

**ASSESSING MEDICAL STUDENT KNOWLEDGE AND ATTITUDES TOWARDS
CHIROPRACTIC
A SCOPING LITERATURE REVIEW**

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ABSTRACT

Chiropractic is one of the most accessed complimentary alternative medicine modalities worldwide. This study aimed to investigate medical student knowledge and attitudes towards chiropractic on a global scale and examine key themes influencing these attitudes. The research was conducted as a narrative review and involved an electronic database search to find twenty eligible studies relevant to the scope of the review. The STROBE checklist was used to critically appraise all studies.

Results: A diverse range of medical student attitudes and knowledge levels of chiropractic from the period of 1998-2020 were found. Twenty studies represented study locations across Australia, North America, Europe, Africa and Asia. Study participants were medical students.

Main conclusions and recommendations: A representative attitude amongst medical students is not currently conclusive in the literature due to considerable heterogeneity across studies and limited data of varying quality. Negative student attitudes towards chiropractic are likely influenced by themes such as safety concerns, lack of evidence, scepticism and lack of knowledge. Views such as the belief that chiropractic is mainstream therapy, evidence-based medicine and that it is effective are likely responsible for neutral or positive student attitudes. Future research should include cross-sectional surveys of medical student populations to identify the sources of information and better evaluate what influences student attitudes.

Keywords: Medical student, chiropractic, complementary alternative medicine, attitudes

INTRODUCTION: The term complementary and alternative medicine (CAM) encompasses a wide range of healthcare modalities and practices that are not considered a part of mainstream medicine. Although CAM modalities are quite diverse, many share similar core values that are based around a holistic approach and preventative medicine.¹ Over the last two decades, the utilisation of CAM has become more prevalent worldwide.^{2,3} Chiropractic, a health profession primarily involved in the diagnosis and treatment of neuromusculoskeletal conditions, is rapidly growing in popularity with data indicating it is one of the most accessed CAM modalities worldwide.^{2,5,6} Historically, interprofessional relations between the chiropractic and medical professions have demonstrated a complicated dynamic of conflict and diversity with negative attitudes between doctors and chiropractors still in some groups prevalent today.⁷

The motivation behind this review stems from a chiropractic perspective with the goal of improving professional rapport with the medical domain to facilitate better management of patients and improve health outcomes. Attitudes of our medical students become the attitudes of our future doctors and negative attitudes as well as a lack of knowledge of chiropractic and its professional scope may persist into medical

students' professional practice, potentially posing a substantial threat to patient-centred collaborative care.^{9,10} Successful collaboration is thought to improve patient outcomes and so it is essential that these shortcomings be understood and addressed.¹⁰ This review attempts to assess the knowledge and attitudes of medical students towards chiropractic globally and endeavours to identify the key underlying themes that may be responsible for such attitudes.

Research question and aim: What are the attitudes and key themes of medical students towards chiropractic?

METHODOLOGY: A computerised literature search was performed in April 2022 of the PubMed, Elsevier Science Direct, PubMed Central and CQU library databases. Key search terms included "medical student," "chiropractic," "complimentary alternative medicine," "attitude." The BOOLEAN operator AND was used. The BOOLEAN operator OR was used to combine the following search terms e.g "chiropractic" or "complimentary alternative medicine" and "attitude" OR "perception." Prior to the application of inclusion and exclusion criteria the initial search returned 875 results. All data was searched, extracted, and filtered by a single author.

