



## Original Article

# Research-related attitudes among Chinese medicine students at a Canadian college: a mixed-methods study

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## ABSTRACT

**Background:** Previous studies have suggested that American Chinese medicine students' research interest declines as their training progresses. Many students further express low confidence in the congruence ('model validity') of bioscientific research methods in relation to the Chinese medicine paradigm. However, prior research has not assessed the impacts of research-related coursework on student perspectives in this regard.

**Methods:** First-, second- and third-year Chinese medicine students were surveyed regarding their research-related views. Final year students were re-surveyed after completing the research course. Qualitative analyses of the participating students' coursework were also undertaken.

**Results:** Over 80% of all participants showed high research interest and engagement, and viewed research as both relevant to clinical practice and important for the profession's socioeconomic legitimation. Male students were significantly more likely to view scientific evidence as improving the quality of Chinese medicine care ( $p = 0.021$ ). A view that conventional research methods have low model validity for Chinese medicine interventions was higher among third year students than those in their first or second years of study ( $p = 0.001$ ). Research coursework appeared to increase self-assessed research interest and skill. Concern regarding model validity was strongly evident in student coursework.

**Conclusion:** Research-related curricular interventions in the Chinese medicine field should directly address model validity, as it is of significant interest to a majority of students.

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## 1. Introduction

In an era of evidence-based medicine, post-secondary institutions training students in traditional and complementary medicine are increasingly incorporating research-focused coursework into their curricula.<sup>1–9</sup> Previous surveys conducted at colleges of acupuncture and East Asian medicine in the United States (US) show the vast majority of students believing that research carries socioeconomic importance in legitimating the profession they will enter, impacting insurance coverage as well as public perception of their field.<sup>2,3</sup> While upwards of 75% of trainees in their first year of training in the aforementioned studies showed high levels of research interest and perception of research value to clinical practice, endorsement of these views was reported to decrease towards the end of students' education.<sup>2,3</sup> Students closer to training completion furthermore reported decreased confidence that

bioscientific research methods are consistent or congruent with the principles and practices of East Asian medicine.

The issue of model validity, representing an appropriate “fit” between a study's design and the conceptual and clinical features of the studied intervention's underlying or originating paradigm,” has been discussed at length in the traditional and complementary medicine literature,<sup>10</sup> including with specific reference to acupuncture and East Asian medicine.<sup>11–21</sup> The importance of ‘whole systems’ or ‘whole practice’-based clinical research, which moves beyond studying isolated modalities using placebo controls to instead evaluate the real-world effectiveness of complex, individualized interventions, continues to be centralized by the Society for Acupuncture Research, and appears to be receiving renewed attention from the National Center for Complementary and Integrative Health in the United States.<sup>22</sup> As Wayne and colleagues note,<sup>2</sup> research coursework at institutions training practitioners of traditional and complementary medicine has the potential to make significant contributions to CAM [complementary and alternative medicine] research, especially toward ensuring that clinical research adequately reflects clinical practice.

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To date, however, no longitudinal studies have specifically evaluated the impact of research-focused coursework on acupuncture and East Asian medicine student attitudes in this regard; the present study begins to fill this gap.

The author used a mixed-methods approach to evaluate research attitudes among students enrolled in a three-year, full-time acupuncture and Chinese medicine training program at a public post-secondary college in Toronto, Canada. The program is meant to fulfil professional regulatory entry requirements in the province of Ontario, and culminates in a diploma (rather than a degree). No prior post-secondary education is required for entry into the program. Using a census-style approach, first and second-year program students were surveyed at the end of their academic year with regards their research interest and value perception, self-assessed research literacy, the socio-economic importance of research, and model validity of conventional research methodologies. In addition, to assess for longitudinal changes in research-related perspectives, third-year program students were similarly surveyed in their final academic term, both immediately prior to beginning, and subsequent to completing a thirteen-week, thirty-hour research literacy course. Qualitative analyses of student assignments from this course provided contextual data to aid interpretation of survey findings, with particular reference to the issue of model validity.

