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RESEARCH

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Exploring knowledge, confidence and barriers to evidence-based practice implementation of self-management strategy for low back pain during chiropractic training in France: a mixed method study

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Abstract

Introduction Non-specific low back pain (NSLBP), with or without radiation, is a leading cause of global disability. International guidelines recommend that healthcare providers extend self-management support (SMS) to patients to alleviate pain and disability. However, the adoption of SMS strategies remains suboptimal. This study aimed to evaluate the levels of knowledge and confidence associated with adopting evidence-based practice (EBP) recommendations on SMS and identify related barriers and facilitators among interns and clinicians at the Franco-European Institute of Chiropractic (IFEC) outpatient clinic.

Methods Methods:Using an explanatory sequential mixed-methods design (quantitative then qualitative), chiropractic interns and clinicians completed two self-reported questionnaires assessing 1) the levels of EBP endorsement (EBP Belief Scale) and application (EBP Implementation Scale), and 2) clinical practice orientation (Pain Attitude and Belief Scale). Semi-structured interviews underpinned by the Theoretical Domains Framework (TDF) were conducted among survey respondents to identify the key barriers and facilitators toward implementing SMS.

Results A total of 48 interns and 23 supervising clinicians participated in the quantitative strand, while 10 interns and 10 clinicians took part in the qualitative strand.Despite positive beliefs towards EBP, interns and clinicians encountered various obstacles in practical implementation. Key TDF barriers included lack of time to apply SMS, familiarity with guideline recommendations, communication skills, and concerns over the potential impacts if patients failed to perform exercises. Additionally, confidence in delivering SMS and the recognition that providing SMS aligns with chiropractic duties emerged as important facilitators.

Conclusion The data suggests that while practitioners demonstrate a solid level of knowledge regarding the use of EBP in patients with low back pain, their actual implementation of these strategies remains moderate. Qualitative analysis further highlights the presence of specific beliefs and attitudes that mirror those reported in other healthcare

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professions. Among the main barriers, significant challenges related to knowledge, skills, and resources—particularly the lack of time—appear to hinder the systematic application of SMS in clinical practice.

Introduction

In 2020, low back pain (LBP) affected 619 million people worldwide [1]. With the aging population and demographic changes, it is estimated that 843 million people could experience LBP by 2050 [1]. This condition affects all ages and all socio-professional classes [2]. Low back pain is a major cause of work absenteeism [3]. Globally, the loss of healthy life years due to LBP is estimated at over 60 million, resulting in significant societal cost [3].

Non-specific low back pain (NSLBP) accounts for approximately 80 to 90% of all low back pain cases [4, 5]. NSLBP is a condition without an identifiable cause that can be managed in primary care by general practitioners, chiropractors, physiotherapists, and acupuncturists, as well as by the patient through self-management. Similar to recommendations for musculoskeletal disorders [6] and comorbidities such as diabetes, hypertension, and mood disorders [7, 9], clinical practice guidelines on the management of LBP recommend clinicians implement self-management strategies (SMS) as a first-line approach [10, 14]. SMS are defined as a set of interventions aimed at equipping patients with the skills necessary to actively participate in and manage their chronic or acute episodes, in order to maintain their daily personal and professional activities [15]. In France, chiropractors are recognized as primary care professionals with a focus on preventing and managing musculoskeletal disorders and their consequences (chiropractic acts and conditions of practice - Decree 2011-32 of January 7, 2011). Many chiropractors provide SMS through therapeutic tools such as education, counseling, and exercises. However, the application of SMS is highly variable across primary healthcare professionals [16, 17], with about one third of chiropractors worldwide implementing therapeutic education and one fourth recommending exercises to their patients [18]. Given the societal and financial burden posed by NSLBP, such a low proportion is far from satisfactory. Therefore, understanding barriers and facilitators to utilizing SMS in the context of chiropractic care is important. It is particularly relevant to focus on chiropractic education, as modifying professional practice is complex.

This study's aims were to (1) explore the knowledge and confidence levels of chiropractic interns and clinical supervisors regarding self-management support (SMS) within the outpatient clinic of a chiropractic school in France, and (2) identify perceived barriers and facilitators influencing the adoption of best practice recommendations for SMS.