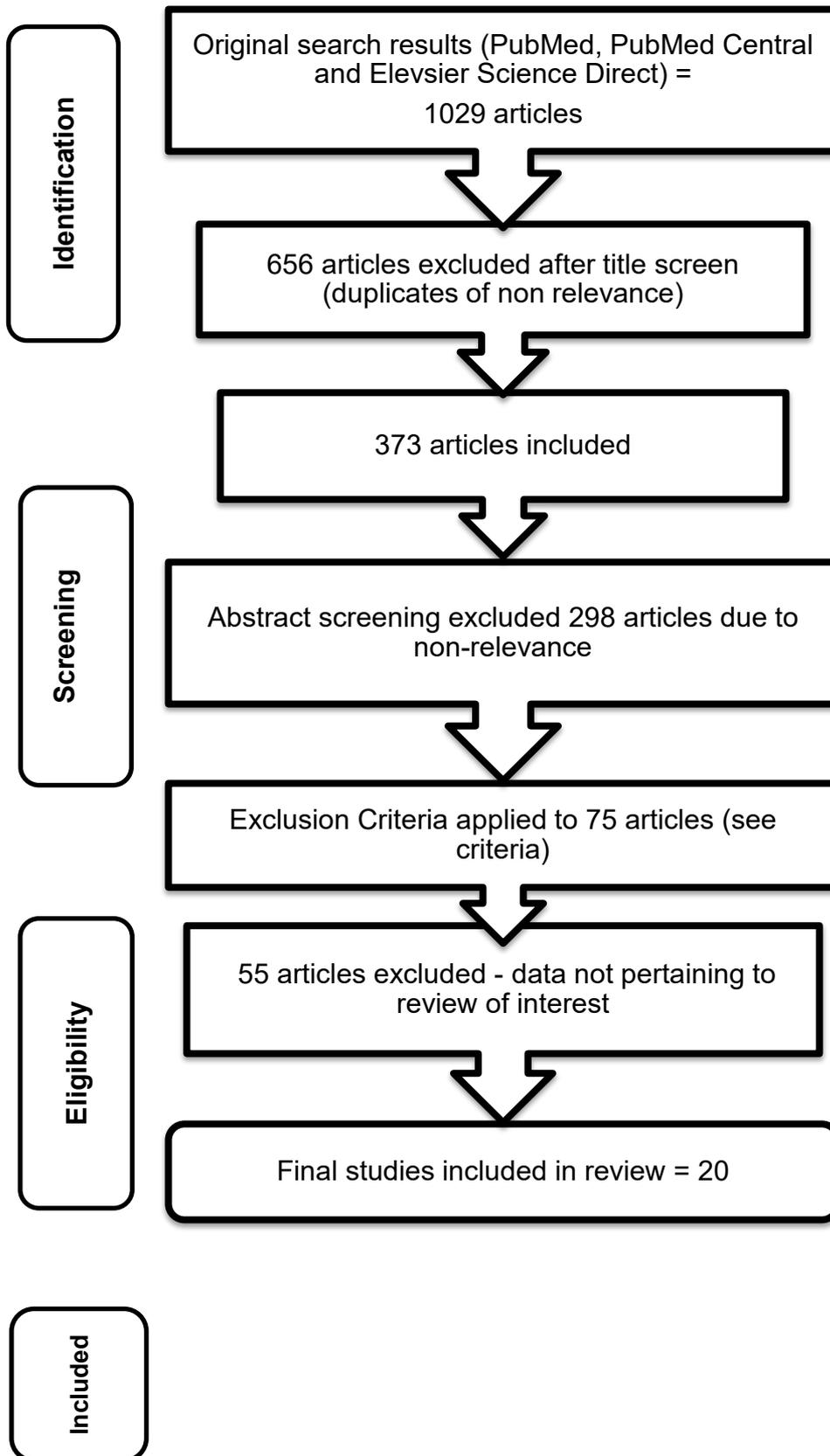
Inclusion Criteria: The inclusion criteria for articles in this narrative review were (1) a 25-year publication range; (2) peer reviewed journal publication; (3) articles written in English; (4) participants that were medical students; and (5) articles that assessed knowledge and attitudes towards CAM including chiropractic.

Exclusion criteria: The exclusion criteria comprised of (1) articles outside of the 25-year publication range; (2) articles that were not written in the English language; (3) articles with participants that did not include medical students; and (4) articles that did not assess knowledge and attitudes towards CAM including chiropractic.

RESULTS

An outline of the selection process for articles included in this review can be seen in Figure 1. The original searches of PubMed, PubMed Central and Elsevier Science direct located 1029 results. After title screening, 656 were excluded due to irrelevance or duplication leaving 373 possible eligible articles. Abstract screening then further eliminated 298 articles. Exclusion criteria were then applied to the remaining 75 articles resulting in the final 20 articles included in this review.

Figure 1. Literature Search Flow Chart



Study Selection:

Twenty studies which aligned with the research question were selected to be included in this review. All articles included were cross-sectional studies using a questionnaire methodology (both quantitative and qualitative).

Analysis of Results:

All twenty studies used in this review were of a questionnaire methodology. The surveys were either electronic or paper based. Qualitative, quantitative, or mixed style questioning was utilised by all studies with a majority of studies using both open ended and closed format style. The selected studies were published between 1998 – 2020 with response rates varying from 10 – 87%. Studies represented thirteen nations including Australia, USA, Canada, England, Netherlands, Germany, Iran, Palestine, Turkey, Saudi Arabia, Singapore, Malaysia, and Ghana. Two studies directly assessed medical student knowledge and attitudes towards chiropractic. Eighteen studies indirectly investigated medical student knowledge and attitudes towards chiropractic via the term “CAM.” The pertinent elements of each included article are presented in Table 1.

Critical Appraisal of Results:

To critically appraise the quality of the cross-sectional studies the combined ‘Strengthening the reporting of observational studies in epidemiology’ STROBE checklist (version 4) statement was used (Appendix 1). The included studies key data and results are summarized and briefly described below. Each study has been rated from fair to good quality with individual study strengths and limitations noted.

