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Beliefs and behaviours: understanding chiropractors and immunization

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Abstract

Background: Concerns have been raised about the beliefs and behaviours of chiropractors related to immunization; however, none have systematically examined the relationships between beliefs and behaviours.
Purpose: We examine the immunization-related behaviours and beliefs of chiropractors in Alberta, Canada, and explore the relationship of beliefs to immunization-related behaviours with patients.
Methods: Data were collected in 2002 from a postal survey of Alberta chiropractors. The questionnaire inquired about six behaviours of interest in the six months prior to survey (gave information about risks/benefits of vaccination; advised patients in favour/against have self/children immunized; counselled on freedom of choice; directed to sources of information on immunization). It included items addressing beliefs and norms related to immunization.
Results: The response rate was 78.2% (503/643). Immunization arose with patients at least monthly for 36.5% of respondents, and at least weekly for 9.2%. One quarter advised patients in favour and 27% against having themselves/their children immunized. A parsimonious model of chiropractor pro/anti-vaccination behaviours included beliefs about the efficacy/safety of vaccination, chiropractic philosophy and individual rights.
Conclusions: Similar proportions of chiropractors advise patients in favour or against immunization. A small minority deals with immunization issues frequently. Behaviours can be understood in the context of beliefs.

Keywords: Chiropractic; Vaccination; Cross-sectional studies; Questionnaire; Knowledge, attitudes, practice; Immunization; Attitude

1. Introduction

Chiropractic was the third most popular complementary or alternative modality used in the USA in 1999 [1,2] and is also commonly used in Canada [3]. Concerns have been raised about the beliefs and behaviours of chiropractors related to immunization; however, published studies have included only relatively small samples [4], studied only beliefs and/or had low response rates and/or were limited to students [5,6]. We examine the immunization-related beliefs and behaviours of chiropractors and explore the relationship between the beliefs and the behaviours, using data collected in a postal survey of Alberta chiropractors conducted in 2002.

2. Methods

A listing of all chiropractors registered to practice in Alberta as of August 2001 was obtained from the College of Chiropractors of Alberta. Survey procedures included up to five contacts and followed the principles described by Dillman [7]. The 55-item questionnaire required 15–20 min for completion.

The questionnaire included items on demographics, immunization behaviours (Table 1), the frequency with which immunization issues arose in practice, and immunization behavioural and normative beliefs (Table 2). The questionnaire addressed immunization generally and did not name specific vaccines or present a patient scenario and request responses. It was based on a literature review [5,6,8–14] guided by the "Theory of Reasoned Action" [15] and consultations with chiropractors and medical experts on immunization. The questionnaire was initially pre-tested among two convenience

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Table 1
Frequency of immunization-related behaviours with patients

Behaviour	*N*	Percentage
(1) Answered questions/gave information on risks of immunization (*N* = 475)[a,b]	322	67.8
(2) Answered questions/gave information on benefits of immunization (*N* = 470)[a,b]	233	49.6
(3) Encouraged/advised patients *in favour* of having themselves/their children immunized (*N* = 466)[a,b]	117	25.1
(4) Encouraged/advised patients *against* having themselves/their children immunized (*N* = 452)[a,b]	123	27.2
(5) Advised patients on importance of freedom of choice about immunization (*N* = 482)[a]	339	70.3
(6) Directed patients to sources of information on immunization (*N* = 488)[a]	341	69.9
(7) Answered questions/gave information on benefits of immunization or Encouraged/advised patients *in favour* of having themselves/their children immunized (*N* = 474)	245	51.7
(8) Answered questions/gave information on risks of immunization or Encouraged/advised patients *against* having themselves/their children immunized (*N* = 475)	322	67.8
(9) Answered questions/gave information on risks *and* benefits of immunization (*N* = 467)	199	42.6
(10) Encouraged/advised patients *in favour and against* having themselves/their children immunized (*N* = 450)	42	9.3
(11) Immunization issues arising with patients one or more times/week (*N* = 502)	46	9.2
(12) Immunization issues arising with patients one or more times/month (*N* = 502)	183	36.5