Methods

Design

An explanatory sequential mixed-methods design (quantitative followed by a qualitative study) was used. To explore levels of knowledge and confidence, we administered two survey questionnaires between October 2 and December 18, 2023, to chiropractic interns and their supervising clinicians working at the French Chiropractic School outpatient clinics located in Toulouse and Ivry-sur-Seine. To identify potential barriers and facilitators to adopting SMS, we conducted semi-structured interviews between June 2023 and January 2024 among the same participants.

Study participants

Participants included final-year chiropractic interns and their supervising clinicians providing care to people with musculoskeletal complaints. Interns had to have completed their entire academic curriculum and be enrolled in their final year of chiropractic training at one of the two IFEC campuses. Supervising clinicians had to be employed as supervising clinicians by the French Chiropractic School and actively overseeing interns at one of these sites.

Ethics approval and consent to participate

Ethical approval for the study was obtained from the Université du Québec à Trois-Rivières Research Ethics Committee for Human Subjects (UQTR CEREH number: CER-22-289-07.10) and the Institut Franco-Européen de Chiropraxie ethic committee (IFEC Ethic committee number : 22_09_002).

All participants provided informed consent before participating in the study. Confidentiality was maintained by anonymizing the data, and participants were assured that their responses would be used solely for research purposes. The entire research protocol was designed in compliance with the principles of the Declaration of Helsinki (latest revision), ensuring the protection of participants' rights, safety, and well-being.

Quantitative study

Final-year chiropractic student ($n = 145$) and supervising clinicians ($n = 49$) were invited via their institutional email addresses to complete the Evidence-Based Practice Belief and Implementation Scale (EBP-B/I) and the Pain Attitude and Belief Scale (PABS) and a demographic questionnaire including age, gender, experience, qualifications, and campus location on Google Forms (Google Inc. 1600 Amphitheatre Parkway – Mountain View, CA

94043). All questions were mandatory, and participants were required to provide a response in order to proceed to the next section of the questionnaire.

The EBP-B/I includes two scales: the EBP-B, which measures beliefs and confidence in EBP, and the EBP-I, which assesses the frequency of using evidence-based components in practice. The EBP-B scale consists of 16 items designed to measure practitioners' beliefs about the importance they place on evidence-based practice, as well as their beliefs and confidence in their ability to implement it in their practice. Each question is rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The EBP-I scale initially consists of 18 Questions designed to measure the frequency with which participants have used essential components and steps of evidence-based practice over the past eight weeks. Each question is rated on a five-point frequency scale ranging from 0 (never) to 4 (more than 8 times). However, for the French version used in this project, item 13 of the original questionnaire was removed, as it was deemed irrelevant for the Swiss and French healthcare systems [19]. The reliability and validity of both scales are described as satisfactory [19].

The PABS differentiates between participants' biomedical and behavioral orientation approaches to practice. The PABS consists of two themes of questions, one measuring the biomedical orientation of treatment (10 items), and the other assessing the behavioral orientation of treatment (9 items). Responses to each question are provided on a six-point Likert scale ranging from 'strongly disagree' to 'strongly agree with intermediate options including 'Mostly disagree', 'Somewhat disagree', 'Somewhat agree', and 'Mostly agree'. The PABS shows a consistent factor structure, good test-retest reliability, and strong construct validity. It has been used across various healthcare professional populations and clinical settings, supporting its external validity [20].

Qualitative study

A subset of participants who completed the questionnaires were invited to take part in semi-structured interviews. This subset of participants was selected using convenience sampling. The interview guide was created following the widely used Theoretical Domain Framework (TDF) framework, encompassing 14 domains seeking to uncover determinants of healthcare professional behavior, including knowledge, skills, social/professional role and identity, beliefs about capabilities, beliefs about consequences, and environmental context and resources [21, 23]. The interview guide was adapted from prior work [24] and contained 24 questions (Appendix 1). The interview guide was reviewed by the research team to ensure cultural relevance and appropriateness for the target population.

