An Investigation of Chiropractor-Directed Weight-Loss Interventions: Secondary Analysis of O-COAST

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Abstract

Objective: The purpose of this study was to investigate weight-loss interventions offered by Canadian doctors of chiropractic to their adult patients.

Methods: This paper reports a secondary analysis of data from the Ontario Chiropractic Observation and Analysis STudy (N_c = 42 chiropractors, N_p = 2162 patient encounters). Multilevel logistic regression was performed to assess the odds of chiropractors initiating or continuing weight management interventions with patients. Two chiropractor variables and 8 patient-level variables were investigated for influence on chiropractor-directed weight management. In addition, the interaction between the effects of patient weight and comorbidity on weight management interventions by chiropractors was assessed.

Results: Around two-thirds (61.3%) of patients who sought chiropractic care were either overweight or had obesity. Very few patients had weight loss managed by their chiropractor. Among patients with body mass index equal to or greater than 18.5 kg/m^2, guideline recommended weight management was initiated or continued by Ontario chiropractors in only 5.4% of encounters. Chiropractors did not offer weight management interventions at different rates among patients who were of normal weight, overweight, or obese (P value = 0.23). Chiropractors who graduated after 2005 who may have been exposed to reforms in chiropractic education to include public health were significantly more likely to offer weight management than chiropractors who graduated between 1995 and 2005 (odds ratio 0.02; 95% CI [0.00-0.13]) or before 1995 (odds ratio 0.08; 95% CI [0.01-0.42]).

Conclusion: The prevalence of weight management interventions offered to patients by Canadian chiropractors in Ontario was low. Health care policy and continued chiropractic educational reforms may provide further direction to improve weight-loss interventions offered by doctors of chiropractic to their patients. (J Manipulative Physiol Ther 2019;42:353-365)

Key Indexing Terms: *Weight Loss; Chiropractic; Public Health*

Introduction

Clinical practice guidelines advise health care professionals to recommend strategies, provide weight management counseling, and offer continued support to patients with overweight and obesity.[1-3] Despite these guidelines, patients who are overweight and have obesity are not well managed by their health care professionals.[4,5] Prior reports have shown that these patients do pursue help managing their weight from health care professionals, with most seeking dietary advice, exercise recommendations, and help setting realistic weight goals.[6]

Chiropractors are trained to provide dietary, nutritional, and lifestyle advice and therapeutic exercise to address specific patient complaints and enhance overall health. An estimated 71% of men and 53% women who seek chiropractic care are overweight or have obesity.[7] As

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practitioners with a holistic approach to care, chiropractors have a unique opportunity to provide dietary and exercise advice to overweight and obese patients.

Little is known about the clinical practice of chiropractor-directed weight-loss management. Previous research suggested chiropractors are willing to undertake weight management interventions with patients but were more likely to provide health information brochures[8] than to offer more effective guideline-recommended interventions, such as a reduced energy diet.[9] Lack of time, resources, patient support, and knowledge are commonly reported reasons by health care providers not to manage overweight and obesity.[10-14] Past investigations have focused extensively on patient-level factors that drive weight management[15,16]; however, the factors determining when chiropractors will initiate or continue weight-loss interventions are not well understood. It is not known what factors influence chiropractors to offer weight management interventions or if such offering is associated with an interaction between patient weight and comorbid conditions.

The purpose of this study was to investigate weight-loss interventions offered by chiropractors to their adult patients. The 4 objectives included (1) determine the prevalence of overweight and obesity in the adult patient population who 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- and chiropractor-level variables, and (4) examine the interaction between the effect of patient weight and comorbid conditions on whether chiropractors offered weight-loss interventions.

Methods

Ontario Chiropractic Observation and Analysis Study

For this secondary data analysis, we used data from the Ontario Chiropractic Observation and Analysis Study (O-COAST).[17] The O-COAST was a cross-sectional observational study of chiropractic practice conducted between August 2014 and November 2015. A random sample of 135 chiropractors was generated from all those registered to practice in Ontario, Canada. Forty-two of 120 eligible invited chiropractors (35%) recorded up to 100 consecutive patient encounters. The study involved 3 inter-related data collections, including relevant provider, patient, and management information (see Appendix A for the data collection forms). Demographics, clinical information, patient characteristics, treatment provided, and recommendations given by the treating chiropractor were recorded. Data were classified according to the *International Classification of Primary Care,* 2nd edition (ICPC-2), using the Australian ICPC-2 PLUS general practice terminology[18] and the ICPC-2 PLUS Chiro terminology.[19] In total, 3523 patient encounters were recorded, of which 2162 met our eligibility criteria (unique patients aged 18 to 80 years with body mass index [BMI] equal to or greater than 18.5 kg/m^2) (See Fig 1).

Study Design Overview

Secondary data analysis was conducted for only complete patient data from the first recorded encounter. The use of time-invariant patient characteristics of subsequent encounters to minimize missing data resulted in less than 9% of the study population patient encounters being excluded from analysis owing to missing data. Multilevel logistic regression was used to examine the 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 the effects of patient weight and comorbid conditions on whether chiropractors offered weight-loss interventions. Two chiropractor-level and 8 patient-level variables were included in our analysis.