[a] The six specific immunization behaviours of which inquiries were made; these items are verbatim from questionnaire.
[b] Item used to construct VACINDEX score.

samples of chiropractors (eight from Ontario, six from British Columbia) who provided comments on the clarity and acceptability of questionnaire items and time requirements for completion. A random sample of 44 Alberta chiropractors pre-tested both the study procedures and the revised questionnaire. These persons were excluded from participation in the subsequent survey. Each questionnaire mailing also included a one-page "partial-responder" questionnaire, which included the same items on demographics and immunization behaviours as the main questionnaire, to be completed and returned if the chiropractors did not wish to complete the main questionnaire. The Conjoint Health Research Ethics Board of the University of Calgary approved the study.

Behavioural and normative belief items were close ended and rated on a scale ranging from strongly agree = 5 to strongly disagree = 1 (Table 2). Six questions scored as either yes or no, assessed the immunization-related behaviours in the six months prior to survey (items 1–6 in Table 1). Responses to the first four items in Table 1 were used to construct a measure (VACINDEX) of pro- and anti-vaccination behaviours. For each item, a response of 'no' was scored as zero. An answer of 'yes' was rescored as follows: item 4 (Encouraged/advised patients *against* having themselves/their children immunized) = −2, item 1 (Answered questions/gave information on risks of immunization) = −1, item 2 (Answered questions/gave information on benefits of immunization) = +1, item 3 (Encouraged/advised patients *in favour* of having themselves/their children immunized) = + 2. To calculate the VACINDEX, the recoded scores were summed across the four items. We used the statistical package SPSS [16] to analyze the beliefs using Principal Component Analysis with Varimax rotation and Kaiser normalization [17], selecting for each factor only those variables with an absolute loading of ≥0.500 per factor. Cronbach alpha reliability coefficients were used to measure the internal consistency of the six resulting derived scales [18]. We used ordinal regression modelling analysis to explore the associations between the six derived scales (independent variables) and VACINDEX (dependent variable), using the statistical package STATA [19]. Two additional independent variables were also included: years since graduation (<10 versus 10 or more) and place of graduation (Canada versus USA). For ease of interpretation of the final results from the ordinal regression, we created a binary variable from each of the derived scales by categorizing the scores as being above or below the median value. We also created a tripartite ordinal variable (VACINDEX3) from VACINDEX by grouping together scores of −3 or −2 (anti-vaccination behaviour); scores of −1, 0, +1 (mixed behaviours), and scores of +2, +3 (pro-vaccination behaviour). The analysis approach for ordinal regression, relating the binary independent variables to the tripartite dependent variable consisted of three steps. First, crude (unadjusted) odds ratios and 95% confidence intervals (CI) were calculated by analysing each independent variable individually (univariate analysis). Next, a regression model with all eight independent variables was analysed, yielding adjusted odds ratios (full multivariate analysis). Two interaction terms (CANGRD by EFFICACY & SAFETY and YRGRP by EFFICACY & SAFETY), constructed on a priori theoretical grounds, were assessed for statistical significance in this model. A final model was derived from the full model by eliminating all independent variables with *P*-values ≥0.05 which were not confounders (parsimonious multivariate analysis). A variable was considered to be a confounder if the ratio of two odds ratios was 1.15 times or greater [20]. Results corresponding to *P*-values <0.05 were considered to be statistically significant.

3. Results

3.1. Response and respondents

Questionnaires were sent to 682 persons and 39 were returned by the post office as not having valid addresses.