Individual interviews were conducted in a private room in the chiropractic outpatient clinic to ensure confidentiality of the participants. Each interview lasted approximately 45 to 60 min, was audio-recorded with the participant's consent, and transcribed verbatim. The first three interviews were jointly conducted by a qualitative research expert (AB) and the principal investigator (SP) to ensure consistency in interview technique and data collection. All subsequent interviews were carried out independently by the principal investigator. As both a faculty member and supervising clinician, the principal investigator served as an educator for the chiropractic interns. The two interviewers had no conflict of interest.

Data analysis

Quantitative data were analyzed using descriptive (means, standard deviations for continuous variables, and percentages and interquartile ranges for categorical variables), and inferential statistics to assess beliefs and the implementation of EBP, as well as the orientation of clinical practice. The inferential analysis includes mean comparison test, and correlation analysis using Pearson correlations for normally distributed data, Spearman correlations for non-normal distributions, to assess associations between the scores or sub-scores of the questionnaires were assessed. The results from the questionnaires were compared between interns and supervising clinicians to identify significant differences.

Qualitative data were analyzed using a thematic content analysis approach. Systematic coding was conducted by the main researcher (SP) to identify relevant text segments related to the interview questions. Specifically, statements were coded into the relevant Theoretical Domains Framework (TDF) domains. Specific beliefs summarizing similar quotes, and overarching themes encompassing similar beliefs were then developed. The senior author experienced in qualitative analysis (AB) was consulted at each step, and differences in interpretation were reconciled.

The results of the quantitative and qualitative analyses were used to provide an in-depth understanding of the factors likely to influence the application of SMS in clinical practice from the viewpoint of interns and supervisory clinicians and identified potential levers to improve adoption.

The integration aimed to explore the underlying reasons behind the quantitative results. After both datasets were analyzed separately, findings were merged during the interpretation stage following Fetter and al. recommendations [25]. A narrative integration approach was used; whereby key quantitative findings were juxtaposed with related qualitative themes to identify points of convergence, divergence, and complementarity. This integration enabled a more comprehensive understanding of the

Table 1 Comparison between the study sample and the target population

	Participating interns (*n* = 48)	Target population of interns (*n* = 161)	*p*-value
Mean age, years (± SD)	23.5 (± 3.2)	23.4 (± 2.3)	0.559[a]
Gender Female n (%)	28 (58%)	96 (60%)	0.733[b]
Had a prior degree n (%)	3 (6%)	N/A	
	Participating supervising clinicians (*n*= 23)	**Target population of supervising clinicians (*n* = 45)**	
Mean age years (± SD)	36.2 (± 9.9)	35.0 (± 8.3)	0.637[a]
Gender Female n (%)	10 (43%)	22 (49%)	0.440[b]
chiropractor degree obtained in France n (%)	20 (87%)	N/A	
Experience as chiropractor (Years) Median [range]	5 [1–34]	N/A	

[a]Wilcoxon test

[b]Khi-square test; N/A: The data are not available for research purpose due to institutional policy

Table 2 EBP B/I and PABS scores by group

		Mean (± SD)	Range	*p* value	Cohen's d
EBP Belief subscale [a]	Interns	57,58 (± 7,82)	36–71/80	0,243	0.22
	Supervising Clinicians	59,20 (± 6,68)	40–72/80		
EBP Implementation subscale [a]	Interns	31,24 (± 8,82)	17–56/68	0,727	0.19
	Supervising Clinicians	33,00 (± 9,65)	21–56/68		
PABS Biomedical subscale [b]	Interns	25,1 (± 6,02)	13–39/60	0,101	0.07
	Supervising Clinicians	25,55 (± 7,59)	13–38/60		
PABS Behavioural subscale [b]	Interns	35,65 (± 4,60)	26–45/54	0,796	0.44
	Supervising Clinicians	33,65 (± 4,28)	27–44/54		

(EBP B-I questionnaire scores were compared using the Wilcoxon test[a], while PABS questionnaire scores were compared using Student's t-test[b])

factors influencing EBP implementation among interns and supervising clinicians. A joint display table was also constructed to visually represent the integration of findings across both phases.