Aligned with broader curricular trends in research education in complementary medicine education,<sup>5</sup> the aforementioned course, taught by the study author, aimed to provide students with the skills to critically review and interpret clinical research in the TCM field. Didactic lectures (supported by course readings) introduced students to the range of clinical research methods used in contemporary health care research, as well as particular considerations in the TCM field. The issue of model validity, and its relevance to research design, was repeatedly discussed in class sessions. In addition to addressing conventional, randomized placebo-controlled trials, systematic reviews and the evidence-based medicine model, the course covered such topics as whole systems research, pragmatic research trial models, comparative effectiveness and mixed methods designs, practice-based research networks, and considerations surrounding verum vs. placebo acupuncture trial methodologies. Course activities included a journal club, a literature review term paper, and an in-class session in which small groups of students developed brief mock-ups of TCM-related clinical trials.

## 2. Methods

### 2.1. Data generation

The conduct of this study was approved by the Research Ethics Board at Humber Institute of Technology and Advanced Learning, a public post-secondary institution in Toronto, Canada that houses a three-year, full-time traditional Chinese medicine (TCM) professional training program. At the time of the study's conduct, the author was instructor of a third-year research-focused course for Chinese medicine students in the aforementioned program. Using an informed consent process, the study's mixed methods data generation approach included delivery of an anonymous online survey (to all TCM students), a anonymous hardcopy survey (to third-year students only), and collection of specified coursework from third-year students in the research course.

Online surveys were administered to students in each of the program's three cohorts (i.e., first, second and third year students) during a single specific class session for each cohort. All survey recruitment/administration sessions took place in April 2019, at the end of the academic year; and each included a brief information

session and informed consent process facilitated by a third-party recruiter from the Humber College's Centre for Teaching and Learning. Incentives in the form of coffee-muffin gift cards were provided to each student who participated in the study. No effort was made to recruit students who were been absent from the class sessions when the surveys were delivered.

In addition to collecting data about students' demographic and educational background, the online survey engaged a five-point Likert scale (Strongly disagree; Disagree; Neutral; Agree; Strongly Agree). The survey's questions were substantially based on those used in related studies<sup>2,3</sup>; and posed twelve closed-ended questions (Q) pertaining to one of five themes. The themes were: Student research interest and engagement (Q=2); Self-assessed research literacy (Q=2); Relevance of research to clinical practice (Q=3); Relevance of research to socioeconomic position of the profession (Q=2); and Model validity (Q=2). The survey also included one open-ended question, as follows: "Please share anything else you would like to say about TCM and scientific research."

Additional data were collected from students enrolled in the program's third (and final) year, prior and subsequent to their completion of a thirteen-week required course focused on research literacy. Consenting students anonymously completed a hardcopy version of the online survey at the beginning of their first class session prior to any course material delivery; the resulting data served as an initial ('before') dataset to facilitate comparisons with post-course survey data. At the end of their final class session, third year students again had the option to complete an augmented version the survey online; this 'post' survey included five additional questions aimed at assessing the impacts of the course on students' research engagement, skills and outlook. In addition, students had the option of consenting to have some of their individual and/or group-based coursework analysed for the study.

### 2.2. Data analysis

The quantitative data analysis undertaken in this study was identified a priori, and was aimed at facilitating comparisons with prior similar studies. Participants' socio-demographic characteristics are reported proportionally in relation to the categorical variables. The results of Likert-scaled survey questions are described as the proportion of respondents who expressed agreement (Agree + Strongly Agree). In addition, the Mann-Whitney U and Kruskal-Wallis tests were used to evaluate for statistically significant differences in the level of agreement expressed in student responses to the Likert-scaled questions by age, year of training and education level; and also to compare first/second vs. third year pre-post survey responses. The decision to use these non-parametric tests was based on the data's ordinal character. The author used SPSS statistical software for Mac (version 25) to conduct quantitative analyses.