Table 2
Frequency distribution of agreement with beliefs

Belief (questionnaire items)	Strongly/somewhat agree	Strongly/somewhat disagree	Neither agree nor disagree
Generally speaking immunizations are safe (*N* = 499)	208 (41.7)	240 (48.1)	51 (10.2)
All immunizing agents have some risk of adverse reactions (*N* = 499)	471 (94.4)	12 (2.4)	16 (3.2)
Immunizations overload/weaken the immune system (*N* = 501)	281 (56.1)	96 (19.2)	124 (24.8)
Some vaccines can cause autism (*N* = 500)	266 (53.2)	43 (8.6)	191 (38.2)
People who are vaccinated are likely to be harmed by a preservative found in many vaccines (*N* = 500)	225 (45.0)	103 (20.6)	172 (34.4)
Some vaccines can cause sudden infant death syndrome (SIDS) (*N* = 498)	217 (43.6)	62 (12.4)	219 (44.0)
Some vaccines can cause multiple sclerosis or other long term (chronic neurological disorders) (*N* = 499)	203 (40.7)	73 (14.6)	223 (44.7)
Some vaccines can cause diabetes if given in the first two years of life (*N* = 498)	137 (27.5)	73 (14.6)	288 (57.8)
Immunizations actually cause more disease than they prevent (*N* = 501)	134 (26.1)	226 (45.2)	141 (28.1)
It is better to be naturally infected (get the disease) than to be vaccinated (*N* = 494)	286 (57.9)	128 (25.9)	80 (16.2)
The risk of a few adverse reactions to some vaccines is acceptable if the majority of the population is protected against infectious diseases (*N* = 496)	212 (42.7)	218 (44.0)	66 (13.3)
There is strong scientific evidence that immunization prevents infectious diseases (*N* = 502)	271 (54.0)	177 (35.3)	54 (10.8)
Immunization has substantially changed the incidence of some major infectious diseases (*N* = 502)	313 (62.4)	128 (25.5)	61 (12.2)
Good nutrition and sanitation are more important than immunization in preventing infectious disease (*N* = 501)	383 (76.4)	52 (10.4)	66 (13.2)
Canadian children need to be immunized because vaccine preventable diseases still occur in Canada (*N* = 501)	171 (34.1)	240 (47.9)	90 (18.0)
It is safer to give vaccines for several diseases as separate shots rather than many in one injection (*N* = 502)	236 (47.0)	57 (11.6)	201 (41.6)
Vaccines should never be given to elderly persons (*N* = 501)	152 (30.3)	170 (33.9)	179 (35.7)
Vaccines should never be given to infants under one year of age (*N* = 500)	319 (63.8)	68 (13.6)	113 (22.6)
The public is adequately informed about risks of some immunizations (*N* = 498)	42 (8.4)	442 (88.8)	14 (2.8)
Health officials including some medical doctors are adequately informed on the risks of some immunizations (*N* = 500)	91 (18.2)	350 (70.0)	59 (11.8)
Parents and other members of the public are adequately informed of their individual rights about immunization (*N* = 498)	21 (4.2)	446 (89.6)	31 (6.2)
Alberta law requires children to be vaccinated (*N* = 492)	50 (10.2)	320 (65.0)	122 (24.8)
Immunization should be on a strictly voluntary basis (*N* = 499)	374 (74.9)	75 (15.0)	50 (10.0)
For immunization, individual rights are more important than mandates of government agencies and school districts (*N* = 500)	382 (76.4)	74 (14.8)	44 (8.8)
I subscribe to the philosophy of D.D. Palmer (*N* = 502)	134 (27.2)	210 (42.6)	149 (30.2)
I subscribe to the philosophy of B.J. Palmer (*N* = 493)	188 (38.1)	145 (39.4)	160 (32.5)
Chiropractors are an integral part of the health care team (*N* = 502)	488 (97.2)	9 (1.8)	5 (1.0)
Chiropractic is an alternate form of health care (*N* = 490)	185 (58.1)	(32.0)	48 (9.8)
There is little/no evidence for the treatment of non-musculoskeletal conditions with chiropractic adjustment (*N* = 500)	60 (12.0)	411 (83.0)	25 (5.0)
Chiropractic science has proven that chiropractic treatment is valid for non-musculoskeletal conditions (*N* = 500)	330 (66.0)	110 (22.0)	60 (12.0)
The scope of chiropractic practice should be limited to musculoskeletal conditions (*N* = 501)	(10.6)	430 (85.8)	18 (3.6)
Many diseases are caused by bacteria and viruses (*N* = 499)	373 (74.8)	92 (18.4)	34 (6.8)
The subluxation is the cause of many diseases (*N* = 497)	220 (44.3)	171 (34.4)	106 (21.3)
Most diseases are caused by spinal malalignment (*N* = 498)	97 (19.7)	305 (61.2)	96 (19.3)
Immunization and issues related to immunization are part of the scope of practice for chiropractic (*N* = 502)	307 (61.1)	113 (28.1)	82 (16.3)
Chiropractors whose opinions are important to me think I should counsel my patients about immunization (*N* = 497)	189 (38.0)	115 (23.1)	193 (38.8)
MDs whose opinions are important to me think I should counsel my patients about immunization (*N* = 496)	66 (13.3)	214 (43.1)	216 (43.5)
RNs whose opinions are important to me think I should counsel my patients about immunization (*N* = 495)	79 (16.0)	170 (34.3)	246 (49.7)
Patients whose opinions are important to me think I should provide counselling about immunization (*N* = 498)	277 (55.6)	68 (13.7)	153 (30.7)