Results

Quantitative data

In total, 71 participants completed both questionnaires, including 48 interns (response rate: 30.4%), and 23 supervising clinicians (response rate: 41.7%), with a mean age of 24 (± 2.1) years, and 38 (± 12.0) years respectively. There were no significant differences between interns and supervising clinician participants and the population contacted for age and gender (Table 1).

Belief and implementation scale for Evidence-Based practice (EBP B/I scale)

Belief subscale

The mean score of interns was 57.6 (± 7.8) [range 36–71/80]. Specifically, 87.5% of interns reported knowing the steps involved in EBP. High scores were also recorded for questions related to the importance of implementing EBP. However, only half (50%) of the interns felt confident in their ability to implement EBP effectively to induce change in practice. Supervising clinicians reported a slightly higher mean score of 59.2 (± 6.7) [range 40–72/80] than interns, with a small effect size (d = 0.22). This difference was not statistically or practically significant(Table 2).

Implementation subscale

The mean score of chiropractic interns was 31.2 (± 8.8) [range 17–56/68]. The mean reported frequency of EBP use was between 4 and 5 instances over the last 8 weeks. Similarly, supervising clinicians' implementation mean score was 33 (± 9.7) [range 21–56/68]. Most of the activities were not frequently performed by supervising clinicians, except for sharing patient results with colleagues at least once during the past 8 weeks (70%) and sharing scientific study results with more than two colleagues (50%). The between group comparison show minimal practical difference between groups with a small effect size (d = 0.19) (Table 2).

Pain attitudes and beliefs scale (PABS)

Biomedical subscale

Interns mean subscale scores was 25.1 (± 6.0) [range 13–39/60], and clinicians mean score was 25.6 (± 7.6) [range 13–38/60], with a negligible effect size ($d = 0.07$), indicating no meaningful difference between groups(Table 2).

Behavioral subscale

For the behavioral subscale, interns answered with an average score of 35.7 ± 4.59 [range 26–45/54]. Supervising clinicians had similar scores with an average score of 33.7 ± 4.6 [range 27–44/54] (Table 2).

Inferential statistics

Results indicate a significant correlation between questionnaire sub-scores, specifically linking the EBP-B/I beliefs sub-score with the biomedical sub-score of the PABS ($p = 0.001$). The coefficient of −0.272 reflects a weak inverse correlation between the two sub-scores, suggesting that lower scores on EBP beliefs among residents or supervising clinicians are associated with a higher inclination toward a biomedical orientation in practice.

Qualitative data

In each group, 10 participants take part in the interview (Table 3). The interview time ranges from 37 min to 74 min with a mean interview time of 44 min. For both interns and supervising clinicians, five key TDF domains were identified as factors likely to inhibit or increase the likelihood of implementing SMS in routine chiropractic care: Knowledge, Skills, Social/professional role and identity, Beliefs about capabilities, and Environmental context and resources (Table 4).

Knowledge and skills

Both interns and clinicians highlighted the importance of adequate training in EBP and SMS. While most participants were aware of the principles of EBP, they expressed a need for more practical training and communication support to effectively implement these strategies in clinical settings. Lack of confidence in their skills was a recurring theme, particularly among interns, who felt they had not yet mastered the techniques required to guide patients in SMS. This is best illustrated by the following quote from an intern who, when explaining the strategies they use, wonders if they align with the recommendations.

> *"Then again, is it really in the recommendations? I'm not sure…" (I.7).*

Social/Professional role and identity

The role of chiropractors as primary care providers was seen as both a facilitator and a barrier. On the one hand, supervising clinicians strongly felt their professional role and responsibility towards patient care included the adoption of SMS as exemplified by this quote:

> *"It's essential. In any case, in my practice, it's just as important as a manipulation or soft tissue relaxation. It's a part of the treatment." (SC.5).*

On the other hand, some interns expressed uncertainty about whether implementing SMS was within their scope of practice, particularly in complex cases where interdisciplinary collaboration might be needed. This was reflected by one intern saying:

> *"Because, after all, we're not physiotherapists either, so we shouldn't start taking on the physiotherapist's role." (I.6).*

Beliefs about Capabilities

A significant barrier was the participants' belief in their own capabilities to implement SMS effectively. Many interns doubted their ability to influence patient behavior and outcomes through these strategies as expressed by one intern:

> *"The position of students, it's not always easy to be in front of an adult. Sometimes we don't feel very legitimate giving advice or prescribing exercises." (I.2).*

Although more confident, clinicians acknowledged that patient resistance to change could hinder the successful implementation of SMS. This is illustrated by the following quote:

> *"In any case, it's quite dependent on the patient. If they don't want to change, we hit a wall." (SC.3).*

Environmental context and resources

The availability of resources, such as educational materials, time, and institutional support, was perceived as a critical factor influencing the implementation of SMS. Both groups reported that limited time during patient consultations and a lack of standardized resources made it challenging to consistently apply SMS in practice. One intern suggested the following:

> *"I'm someone who's a bit lazier, it would be on the institution's website. That would be easier, and everyone would have the same information." (I.7).*

Additionally, some interns mentioned receiving support from their supervising clinicians, others felt that more could be done to facilitate the integration of EBP and SMS into everyday clinical practice. One intern stated:

Table 3 Interview participants demographic data

Variable	Interns interview participants (*n* = 10)	target population of interns (*n* = 161)
Mean age (year) ±SD [a]	23,3 ± 1,5	23,4 ± 2,3
Gender Female n (%) [b]	5 (50%)	96 (60%)
Had a prior degree n (%)	1 (10%)	N/A
Variable	**Supervising clinician interview participants (*n* = 10)**	**target population of supervising clinicians (*n* = 45)**
Mean age (year) ±SD [a]	36,6 ± 8,1	35,0 ± 8,3
Gender Female n (%) [b]	4 (40%)	22 (49%)
chiropractor degree obtained in France n (%)	10/0 (100%/0%)	N/A

N/A The data are not available for research purposes due to institutional policy

Table 4 Thematic analysis from the TDF

TDF Domains	Questions (*n*)	Number of iteration interns/clinicians (*n*/*n*)	Specific belief (*n*)	Specific belief (Number of iterations: interns/clinicians)	Positive influence $N^{interns}/N^{clinicians}$	Neutral $N^{interns}/N^{clinicians}$	Negative influence $N^{interns}/N^{clinicians}$
Skills	3	17/22	4	I have the communication skills to implement the SMS (5/9). I know when and how to implement the SMS during my consultation (4/9). I easily use the SMS (5/1). I still need to learn new techniques related to the SMS (2/3)	8/16	2/2	7/4
Knowledge	2	20/16	3	I am familiar with SMS (5/8). I know the conditions under which SMS are useful (9/3). I am aware of the best practice guidelines regarding SMS (6/5).	10/12	4/2	6/2
Social, Professional role and Identity	1	17/11	2	Proposing SMS is part of my role as a chiropractor (13/11). SMS are more the responsibility of another professional (2/0).	12/11	2/0	3/0
Beliefs About capabilities	1	11/13	1	I am confident in my ability to implement SMS (11/13).	9/12	0/0	2/1
Beliefs about consequences	2	33/27	2	I primarily expect positive outcomes when I propose SMS (treatment duration, speed of treatment, patient empowerment) (23/19). I have concerns that the patient may not correctly follow the advice and exercises when they are on their own (9/6)	23/19	1/1	9/6
Optimism	1	12/5	1	I am generally optimistic about the outcomes I achieve when proposing SMS (12/5).	6/4	0/1	6/0
Reinforcement	2	15/14	3	Those who supervise me motivate me to use SMS (6/4). Providing comprehensive and high-quality care is an important source of motivation (7/9). The evaluations focus on the implementation of SMS (2/1).	10/11	0/0	5/3
Intentions	1	12/10	1	I intend to propose SMS to my next patients with low back pain (12/10).	12/10	0/0	0/0
Goals	2	6/6	2	Proposing SMS is one of my priorities when treating a patient (5/5). The use of SMS is not compatible with a profitable private practice (1/1).	3/5	0/0	3/1

Table 4 (continued)