Chiropractor-level Study Variables

Participating chiropractors completed a baseline questionnaire providing demographic and clinic information. The chiropractor-level variables "years since graduation" and "type of practice" were used as cluster (level 2) variables in a multilevel model analyzing predictors of chiropractor-delivered weight-loss management (Table 1). Years since graduation was divided into categories: graduated between 2005 and 2014, graduated between 1995 and 2004, and graduated before 1995. This reflected time relevant to public health education reforms related to "A Model Course for Public Health Education in Chiropractic Colleges" that was published in 2002.[20] Chiropractic care provided by sports and rehabilitation clinics is specialized and therefore may have been different than care offered in other practice settings. Type of practice was divided into sports and rehabilitation practice and other (including general, family, lifestyle counseling, and wellness practice).

Patient-Level Study Variables

During each encounter, participating chiropractors recorded patient characteristics, demographic data, and treatment provided or recommendations made. Eight patient-level (level-1) variables were included: BMI, sex, age, smoking habits, physical activity, diet, the presence of a comorbid condition (including arthritis, diabetes, hypertension, and hyperlipidemia), and time spent by the chiropractor with the patient (Table 1). The BMI was

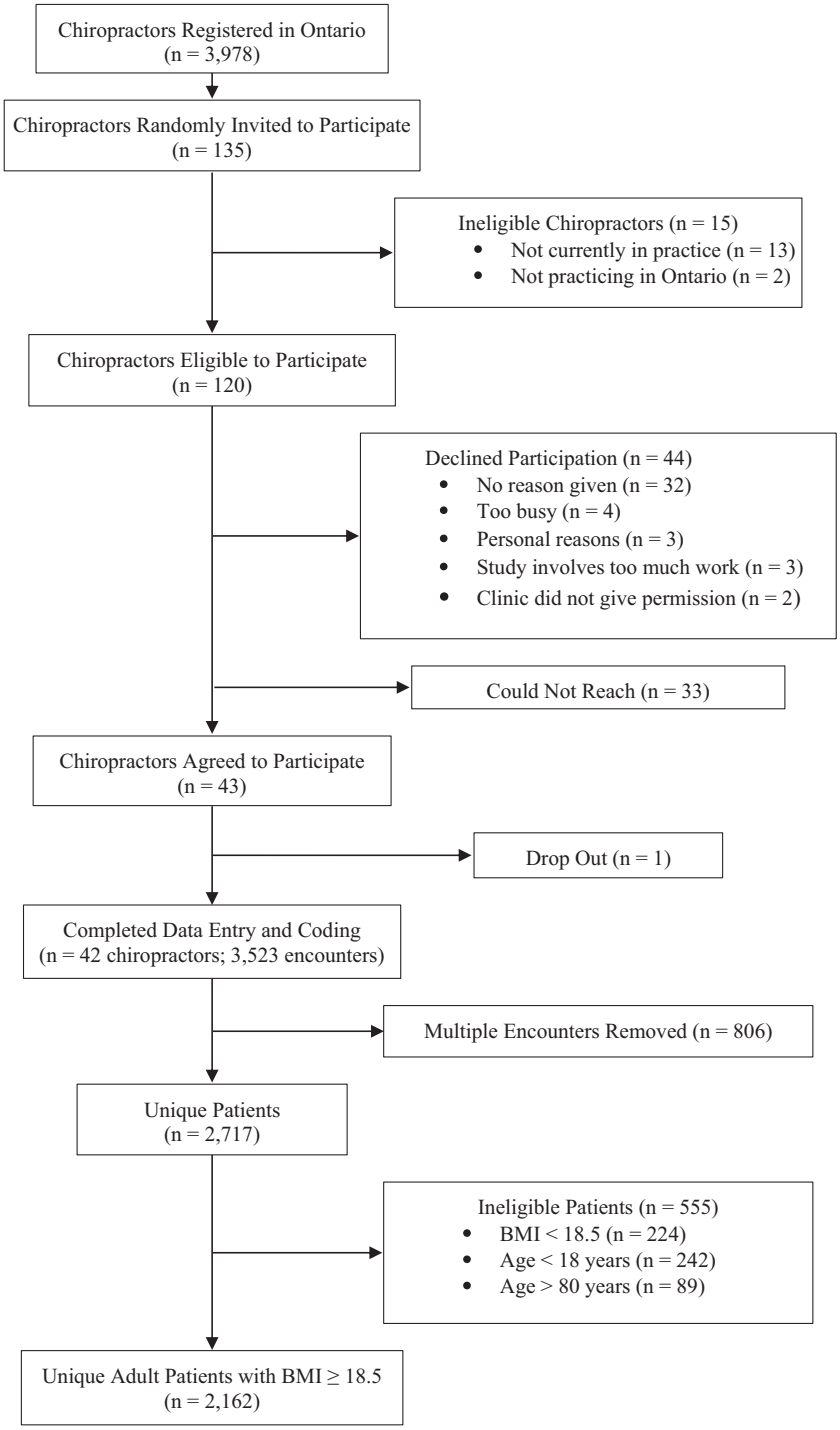

Fig 1. *Detailed study sample selection.* BMI*, body mass index.*

calculated using patient-reported height and weight. Patients were categorized as underweight (BMI < 18.5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2), or obese (BMI ≥30 kg/m^2); however, underweight patients were excluded from analysis. Patient sex (self-reported) was recorded and used as a dichotomous variable (male and female). Self-reported date of birth was used to calculate patient age with 3 categories used: aged 18 to 24 years, aged 25 to 54 years, and aged 55 to 80 years.