The data is presented as number (%).

Completed questionnaires were returned by 503 chiropractors (78.2% of those with a valid address); however, a variable number of these persons responded to each item. Forty-one persons returned the partial-responder questionnaire. The median year of graduation from Chiropractic College was 1992. Nearly 80% had graduated from one of four Colleges of chiropractic: 199 from the Canadian Memorial Chiropractic College, 90 from Palmer, 53 from Western States and 58 from Palmer West. None had trained outside of North America. Most respondents (476/496) were members of the Canadian or American Chiropractic Associations; 19 (3.8%) were members of the American Association. The number of respondents who did not belong to the Canadian Chiropractic Association was so small as to be potentially identifying. A small proportion (8.5%) belonged to the International Chiropractic Association or the International Chiropractic Pediatric Association (5.6%).

3.2. Behaviours

Respondents answered "yes" to a median of three of the six behaviours of interest for the six months prior to survey. Sixty-eight (15.3%) answered "no" to all six questions and 31 (7.0%) indicated that they engaged in only one of the six behaviours of interest. The modal number of behaviours was four (N = 141, 31.7%). As can be seen in Table 1, the most common behaviour was to advise patients on the importance of freedom of choice about immunization (70.3%) followed closely by directing patients to sources of information on immunization (69.9%). Similar proportions of chiropractors encouraged/advised patients in favour (25.1%) or against (27.2%) having themselves/their children immunized. However, a larger proportion of respondents indicated that they provided information on risks or advised against immunization (67.8%) than provided information on benefits or advised in favour of immunization (51.7%). Immunization arose with patients at least once a month for a minority of chiropractors (36.5%) and at least once a week for 9.2%.

The Cronbach alpha for the VACINDEX score was 0.58. The mean VACINDEX score was −0.24 (range −3 to +3). Those who discussed immunization at least once a week had a significantly more negative mean VACINDEX score (−1.41) than those who did so less frequently (−0.13; $P \ll 0.0001$). Those who directed patients to sources of information on immunization had a significantly more negative VACINDEX score (mean −0.46) than those who did not (mean +0.38; $P \ll 0.0001$). A similar pattern was observed for those who advised patients on the importance of freedom of choice about immunization (mean VACINDEX score −0.56 versus +0.48; $P \ll 0.0001$).

3.3. Comparison of respondents to partial-respondents

Respondents were similar to partial-respondents with respect to number of years since graduation from Chiropractic College and memberships in professional organizations. Partial-respondents had a more negative VACINDEX score than respondents (−0.472 versus −0.242), although not significantly so (P = 0.34). Although smaller proportions of partial-respondents than respondents gave information on risks of immunization (41.7% versus 67.8%; P = 0.003) and advice to patients against being immunized (8.3% versus 27.2%; P = 0.02), none of the partial-respondents advised patients in favour of immunization compared to 25.1% of the respondents (P = 0.001). Finally, a smaller proportion of partial-respondents (11.1%) than respondents (49.6%) gave information on benefits of immunization ($P \ll 0.0001$).