TDF Domains	Questions (*n*)	Number of iteration interns/clinicians (*n*/*n*)	Specific belief (*n*)	Specific belief (Number of iterations: interns/clinicians)	Positive influence $N^{interns}/N^{clinicians}$	Neutral $N^{interns}/N^{clinicians}$	Negative influence $N^{interns}/N^{clinicians}$
Cognition	2	8/8	1	I can easily decide which SMS to implement based on the patient's presentation (8/8).	4/8	1/0	3/0
Environmental	2	17/21	3	I do not have enough time to implement SMS (5/4). I have the necessary equipment to implement SMS (4/6). I have resources (booklet/video) to support the implementation of SMS (3/5)	4/8	3/1	10/12
Social Influences	2	22/27	2	Members of my profession are also involved in the implementation of SMS (12/16). Patients are expecting SMS (4/8). I have a 'champion' in my circle who inspires me in my clinical practice (3/1)	16/7	0/3	6/17
Emotion	1	7/5	1	I feel a sense of satisfaction when I implement SMS with my patients (6/4).	6/4	0/0	1/1
Behavioural regulation	2	8/14	2	I perform a retrospective analysis of the SMS used with my patients with low back pain (3/3). I have a Plan B to use when I am unable to implement SMS (4/11).	7/7	0/6	1/1

Note $N^{interns}$ number of iterations for the chiropractic intern, $N^{clinicians}$ number of iterations for the supervising clinician

"At the beginning of my internship, I didn't necessarily think about it, and the clinicians were not equally involved in those things [i.e. promoting SMS utilization]. " (I.3).

"Then again, is it really in the recommendations? I'm not sure..." (I.7).

Integration of quantitative and qualitative data

To synthesize the quantitative and qualitative findings, we employed a narrative integration approach. The key insights resulting from this process are summarized in the Joint Display Table below (Table 5).

Quantitative data from the EBP Belief Scale showed that both interns and supervising clinicians held generally positive beliefs about EBP. Interns scored an average of 57.6 (± 7.8) and clinicians 59.2 (± 6.7) out of 80, with 87.5% of interns reporting they knew the steps of EBP. This was reflected and nuanced in the interviews: while many participants reported familiarity with the principles of EBP, they often described their knowledge as theoretical, with limited hands-on exposure. Several interns expressed uncertainty about whether their actions aligned with best-practice recommendations.

Clinicians, on the other hand, often referenced EBP knowledge as part of their professional responsibility, although they also acknowledged variability in how deeply it was understood or applied.

Despite the generally positive beliefs, EBP Implementation Scale scores were moderate: interns averaged 31.2 (± 8.8) and clinicians 33.0 (± 9.7) out of 68. These scores indicate that while participants support EBP in principle, its regular application in clinical settings remains limited. Qualitative data confirmed this gap. Interns often cited lack of time, limited resources, and uncertainty about how to apply EBP in real-time clinical decision-making. Even clinicians reported that while they occasionally shared research findings, systematic use of EBP tools (e.g., PICO questions, data collection) was not routine. As an example, one supervising clinician said, regarding the search for EBP data:

Table 5 Integration of quantitative and qualitative data

Theme	Quantitative Findings	Qualitative Insights	Interpretation/Meta-inference
EBP Knowledge	High belief scores in EBP: Interns 57.6 (± 7.8), Clinicians 59.2 (± 6.7); 87.5% of interns reported knowing EBP steps.	Participants expressed familiarity with EBP principles, but mostly theoretical knowledge; interns were unsure if their strategies aligned with recommendations.	EBP knowledge is present but remains surface-level for many, especially interns. Need for deeper integration into clinical learning.
EBP Implementation	Moderate implementation scores: Interns 31.2 (± 8.8), Clinicians 33.0 (± 9.7); low frequency of EBP actions in past 8 weeks.	Lack of time, resources, and confidence noted; EBP actions rarely applied systematically; interns and clinicians acknowledged implementation gaps.	Positive beliefs toward EBP are not translating into consistent practice. Structural and educational support needed for behaviour change.
Practice Style	PABS scores indicate behavioural > biomedical orientation: Interns behavioural 35.7, biomedical 25.1; Clinicians behavioural 33.7, biomedical 25.6.	Clinicians affirmed behavioural practice as part of their role; interns are sometimes hesitant, unsure about professional boundaries in complex cases.	A shared behavioural orientation exists, but differences in confidence and role clarity highlight the need for mentorship and clearer scope definition.

