underestimate of patient BMI as those patients may have over-reported their height and under-reported their weight. This is especially true of information about behavioural aspects and health conditions associated with taboos.[9]

The analysis also interpreted current exposures for which their effects on the outcome were considered valid. However, because temporal relationships could not be determined for most factors analysed, it is not possible to determine if the recorded chiropractor-patient encounter reflected recent initiation of weight management interventions or the result of ongoing interventions. For example, an encounter may have shown chiropractor-initiated weight management interventions were offered inappropriately to a person who was of normal weight. However, this encounter may have reflected the continued support of a patient who was offered weight management interventions by their chiropractor many years ago when the patient was overweight or obese.

4.3.3 Confounding

The investigation presented in this thesis was based on survey data. When identifying the prevalence of weight management initiated or continued by chiropractors no causal relationship was examined hence confounding was not a problem with estimation accuracy. When determining associations between the various patient-level and chiropractor-level factors and whether weight management was initiated or continued by the chiropractor confounding was considered. The factors known to be associated with the
outcome of interest (patient BMI, sex, age, smoking status, physical activity, diet, and comorbidities as well as how much time the chiropractor spent with the patient, chiropractors’ years since graduation, and type of practice) were included in the analysis to ensure the comparisons were valid.

4.3.4 Cognitive Bias

Cognitive bias describes the conscious or unconscious actions of researchers’ systematic but potentially flawed patterns of responses to judgement and decision making.[10] Within the context of a scoping review, a reviewer may examine literature only from a limited set of sources, authors, or research communities and may select only preferred topics specified by funders. Researchers may unconsciously guide findings towards those of expected or desired results. In addition, those conducting the scoping review may be unfamiliar with the relevant literature and miss areas of importance or misinterpret their impact.[11]

Several steps were taken to reduce such biases. The methodology used to conduct the scoping review was well documented and fully developed prior to any database searches.[12–15] The scoping review study protocols were fixed ahead of the searches, and therefore were not changed by the results, so that the selection of articles included in the review were not distorted. The framework used to conduct the scoping review was systematic and the methods used throughout the different stages were conducted in a rigorous and transparent way as recommended in the literature.[16, 17] The process was documented in detail to enable the study to be replicated by others. This approach was taken to increase the reliability of the findings to address criticisms that the study lacked methodological rigour as addressed by Mays et al.[17]
Database searches were developed with the aid of and conducted by Kent Murnaghan, a librarian at the Canadian Memorial Chiropractic College. Multiple review authors conducted the phase I and phase II screenings in pairs and consensus between each pair was reached during each stage of the review process to reduce any biases of a single researcher. In addition, these processes were monitored by a third review author to encourage rigour and resolve disagreements. Arksey and O’Malley state that a scoping review needs to achieve in-depth and broad results and that the scoping study method be guided by a requirement to identify all relevant literature.[12] As recommended, this scoping review was developed with broad inclusion criteria and few exclusion criteria. A great effort was made to identify all relevant literature. Given the scope and breadth of the review, three experts (André E Bussières, Silvano Mior, and Simon French) were consulted to ensure completeness of the scoping review.

4.4 Models and Goodness-of-fit

Logistic regression is the most commonly used method for studying relationships that have a binary outcome.[18] Generalized linear mixed models (GLMM) allow for an extension of logistic regression that include both fixed and random effects.[19] GLMM was employed for the analysis presented in this thesis as the fixed effects associated with the covariates of interest could be calculated while controlling for the random subject effects. In addition, estimates of the variance of the random subject effects were calculated. The O-COAST design was ideal for analysis under GLMM because the study sample was multi-leveled and consisted of patients nested within participating chiropractors’ clinics. GLMM analysis enabled the study of influence at each level in the hierarchy on whether weight management interventions were offered by the chiropractor to the patient. Care was taken to design the GLM-type models as suggested by the literature.[20] Stratification within the study population was informative. Thus, stratification was accounted for by including stratum identifiers as fixed effects in the model. In addition, increases in variance attributable to the interclass correlation were accounted for. Design clusters were integrated into the natural hierarchy of the GLMM, and the cluster effects on outcomes were directly
modeled using additional levels of random effects – nesting patients within chiropractors (chiropractor directed care). Weighting of survey data was not conducted in the O-COAST nor was it conducted within this thesis.