Table 1. Evidence Summary

Author/Year	Study Design	Sample size/Characteristic	Outcome measure	Results
Albadr et al (2018)	Paper based questionnaire Electronic survey	n=1613 1433 1 st -5 th year medical students at King Saud University (KSU), Saudi Arabia 180 1 ST – 4 th years at Majmaah University (MU), Saudia Arabia	Perceived attitudes towards CAM (chiropractic included)	399 respondents, overall response rate 25% KSU = 307 responses, 21.5% response rate MU = 92 responses, 50% response rate <u>Knowledge:</u> 19% were familiar with chiropractic. Only 24% of the students were satisfied with their knowledge of CAM. <u>Attitudes:</u> 68% students were interested in learning more about CAM 59% support the inclusion of CAM in the medical curriculum. The overall assessment of the attitude toward CAM was neutral
Alzahrani et al (2016)	Paper based survey	n=273 4 th , 5 th , 6 th year medical students at King Abdulaziz University, Saudi Arabia	Attitudes and Knowledge towards CAM (including chiropractic)	242 respondents, overall response rate of 88.6% <u>Knowledge:</u> Only 17.4% recognized that chiropractic is associated with pain management.
Ameade et al (2016)	Paper based survey	n=284 2 nd , 3 rd and 4 th year medical students of the University for Development Studies in Tamale, Ghana	Attitudes and knowledge of CAM (including chiropractic)	203 respondents, overall response rate of 71.5%; 2 nd year n = 97/124 (78%) 3 rd year n = 62/83, (75%) 4 th year n = 44/77 (57%). <u>Knowledge:</u> Heard of chiropractic 2 nd year n = 26.8% 3 rd year n = 27.4% 4 th year n = 34% Correct description: 2 nd year n = 5.2% 3 rd year n = 0%

				4 th year n = 2.3% <u>Attitudes:</u> Majority of the students (85.5%) believed it is necessary for a doctor to have adequate knowledge on CAM
Baugniet et al (2000)	Survey format unknown	– n= unknown amount of medical, physiotherapy, occupational therapy, nursing and pharmacy students University of Western Ontario, Canada	Attitudes and knowledge of CAM therapies (including chiropractic)	61 medical student respondents <u>Knowledge:</u> 37.7% self-perceived to know a lot or a considerable amount about chiropractic <u>Attitudes:</u> 44.2% perceived chiropractic as useful or very useful. When compared with other students, medical students were the least likely to agree or strongly agree that, “CAM is a useful supplement to regular medicine,” “CAM includes ideas and methods from which regular medicine could benefit,” “Most CAM therapies stimulate the body’s natural healing powers,” or “Practitioners should have some knowledge and geographical awareness about the most commonly used CAM therapies.” <u>Sources of information:</u> students reported no discussion of CAM in their training, it is not surprising that they rated the usefulness of all CAM therapies lower than all other student groups
Chaterji et al (2007)	Paper based survey	n=340 1 st and 2 nd year medical students at Georgetown University School of Medicine, Washington, United States	Attitudes towards CAM modalities (including chiropractic) and its inclusion in the curriculum and use/utility in clinical practice.	266 respondents, overall response rate of 78% 1 st year n=111/170 (65%) 2 nd year n=155/170 (91%) <u>Attitudes:</u> The greatest level of training was wanted for chiropractic among other CAM modalities. The majority (72% to 85%) wanted education on chiropractic. 91% of students surveyed agreed that conventional medicine could benefit from CAM teachings and techniques. 85% agreed that knowledge about CAM would play an important role in their futures as practicing physicians

<p>Chez et al (2001)</p>	<p>Survey format unknown</p>	<p>n=94 3rd year medical students at University of South Florida, United States</p>	<p>Attitudes and knowledge related to CAM (including chiropractic)</p>	<p>78 respondents, overall response rate of 83%</p> <p><u>Knowledge:</u> 67% responded that they understand the basic principles of chiropractic or have pursued education</p> <p><u>Attitudes:</u> 36% thought chiropractic to be either harmful or not useful and 56% thought chiropractic to be useful or very useful with 39% stating they would discourage or persuade patient use of chiropractic</p>
<p>DeSylvia et al (2011)</p>	<p>Online survey and paper survey</p>	<p>n=441 1st, 2nd and 3rd year medical students at the University of California, Los Angeles, United States</p>	<p>Attitudes, familiarity, and attitudes toward CAM modalities including chiropractic</p>	<p>261 respondents, overall response rate of 59%</p> <p>1st year n = 93/152, 61% 2nd year n = 80/144, 56% 3rd year n = 88/145, 61%)</p> <p><u>Attitudes:</u> Likelihood of suggesting chiropractic to a friend – 33.7% 1st year, 32.9% second year and 16.1% third year Likelihood of suggesting chiropractic to a patient – 34.7% of 1st years, 39% of 2nd years and 14.8% of 3rd years</p> <p>-beliefs and opinions about CAM did not differ significantly between the 1st and 2nd years. However, 3rd year students were more negative on the CAM attitude scale than either 1st or 2nd year students</p>
<p>Demir-Dora et al (2020)</p>	<p>Online survey</p>	<p>N=440 1st and 5th year medical students at Akdeniz University, Turkey</p>	<p>Knowledge level and attitude towards CAM methods (including chiropractic)</p>	<p>188 respondents, overall response rate of 43%</p> <p>1st year n=101/221 (46%) 5th year n=87/219 (40%)</p> <p><u>Knowledge of chiropractic:</u> 5% of 1st year students had knowledge of chiropractic whereas 13% of 5th year students had knowledge</p> <p><u>Attitudes</u> 1st year – 44% were willing to learn chiropractic 5th year – 29% were willing to learn chiropractic</p>