Table 1. *Level 1, Level 2, and Outcome Variable Details*

Variable Name	Categories			
Level 2 (chiropractor level)				
Years since graduation	Prior to 1995	1995-2004	2005-2014	
Type of practice	Sports/rehabilitation	Other	-	
Level 1 (patient level)				
BMI	Normal weight (BMI 18.5-24.9 kg/m^2)	Overweight (BMI 25-29.9 kg/m^2)	Obese (BMI ≥30 kg/m^2)	
Sex	Male	Female	-	-
Age (y)	18-24	25-54	55-80	-
Smoking status	Nonsmoker	Smoker	-	-
Physical activity	Met recommendation	Did not meet recommendation	-	-
Diet	Met recommendation	Did not meet recommendation	-	-
Comorbid conditions	Present	Absent	-	-
Time with the patient (min)	0-9	10-15	16-20	>20
Outcome				
Weight management imitated or continued by chiropractor	Yes	No	-	-

BMI, body mass index.

A dichotomous variable (nonsmoker and smoker) was used in which "never smoked" and "used to smoke" responses were combined as "nonsmoker"; the "now smoke occasionally" and "now smoke regularly" responses were combined as "smoker." Physical activity was measured in accordance with current Canadian guideline recommendations[21-23] by grouping those who reported being physically active 4 or more times per week as "met recommended physical activity level" and those who reported less than 4 days per week of physical activity as "did not meet recommended physical activity level."

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.[24,25] Study participants were asked how many servings of vegetables and fruit they usually ate each day and categorized accordingly: "5 or more servings of fruit and vegetables per day" and "less than 5 servings of fruit and vegetables per day." Patients were asked to list other conditions they had 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 1 or more patient-reported comorbid conditions or the absence of any comorbid conditions.

Chiropractors reported the time that 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 to 9 minutes, 10 to 15 minutes, 16 to 20 minutes, and greater than 20 minutes spent with the patient. Typically initial patient encounters, where a patient sought care from a chiropractor for the first time and not a repeat visit, are longer in duration to provide a detailed workup of the patient. As such, all initial patient encounters were excluded from analysis because they were not representative of the typical time spent with the patient.

Chiropractor-Initiated Weight Management

Chiropractors recorded the treatments delivered at the time of each patient encounter, recommendations made relating to the conditions treated, and interventions initiated or continued for those conditions identified. We identified weight management interventions using ICPC-2 PLUS codes. Three specific chiropractor-directed weight management recommendations consistent with international weight

Table 2. *Characteristics of the 42 Participating Chiropractors*

Characteristics	Chiropractors
Mean age, y (range, SD)[a,b]	43.5 (25-71, 11.4)
Mean y in practice (range, SD)	15.6 (2-45, 11.0)
Years since graduation (% of participating chiropractors)	
Less than 10 years (2005 or sooner)	15 (35.7)
Between 10 and 20 years (1995 to 2005)	14 (33.3)
Greater than 20 years (1995 or later)	13 (31.0)
Female (% of participating chiropractors)[a,b,c]	14 (33.3)
Practice in languages other than English	11
Country of chiropractic education	
Canada	34
United States	6
Australia	2
Practice characteristics	
Type of practice [d]	
General/family	34
Sports	3
Rehabilitation	3
Lifestyle counseling	1
Wellness	1

BMI, body mass index; *SD*, standard deviation.

[a] 52.7% and 41.4% of all Canadian chiropractors were between ages 25-44 years and 45-64 years, respectively, with a mean age of 45.0 years (Statistics Canada 2011 National Household Survey[26]).

[b] Proportion of all chiropractors who were women was 35.0% (Statistics Canada Employment Income Statistics 2010[27]).

[c] 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).

[d] Study analysis grouped sports and rehabilitation types of practice together and all other reported types of practice were grouped together as the other category.

management guideline recommendations were considered: (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 an indicator of "weight management initiated or continued by the chiropractor."

Analysis and Multilevel Modeling

Descriptive analyses were performed to profile the patient study population by age, sex, and adiposity. Multilevel logistic regression models were employed to determine associations with chiropractor-directed weight management. The first level controlled for any variation between patients. The second level considered clustering of patients who sought care from each chiropractor. Hierarchical logistic regression models were used to investigate the relationship between weight management interventions initiated or continued by the chiropractor and predictor variables. Full maximum likelihood with Laplace approximation was used to fit the models. The -2 log likelihood and Akaike's information criterion (AIC) fit indices were used to assess model fit. Odds ratios were calculated as the measure of effect. Significance tests were based on the ratio of residual likelihoods or pseudo-likelihoods. Confidence limits

and bounds were computed as Wald intervals. SAS 9.4 (SAS Inc, Cary, North Carolina) was used for all analyses.

Results

Characteristics of participating chiropractors are summarized in Table 2. When compared with all registered chiropractors in Ontario, the O-COAST participants had similar mean age (Ontario = 44.9 years, O-COAST = 43.5 years) and sex (Ontario = 37.7% female, O-COAST = 33.3%). The participating chiropractors were evenly distributed across the 3 categories of reported years since graduation, and 81.0% of chiropractors received their chiropractic education in Canada.

In total, 2162 unique patient encounters were recorded that included sufficient information to determine patients' weight category (normal weight, overweight, or obese). Patient demographics, stratified by weight category, are summarized in Table 3. The prevalence of overweight and obesity within the study sample were 37.8% and 23.5%, respectively (61.3% in total). We found that 5.4% of patient encounters involved weight management being initiated or continued by chiropractors. There was no significant difference in the odds of chiropractors undertaking weight management across the different BMI categories ($P = .23$).