4.5 Strengths and Limitations

This thesis provided valuable information about the chiropractic profession. The main strength of this thesis is the application of epidemiological principles to aid in the investigation of the clinical practice of an important health care profession. The data used for analysis were from a recent study that produced a large, representative sample. During analysis, careful assessment of both chiropractor and patient variables was undertaken to minimize error. Measures of diet, physical activity, and adiposity used within this thesis have been validated and are commonly used in the literature. Prominent clinical practice guidelines were used when determining what constituted “weight management interventions initiated or continued by the chiropractor”. Thus, the latest theoretical thinking on the application of weight management interventions was implemented during analysis of this thesis.

Several limitations existed which may have affected the results of this thesis. Chiropractors were trained by a single project manager in a standardized manner, however, the application and means used to capture the O-COAST data were ultimately at the discretion of the participating chiropractor. This may have resulted in data being collected in different ways, with some chiropractors asking all questions during the patient encounter, while others may have simply had the patient complete the questions in the waiting room or delegated data collection to another staff member – such as a receptionist or chiropractic assistant. In addition, questions may have been interpreted differently or asked in different ways. It is difficult to know if all chiropractors recorded all events that occurred during the patient encounter. The doctor-patient encounter is a complex event with much information and discussions related to weight
management may have been overlooked and not recorded by the chiropractor. However, the encounter forms used in the O-COAST were based on encounter forms used in similar studies[21, 22] with an established reliable and valid data collection process.[23]

Errors may have resulted from the interpretation of the O-COAST data. Chiropractors who participated in O-COAST occasionally recorded a treatment or service on the encounter form that was ambiguous or was left to interpretation. The coder may have input a treatment other than what was actually performed or intended by the participating chiropractor. For example, a chiropractor may have recorded that they simply recommended ‘exercise’ for their patient with the intent of weight management. However, without clear indication that this intervention was intended for weight management the coder would have interpreted this ‘exercise’ to be for rehabilitation purposes by default and not for weight management. Such errors may have resulted in an underestimate of the amount of weight management interventions offered by chiropractors to patients.

Another limitation was that important covariates were not measured during assessment of the cross-sectional study data. When analysis was conducted to evaluate the association between patient-level and chiropractor-level variables and whether weight management was initiated or continued by the chiropractor several covariates were suspected to confound the association of interest. Given the complexity of chiropractic clinical practice and the heterogeneity of the population that sought chiropractic care there may have been other potential confounders, such as socioeconomic status, that were not measured and accounted for in the analysis. Furthermore, residual confounding may have resulted due to poor measurement of covariates as a result of bias or imprecise measurement techniques.
Finally, while the O-COAST design was ideal for prevalence estimation, it presented a challenge for accurately measuring weight management interventions initiated or continued by chiropractors. The management of weight is a long and committed process that occurs over time. It was possible that chiropractors may have been providing weight management interventions to their patients but during the specific chiropractor-patient encounter captured by this study no weight management intervention was conducted or recorded. For example, a patient may have presented to a participating chiropractor with an acute condition that then took precedence over any ongoing weight management intervention that would have normally occurred. Therefore we may have underestimated the amount of weight management interventions that were provided by chiropractors. However, the rate of weight management interventions offered was so low that even a tripling of this observed rate would still mean that chiropractors were underutilising this opportunity to improve the health of their patients.

4.6 Power Calculation

The sample size for this thesis was predetermined. Given the lack of research on the relationship between chiropractor-directed weight management interventions and specific patient-level and chiropractor-level variables, post hoc statistical power was computed at three different odds ratios for two of the variables of interest, one at the patient-level (BMI) and one at the chiropractor-level (type of practice). Prior data on error and ICC was lacking, therefore the power calculations were conducted using simulations.

Simulation were used to generate the power achieved for each variable within Model 3 of this thesis. Methods described by Cassell [24, 25] were used to generate 500 bootstrap samples each with 2162 unique cases based on the data used for analysis in chapter 3. The bootstrapping method utilized case resampling of the data using simple random sampling with replacement from the original sample. This method was based on similar simulations presented in the literature.[26, 27]
Appendix C, Table C.1 shows the calculated power for the patient-level variable ‘BMI’ and the chiropractor-level variable ‘type or practice’ at three fixed effect sizes. It was determined that the analysis presented in chapter 3 of this thesis had little power when the effect size of BMI for both the odds ratios between overweight compared to normal weight and obese compared to normal weight were set at 1.3. The study also had little power when the effect size of type of practice was fixed to 10. However, the analyses presented in chapter 3 did have sufficient power to detect a meaningful difference for BMI at an odds ratio of 1.65 and with an odds ratio of 15 for type of practice.