> *"I'm not comfortable enough with the tools; it takes me a lot of time when I try to do it" (SC.3).*

Together, these findings illustrate a disconnect between beliefs and behaviour, and highlight the need for structured support and training, particularly in practical application and patient communication.

Quantitative data showed that both interns and supervising clinicians had higher behavioural subscale scores (interns: 35.7 ± 4.6; clinicians: 33.7 ± 4.3) than biomedical scores (interns: 25.1 ± 6.0; clinicians: 25.6 ± 7.6), suggesting a general preference for a behavioural approach to care. These results were supported by the qualitative findings. In interviews, most participants expressed that providing self-management support (SMS) aligned with their professional identity, a key element of a behavioural practice style. Clinicians often equated SMS with core treatment strategies, while interns showed greater variability, with some expressing uncertainty about their role, especially in complex cases. For instance, one clinician stated:

> *"In my practice, it's just as important as a manipulation or soft tissue relaxation. It's a part of the treatment." (SC.5).*

In contrast, an intern expressed hesitation:

> *"We're not physiotherapists either, so we shouldn't start taking on the physiotherapist's role." (I.6).*

Together, these findings suggest a shared orientation towards a behavioural approach, although confidence and clarity about scope of practice vary, particularly among interns.

Discussion

Both interns and clinicians obtained mean scores above the mid-range on the EBP Belief Scale (interns: 57.6 ± 7.8; clinicians: 59.2 ± 6.7 out of 80), suggesting generally favourable beliefs toward evidence-based practice. However, only 50% of interns reported feeling confident in their ability to implement EBP to effect change in clinical practice, indicating potential gaps in readiness. Regarding EBP implementation, the mean scores were moderate for both groups (interns: 31.2 ± 8.8; clinicians: 33.0 ± 9.7 out of 68), reflecting infrequent application of EBP principles in day-to-day clinical settings. This limited engagement was particularly evident in key activities such as formulating clinical questions or integrating research findings into care plans. For practice orientation, participants tended to score higher on the behavioural subscale of the PABS than on the biomedical subscale (interns: 35.7 vs. 25.1; clinicians: 33.7 vs. 25.6), suggesting a general preference for behavioural approaches in clinical reasoning. However, in the absence of validated thresholds to define what constitutes a "high" or "low" score, as noted by Mutsaers et al. (2012), these results should be interpreted cautiously and primarily used for comparative purposes [26].

The positive attitude towards EBP, but moderate implementation of EBP into practice has consistently been observed among chiropractic interns, supervisory clinicians, and chiropractic practitioners in the US, Canada, Belgium, the Netherlands, Swiss, Sweden, and Norway [18, 27–31]. These results were supported by participants we interviewed who generally agreed that providing SMS

is an integral part of their professional role and identity and expected that utilizing SMS would result in better patient health outcomes. However, time constraints, lacking negotiation skills, and uncertainty about when and how to propose SMS were key barriers identified, similar to a related study of Canadian chiropractic interns and supervisory clinicians [32] and among general physicians as well [33].

The fact that interns and clinicians leaned toward a behavioral rather than a biomedical approach is consistent with the gradual move of the chiropractic profession over the past 20 years toward a favorable attitude toward EBP both in educational settings and in clinical practice [34–36]. Furthermore, the inverse relationship observed between the PABS biomedical subscore and the EBP belief scale suggest that stronger negative beliefs towards EBP increase the likelihood of espousing a biomedical practice orientation. From the education stand point, improving the adoption of a biopsychosocial (BPS) model requires integrating BPS-related topics within chiropractic curricula, and expanding continuing education programs focusing on BPS principles, such as cognitive behavioral therapy, motivational interviewing, and acceptance and commitment therapy [37]. This recommendation is consistent with a study by Ostelo et al. (2003) demonstrating that curricula focused on manual therapy tend to foster a biomedical approach, while those focused on therapeutic education and exercises promote a behavioral approach [38]. Domenech et al. also found that biomedical training exacerbates negative beliefs about EBP and reduces adherence to best practice guidelines [39]. Addressing skepticism and misconceptions about clinical practice guidelines is an important first step [40]. More recently, Sorondo et al. (2022) proposed to implement guidelines across the training curriculums, with a focus during the clinical training of future chiropractors in France [41]. A deeper dive into our results suggests that less than half of the participating interns reported engaging in EBP activities over the past eight weeks, including patient data collection, interdisciplinary activities, formulating PICO questions or sharing results with colleagues, despite these being integral components of their chiropractic evidence-based curriculum approved by a ministerial decree [42]. A 2016 systematic audit examining the integration of EBP into European chiropractic curricula revealed important gaps such as the limited use of EBP terminology, inconsistent adoption across regions, and lack of emphasis on research [43]. Some authors suggest innovative methods for bringing EBP to students are needed. For instance, Swiss researchers evaluated the feasibility of setting up a scientific literature journal club to improve critical thinking; however, the authors found only minimal changes in the use of evidence-based data [44].