Table 4 shows the iterative model-building process. Model 1 was the empty model, whereas Model 2, model 3, and model 4 were, respectively, created by sequentially including patient-level variables, chiropractor-level variables, and patient-level variable interaction as fixed effects. Model 3, which included both patient-level and chiropractor-level variables, fit the data best (-2 log likelihood = 668.42, Akaike's information criterion = 702.42); the addition of the interaction term between patient BMI and comorbid conditions as a fixed effect (model 4) was not statistically significant when compared with model 3 ($P = .15$ comparing model 4 to model 3; $P < .01$ comparing model 3 to model 2). Therefore, the parameter estimates generated by model 3 were used to answer the remaining research questions.

The odds ratios (ORs) describing the relationship between predictors and the outcome are shown in Table 5. The odds of chiropractor-directed weight management intervention were about half (OR = 0.52; 95% CI: [0.29-0.93]) as large for those who did not meet dietary recommendations compared wtih those who did. The odds that patients received weight management interventions from their chiropractor differed between the 4 categories of time the chiropractor spent with the patient; however, these associations were not statistically significant.

Although still infrequently offered, weight management intervention was initiated or continued significantly more often by chiropractors who graduated between 2005 and 2014 than chiropractors who graduated in either of the earlier periods (12.9%, 1.0%, and 5.7% of patients received weight management interventions from chiropractors who graduated between 2005 and 2014, from 1995 to 2004, and before 1995, respectively). When compared with other types of practice, patients who received care from chiropractors who reported 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]).

Discussion

In this study, most patients seeking chiropractic care were overweight or had obesity. Yet, the chiropractors in this study rarely offered these patients weight management interventions. Two commonly cited reasons for not providing weight management to patients are insufficient time and lack of knowledge.[10-14] However, we found time spent by chiropractors with their patient was not significantly associated with whether weight management was initiated or continued. A more important factor appears to be when chiropractors were educated: chiropractors who graduated after 2005 were significantly more likely to offer weight management information to their patients than were chiropractors who graduated between 1995 and 2005 or before 1995.

It is possible that the public health educational reforms of the early 2000s within the chiropractic profession, which included topics of overweight and obesity, resulted in an increased awareness of the importance of preventive health initiatives and increased confidence in providing such services to patients.[20,28-31] A previous study showed no statistically significant impact of the introduction of the new public health education on chiropractor clinical behavior.[32] On the contrary, our study demonstrates that the reforms to public health education offered to chiropractors may have affected clinical behavior, as evidenced by recently graduated chiropractors offering significantly more weight management interventions than those who did not receive this formal preventive health education. However, direct examination of the public health education reforms in Canadian chiropractic education could not be assessed within our study because O-COAST did not focus on weight management or education reforms. In addition, other considerations must be accounted for, such as general health awareness of overweight and obesity as a health concern, which could have influenced chiropractor clinical behavior.

Ontario chiropractors who described their practice type as sport or rehabilitation were significantly less likely to offer weight management interventions to patients. Non-intervention may have been the result of the clinicians' decision to not to include weight management when such treatment may detract from the immediate treatment goals.

Table 3. *Characteristics of Chiropractic Patients Aged 18 to 80 Years Who Were of Normal Weight, Overweight, and Obese*

Descriptors	Total Sample Size (%)	No. (%) of Recorded Encounters Normal Weight (BMI 18.5-24.9 kg/m^2) n_{nw} = 837	No. (%) of Recorded Encounters Overweight (BMI 25-29.9 kg/m^2) n_{ow} = 817	No. (%) of Recorded Encounters Obese (BMI ≥ 30 kg/m^2) n_{ob}=508
Sex				
Male	906 (41.9)	253 (30.2)	426 (52.1)	227 (44.7)
Female	1256 (58.1)	584 (69.8)	391 (47.9)	281 (55.3)
Age				
18-24 y	118 (5.5)	75 (9.0)	32 (3.9)	11 (2.2)
25-54 y	1201 (55.5)	502 (60.0)	414 (50.7)	285 (56.1)
55-80 y	843 (39.0)	260 (31.0)	371 (45.4)	212 (41.7)
Smoking status				
Nonsmoker	2062 (95.4)	795 (95.0)	782 (95.7)	485 (95.5)
Smoker	100 (4.6)	42 (5.0)	35 (4.3)	23 (4.5)
Physical activity				
Met recommendation	101 (4.7)	48 (5.7)	38 (4.7)	15 (3.0)
Did not meet recommendation	2061 (95.3)	789 (94.3)	779 (95.3)	493 (97.0)
Diet				
Met recommendation	304 (14.1)	157 (18.8)	89 (10.9)	58 (11.4)
Did not meet recommendation	1858 (85.9)	680 (81.2)	728 (89.1)	450 (88.3)
Comorbid conditions				
Present	263 (12.2)	54 (6.4)	103 (12.6)	106 (20.9)
Absent	1899 (87.8)	783 (93.6)	714 (87.4)	402 (79.1)
Time with the patient (min)				
0-9	783 (36.2)	306 (36.6)	290 (35.5)	187 (36.8)
10-15	603 (27.9)	252 (30.1)	218 (26.7)	133 (26.2)
16-20	258 (11.9)	75 (9.0)	108 (13.2)	75 (14.8)
>20	518 (24.0)	204 (24.3)	201 (24.6)	113 (22.2)
Outcome				
Weight management initiated or continued by chiropractor [a]				
Yes	116 (5.4)	41 (4.9)	40 (4.9)	35 (6.9)
No	2,046 (94.5)	796 (95.1)	777 (95.1)	473 (93.1)

BMI, body mass index.

[a] Fisher exact test *P* value = .2319 comparing the distribution of weight management initiated or continued by chiropractors between BMI groups.