Thematic content analysis, at the level of the individual, was used to analyse of all qualitative data. All open-ended, text-based survey responses were first coded in a deductive manner with reference to the five themes around which the Likert-scaled survey questions had been shaped; and subsequently evaluated inductively for additional emergent themes. To address potential for bias, qualitative analysis was separately undertaken by the author and a research assistant, and results were subsequently corroborated. Excerpts from consenting students' coursework were theoretically searched by the author for evidence of student engagement with the *model validity* principle. Illustrative excerpts are presented to substantiate all qualitative findings.

**Table 1**  
Student demographics.

Variables	n	%
Gender		
Female-identified	21	45.7%
Male	20	43.5%
Other/undisclosed	5	10.8%
Age (years)		
18–25	16	34.8%
26–35	15	32.6%
36–45	13	28.3%
46–55	2	4.3%
Education – highest level		
Secondary school	8	17.4%
College diploma	11	23.9%
Undergraduate	17	36.9%
Masters degree	5	10.9%
Medical doctorate	4	8.7%
Other profession	1	2.2%

### 3. Results

A total of forty-six students, representing 80.7% of XX College's total TCM student population (n = 57), responded to the survey. This included thirty-two students in their first and second years of TCM training, who completed the survey online; and fourteen third-year students who completed hardcopy surveys on the first day of a thirteen-week, thirty-hour introductory-level research literacy course. Table 1 presents demographic details about these students' gender, age and prior education.

All forty-six responders provided answers to each of the survey's closed-ended questions; the margin of error for the reported responses is 6%. Table 2 shows the summarized descriptive results of responses organized by theme, reflecting the percentage of students who either "agreed" or "strongly agreed" with each item. Overall, over 80% of students expressed a high level of research interest and engagement, viewed research as significantly relevant to clinical practice, and as having importance in relation to their future profession's socioeconomic position. While most students expressed ease in searching for scientific research about TCM therapies (78.3%), fewer felt they had the skills and knowledge to understand (60.9%) and critically evaluate (41.3%) such research. Relatively lower levels of student endorsement were evident on questions pertaining to model validity, with 41.3% of students agreeing that contemporary scientific research methods are congruent with TCM principles, and 43.5% agreeing that TCM perspectives should be studied using such bioscientific methods.

#### 3.1. Statistically-significant comparisons

Using the Mann–Whitney U test, a statistically significant difference was observed when comparing First/Second year students with Third year students on the following item: "Using contemporary scientific methods to study TCM is consistent with the principles of TCM";  $U = 88.50$ ,  $z = -3.47$ ,  $p = 0.001$ . First/Second Year students (N = 33, mean rank = 28.32) scored higher than Third Year students (N = 14, mean rank = 13.82). The Mann–Whitney U test also showed statistical significance upon comparison of non-university educated vs. university-educated students self-assessed comfort levels "searching for scientific articles about TCM therapies";  $U = 338.5$ ,  $z = 2.26$ ,  $p = 0.024$ . Non-university educated students that is, those with high school or college completion as their highest level of pre-TCM education, (N = 26, mean rank = 26.52) scored higher than those with one more university degree (n = 19, mean rank = 18.18).

In addition, the Kruskal-Wallis test found a statistically significant difference between genders with respect to the following

statement: "The quality of patient care is improved when TCM practitioners use scientific evidence to inform their treatment choices",  $\chi^2(2) = 7.76$ ,  $p = 0.021$ . Pairwise comparisons revealed that participants who identified as Males (N = 13, Mean Rank = 31.50) scored this item significantly higher than participants who identified as Female (N = 30, Mean Rank = 20.17),  $p = 0.021$ . No significant difference was found between participants who did not specify their gender identity (N = 4, Mean Rank = 28.38), and Males or Females.

#### 3.2. Qualitative responses to census-style survey

45.6% (n = 21) of all survey participants provided answers to the survey's open-ended question. On the whole, responses coincided with the survey's over-arching themes and affirmed quantitative findings; sample quotes are shown in Table 2. The most detailed and varied textual responses pertained to the model validity theme, and as such are over-represented in the sample quotes. Consistent with numeric findings, multiple students conveyed a view that conventional biomedical research methods were not well-suited to studying Chinese medicine interventions. Some, as evident in the second listed quote, called for more appropriate (i.e., model valid) research approaches to be engaged. Conversely, as shown in the third quote, one student articulated wholehearted support for bioscientific research methods, and expressed a perception that some in the TCM community were opposed to an evidence-based approach.