				The 1 st students were more likely to prefer CAM methods than 5 th year students. 80% of the 1 st year and 76% of the 5 th year students thought that physicians should recommend CAM methods
Furber et al (2004)	Survey	n= 594 1 st , 2 nd and 5 th year medical students at University of New South Wales, Sydney Australia	Perceived knowledge and opinions on CAM (including chiropractic) and their interest in receiving information about CAM in their training.	374 respondents, overall 63% response rate <u>Knowledge:</u> 56.3% reported that they knew some of a lot of chiropractic. There was no significant difference between the preclinical and clinical students' self-reported chiropractic knowledge. <u>Attitudes:</u> 9% thought that chiropractic was frequently harmful and 50.4% thought it was occasionally or seldom harmful. 43.6% thought it was highly or moderately effective and 15.1% thought it was seldom effective. 69% of students were interested in learning about chiropractic as part of their medical undergraduate curriculum. More preclinical students were interested than clinical students in receiving information about chiropractic (72.1% versus 59.6%, p=0.03)
Furnham & McGill (2003)	Paper based survey	n=311 1 st and 3 rd year medical students at Newcastle university and university college London (UCL) 141 UCL 170 Newcastle	Perceived knowledge and attitudes towards CAM (including chiropractic)	94% response rate Newcastle 91% response rate UCL <u>Knowledge:</u> 72.3% of English medical students had no knowledge of Chiropractic <u>Attitudes:</u> 33.1% thought that chiropractic was ineffective 40.5% would refer a patient/client for CAM, and 51.4% believe CAM to be an effective means of therapy - Results indicated that 1 st year students believed CAM to be more effective than 3 rd years - 1 st year students demonstrated a greater desire for training in CAM therapies than did 3 rd year students - Time at medical school decreased the desire to train in CAM, to refer patients for CAM, and the belief that CAM should be available via the NHS. - They also showed that education at medical schools influences attitudes to CAM
Haque et al (2015)	Paper based survey	n=398 phase 1A, 1B and phase 2 medical students at Universiti Kuala Lumpur Royal	Knowledge and attitudes towards CAM (including chiropractic)	267 students, overall response rate 67% 1A – 72%, 1B- 51% 2 – 76%

		College of Medicine Perak, Malaysia		<p><u>Knowledge:</u> When given the statement “Chiropractic is the science of the spinal manipulation and commonly used to treat lower back pain” 64% of students did not know the answer</p> <p><u>Attitudes:</u> 67% of the respondents possessed a good attitude towards CAM modalities</p>
Hopper & Cohen (1998)	Paper based survey	n=1097 1 st , 3 rd and 5 th year medical students from Monash University and the University of Melbourne, Australia	Perceived knowledge and attitudes toward CAM (including chiropractic)	<p>800 respondents, overall response rate of 73%</p> <p><u>Knowledge:</u> 44% self-perceive that they understand the basic principles of chiropractic or have received some training. Students having little knowledge of chiropractic and naturopathy, the two therapies most commonly used by Australians.</p> <p><u>Attitudes:</u> 53% considered chiropractic useful or very useful. 55% of students would like chiropractic included in the undergraduate curriculum .Australian medical students were positive toward complementary therapies, their self-reported knowledge was low, with 56% having no knowledge of the principles of complementary therapies. 75% agreed that complementary therapies include ideas and methods from which conventional medicine could benefit, that these therapies could provide a useful supplement to mainstream medicine (70%), and that CAM did not threaten public health (62%)</p>
Meinema & Knaap (2012)	Online survey	n= 5684 3 rd – 6 th year medical students in the Netherlands	Perceived knowledge level and attitude towards chiropractic	<p>n=551, overall response rate of 10%</p> <p><u>Knowledge:</u> 19% of students had some knowledge of chiropractic with only 2% stating their knowledge was good. Knowledge of chiropractic was low amongst medical students in the Netherlands and was incongruent with the current state of the profession.</p> <p><u>Attitudes:</u> When asked how they would like to see chiropractic in the future, 55% favoured chiropractic as a CAM.</p>
Münstedt et al (2008)	Paper based survey	n= 270 7 th semester medical	Perceived knowledge, attitudes and interest	217 respondents, overall response rate of 80.4%