4.7 Implications

There are a number of important implications that stem from this thesis. First, the strong association between chiropractor year since graduation and whether chiropractors offered weight management interventions to patients may help inform the chiropractic profession of future areas to focus their continuing education efforts. A lack of knowledge about weight management interventions may pose a barrier to chiropractors offering these services to their patients. Increased awareness within the chiropractic profession as well as accessible practical applications of the recommendations made within the clinical practice guidelines on the management of patients with overweight and obesity may encourage more chiropractors to engage in weight management with their patients.

4.8 Future Research

This thesis has served as an effective first step in describing the weight management practices of the chiropractic profession. It has contributed to the growing body of literature about the chiropractic profession. However, additional research is required to expand on the finding of this thesis. Future study of chiropractors and the people who seek chiropractic care is required outside the US and Canada to determine if similar trends in whether weight management interventions are offered by chiropractors to
their patients emerge. Such research may help further describe the findings of increased prevalence of weight management interventions offered by chiropractors who graduated after 2005. This investigation may also support the claim that this change in the prevalence of weight management intervention was due to chiropractic public health education reforms and not from some other factors.

Finally, additional research is required to examine the effects of the application of weight management interventions, as recommended by the clinical practice guidelines, within the chiropractic profession. A longitudinal study design would be a logical next step to observe what effects chiropractor-directed weight management interventions have over the course of treatment. Such research might then describe how weight management within chiropractic practice is best applied.

### 4.9 Conclusions

This thesis provided an overview of weight management within the chiropractic profession. The findings of the two manuscripts act as an important first step towards identifying the evidence-practice gap between the evidence-based clinical practice guideline recommendations on the management of those with overweight and obesity and current chiropractic practice. Chiropractors are dedicated to meeting the healthcare goals of their patients. To this end the chiropractic profession must do more to ensure that those with overweight and obesity are properly cared for. The burden overweight and obesity place on health is immense. Chiropractors are in a unique position to help improve patient health through offering weight management. However, it appears that this opportunity has not been fully realized by the chiropractic profession.
4.10 References


17. Mays N, Roberts E, Popay J: Studying the organisation and delivery of health services: Research


Appendix A

Ethics Approval

QUEEN’S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS
RESEARCH ETHICS BOARD (HSREB)

HSREB Initial Ethics Clearance

September 28, 2015

Dr. Peter Beliveau
Department of Public Health Sciences
Queen’s University

ROMEO/TRAQ: #6016204
Department Code: EPID-521.15
Study Title: Identifying Evidence-Practice Gaps in the Chiropractic Profession when
Recommended Weight Loss Strategies to Patients who Suffer from Overweight or Obesity
Co-Investigators: Dr. S. French, Dr. M. McIsaac
Review Type: Delegated
Date Ethics Clearance Issued: September 28, 2015
Ethics Clearance Expiry Date: September 28, 2016

Dear Dr. Beliveau,

The Queen’s University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board
(HSREB) has reviewed the application and granted ethics clearance for the documents listed below.
Ethics clearance is granted until the expiration date noted above.

- Protocol (July 2015)

Documents Acknowledged:

- Practitioner Encounter Form No. 1
- Practitioner Encounter Form No. 2
- Recruitment Script
- CORE Certificate – P. Beliveau
- Public Health Sciences Approval
- O-COAST REB application

Amendments: No deviations from, or changes to the protocol should be initiated without prior written
clearance of an appropriate amendment from the HSREB, except when necessary to eliminate immediate
hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of
the trial.
Renewals: Prior to the expiration of your ethics clearance you will be reminded to submit your renewal report through ROMEO. Any lapses in ethical clearance will be documented on the renewal form.

Completion/Termination: The HSREB must be notified of the completion or termination of this study through the completion of a renewal report in ROMEO.

Reporting of Serious Adverse Events: Any unexpected serious adverse event occurring locally must be reported within 2 working days or earlier if required by the study sponsor. All other serious adverse events must be reported within 15 days after becoming aware of the information.