#### 3.3. Third year students' survey responses and coursework

Of the fifteen students who completed the third year research course, fourteen (93.3%) and thirteen (86.6%) were present, respectively, during the first and last class sessions when the surveys were administered. 100% of students present elected to anonymously participate on each occasion. Demographic features of this subgroup of students did not differ significantly from the broader TCM student cohort. There was no statistically significant difference between this cohort's answers to the survey questions prior and subsequent to completing the course in other words, their self-assessed views on research remained consistent. That said, on a the augmented post-course set of survey questions, the vast majority (93%, n = 12) of these students indicated that the course had supported their overall research engagement, indicating that they 'agreed' or 'strongly agreed' with each of the five distinct points identified in Table 3.

In addition, nine of the thirteen students in this cohort (69.2%) provided answers to the open-ended qualitative question, in which they were asked if they had anything additional to say about their course experience and/or the field of Chinese medicine research. A majority (n = 7) of these participants (n = 7) provided positive and constructive feedback about the course, whereas others did not comment on their course experience *per se*. That said, as illustrated in Table 3, over half (n = 5) either accompanied their course-related comments with, or commented exclusively upon the issue of model validity. Qualitative analyses of consenting students' coursework further demonstrated many students' significant pre-occupation with using appropriate scientific methodologies to evaluate Chinese medicine therapies. This was evident both in students' individual term papers and in the brief clinical trial protocol mock-ups they developed in small groups.

The third-year research course term paper assignment required that students review a focused body of scholarly literature pertaining to some aspect of Chinese medicine research or practice. Across their diverse papers, students demonstrated significant concern for model validity in clinical research. For example, one student, whose term paper reviewed a series of systematic reviews pertaining to

**Table 2**  
Perspectives on research among first, second and third year TCM students.

THEME	Question topic	% Agreeing (n = 46)	Sample qualitative responses (n = 21)
Research interest and engagement	Interested in <b>learning more about</b> TCM-related research	84.5%	I know almost nothing about TCM research, but I am very interested in knowing more and contributing if possible. It would be helpful to be involved in studies in any capacity - as participants, contributors, and researchers.
	Interested in <b>being involved in</b> TCM-related research	82.6%	
Self-assessed research literacy	Comfortable <b>searching for scientific research</b> about TCM therapies	78.3%	The research course should have taken place in the first year. We have some training, however this course could be helpful throughout all of our years of study, not just the final semester of the last year.
	Have <b>skills to understand</b> TCM-related scientific research	60.9%	
	Have <b>knowledge to critically evaluate</b> scientific research about TCM therapies	41.3%	
Relevance of research to clinical practice	TCM-related scientific research findings will be <b>useful in future clinical practice</b>	86.9%	It is necessary for a practitioner to be informed about scientific investigation and result in order to give to the patient.
	Quality of TCM <b>patient care is improved when informed</b> by scientific evidence	82.6%	
	<b>Important for TCM practitioners to stay informed</b> about TCM-related clinical research	82.6%	
Relevance of research to socioeconomic position of the profession	TCM-related research has a <b>positive influence on public perception</b> of the profession	82.6%	I think it's very important for TCM to be studied using contemporary methods as it will help with the public perception of TCM.
	<b>Insurance companies more likely to cover</b> TCM care when research demonstrates effectiveness	82.6%	
Model validity	Using contemporary scientific methods to study TCM is <b>consistent with TCM principles</b>	41.3%	Sometimes it is difficult to do scientific studies in TCM since we treat in an individual way for each and every patient. Some believe strongly TCM methods cannot be effectively studied using western medical techniques/standards. Interested in finding alternative research method consistent with TCM methods and able to support efficacy of the treatment in western societal views Unfortunately, there is an anti-scientific, anti-evidence bias among a minority of TCM practitioners and students that harms our profession and the public perception of it. . . I look forward to scientific research clarifying the mechanisms of TCM and creating a stronger evidence base for our practice. I hope TCM practitioners will welcome the scientific investigation of TCM and adopt a more evidence-based approach.
	TCM principles and practices <b>should be investigated for accuracy</b> using conventional biomedical methods	43.5%	