3.4. Beliefs

Table 2 displays the frequency of the beliefs. Only 41.7% of respondents agree that immunizations are safe. More than 40% perceive that immunizations overload/weaken the immune system, or that some vaccines can cause autism, SIDS or MS, or that people who are vaccinated are likely to be harmed by a preservative found in many vaccines. Interestingly, in each case, a much smaller proportion of respondents disagree with these statements while a larger proportion neither agree nor disagree. A majority indicates that there is strong scientific evidence that immunization prevents infectious diseases (54.0%) and that it has substantially changed the incidence of some major infectious diseases (62.4%). On the other hand, 57.9% agree that it is better to be naturally infected than to be vaccinated and 76.4% agree that good nutrition and sanitation are more important than immunization in preventing infectious disease. More than 60% agreed that vaccines should never be given to infants under one year of age and 30% indicate they should never be administered to the elderly. The majority of respondents perceive that people are not adequately informed about the risks of immunization: both the public (88.8%) and health officials including some medical doctors (70%). They also do not think that parents and other members of the public are adequately informed of their individual rights about immunization (89.6%). More than 60% perceive that immunization and issues related to immunization are part of the scope of practice of chiropractic, and 55% that patients thought they should counsel on immunization. However, a smaller proportion (38%) agreed that other chiropractors thought they should counsel patients on immunization.

The factor analysis supported six factors with reliability coefficients ranging from 0.6746 to 0.9528 (indicative of reasonable internal consistency for early scale development) and accounted for 33 of the 39 beliefs (Table 3). The six factors were: (1) vaccine efficacy and safety (EFFICACY & SAFETY); (2) PEOPLE BEING INFORMED; (3) RIGHTS; (4) CHIROPRACTIC PHILOSOPHY; (5) norms of chiropractors and their patients (CHNORM); and (6) norms of conventional practitioners (CONVNORM). A higher score on the EFFICACY & SAFETY scale indicates an orientation towards immunization being safe/effective; and for the PEOPLE BEING INFORMED scale toward agreement that

Table 3
Mean scores for the factors and their items

Item	Mean score
EFFICACY & SAFETY (Cronbach alpha = 0.9528)	43.75
Generally speaking, immunizations are safe	2.84
Immunizations overload/weaken the immune system[a]	2.47
Some vaccines can cause autism[a]	2.36
People who are vaccinated are likely to be harmed by a preservative found in many vaccines[a]	2.68
Some vaccines can cause sudden infant death syndrome (SIDS)[a]	2.59
Some vaccines can cause multiple sclerosis or other long term (chronic) neurological disorders[a]	2.67
Some vaccines can cause diabetes if given in the first two years of life[a]	2.82
Immunizations actually cause more disease than they prevent[a]	3.32
It is better to be naturally infected (get the disease) than to be vaccinated[a]	2.56
The risk of a few adverse reactions to some vaccines is acceptable if the majority of the population is protected against infectious diseases	2.88
There is strong scientific evidence that immunization prevents infectious diseases	3.25
Immunization has substantially changed the incidence of some major infectious diseases	3.59
Good nutrition and sanitation are more important than immunization in preventing infectious disease[a]	1.94
Canadian children need to be immunized because vaccine preventable diseases still occur in Canada	2.70
Vaccines should never be given to elderly persons[a]	2.97
Vaccines should never be given to infants under one year of age[a]	2.12
PEOPLE BEING INFORMED (Cronbach alpha = 0.7385)	5.41
The public is adequately informed about risks of some immunizations	1.61
Health officials including some medical doctors are adequately informed on the risks of some immunizations	2.20
Parents and other members of the public are adequately informed of their individual rights about immunization	1.60
RIGHTS (Cronbach alpha = 0.7460)	5.78
Alberta law requires children to be vaccinated	2.00
Immunization should be on a strictly voluntary basis[a]	1.90
For immunization, individual rights are more important than mandates of government agencies and school districts[a]	1.88
CHIROPRACTIC PHILOSOPHY (Cronbach alpha = 0.6746)	19.37
I subscribe to the philosophy of DD Palmer	3.16
I subscribe to the philosophy of BJ Palmer	3.05
There is little or no evidence for the treatment of non-musculoskeletal conditions with chiropractic adjustments[a]	4.21
Chiropractic science has proven that chiropractic treatment is valid for non-musculoskeletal conditions	3.66
The subluxation is the cause of many diseases	3.04
Most diseases are caused by spinal malalignment	2.26
Norms of chiropractors and their patients (CHNORM) (Cronbach alpha = 0.7281)	10.30
Immunization and issues related to immunization are part of the scope of practice for chiropractic	3.58
Chiropractors whose opinions are important to me think I should counsel my patients about immunization	3.17
Patients whose opinions are important to me think I should provide counselling about immunization	3.56
Norms of conventional practitioners (CONVNORM) (Cronbach alpha = 0.7939)	5.21
MDs whose opinions are important to me think I should counsel my patients about immunization	2.52
RNs whose opinions are important to me think I should counsel my patients about immunization	2.69