Table 4. *Multilevel Model Log Odds Estimates for the 2-Level Generalized Linear Dichotomous Models of Weight Management Intervention Initiated or Continued by Chiropractors*

Estimates	Model 1	Model 2	Model 3 [a]	Model 4
Fixed-Effects Patient-Level Variables				
Intercept	-4.41(0.54) [b]	-5.15 (0.82) [b]	-2.40 (0.90) [b]	-2.45 (0.90) [b]
BMI (kg/m^2)				
18.5-24.9	-	Ref	Ref	Ref
25.0-29.9	-	0.12 (0.26)	0.11 (0.27)	0.00 (0.30)
≥ 30.0	-	0.33 (0.29)	0.32 (0.29)	0.52 (0.31)
Sex				
Female	-	Ref	Ref	Ref
Male	-	0.11 (0.24)	0.12 (0.24)	0.14 (0.24)
Age (y)				
18-24	-	-0.06 (0.49)	-0.08 (0.49)	-0.07 (0.50)
25-54	-	Ref	Ref	Ref
55-80	-	0.11 (0.25)	0.11 (0.25)	0.13 (0.25)
Smoking status				
Nonsmoker	-	Ref	Ref	Ref
Smoker	-	-0.83 (0.57)	-0.82 (0.57)	-0.89 (0.57)
Physical activity				
Met recommendation	-	Ref	Ref	Ref
Did not meet recommendation	-	0.83 (0.59)	0.88 (0.59)	0.91 (0.60)
Diet				
Met recommendation	-	Ref	Ref	Ref
Did not meet recommendation	-	-0.64 (0.30) [c]	-0.65 (0.30) [a]	-0.64 (0.30) [c]
Comorbid condition				
Absent	-	Ref	Ref	Ref
Present	-	0.18 (0.32)	0.19 (0.32)	0.31 (0.58)
Time with patient (min)				
0-9	-	Ref	Ref	Ref
10-15	-	0.47 (0.30)	0.42 (0.30)	0.42 (0.30)
16-20	-	0.21 (0.42)	0.16 (0.42)	0.13 (0.42)
>20	-	0.31 (0.35)	0.30 (0.35)	0.30 (0.35)

Table 4. (*continued*)

Estimates	Model 1	Model 2	Model 3 [a]	Model 4
BMI × comorbid condition				
25.0-29.9 × present	-	-	-	0.36 (0.70)
≥30.0 × present	-	-	-	-0.88 (0.75)
Fixed-Effects Chiropractor-Level Variables				
Time since graduation (y)				
<10 (2005-2014)	-	-	Ref	Ref
10-20 (1995-2004)	-	-	-3.88 (0.95) [b]	-3.91 (0.95) [b]
>20 (before 1995)	-	-	-2.59 (0.88) [c]	-2.63 (0.88) [b]
Style of practice				
Other	-	-	Ref	Ref
Sports/rehabilitation	-	-	-3.24 (1.38) [c]	-3.25 (1.39) [c]
Model fit				
-2 log likelihood	700.02	684.82 [d]	668.42 [d]	664.62
AIC	704.02	712.82	702.42	702.62

AIC, Akaike's information criterion; *BMI*, body mass index; *ICC*, intraclass correlation coefficient; *Ref*, reference group.

[a] Best fitting model.

[b] $P < .01$.

[c] $P < .05$.

[d] Likelihood ratio test significant when compared to previous model; ICC = 0.26794; entries show parameter estimates with standard errors in parentheses; estimation method = Laplace.

Clinicians may even be impartial to providing weight management given the high prevalence of overweight and obesity in the patient population. The chiropractic literature suggests that chiropractors with lifestyle counseling and wellness types of practice would offer weight management interventions more frequently.[33] The O-COAST 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)[24,25] were significantly less likely than those who did consume this recommended daily intake 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 or another health care professional 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.

The performance of chiropractors in the management of overweight and obesity requires comparison with that of other health professionals. Past research has shown that among Canadians, between 30% to 40% of patients with obesity received recommendations from their physician regarding weight management.[34,35] However, a large review of UK medical records conducted in a more comparable method to this study found that only 10% of overweight patients received weight management interventions from their medical doctor.[36] Miller and colleagues found that nurses pursued weight management with 24% of their overweight and obese patients.[37] When considering weight management offered by any health professional, an investigation using US State Health Department data found the prevalence to be 5.6% and 32.4% with overweight and obese patients, respectively.[38] Data from the US Sample Adult Core component of the 2006 National Health

Table 5. *Multilevel Model 3 Odds Ratio Estimates of Predictor and Outcome*

Odds Ratios of Weight Management Initiated or Continued by Chiropractor		
Comparison	Estimate	95% CI
Patient-level variables		
BMI (kg/m^2)		
18.5-<25	Ref	0.66-1.88
25-<30	1.12	0.78-2.42
≥30	1.38	-
Sex		
Female	Ref	0.71-1.79
Male	1.13	-
Age category (y)		
18-24	0.93	0.35-2.43
25-54	Ref	0.68-1.81
55-80	1.11	-
Smoking status		
Nonsmoker	Ref	0.15-1.33
Smoker	0.44	-
Physical activity		
Met recommendation	Ref	0.75-7.72
Did not meet recommendation	2.40	-
Diet		
Met recommendation	Ref	0.29-0.93
Did not meet recommendation	0.52	-
Comorbid conditions		
Absent	Ref	0.65-2.26
Present	1.21	-
Time spent with patient (min)		
0-9	Ref	0.85-2.73
10-15	1.53	0.52-2.67
16-20	1.17	0.68-2.73
> 20	1.36	-
Chiropractor-level variables		
Years since graduation		
<10 (2005-2014)	Ref	0.00-0.13
10-20 (1995-2004)	0.02	0.01-0.42
>20 (before 1995)	0.08	-
Type of practice		
Other	Ref	0.00-0.59
Sports/rehabilitation	0.04 [a]	-

BMI, body mass index; *Ref*, reference group.
[a] Because of a high level of variation due to small cell size, estimates may be unreliable.