		students at Giessen University Medical School, Germany	towards CAM (including chiropractic)	<p><u>Knowledge:</u> 20% of students had knowledge of chiropractic</p> <p><u>Attitudes:</u> When asked whether they disapproved of chiropractic less than 30% had objections to chiropractic. Medical students would like to be better informed so that they can better manage any CAM questions or problems that arise in their daily practice</p>
Sadeghi et al (2016)	Paper based survey	n110 4 th and 5 th year medical students at Urmia University of Medical Sciences, West Azerbaijan, Iran	Knowledge and attitudes toward CAM (including chiropractic)	<p>100 respondents, overall response rate 91%</p> <p><u>Knowledge:</u> A lack of knowledge was observed in students regarding chiropractic with 61% having incorrect answers regarding chiropractic</p> <p><u>Attitudes:</u> 49% of students showed a positive attitude toward CAM and moderate attitude was observed in 51% of participants.</p>
Samara et al (2019)	Paper based survey	n300 4 th , 5 th and 6 th year medical students at An-Najah National University, Palestine	Knowledge, attitudes, and beliefs towards CAM (including chiropractic)	<p>255 students, overall response rate of 85%</p> <p>4th year n=98 (39%) 5th year n=63 (24.7%) 6th year n= 91 (36.3%)</p> <p><u>Knowledge:</u> Student's knowledge on CAM was lacking. 64.9% unfamiliar with chiropractic</p> <p><u>Attitudes:</u> 40.6% stated they would not advise using it to patients. It was concluded that student attitudes towards CAM varied.</p>
Riccard & Skelton (2008)	Online survey	n355 medical students 1 st , 2 nd , and 4 th year medical students at University of South Florida, United States	Attitudes and beliefs of toward complementary alternative medicine (including chiropractic)	<p>95 respondents, overall response rate of 27%</p> <p>1st year – 36 (30%) 2nd year - 29 (24.2%) 4th year – 30 (25.2%)</p> <p><u>Attitudes:</u> Significantly more positive attitudes toward CAM in both 1st and 2nd year medical students as compared to 4th year student's attitudes.</p>
Wong et al (2013)	Paper based survey	2 nd year (n=224) medical students University of Toronto, Canada	Attitudes, knowledge and perspectives to chiropractic	112 Respondents, response rate 50%

	<p>Nine key informant interviews</p> <p>One focus group</p>			<p><u>Attitudes:</u> 83.9% agreed that interprofessional education was important to them. Students were interested in learning about chiropractic in their undergraduate degree, particularly regarding conditions that chiropractors treat. Several respondents (18.8%) endorsed both beliefs that chiropractic was a mainstream and CAM therapy</p> <p><u>Knowledge:</u> 50.4% of students either indicated an incorrect response or selected undecided/didn't know when asked about the types of treatment chiropractors can provide within their scope of practice. 73.2% indicated that they were not aware of the scientific evidence of chiropractic</p>
<p>Yeo et al (2005)</p>	<p>Paper based survey</p>	<p>n= 1,023 1st-5th year medical students at National University of Singapore, Singapore.</p>	<p>Perceived knowledge of and attitudes towards CAM (chiropractic included)</p>	<p>555 respondents, 54% response rate</p> <p>1st year – 161 (69%) 2nd year - 137 (64%) 3rd year – 139 (70%) 4th year – 80 (40%) 5th year – 38 (22%)</p> <p><u>Knowledge:</u> 30.5% students had never heard of chiropractic 52.6% had only heard of chiropractic, 16.9% knew something/a lot of chiropractic</p> <p><u>Attitudes:</u> - 30.3% student thought that chiropractic was effective, 66.3% were not sure of the effectiveness - 8.1% thought that it was harmful and 13.9% thought it was not harmful. - 91% felt that knowledge of CAM is important to them as practising health professionals. When asked if they desired some introduction or exposure to CAM during their course of study as a medical student or a practising doctor, 86% students indicated that they did however</p>

				chiropractic was not among the top 5 modalities that students had the greatest interest in
Yildirim et al (2010)	Paper based survey	n=1353 medical students at Ege university in Izmir, Turkey	Perceived knowledge, attitude and sources of knowledge of CAM (including chiropractic)	495 respondents, overall response rate of 36.5% <u>Knowledge:</u> 69% students stated they had no knowledge of chiropractic, 2.0% stating they had enough knowledge <u>Attitudes:</u> 86.1% of medical students were undecided over the usefulness of chiropractic with 5.7% having the view that it was harmful. 80.2% were undecided whether they would recommend chiropractic to patients with 12.5% saying they wouldn't recommend.