**Table 3**  
Post-course survey responses among third-year TCM students.

Taking this course. . .	% Agreeing (n = 13)	Sample qualitative responses (n = 9)
Increased my <b>comfort level searching for scientific articles</b> about TCM clinical therapies	93%	[The course] was a very good experience and I appreciate more the importance of establishing the right methodology to conduct scientific research regarding TCM as a whole system.
Helped develop my <b>skills in understanding scientific articles</b> about TCM clinical therapies	93%	[The course] provided me with the means to understand and critically analyse the research in TCM. This is especially important because much current research is conducted in a way where it doesn't represent the practice of TCM in the real world setting.
Gave me experience in <b>critically evaluating the quality of scientific articles</b> about TCM therapies	93%	It would be great to have a vocabulary list explaining all the terms needed to be research literate and how they work against or in favour of TCM research since there is a lot and is hard at times to get it all down.
Increased my <b>interest in being involved in a research team</b> investigating TCM therapies	93%	TCM is individualized treatment. [Research] design should be based on TCM theory.
Helped me to <b>understand what kinds of research methods are appropriate</b> for studying TCM therapies.	93%	I am hesitant when it comes to the field of research of TCM because I don't want future advancements in research to somehow take away from the traditions of this profession/art.

the use of acupuncture for a particular health condition, noted in his paper's discussion section:

There were methodological issues with these studies, which may not reflect the practice of acupuncture in the context of traditional Chinese medicine. These reviews didn't clearly indicate whether the acupuncture treatments were individualized to the patient or standardized. In addition, the diagnostic

criteria were strictly bio-medical, and didn't involve TCM pattern differentiation.

Another student, whose project investigated sham and placebo control methods in clinical trials of acupuncture, summarized her carefully-cited critical argument as follows:

Sham acupuncture is not an appropriate control method for acupuncture studies because it may induce non-specific effects



when the needle penetrates the skin and thus not completely inert. Placebo acupuncture devices such as Streitberger or Park device apply pressure on the skin and the effects of acupressure has not been identified. Without a complete understanding of the biological mechanism of acupuncture and knowing what is being controlled for, it is challenging to design a valid sham method for acupuncture trials.

Another course student, who focused her term paper on “research controversies surrounding evaluation of Chinese herbal medicine”, cited various scholars in the field to note that these medicines’ “mechanism of action” are “not well understood due to the complexity of studying the synergistic effects of single constituents within herbs, between single herbs, as well as multi-herb formulas.”

Students’ brief mock-ups of research protocols, developed in a 60-minute in-class, group-based exercise, showed similar engagement with the model validity principle – as evident in the protocol laid out in Table 4. This brief protocol mock-up for a three-armed, pragmatic randomized controlled trial proposed by three course students was modeled after – but included important modifications upon – a study by MacPherson and colleagues<sup>23</sup> that evaluated the effectiveness of individualized traditional acupuncture for patients with irritable bowel syndrome. The MacPherson study was not one that had been previously discussed or evaluated in the course; rather, students successfully searched for, reviewed and identified this study as having a relevant design within the time frame allotted to the protocol development exercise.

Like the MacPherson study, students’ pilot design proposed to compare individualized acupuncture (implemented with reference to Chinese medicine diagnostics) to usual biomedical care, but would add a third ‘whole systems’ Chinese medicine treatment arm, reflecting yet more complex individualized care. Reflecting their concurrent concern for patient safety and patient feedback, students further proposed to evaluate bloodwork among herbal patients and measure patient satisfaction across all treatment arms. Other student groups’ brief protocol mock-ups reflected a similar whole systems focus, in some cases including economic evaluations and qualitative methods to evaluate the effects of Chinese medicine therapies on various health conditions.