[a] Item reverse scored; i.e., 1 = strongly agree; 5 = strongly disagree.

people are adequately informed. A higher RIGHTS score indicates a more social than individualistic orientation. Higher scores for CHIROPRACTIC PHILOSOPHY are in the direction of a broader, non-musculoskeletal limited scope of practice for chiropractic. Finally, higher scores on the CHNORM scale indicates agreement that chiropractors should be involved in counselling on immunization as does a higher score on the CONVNORM scale.

3.5. Relationship between beliefs and behaviour

The distribution of respondents on the VACINDEX3 was as follows: anti-vaccination behaviour (scores −3 or −2) = 17.3%; mixed behaviours (scores −1, 0, +1) = 68.3%, and pro-vaccination behaviour (scores +2, +3) = 14.4%. Table 4 displays the relationship between VACINDEX3 and the binary demographic, beliefs and normative indices. For these analyses, the sample consisted of the 398 individuals for whom there were no missing values for any of the eight variables analysed. There was no pattern of missingness nor any differences in subject characteristics between the 398 who had complete data compared to those who had missing data. In univariate analysis, the following variables were not associated with VACINDEX3: being a graduate of the Canadian Memorial Chiropractic College (CANGRD), norms of conventional practitioners (CONVNORM), or years since graduation from chiropractic college (YRGRP). The two interaction terms (CANGRD by EFFICACY & SAFETY and YRGRP by EFFICACY & SAFETY) were eliminated from the full multivariate analysis, as they were

Table 4
VACINDEX3 and demographic, belief and normative scales (N = 398)

Independent variable	Univariate analysis		Full multivariate analysis		Final parsimonious multivariate analysis	
	Crude (unadjusted) odds ratio (95% CI)[a]	P-value (two-tailed)	Adjusted odds ratio (95% CI)[b]	P-value (two-tailed)	Adjusted odds ratio (95% CI)[b]	P-value (two-tailed)
EFFICACY & SAFETY	46.2 (16.6–128.4)	<0.0001	22.0 (7.5–64.9)	<0.0001	25.2 (8.7–72.7)	<0.0001
PEOPLE BEING INFORMED	4.9 (3.0–7.9)	<0.0001	1.5 (0.9–2.5)	0.178	–	–
CHIROPRACTIC PHILOSOPHY	0.2 (0.1–0.3)	<0.0001	0.6 (0.4–1.1)	0.073	0.6 (0.3–1.1)	0.088
Graduate of Canadian Memorial Chiropractic College (CANGRD)	0.7 (0.5–1.1)	0.094	0.8 (0.5–1.2)	0.288	–	–
CHNORM	0.4 (0.2–0.6)	<0.0001	0.9 (0.5–1.4)	0.610	–	–
CONVNORM	0.9 (0.6–1.4)	0.649	1.5 (1.0–2.4)	0.082		
RIGHTS	7.3 (4.3–12.4)	<0.0001	2.8 (1.6–4.9)	<0.0001	2.9 (1.7–5.1)	<0.0001
Years since graduation from chiropractic college (YRGRP)	1.0 (0.6–1.5)	0.888	0.9 (0.6–1.4)	0.557	–	–

[a] 95% CI = 95% confidence interval.
[b] Simultaneously adjusted for all variables in model.