Table 2. Article Critique

Study	Strengths	Limitations
Albadr et al (2018)	Pre-piloted survey Recent publication	Uncertain generalisability of results Varied distribution methods Low response rate
Alzahrani et al (2016)	Use of validated questionnaire High response rate Recent publication	Uncertain generalisability of results
Ameade et al (2016)	Pilot study performed High response rate Recent publication	Limited generalisability of results Respondents were mostly male
Baugniet et al (2000)	Reliable and valid survey adapted from earlier research	Older publication Small sample size Uncertain generalisability of results
Chaterji et al (2007)	High response rate	Uncertain generalisability of results Differential coverage due to varied recruitment methods
Chez et al (2001)	High response rate	Small sample size Older publication
De-Sylvia et al (2011)	Comparable response rate in each of the 3 years	Uncertain generalisability of results Varied methods of distribution
Demir-Dora et al (2020)	Recent publication Pre-piloted survey Comparable response rates	Limited generalisability Cross-sectional study Risk of self-selection bias Workload may have caused low response rate
Furber et al (2004)	Pre-piloted survey Moderate sample size	Limited generalisability of results
Furnham & McGill (2003)	High response rate	Limited generalisability of results Self-selection bias
Haque et al (2015)	Recent publication	Predominantly female respondents
Hopper & Cohen (1998)	Large sample size No significant differences were found in the responses between cohorts	Older publication
Meinema & Knaap (2012)	Large sample size Study directly assessing student knowledge and attitudes towards chiropractic	Low response rate
Münstedt et al (2008)	High response rate	Limited generalisability of results Risk of selection bias
Sadeghi et al (2016)	Recent publication Random participant selection	Small sample size Limited generalisability of results
Samara et al (2019)	Pre-piloted survey Recent publication High response rate	Uncertain generalisability of results Use of non-validated questionnaire
Riccard & Skelton (2008)	Use of previously validity and reliability tested questionnaire	Low response rate

Wong et al (2013)	Study directly assessing student knowledge and attitudes towards chiropractic Multimodal Equal gender split	Small sample size Limited generalizability of results
Yeo et al (2005)	Large sample size	Low response rate in 5 th year and thus may not be representative Limited generalisability of results
Yildirim et al (2010)	Moderate sample size Dated study	Limited generalisability of results Lack of pilot survey

Table 3. Thematic analysis – negative themes

Themes influencing negative student attitudes	Study
Not evidence based	Meinema & Knaap (2012) Wong et al (2013)
Results are mainly placebo effect	Samara et al (2019)
Lack of knowledge	Wong et al (2013)
Chiropractic was ineffective	Furber et al (2004) Chez et al (2001)
More scientific research is required	Samara et al (2019)
Safety of chiropractic	Chez et al (2001) Furber et al (2004) Yeo et al (2005) Yildirim et al (2010) Wong et al (2013)

Table 4. Thematic analysis – positive themes

Themes influencing positive student attitudes	Study
Chiropractic is a mainstream therapy	Wong et al (2013) Meinema & Knaap (2012)
Chiropractic is useful or effective	Hopper & Cohen (1998) Chez et al (2001) Furber et al (2004) Riccard & Skelton (2008)
Interest in learning more about chiropractic	Furber et al (2004) Chaterji et al (2007) Demir-Dora et al (2020)
Chiropractic is evidence-based medicine	Meinema & Knaap (2012)

DISCUSSION:

At the time of writing, this review is the first known attempt to evaluate the current research investigating medical student attitudes and knowledge of chiropractic independent of other CAM therapies on a global scale. For brevity, each articles strengths and limitations are presented in Table 2. A thematic analysis was conducted and tabulated (Table 3 and Table 4) based on individual analysis of each studies results. Medical student attitudes are classified as negative, positive, or neutral whilst knowledge is classified as low or high.

Geographic Themes

Australian knowledge and attitudes

In Australian research, Hopper and Cohen¹¹ demonstrated that over half of the medical students surveyed (53%) considered chiropractic to be useful or very useful with over half (55%) wanting chiropractic to be included in the curriculum. The results of this study are limited due to an older publication date. Similar positive attitudes were found among students in another Australian study conducted by Furber et al¹² six years later which demonstrated that a majority of participants (69%) were interested in learning about chiropractic as part of their medical undergraduate curriculum. Chiropractic was included in the top group of CAM therapies that students desired to receive information about in their undergraduate training with more preclinical students were interested than clinical students (72.1% versus 59.6%). Many students (43.6%) thought it was highly or moderately effective. Self-perceived knowledge levels amongst students were higher in Furber et al¹² in comparison to earlier research (*Hopper and Cohen¹¹*) with over half (56.3%) of students reporting that they knew some or a lot about chiropractic. The authors concluded over half the students had limited knowledge on the effectiveness or harmfulness of the CAM therapies explored and that most students had a desire to receive CAM training in their undergraduate studies so that they could better inform future patients and have a greater understanding of different treatment methods that were available for patients. Thematic analysis revealed that educating medical students on the safety and efficacy of chiropractic may serve to foster better most positive attitudes. From these results, it can be concluded that Australian medical students were positive towards CAM however self-perceived knowledge was low.