#### 4. Discussion

This mixed methods study both affirms and enriches the findings of previous related studies addressing Chinese medicine student perspectives on scientific research. Aligned with data published by Wayne et al.<sup>2</sup> and Anderson et al.<sup>3</sup> from the United States context, students in a Canadian post-secondary Chinese medicine professional training program strongly endorse a view that research is relevant to clinical practice, and that biomedical style research about Chinese medicine therapies positively impacts the socioeconomic position of their future profession. Also consistent with these prior studies, participants express high levels of research interest and engagement; but, unlike previous findings, these Canadian data do not show a drop in students’ level of research engagement as they progress towards completion of their Chinese medicine studies. Echoing the views of American Chinese medicine students, and affirmed in open-ended survey responses, fewer than half of students in the current study believe that the use of contemporary scientific methods is consistent with Chinese medicine principle.

Consistent with the cited prior research, this study shows such a stance to be significantly more pronounced among senior (third year) students than those in their first and second years of study. Indeed, Wayne et al observed that students of increasing levels of TCM education progressively endorsed in larger numbers a

views that the “scientific method is inconsistent” with their profession’s principles.<sup>2</sup> Anderson et al similarly found that student endorsement of the “scientific method [being] compatible with [TCM]” decreased progressively with additional years of training.<sup>3</sup> The current work furthermore shows a considerable preoccupation around the issue of model validity, and concern about the relevance of research to clinical practice within senior students’ research-focused coursework.

Some notable demographic differences were evident between students in the present study and those in previous American studies. Among those who clearly specified their gender identities, 51% of the Canadian students surveyed identified as female, as compared to over 70% in earlier related surveys. Further, whereas the vast majority of participants in prior surveys had earned a university degree prior to their Chinese medicine training, 41.3% of participants in the current study had no university degree. Participants were, on average, also somewhat younger than their American counterparts. That students’ views about research were on the whole similar across the present and prior studies<sup>2,3</sup> despite these demographic differences suggests that: a) these views may be reasonably generalized across a larger North American population of Chinese medicine trainees; and b) on the whole, that these views are not significantly impacted by demographic differentials. However, the current study presents some particular demographically-related findings that were not evident in prior studies.

Male participants in this study were significantly more likely to characterize the use of scientific evidence by TCM practitioners as improving the quality of patient care. Such a finding was not evident in previous research and raises interesting questions. Women’s disproportionate usage of a range of complementary therapies has been widely documented, as has the significant feminization of complementary medicine professions in the global North.<sup>24</sup> Indeed, in the Ontario context, 61% of registered practitioners of traditional Chinese medicine and acupuncture identify as women.<sup>25</sup> In one qualitative study, Brenton and Elliot<sup>26</sup> showed how male users of complementary medicine, a “feminised form of health care [that] does not enjoy the scientific legitimacy of standard biomedical practices,”<sup>26</sup> tended to frame their use of these therapies in alignment with traditional concepts of masculinity by emphasizing “science and logic”.<sup>26</sup> Whether the current study data similarly suggest that such a gendered discourse may be evident among male practitioners of unconventional and/or conventional therapies warrants further investigation.

In addition, the higher self-perceived efficacy in searching for scientific articles among those without (as compared to with) at least one university degree raises multiple questions about the accuracy of self-reporting on this particular issue. On one hand, student responses in this regard may have been an artefact of the unvalidated survey question wording, which was not directly relevant to TCM scientific articles. Alternately, since university education is often associated with the development of critical thinking and research skills, those without such training may be over-estimating their abilities. Other study data further suggest it likely that students’ self-assessments may not accurately reflect their skills in this regard. Indeed, on the survey delivered twice to third year students in the current study, self-ranked assessments of research skills did not significantly differ before and after taking the research-focused course. Yet, students in this same third year cohort universally endorsed, post-course, a series of statements indicating that their course experience had indeed increased their ease and skill in searching for, understanding and critically evaluating Chinese medicine-related scientific articles. Student self-rankings on this particular item may thus not be considered reliable indicators. Validation of this and other survey items may be advantageous in future studies.