Interview Survey (n = 24 275) indicated that 11.5% of respondents reported receiving weight-loss advice from their chiropractor, whereas 23.1% received weight-loss advice from a medical doctor, and 18.8% received weight-loss advice from a physical therapist.[39] Our findings are consistent because they show that chiropractors offer weight management interventions during only 5.4% of patient encounters—less than the rates reported by other health professions in the literature.

Implications

This study is an important first step in examining the clinical practices of weight management initiated or continued by doctors of chiropractic. People may not typically attend chiropractors for weight-loss interventions alone, but chiropractors are well placed to help manage this public health issue owing to their training and general holistic lifestyle approach to care. We found a strong association between participating chiropractors' years since graduation and if they offered weight loss interventions to their patients. One of the barriers clinicians cite to offering weight management interventions is lack of knowledge.[10-14,40-43] Our findings suggest that changes in chiropractic public health education may account for more chiropractors who graduated after 2005 offering weight management to their patients. Nevertheless, 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. An education campaign initiated by chiropractic associations to promote the guideline recommendations may help raise awareness among chiropractors about how they can assist to improve the general health of their patients.

Strengths and Limitations

We used the O-COAST dataset, which is the largest dataset of chiropractors' clinical practice in Canada. The data collection and coding process used in this study were robust. Data collection occurred during each chiropractor-patient encounter, thereby reducing errors owing to 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.[21-25] The outcome variable created used multiple international clinical practice guideline recommendations to ensure the most up-to-date definition of *weight management intervention*. The Australian ICPC-2 PLUS general practice terminology system used to classify the patient encounter has been validated within the chiropractic profession.[44] However, this study relied on 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, including reporting weight management recommendations.

The O-COAST had a recruitment rate of 36% of the eligible chiropractors approached. Selection bias may have affected the results, despite the similarity of age and sex of participating chiropractors with those in Ontario. Currently, there are no representative comparative Canadian chiropractic patient data available; however, the O-COAST patient data collected were similar to findings of international chiropractic patient populations.[45,46] 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 of 35.3% overweight and 22.9% obese.[47,48]

The measure of adiposity (self-reported height and weight to calculate BMI) used in this study was imprecise and does not distinguish lean body mass from fat mass.[49] Although measures of waist circumference and waist-to-hip ratio are a better measure of adiposity, BMI remains the most commonly used population measure due to its convenience, safety, minimal cost, and correlation with body fat.[49,50] The BMI used for analysis was calculated from patient-reported data that may have resulted in information bias. Although self-reported data are easier and less expensive to collect, they are affected by self-reporting bias[51] and tend to underestimate the prevalence of obesity when compared with measured data.[52] The sensitivity and specificity of self-reported height and weight used to calculate BMI is between 74% and 80% and 92% and 99%, respectively, with people of higher BMI being more likely to underreport.[53-55]

Socioeconomic status (SES) is important regarding the sociocultural context of obesity.[56] In Canada, there is an increased risk of obesity among groups with a low SES.[57] The SES data were not collected in O-COAST. Future research in this area should consider SES as a covariate. We did find significant relationships between both years since graduation and type of practice and weight-loss management offered by the chiropractor. Nonsignificant findings, such as the time spent with the patient, may be due to a lack of power. Lastly, this study was focused on only 1 area of Canada, so it does not represent the entire country or profession. Thus, our findings may not necessarily be applicable to other regions or countries. Further studies will need to be done in other regions to identify if those regions are similar or different.

Conclusion

This study provides valuable information in an under-researched area of Canadian health care. Although the prevalence of patients in chiropractic practice with overweight or obesity is high, Canadian chiropractors infrequently provide weight management interventions to their patients. We found that the chiropractors in this study who graduated after 2005 and were educated after public health chiropractic education reforms offered 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 may provide further guidance to ensure patient needs are met. Reducing the health burden of overweight and obesity will significantly contribute to the well-being of Canadians. Chiropractors have the potential to play an important role in supporting the health care movement in aid of overweight and obese patients.

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Contributorship Information

Concept development (provided idea for the research): P.J.H.B., S.D.F.
Design (planned the methods to generate the results): P.J.H.B., M.A.M., S.A.M., S.D.F.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): P.J.H.B., M.A.M., S.A.M., S.D.F.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): P.J.H.B.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): P.J.H.B., M.A.M.
Literature search (performed the literature search): P.J.H.B.
Writing (responsible for writing a substantive part of the manuscript): P.J.H.B., M.A.M., S.A.M., S.D.F.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): P.J.H.B., M.A.M., S.A.M., S.D.F.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jmpt.2018.11.015.

Practical Applications

- Chiropractors are well placed to provide dietary and exercise advice to overweight and obese patients, yet our findings show that few Canadian chiropractors who participated in this study currently offer such weight-loss interventions.
- Our findings suggest that changes in chiropractic education of Canadian chiropractors could potentially increase chiropractors offering weight management to their patients.
- Stakeholders could use our findings along with existing evidence to develop and promote an education campaign to raise chiropractic awareness of the weight management guideline recommendations, thereby enabling more chiropractors to assist in weight management and improve the overall health of their patients.