American and Canadian knowledge and attitudes

Recently, chiropractic has become one of the most commonly used CAM modalities in the United States, with data from Canada indicating that chiropractic care was the second most common form of CAM used by Canadians.¹³ Early American research conducted by Chez et al¹⁴ found that self-perceived medical student knowledge of chiropractic was quite high and over half (56%) of students believed chiropractic to be useful or very useful. The authors concluded that participants did not have sufficient knowledge regarding the safety of the modalities investigated and argued that the inclusion of CAM subjects in the tertiary medical curriculum was necessary to better prepare them as future doctors to advise patients on CAM use. The authority of this study was greatly limited by the sample size (n78). Results in more recent cross-sectional survey conducted by Chaterji et al¹⁵ in 2007 revealed that the majority of students (85%) agreed that knowledge about CAM would play an important role in their futures as practicing physicians. Amongst the CAM modalities surveyed, the greatest level of training was wanted for chiropractic, mirroring Australian research by *Furber et al.¹²* The authors concluded that their results indicated a high level of student interest in CAM topics and reflected a wish for CAM curricular integration so that they could better advise patients.

Two single population American studies *Riccard and Skelton*¹⁶ and *De-Sylva et al*¹⁷ addressed medical student attitudes towards CAM directly, with chiropractic being addressed indirectly. Comparing attitudes over different years of medical school, Riccard and Skelton¹⁵ found that medical students in 1st and 2nd year had significantly more positive attitudes towards CAM in comparison to their 4th year counterparts. The authors postulated that the main reason for the change in attitude was due to the different methods utilized during the early years of medical school. In comparison to earlier years, 4th year classroom time decreases as the students' time in clinical rotations increases. The authors believed that this decrease in classroom time and the exposure to allopathic procedures and techniques can lead to a change in the students' attitudes toward CAM. However, no specific investigation into the sources of CAM knowledge and teachings was undertaken. This trend was also found in research by De-Sylva et al¹⁷ in 2016 which indicated that while beliefs about CAM did not differ significantly between the 1st and 2nd years their 3rd year counterparts were more negative on the CAM attitude scale.

Similar to results found by *Chaterji et al*¹⁵ a study of Canadian medical students conducted by Wong et al¹⁸ in 2013 indicated a majority of students (84%) agreed that interprofessional education was important. Thematic analysis revealed students were interested in learning about chiropractic in their tertiary studies with nearly one fifth of participants (19%) endorsing the beliefs that chiropractic was both a mainstream and CAM modality. The authors argued that these results may indicate a shift in the perception of chiropractic from CAM into mainstream healthcare due to the increasing utilisation and research behind the profession. Despite this, a lack of knowledge of chiropractic was apparent among students with half of participants (50%) unaware of the types of treatment chiropractors can provide.

A lack of chiropractic knowledge amongst students was also found in an earlier Canadian study conducted by Baugniet et al⁸ in 2000 which found that less than 40% claiming to know a considerable amount about chiropractic. Many participants (44%) perceived chiropractic to be useful however in comparison to other students, medical students were the only ones who reported no discussion of CAM in their training and thus it was postulated by the authors that this may explain why they rated the usefulness of CAM therapies lower than all other students. Limitations of this study that must be considered are noted in Table 2.

European knowledge and attitudes

In recent times, Chiropractic has become one of the most commonly used CAM modalities in the Europe.¹⁹ Results from a British study conducted by Furham & McGill²⁰ indicated that among the 1st and 3rd year medical students surveyed, 27.8% of respondents were knowledgeable in CAM therapies, 40.5% would refer a patient/client for CAM, and 51.4% believe CAM to be an effective means of therapy. When comparing the differences between class levels, results reflected the general trend observed in American research (*Riccard and Skelton*¹⁶ and *De-Sylva et al*¹⁷) and it was found that 1st year medical students believed CAM to be more effective than 3rd year medical students. The authors postulated that this may have been due to increased medical knowledge, more contact with patients

who had not found it to be effective and exposure to sceptical clinicians. Similarly, 1st year students demonstrated a greater desire for training in CAM therapies than their 3rd year counterparts. In 2012, Meinema and Knaap²¹ conducted a study investigating medical students' attitudes directly towards chiropractic. Congruent with results found by chiropractic-specific analysis *Wong et al*¹⁸ the Netherlands students were found to have low knowledge of chiropractic with only a very small portion (2%) stating that their knowledge was good. Attitudes towards chiropractic were generally positive with more than half of the students (54%) believing co-operation with chiropractors within the health care system to be important. This study demonstrated positive attitudes of a select sample of Netherlands medical students however there were some limitations (see table 2).

Research conducted by Münstedt et al²² investigating the attitudes of German medical students found one fifth (20%) of students had a knowledge of chiropractic and indicated generally positive attitudes towards chiropractic. This study reflected similar findings seen in this region (*Furham and McGill*,²⁰ *Wong et al*¹⁸ and *Chaterji¹⁵ et al*) and suggested that medical students desired to be more informed and believed that CAM should be included in medical education.