Reporting of Complaints: Any complaints made by participants or persons acting on behalf of participants must be reported to the Research Ethics Board within 7 days of becoming aware of the complaint. Note: All documents supplied to participants must have the contact information for the Research Ethics Board.

Investigators please note that if your trial is registered by the sponsor, you must take responsibility to ensure that the registration information is accurate and complete.

Yours sincerely,

Chair, Health Sciences Research Ethics Board

The HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 5 of the Medical Devices Regulations, Canadian General Standards Board, and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is qualified through the CTO REB Qualification Program and is registered with the U.S. Department of Health and Human Services (DHHS) Office for Human Research Protection (OHRP). Federalwide Assurance Number: FW4#: 00004134, IRB#: 00001173

HSREB members involved in the research project do not participate in the review, discussion or decision.
Appendix B

O-COAST Patient Encounter Forms

**O-COAST Data Collection Intake Patient Encounter Form 1**

<table>
<thead>
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<th>Patient Last Name</th>
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</thead>
<tbody>
<tr>
<td>_ _ _ _ _ _</td>
<td>Yes/No</td>
<td>_ _ _ _ _ _</td>
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</tr>
</tbody>
</table>

<table>
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<tr>
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<table>
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<tr>
<th>Encounter Number:</th>
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</thead>
<tbody>
<tr>
<td>_ _ _ _ _ _</td>
<td>_ _ _ _ _ _</td>
</tr>
</tbody>
</table>

**Diagnosis 1:**

- **Techniques and care provided:**
  - Manual adj.:
  - Activator:
  - Flexion:
  - STT:
  - Mobil:
  - Blocks:
  - Drop:
  - Acupunct:

- **Duration:**

- **Problem status:**
  - NEW:
  - OLD:

- **Work related:**
  - Y
  - N

- **MVA related:**
  - Y
  - N

<table>
<thead>
<tr>
<th>Patient referred FROM (check all that apply):</th>
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</thead>
<tbody>
<tr>
<td>Family physician:</td>
</tr>
<tr>
<td>Other chiropractor:</td>
</tr>
<tr>
<td>Other provider (name, purpose):</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient referred TO (check all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family physician:</td>
</tr>
<tr>
<td>Other provider (name, purpose):</td>
</tr>
<tr>
<td>Other (please describe):</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problem referred:</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Patient:</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Imaging ordered/done today:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body site:</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other recommendations/actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ _ _ _ _ _</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional provider(s) seen by patient at encounter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis/Problem(s):</td>
</tr>
<tr>
<td>1 2 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Provider(s) communicated with during encounter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis/Problem(s):</td>
</tr>
<tr>
<td>1 2 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check all that apply:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient paid:</td>
</tr>
<tr>
<td>Aboriginal:</td>
</tr>
<tr>
<td>Workers comp paid:</td>
</tr>
<tr>
<td>Non-English speaking background:</td>
</tr>
<tr>
<td>MVA paid:</td>
</tr>
<tr>
<td>Indian affairs paid:</td>
</tr>
<tr>
<td>Veterans affairs paid:</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Follow-up appt:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ _ _ _ _ _</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What is the intent of care today?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute care:</td>
</tr>
<tr>
<td>Supportive care:</td>
</tr>
<tr>
<td>Wellness/maintenance care:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other recommendations/actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ _ _ _ _ _</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many servings of the following do you usually eat each day?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables and Fruit:</td>
</tr>
<tr>
<td>Grain Products:</td>
</tr>
<tr>
<td>Milk and Alternatives:</td>
</tr>
<tr>
<td>Meat and Alternatives:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In a normal week, how many times do you engage in vigorous physical activity lasting 30 minutes or more?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never:</td>
</tr>
<tr>
<td>Once a week:</td>
</tr>
<tr>
<td>1-2 times per week:</td>
</tr>
<tr>
<td>3-5 times per week:</td>
</tr>
<tr>
<td>6-7 times per week:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How many standard drinks do you have on an average day?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never:</td>
</tr>
<tr>
<td>1-2 drinks:</td>
</tr>
<tr>
<td>3-5 drinks:</td>
</tr>
<tr>
<td>6-7 drinks:</td>
</tr>
<tr>
<td>8-10 drinks:</td>
</tr>
<tr>
<td>11-14 drinks:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicate how many standard drinks you had on each day in the past 7 days:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1:</td>
</tr>
<tr>
<td>Day 2:</td>
</tr>
<tr>
<td>Day 3:</td>
</tr>
<tr>
<td>Day 4:</td>
</tr>
<tr>
<td>Day 5:</td>
</tr>
<tr>
<td>Day 6:</td>
</tr>
<tr>
<td>Day 7:</td>
</tr>
</tbody>
</table>
### O-COAST Data Collection Intake Patient Encounter Form 2