References

1. Expert panel report. Guidelines (2013) for the management of overweight and obesity in adults. *Obesity.* 2014;22(suppl 2):1-370.
2. Mathus-Vliegen L, Toouli J, Fried M, et al. World Gastroenterology Organisation Global Guidelines on Obesity. *J Clin Gastroenterol.* 2012;46(7):555-561.
3. Stegenga H, Haines A, Jones K, Wilding J. Identification, assessment, and management of overweight and obesity: summary of updated NICE guidance. *BMJ.* 2014;349:g6608.
4. Haslam DW, James WPT. Obesity. *Lancet.* 2005;366(9492):1197-1209.
5. Flodgren G, Deane K, Dickinson HO, et al. Interventions to change the behaviour of health professionals and the organisation of care to promote weight reduction in overweight and obese people. *Cochrane Database Syst Rev.* 2010;3:CD000984.
6. Potter M, Vo J, Croughan-Minihane M. Weight management: what patients want from their primary care physicians. *J Fam Pract.* 2001;50(6):513-518.
7. Charity MJ, Britt HC, Walker BF, et al. Who consults chiropractors in Victoria, Australia?: Reasons for attending, general health and lifestyle habits of chiropractic patients. *Chiropr Man Ther.* 2016;24(28):1-9.
8. Jamison J. Health information and promotion in chiropractic clinics. *J Manipulative Physiol Ther.* 2002;25(4):240-245.
9. Franz MJ, VanWormer JJ, Crain L, et al. Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. *J Am Diet Assoc.* 2007;107(10):1755-1767.
10. Kristeller JL, Hoerr RA. Physician attitudes toward managing obesity: differences among six specialty groups. *Prev Med.* 2000;26(4):542-549.
11. Ampt AJ, Amoroso C, Harris MF, McKenzie SH, Rose VK, Taggart JR. Attitudes, norms and controls influencing lifestyle risk factor management in general practice. *BMC Fam Pract.* 2009;10:59.
12. Hansson LM, Rasmussen F, Ahlstrom GI. General practitioners' and district nurses' conceptions of the encounter with obese patients in primary health care. *BMC Fam Pract.* 2011;12(1):7.
13. Jochemsen-van der Leeuw HG, van Dijk N, Wieringa-de Waard M. Attitudes towards obesity treatment in GP training practices: a focus group study. *Fam Pract.* 2011;28(4):422-429.
14. Plourde G, Prud'homme D. Managing obesity in adults in primary care. *Can Med Assoc J.* 2012;184(9):1039-1044.
15. Lemstra M, Bird Y, Nwankwo C, Rogers M, Moraros J. Weight loss intervention adherence and factors promoting adherence: a meta-analysis. *Patient Prefer Adherence.* 2016;10:1547-1559.
16. Olander E, Fletcher H, Williams S, Atkinson L, Turner A, French D. What are the most effective techniques in changing obese individuals' physical activity self-efficacy and behavior: a systematic review and meta-analysis. *Int J Behav Nutr Phys Act.* 2013;10:10-29.
17. Mior S, Wong J, Beliveau P, Bussieres A, French S. Profiling chiropractic practices and their patients: Ontario chiropractic observation and analysis study (O-COAST). *J Chiropr Educ.* 2017;31(1).
18. University of Sydney Family Medicine Reaserch Centre. ICPC-2-PLUS: the BEACH coding system. Available at: http://sydney.edu.au/medicine/fmrc/icpc-2-plus/index.php. Accessed January 1, 2015.
19. Charity MJ, French SD, Forsdike K, Britt H, Polus B, Gunn J. Extending ICPC-2 PLUS terminology to develop a classification system specific for the study of chiropractic encounters. *Chiropr Man Ther.* 2013;21(1):4.
20. Anderson E, Katz D, Perillo M. A model course for public health education in chiropractic colleges: a user's guide. US Health Resources and Services Administration through the Association of Schools of Public Health Available at: http://depts.washington.edu/ccph/pdf_files/MCWBFinalDrft02-19-02.pdf. Accessed May 24, 2016.
21. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. *Int J Behav Nutr Phys Act.* 2010;7:39.
22. Tremblay MS, Kho ME, Tricco AC, Duggan M. Process description and evaluation of Canadian Physical Activity Guidelines development. *Int J Behav Nutr Phys Act.* 2010;7(42):1-16.
23. World Health Organization (WHO). *Global Recommendations on Physical Activity for Health*. Switzerland: Geneva; 2010.