Asian and African knowledge and attitudes

In nationwide research on CAM utilisation by the public conducted in Turkey in 2017, chiropractic placed 15th out of 16 CAM modalities investigated with 99.5% of participants never having utilised this therapy.²³ In 2010, Yildirim et al²⁴ indicated that there was a negative consensus regarding chiropractic with a large portion (86.1%) of students undecided over the usefulness of chiropractic. This contrasts results found in the other regions (*Furber et al*,¹² *Chaterji et al*,¹⁵ *Wong et al*,¹⁸ *Meinema and Knaap*²¹ and *Münstedt et al*²²) which generally reflected more positive student views towards chiropractic. A more recent Turkish cross-sectional survey conducted in 2020 by Demir-Dora et al²⁵ compared the attitudes between 1st and 5th year students and found that positive attitudes towards chiropractic lessened as medical education progressed. These results are congruent with previous research (*Furber et al*,¹² *Riccard and Skelton*,¹⁵ *De-Sylva et al*¹⁷ and *Furham & McGill*²⁰)

Similar to *Yildirim et al*,²⁴ a study conducted by Yeo et al²⁶ found over half (66.3%) of Singaporean students were unsure of the effectiveness of chiropractic. Although many students (86%) indicated a desire to have some CAM training, chiropractic was not among the top 5 modalities that students had the greatest interest in. This could be attributed a lack of awareness of chiropractic with nearly one third of students (30.5%) never having heard of the modality. A Malaysian study conducted in 2015 by Haque et al²⁷ indirectly assessed attitudes towards chiropractic and found many students (67%) possessed a positive attitude towards CAM modalities. Limitations of this study include the predominantly female response. Two years later, a study assessing Saudi Arabian medical student attitudes towards chiropractic indirectly conducted by Albadr et al²⁹ found that a majority of students (68%) agreed that a previously taken CAM course helped to improve

their knowledge. 51.6% of students admitted that the course gave them a positive attitude toward CAM. It was concluded that attitudes towards CAM were neutral but can but can be affected positively by improving their knowledge.

Just as reported in other literature,^{11, 12, 15, 18, 22, 24, 27} results of a Ghanaian study conducted by Ameade et al³⁰ found that a majority of students (85.5%) were of the opinion that adequate CAM knowledge is important for a doctor to have. Iranian students were found by Sadeghi et al³ (2016) to have a positive attitude (49%) toward CAM with neutral attitude observed in 51% of participants. A representative attitude towards CAM was not established with the authors concluding that student's attitudes towards CAM as a whole were varied. Data on the utilisation of chiropractic in this geographical region is scarce which may explain the disparity in attitudes towards chiropractic in comparison to other regions. Trends in student knowledge throughout this region were found to reflect previously aforementioned literature findings^{16,18,22,24,26,28} with low knowledge reported in all studies (*Yildirim et al*²⁴ *Yeo et al*,²⁶ *Haque et el*,²⁷ *Samara et al*,³¹ *Sadeghi et al*³ and *Ameade et al*.³⁰)

LIMITATIONS

This review was conducted by a single author and thus the risk of unintentional bias may be present. This review also excluded studies that were not in English and thus may be omitting articles that would alter the findings of this review. All studies included were cross-sectional in design meaning that it was not possible to explore factors which influence attitudes over time. As a result, the findings are only a reflection of the attitudes and knowledge at a specific point in time. Most studies lacked a comparison between knowledge levels across different years and as knowledge generally increases with education progression the results may not be immediately comparable. Furthermore, as all studies used a questionnaire methodology most contained self-selection bias in that only students interested in chiropractic volunteered to participate. Most knowledge was self-perceived and thus may not be an accurate representation of true student knowledge of chiropractic. Additionally, many studies assessed chiropractic indirectly under the umbrella term CAM. Lastly, due to small sample sizes the generalisability of the data is limited due to cultural differences across countries as well as educational curriculum discrepancies both across countries and between tertiary institutions in countries.

CONCLUSION

As the utilisation of chiropractic continues to grow, the attitudes, knowledge and underlying themes determining the attitudes of our future health practitioners must be examined as this has potential implications for future interdisciplinary care and patient health outcomes. The analysis of evidence within this review demonstrates that globally, medical student knowledge of chiropractic appears to be low. Due to a heterogeneity of results found in the global data that indicate a range of negative, neutral, and positive attitudes, the results of this review are inconclusive with no representative medical student attitude towards chiropractic currently able to be defined. Multiple studies demonstrate that recurring themes such as lack of evidence, lack of knowledge, inefficacy and safety concerns may be factors associated with negative student attitudes whereas subjective belief that chiropractic is effective or mainstream therapy, interest in learning more about chiropractic, and belief that chiropractic is safe and evidence-based may be factors facilitating neutral-positive medical student attitudes. Future research should include cross-sectional surveys that investigate true student knowledge of chiropractic and aim to identify the sources of information to better evaluate what influences student attitudes towards the chiropractic profession and how this may be addressed. Greater generalisability would also be achieved by a meta-analysis as this would represent a larger proportion of medical students worldwide.

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