**Table 4**  
Sample student clinical trial protocol brief mock-ups.

Study design	Three-armed, open-label pragmatic randomized controlled trial with dual diagnosis and factorial design
Focus	Irritable bowel syndrome (all types: constipation dominant, diarrhea-dominant, and mixture)
Population	Ages 20 – 50, all genders, n = 60
Duration	10 weeks
Arm I	Individualized TCM acupuncture + usual biomedical care
Arm II	Individualized whole systems TCM (acupuncture, herbal medicine, dietary therapy, moxibustion) + usual biomedical care
Arm III	Usual biomedical care
Outcome measures	<i>Primary:</i> IBS Symptom Severity Score <i>Secondary:</i> IBS Non-Colonic Symptom Score; Frequency of flare-ups; Use of emergency medication; Treatment satisfaction <i>Safety:</i> Adverse events (frequency, severity); Bloodwork to monitor liver enzyme levels among herbal patients

To the author's knowledge, this is the first study that surveyed the same group of Chinese medicine students about their perspectives on research both prior and subsequent to their completion of a research-related course. As noted, survey data indicate that research engagement among such students remained consistently strong both prior and subsequent to taking the course, as did their views about the relevance of research both to their profession's socioeconomic position, and to clinical practice. Most students furthermore found the course to have been a positive experience, and to have advanced their research literacy overall. That said, the issue of model validity – and ultimately, the translation of research to TCM clinical practice – remained a predominant concern among these students, as further demonstrated in excerpts from their coursework. As Chinese medicine educators work to design research-related curricula, it is thus essential that the issue of model validity be directly addressed to ensure ongoing student engagement. Additional research and documentation of best practices in curricular development and delivery that center whole systems research methods in the field of Chinese medicine will likely be important.

This study has strengths, limitations, and design shortcomings, which should be noted for future research. A considerable strength of this study is its high survey response rate, suggesting that findings are representative of the population surveyed. The response rate to the survey's open-ended question was higher than in previous related studies; and qualitative survey responses further echoed and reinforced the study's quantitative findings. The mixed methods approach, which provided further insight regarding student engagement with the model validity principle, is another strength.

The survey instrument used in this work was not validated nor pre-tested, a clear limitation that may have tacitly informed the results of the present study as well as those in the prior studies upon which the survey design was based. Furthermore, the study author's dual role as course instructor and researcher may have introduced bias into the study at the level of course content as well as qualitative analysis. The low number of students enrolled in the present study's third-year research course is another limitation that weakens the validity of reported findings. Finally, while the Canadian program housing the students in the current study leads to TCM professional licensure, it does not – in contrast to the American educational programs discussed in related prior studies – lead to undergraduate or graduate degree. As such, the programs may not constitute strongly compatible comparators upon which to contextualize findings.

It was, moreover, unfortunate that data about student ethnicity and immigrant status were not collected, especially in light of Toronto's significant ethnocultural diversity, and high proportion of East Asian immigrants. Although Anderson et al.<sup>3</sup> measured but did not find ethnicity to be associated with significant differences in Chinese medicine student views regarding research, additional data would assist in clarifying the degree to which their findings may be generalized. As the current work demonstrates,

demographic features such as prior education and gender may bear significantly on student views regarding research, a consideration that educators may wish to take into account.

In conclusion, this study provides important data to substantiate and enrich previous work pertaining to the implementation of research-related coursework at Chinese medicine professional colleges in North America. Worth further consideration is whether such courses should directly address research-related challenges associated with model validity in order to sustain research engagement among future practitioners. New data emerged that draw attention to potential gender-related differences in research-related outlook among Chinese medicine practitioners, warranting additional exploration. Future research should emphasize validation of survey instrumentation, and address specific curricular strategies in greater detail.

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#### Conflict of interest

The author declares no conflict of interest.

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#### Ethical statement

This study was approved by the Research Ethics Board at Humber Institute of Technology and Advanced Learning, Toronto, Canada.

#### Data availability

Data will be made available upon request.

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