not statistically significant and thus are not shown in Table 4. The final parsimonious multivariate regression model consisted of three independent variables: EFFICACY & SAFETY, CHIROPRACTIC PHILOSOPHY, and RIGHTS. CHIROPRACTIC PHILOSOPHY was retained in the final model despite the P-value >0.05 because it was deemed to be a confounder. Specifically, removing it from the final model would have changed the adjusted odds ratio from 25.2 for EFFICACY & SAFETY to 30.7 in a model containing only EFFICACY & SAFETY and RIGHTS. Interpreting the adjusted odds ratios from the final parsimonious multivariate regression analysis, people categorized as having above median EFFICACY & SAFETY scores were 25.2 times as likely to exhibit greater pro-vaccination behaviour than people who were below the median. Similarly those with above median RIGHTS scores were 2.9 times as likely to exhibit greater pro-vaccination behaviour than those who were below the median. In contrast, those with above median CHIROPRACTIC PHILOSOPHY scores were 1.7 times (i.e., 1/0.6) as likely to exhibit greater anti-vaccination behaviour than people who were below the median.

4. Discussion

The strengths of this study include being population-based, the high response rate, and collection of data on partial-respondents (considered to be proxies for non-respondents) that included information on the behaviours of interest.

The data shows that for about 10% of chiropractors practicing in Alberta immunization is discussed with patients on a weekly basis while for about 35% on a monthly basis. For most others the issue is raised also, albeit less frequently, suggesting that the immunization beliefs and behaviours of chiropractors have the potential to influence patient opinions. Chiropractors who deal with immunization-related issues frequently were found to be significantly less pro-vaccination than those who do so less often. Scrutiny of the beliefs data indicates that despite a majority accepting immunization as an effective means of curbing infectious diseases, many responses are consistent with common misconceptions [9].

The single most common behaviour was to advise on freedom of choice about immunization. This is interesting because Alberta (unlike several other Canadian provinces) has no immunization laws, and a majority of the respondents (65%) appeared to be aware of this. The focus of the policy statements of the International Chiropractic Association, and the American Chiropractic Association [8] is on freedom of choice. The official position of the Canadian Chiropractic Association is that the organization “accepts vaccination as a cost-effective and clinically efficient public health preventive procedure for certain viral and microbial diseases, as demonstrated by the scientific community” [8]. The College of Chiropractors of Alberta (CCOA) holds a similar position; with the additional qualification that “CCOA supports each individual’s right to freedom of choice in health care, based on the

advantages, disadvantages and potential side effects of such choice" [21]. The high frequency of counselling on freedom of choice may simply be reflective of those policies, but the finding that those who do such counselling have significantly more negative VACINDEX scores than those who do not, suggests that counselling on freedom of choice is actually an indicator of anti-vaccination behaviours. Similarly, a negative VACINDEX score was associated with directing patients to sources to of information on immunization suggesting that this behaviour too may be an indicator of anti-vaccination behaviour. Validation of this requires examination of the information sources to which referrals are made.

We have also found that chiropractor behaviour can be understood in the context of both behavioural and normative beliefs, an important finding for the potential future development of interventions for behavioural change. Previous research has focused simply on the distribution of beliefs among chiropractors [6] or chiropractic students [5] and failed to relate these to behaviours. In univariate analyses, VACINDEX3 (behaviour categorized as pro-immunization) was significantly inversely associated with social norms (CHNORM) — perceptions that patients and other chiropractors thought that chiropractors should counsel patients on immunization. Other factors associated with pro-immunization behaviour in univariate analyses were the behavioural beliefs indicators: EFFICACY & SAFETY, CHIROPRACTIC PHILOSOPHY, orientation towards individual rights (RIGHTS). Demographic characteristics of the chiropractors (including place and year of graduation from Chiropractic College) were not statistically significant. The final parsimonious model indicates that pro-immunization behaviour can be explained by a higher EFFICACY & SAFETY score, a higher RIGHTS score (i.e., orientation towards rights of society versus individual rights), and a lower CHIROPRACTIC PHILOSOPHY score (i.e., those oriented towards a more narrow, musculoskeletal focus of practice are more likely to be pro-vaccination than those oriented to a broader scope of practice that is not limited to the musculoskeletal system).