24. Garriguet D. Diet quality in Canada. *Health Rep.* 2009;20(3):41-52.
25. Statistics Canada. Fruit and vegetable consumption. 82-229-X. Available at: http://www.statcan.gc.ca/pub/82-229-x/2009001/deter/fvc-eng.htm. Accessed April 23, 2016.
26. Statistics Canada. 2013. Canada (Code 01) (table). National Household Survey (NHS) Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Available at: https://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/dt-td/Index-eng.cfm. Accessed September 26, 2016.
27. Statistics Canada. 2013. Canada (table). National Household Survey (NHS) Employment Income Statistics. Statistics Canada Catalogue no. 99-014-X2011042. Ottawa. Available at: https://www150.statcan.gc.ca/n1/en/catalogue/99-014-X2011042. Accessed September 26, 2016.
28. Evans MW, Rupert R. The Council on Chiropractic Education's new wellness standard: a call to action for the chiropractic profession. *Chiropr Osteopat.* 2006;14:23.
29. Killinger L, Hawk C, Perillo M. The collaborative development of a model course in public health education. *J Chiropr Educ.* 2000;14:10-11.
30. Piccininni JJ, Johnston CC, Kopansky-Giles DR, Robinson SJ. Patient education initiatives at the Canadian Memorial Chiropractic College. *J Manipulative Physiol Ther.* 2000;23(1):56-59.
31. Borody C, Till H. Curriculum reform in a public health course at a chiropractic college: are we making progress toward improving clinical relevance? *J Chiropr Educ.* 2007;21(1):20-27.
32. Globe GA, Azen SP, Valente T. Improving preventive health services training in chiropractic colleges: a pilot impact evaluation of the introduction of a model public health curriculum. *J Manipulative Physiol Ther.* 2005;28(9):702-707.
33. DeMaria A, DeMaria C, DeMaria R, Alcantara J. A weight loss program in a chiropractic practice: a retrospective analysis. *Complement Ther Clin Pract.* 2014;20(2):125-129.
34. Lau DCW, Douketis JD, Morrison KM, Hramiak IM, Sharma AM. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children [summary]. *CMAJ.* 2007;176(8):S1-13.
35. Kirk SF, Tytus R, Tsuyuki RT, Sharma AM. Weight management experiences of overweight and obese Canadian adults: findings from a national survey. *Chronic Dis Inj Can.* 2012;32(2):63-69.
36. Booth HP, Prevost AT, Gulliford MC. Access to weight reduction interventions for overweight and obese patients in UK primary care: population-based cohort study. *BMJ Open.* 2015;5(e006642):1-6.
37. Miller S, Alpert P, Cross C. Overweight and obesity in nurses, advanced practice nurses, and nurse educators. *J Am Acad Nurse Pr.* 2008;20(5):259-265.
38. Sciamanna C, Tate D, Lang W, Wing R. Who reports receiving advice to lose weight? Results from a multistate survey. *Arch Intern Med.* 2000;160(15):2334-2339.
39. Ndetan H, Evans MW, Bae S, Felini M, Rupert R, Singh KP. The health care provider's role and patient compliance to health promotion advice from the user's perspective: analysis of the 2006 national health interview survey data. *J Manipulative Physiol Ther.* 2010;33(6):413-418.
40. Fogelman Y, Vinker S, Lachter J, Biderman A, Itzhak B, Kitai E. Managing obesity: a survey of attitudes and practices among Israeli primary care physicians. *Int J Obes Relat Metab Disord.* 2002;26(10):1393-1397.
41. Bocquier A, Verger P, Basdevant A, et al. Overweight and obesity: knowledge, attitudes, and practices of general practitioners in france. *Obes Res.* 2005;13(4):787-795.
42. Forman-Hoffman V, Little A, Wahls T. Barriers to obesity management: a pilot study of primary care clinicians. *BMC Fam Pract.* 2006;7:35.
43. Alexander S, Ostbye T, Pollak K, Gradison M, Bastian L, Brouwer R. Physicians' beliefs about discussing obesity: results form focus groups. *Am J Health Promot.* 2007;21(6):498-50.
44. Testern CD, Hestbæk L, French SD. The use of diagnostic coding in chiropractic practice. *Chiropr Man Ther.* 2015;23(1):8.
45. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet.* 2012;380(9859):2224-2260.
46. French SD, Densley K, Charity MJ, Gunn J. Who uses Australian chiropractic services? *Chiropr Man Ther.* 2013;21(1):31.
47. Hurwitz EL, Chiang L. A comparative analysis of chiropractic and general practitioner patients in North America: findings from the joint Canada/United States survey of health, 2002-03. *BMC Health Serv Res.* 2006;6:49.
48. Weigel PM, Hockenberry JM, Wolinsky FD. Chiropractic use in the Medicare population: prevalence, patterns, and associations with 1-year changes in health and satisfaction with care. *J Manipulative Physiol Ther.* 2014;37(8):542-551.
49. Romero-Corral A, Somers V, Sierra-Johnson J, et al. Accuracy of body mass index to diagnose obesity in the US adult population. *Int J Obes.* 2008;32(6):959-966.
50. National Heart, Lung and Blood Institute. NHLBI Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. 1998. Publication #NIH 98-4083.
51. Elgar F, Stewart J. Validity of self-report screening evidence from the Canadian Community Health Survey. *Can J Public Heal.* 2008;99(5):423-427.
52. Turner JA, Fulton-Kehoe D, Wickizer T, Turner J. Clinically significant weight gain one year after occupational back injury. *J Occup Env Med.* 2013;55(3):318-324.
53. Nieto-Garcia FJ, Bush TL, Keyl PM. Body mass definitions of obesity: sensitivity and specificity using self-reported weight and height. *Epidemiology.* 1990;1:146-152.
54. Fonseca Mde J, Faerstein E, Chor D, Lopes CS. Validity of self-reported weight and height and the body mass index within the "Pró-saúde" study. *Rev Saude Publica.* 2004;38(3):392-398.
55. Boring AL, Peeters A, Freak-Poli R, Lim MSCGM, Halliard M. Measuring the accuracy of self-reported height and weight in a community-based sample of young people. *BMC Med Res Methodol.* 2012;12:175-182.
56. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev.* 2007;29(1):29-48.
57. Kwan A, Corscadden L. Obesity in Canada. *Can J Diabetes.* 2011;35(2):152.