The findings of this study underscore the necessity of future research to design and evaluate effective, tailored implementation strategies. These strategies should be informed by the results of the current study and aligned with evidence from similar investigations. For instance, employing a cluster step-wedge design could provide robust insights by comparing outcomes across chiropractic teaching institutions. Such approaches would enable a deeper understanding of how to integrate self-management strategies (SMS) into clinical training and practice, ultimately enhancing patient outcomes and professional competencies.

This study has several limitations. The response rate was low, particularly among interns, which may be partly due to limited in-person engagement at the Toulouse campus, as the principal investigator was based in Ivry-sur-Seine. As a result, all interviews were conducted at the Ivry site. The dual role of the principal investigator as both colleague and educator may have introduced social desirability bias in participants' responses. Additionally, the qualitative analysis was conducted by the principal investigator, though coding decisions were regularly reviewed in consultation with a TDF expert to ensure consistency.

For program directors, these results highlight the importance of incorporating SMS into clinical education. This includes training supervising clinicians in the principles and application of SMS to ensure consistency and effectiveness in instruction. Additionally, implementing competency-based evaluation frameworks focused on SMS will provide measurable outcomes, ensuring that students are proficient in these strategies before entering practice. These efforts will enhance the overall quality of education and better prepare graduates for patient-centered care.

Conclusion

Our mixed-methods study provides a comprehensive understanding of the factors influencing the implementation of SMS in a French educational chiropractic setting. While beliefs about EBP were generally favorable, its implementation in routine care remains suboptimal. Despite participants reporting having a positive attitude toward SMS, significant barriers related to knowledge, skills, and resources hinder the systematic application of SMS in practice. Overall, the study highlighted the need for targeted interventions to enhance the implementation of SMS in chiropractic care, addressing both the individual and organizational barriers identified.

Abbreviations

NSLBP	Non-Specific Low Back Pain
SMS	Self-Management Support
EBP	Evidence-Based Practice
EBP-B/I	Evidence-Based Practice Belief and Implementation Scale

EBP-B	Evidence-Based Practice Belief subscale
EBP-I	Evidence-Based Practice Implementation subscale
PABS	Pain Attitudes and Beliefs Scale
TDF	Theoretical Domains Framework
IFEC	Institut Franco-Européen de Chiropraxie
UQTR	Université du Québec à Trois-Rivières
BPS	Biopsychosocial

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
Sylvain Pigeon: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition. Arnaud Lardon: Conceptualization, Writing – review & editing, Supervision, Software, Resources, Funding acquisition, Project administration. André Bussières: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Supervision, Resources, Funding acquisition.

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Data availability
The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval for the study was obtained from the Université du Québec à Trois-Rivières Research Ethics Committee for Human Subjects (UQTR CEREH number: CER-22-289-07.10) and the Institut Franco-Européen de Chiropraxie ethic committee (IFEC Ethic committee number : 22_09_002).
All participants provided informed consent before participating in the study. Confidentiality was maintained by anonymizing the data, and participants were assured that their responses would be used solely for research purposes. The entire research protocol was designed in compliance with the principles of the Declaration of Helsinki (latest revision), ensuring the protection of participants' rights, safety, and well-being.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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