#### O-COAST (Ontario Chiropractic Observation & Analysis Study)

**Encounter Number:**

**Patient reported reasons for encounter:**

**Chiropractor ID:**

**Patient consent obtained?**

**Emergency patient?**

**Patient Date of Birth:**

**Patient Postal Code:**

**Patient Size:**

**Height:**

**Weight:**

**Occupation:**

**Health consent:**

**Disability:**

**Co-morbidities:**

**Duration:**

**Problem status:**

**Work related:**

**MVA related:**

**Techniques and care provided:**

**Modalities:**

**Other recommendations/actions:**

**Additional provider(s) seen by patient at encounter:**

**Diagnosis/Problem(s):**

**Imaging ordered/done today:**

**Body Site:**

**Check all that apply:**

**Patient paid:**

**Extended health ins paid:**

**Workers comp paid:**

**MVA paid:**

**Indian affairs paid:**

**Veterans aff paid:**

**Other:**

**What is the length of care today?**

**Acute care**

**Supportive care**

**Wallace/maintenance care**

**In general, would you say your health is:**

- **Excellent**
- **Very good**
- **Good**
- **Fair**
- **Poor**

**Very good**

**Very satisfied**

**Neither satisfied nor dissatisfied**

**Very dissatisfied**

**Not sure how many activities does your pain or discomfort prevent?**

- **None**
- **A few**
- **Some**
- **Very dissatisfied**

**Using a scale of 0 to 10, how do you feel about your life as a whole right now? Please circle one:**

- **0**
- **1**
- **2**
- **3**
- **4**
- **5**
- **6**
- **7**
- **8**
- **9**
- **10**

**satisfied**
Appendix C

Power Calculations

Table C.1: Power calculations for multilevel Model 3 when the patient-level variable ‘body mass index’ and the chiropractor-level variable ‘type of practice’ were simulated with fixed effect sizes

<table>
<thead>
<tr>
<th>Chiropractor-level variable (type of practice)</th>
<th>Effect size</th>
<th>Patient-level variable (body mass index)</th>
<th>1.3</th>
<th>1.65</th>
<th>2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BMI OW:N = 11.8%</td>
<td>BMI OW:N = 74.5%</td>
<td>BMI OW:N = 86.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>BMI Ob:N = 6.4%</td>
<td>BMI Ob:N = 46.4%</td>
<td>BMI Ob:N = 77.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Practice type = 52.7%</td>
<td>Practice type = 65.5%</td>
<td>Practice type = 66.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>BMI OW:N = 20.9%</td>
<td>BMI OW:N = 94.5%</td>
<td>BMI OW:N = 96.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI Ob:N = 22.7%</td>
<td>BMI Ob:N = 81.8%</td>
<td>BMI Ob:N = 91.8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Practice type = 80.9%</td>
<td>Practice type = 87.3%</td>
<td>Practice type = 89.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>BMI OW:N = 22.7%</td>
<td>BMI OW:N = 97.3%</td>
<td>BMI OW:N = 99.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BMI Ob:N = 32.7%</td>
<td>BMI Ob:N = 90.9%</td>
<td>BMI Ob:N = 93.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Practice type = 90.9%</td>
<td>Practice type = 94.5%</td>
<td>Practice type = 98.8%</td>
<td></td>
</tr>
</tbody>
</table>

BMI = body mass index, N = normal weight (BMI 18.5 kg/m² – 24.9 kg/m²), OW = overweight (BMI 25.0 kg/m² – 29.9 kg/m²), Ob = obese (BMI ≥ 30.0 kg/m²)

Calculations were made using simulated data that fixed the effect size of the ‘BMI’ variable to an odds ratio of 1.3, 1.65, and 2.0 and the ‘type if practice’ variable to an odds ratio of 10, 15, and 20. Simulations were created using 500 bootstrap samples and power was calculated from these data.
Appendix D