The models provide insights into the behaviours. When the EFFICACY & SAFETY scale is considered, a higher score indicates an orientation towards perceptions that immunization is effective and safe, thus it is not surprising that the association with VACCINDEX3 is both positive (i.e., higher score on EFFICACY & SAFETY associated with higher score — more likely to counsel and advise in favour of vaccination) and highly significant. The frequencies of the ratings of each item within the EFFICACY & SAFETY score itself are also interesting because they suggest that a substantial proportion of chiropractors are either unsure or actively agree with several common misconceptions about immunization generally [9]. This is worrisome because more than two-thirds of the respondents indicated that they answer questions/provide information on the risks of immunization. However, the questions posed to the chiropractors addressed immunization in general rather than specific antigens or vaccines. The observed pattern of response might also be consistent with chiropractors framing their responses in the context of specific and different vaccines. Studies of homeopathic physicians have demonstrated that not all vaccines are equally acceptable, possibly related to perceptions of the seriousness of the diseases against which they protect [22].

For the PEOPLE BEING INFORMED scale, our data suggest a perception that neither the public nor health care officials are adequately informed about the risks of immunization; however, the parsimonious model indicates that these perceptions are not important for understanding vaccination behaviour after adjusting for EFFICACY & SAFETY, RIGHTS and CHIROPRACTIC PHILLOSOPHY in the regression model. With respect to the RIGHTS scale, the frequencies of the items comprising the scale suggest that among Alberta chiropractors in the context of immunizations, individual rights are more important than the rights of society collectively. This latter is of concern because RIGHTS score was associated with immunization behaviour in the final model and because an orientation towards individual over societal rights in this arena is in opposition to one of the fundamental principles of population based immunization programs, namely that maximizing the number of individuals who are vaccinated attains optimal protection for the population, not just the individual.

With respect to the CHIROPRACTIC PHILOSOPHY scale, our results indicate that most responders do not focus on a conservative scope of practice related to the musculoskeletal system. Other research has shown that there is regional variation within Canada with respect to chiropractic philosophy [23]. The models also indicate the importance of considering CHIROPRACTIC PHILOSOPHY in future research that examines the relationships between EFFICACY & SAFETY and vaccination behaviours: the failure to do so will result in the effect of CHIROPRACTIC PHILOSOPHY to be mixed in the data with the effects of EFFICACY & SAFETY.

The proportion of chiropractors that advised patients in favour of immunization for themselves/their children is similar to the 30% who stated that they did so in a smaller survey conducted in Boston [4]. However, the Boston study found that only 7% of respondents recommended against immunization, a much lower proportion than we observed. The reasons for these differences might include differences in the specific questions that were used (i.e., the Boston study specifically referred to childhood immunization; the present work did not), the sub-populations of chiropractors studied, or the survey methodologies employed. The Boston study had a response rate of 60% which is consistent with the mean response rate of 53% for surveys of chiropractors [24], and might be attributed to an insufficient number of contacts made with the target population in the study; and suggestive of response bias. Further, the Boston study had no data on partial-respondents. Partial-respondents might be more similar to non-respondents than to respondents [25]. If this is true, then our data suggest that anti-vaccination behaviours might be more prevalent among Alberta chiropractors than estimated through our main questionnaire.

Although our data show that there is considerable heterogeneity among chiropractors' behaviours related to immunization, the high rate of utilization of chiropractors in some parts of Alberta [26] and elsewhere [27–29]; including for children [30,31] combined with the relatively high prevalence of anti-vaccination behaviours that we observe raises questions about possible impacts on vaccination coverage rates. However, many other questions also remain to be answered. There are no data on the nature and quality of the information given by chiropractors on the benefits of immunization, the risks of immunization; or the content of the information sources to which chiropractors direct patients. We also lack information on the context in which immunization issues arise in the chiropractor–patient relationship. Is the subject initiated by the chiropractor? Does the patient initiate it? Do patients who are themselves opposed to immunization selectively visit chiropractors who are similarly oriented? How specific are the concerns that the chiropractors may have about immunization? — to what degree are the concerns vaccine/antigen specific? Finally, what impact does the information and advice given to patients by chiropractors have on the actual vaccination behaviours of patients for themselves and for their families? Qualitative studies are needed to begin to answer these questions.

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