Manuscript Appendices

Appendix 2.1: MEDLINE Search Strategy

1. Exp Chiropractic/
2. chiropract*.ab,ti.
3. chiropraxis*.ab,ti.
4. or 1-3
5. Manipulation, Spinal/
6. Exp Manipulation, Chiropractic/
7. Musculoskeletal Manipulations/
8. Musculoskeletal Diseases/therapy*
9. SMT.ab,ti.
10. HVLA.ab,ti.
11. spinal adj2 manipulat*.ab,ti.
12. spinal adj2 adjustment*.ab,ti.
13. spinal adj2 therap*.ab,ti.
15. or 5-14
16. Complementary Therapies/
17. complementary adj2 therap*.ab,ti.
18. complementary adj2 medicine*.ab,ti.
19. CAM.ab,ti.
20. alternative adj2 therap*.ab,ti.
21. alternative adj2 medicine*.ab,ti.
22. or 16-21
23. Allied Health Occupations/
24. allied adj2 health.ab,ti.
25. primary adj2 contact*.ab,ti.
26. or 4 or 15 or 22 or 23 or 24 or 25
27. Patient Participation/
28. Patient Preference/
29. Patient Compliance/
30. Exp Patient Care Team/
31. Patients/
32. Health Services Administration/
33. Patient Care Management/
34. Patient Acceptance of Health Care/statistics & numerical data*.ab,ti.
35. Professional Practice/statistics & numerical data*.ab,ti.
36. [patient* or customer* or consumer* or client*] adj2 encounter*.ab,ti.
37. [patient* or customer* or consumer* or client*] adj2 profile*.ab,ti.
38. [patient* or customer* or consumer* or client*] adj2 care*.ab,ti.
39. [patient* or customer* or consumer* or client*] adj2 characteristic*.ab,ti.
40. [patient* or customer* or consumer* or client*] adj2 feature*.ab,ti.
41. [patient* or customer* or consumer* or client*] adj2 referral*.ab,ti.
42. [patient* or customer* or consumer* or client*] adj2 payment*.ab,ti.
43. [patient* or customer* or consumer* or client*] adj2 reimbursement.ab,ti.
44. [patient* or customer* or consumer* or client*] adj2 satisfaction.ab,ti.
45. treatment* adj2 satisfaction.ab,ti.
46. health* adj2 profile*.ab,ti.
47. reason* adj2 encounter*.ab,ti.
48. health adj2 survey*.ab,ti.
49. practice* adj2 pattern*.ab,ti.
50. utilization*.ab,ti.
51. or 27-51
52. and 26 and 51
53. limit 53 to human studies
Appendix 3.1

**Interclass Correlation Coefficient Calculation**

\[
\text{ICC} = \frac{\sigma^2_{\text{chiropractor}}}{\sigma^2_{\text{chiropractor}} + \sigma^2_{\text{error}}}
\]

\[
\text{ICC} = \frac{0.01527}{0.01527 + 0.04172}
\]

\[
= 0.26794
\]

**Design Effect Calculation**

Design effect = 1 + ((\(n_{h1-1}/n_{h1-2}\) -1) ICC)

Design effect = 1 + ((2193/42 -1) 0.26794)

\[
= 14.5247
\]
### Appendix 3.2

Table A.1: Distribution of patients by BMI category and type of chiropractic practice

<table>
<thead>
<tr>
<th>Type of Chiropractic Practice</th>
<th>No. (%) of recorded encounters Normal Weight (BMI 18.5-24.9 kg/m²)</th>
<th>No. (%) of recorded encounters Overweight (BMI 25-29.9 kg/m²)</th>
<th>No. (%) of recorded encounters Obese (BMI ≥ 30 kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>$n_{nw} = 837$</td>
<td>$n_{ow} = 817$</td>
<td>$n_{ob} = 508$</td>
</tr>
<tr>
<td></td>
<td>789 (94.3)</td>
<td>762 (93.3)</td>
<td>476 (93.7)</td>
</tr>
<tr>
<td>Sports/Rehabilitation</td>
<td>48 (5.7)</td>
<td>55 (6.7)</td>
<td>32 (6.3)</td>
</tr>
</tbody>
</table>