JOURNAL OF ATHLETIC TRAINING EDUCATION AND PRACTICE

www.natajournals.org
ISSN: 3067-1833
DOI: 10.4085/1947-380X-24-067

ORIGINAL RESEARCH

Metacognitive Awareness Among Learners Enrolled in Athletic Therapy Programs in Ireland

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Context: Metacognitive awareness is a higher-order cognitive process that allows learners to regulate, reflect and evaluate knowledge, and identify strengths and weaknesses to improve performance. Metacognitive awareness provides a framework for the development of effective clinical reasoning, which is a core competency in the practice of athletic therapy and consequentially a critical component of athletic therapy education. Clinical reasoning is an essential skill for athletic therapy students to develop especially during clinical encounters. To date, the level of metacognitive awareness remains unknown in undergraduate athletic therapy students studying in Ireland.

Objective: To examine metacognitive awareness in undergraduate athletic therapy students.

Design: Cross-sectional survey.

Patients or Other Participants: Undergraduate athletic therapy students enrolled in Athletic Rehabilitation Therapy Ireland (ARTI)-accredited programs.

Data Collection and Analysis: Athletic therapy undergraduate students in Ireland (n = 233) completed the 52-item Metacognitive Awareness Inventory.

Results: A strong positive correlation was found between total knowledge of cognition and total regulation of cognition ($r = 0.69$, $P < .001$). Athletic therapy students from all 4 years of their undergraduate degrees demonstrated moderately good metacognitive awareness as measured by the total Metacognitive Awareness Inventory (183.9 ± 49.0). No significant differences in metacognitive awareness for year of study or gender were observed. Learners that had not yet completed a clinical immersive placement had significantly higher metacognitive awareness than those who had ($P = .03$).

Conclusions: Metacognitive awareness among athletic therapy students is lower than other health care student cohorts. Clinical immersive placements provide opportunities to develop clinical knowledge and skills in a supportive environment for students and enhance metacognitive awareness. Action should be taken to improve teaching metacognitive awareness to athletic therapy students in Ireland.

Key Words: Clinical education, higher education, undergraduate athletic therapy students, cognitive skills

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Full Citation:
Allen L, O'Connor S, O'Keeffe S, Whyte E. Metacognitive awareness among learners enrolled in athletic therapy programs in Ireland. *J Athl Train Educ Pract*. 2025;21(2):107–114.

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KEY POINTS

- Metacognitive awareness provides a framework for athletic therapy students to enhance their academic performance and ultimately their clinical reasoning skills.
- The use of metacognitive teaching strategies provides opportunities for athletic therapy students to further enhance their metacognitive awareness both inside and outside the classroom.
- Educators need to be cognizant of the essential role metacognitive awareness plays in athletic therapy education and seek to establish best practices in the development and implementation of metacognitive awareness in undergraduate and postgraduate curricula.

INTRODUCTION

Clinical reasoning skills are of critical importance to all health care professionals, including athletic therapists, as they allow clinicians to integrate cognitive, psychomotor, and affective skills to diagnose, manage, and treat a patient's medical needs in each context.[1–5] Clinical reasoning requires lower- and higher-order cognitive processes. Metacognitive awareness is a higher-order cognitive process consisting of 2 main components: (1) knowledge of cognition (KC) and (2) regulation of cognition (RC). *Knowledge of cognition* is the awareness of how we learn, our ability to learn, and the effectiveness and efficacy of learning.[6–8] *Regulation of cognition* is the conscious ability to control and manage learning through monitoring and evaluation.[7–9] Metacognitive awareness allows "individuals to plan, sequence, and monitor their learning in a way that directly improves performance."[10(p460)]

Metacognitive awareness provides a structured approach for clinicians and students to use and consequently is associated with better patient care.[11–15] Metacognitive awareness allows athletic therapy students to develop their thinking to be more expert-like by regulating, reflecting, and evaluating their knowledge and learning, identifying gaps in their knowledge, and taking the remedial action needed to address this.[8,16,17] This facilitates students to become more cognitively aware, enhancing their ability to adapt to unpredictable and complex clinical situations.[11,18]

Metacognitive awareness has been investigated in health care students, predominantly in medicine and nursing, whereby undergraduate students in these disciplines typically had poor metacognitive awareness, which potentially contributed to poor academic grades and performance.[16,19] This may have been due to a reliance on rote learning, memorization, and surface learning techniques that were not sufficient for metacognitive awareness to develop.[20] As a result, students may have grossly overestimated their performance in comparison with experts.[21,22] Metacognition is improved by using metacognitive teaching strategies in the classroom such as think aloud, reflections, and concept mapping.[16,20,23] Therefore, supporting educators to facilitate the development of metacognitive strategies to aid students' metacognitive awareness is of paramount importance.[8,24]

Traditionally in Ireland, athletic therapy education programs have facilitated the development of clinical reasoning through practical clinical skills with semester-long clinical immersive placements in the final year (year 4) of the undergraduate programs. Immersive clinical placements play an important role in experiential learning, learning by doing, and reflecting on an experience or past experiences. They play a significant part in the development of metacognitive awareness and clinical reasoning,[11,25,26] developing both psychomotor and cognitive skills in a controlled and supervised way.[27] Learning that occurs in a clinical setting allows social, cultural, and contextual elements of clinical reasoning to develop, thus enhancing metacognitive skills.[11,28] To the authors' knowledge, the examination of metacognitive awareness in athletic therapy students enrolled in Athletic Rehabilitation Therapy Ireland (ARTI) programs has not been studied to date. It is unknown if students develop better metacognitive awareness as they progress through their formal education. The aims of this study were to (1) examine undergraduate athletic therapy students' metacognitive awareness and (2) explore whether year of study, completion of immersive clinical placement experiences, or gender affects athletic therapy students' metacognitive awareness.

METHODS

Participants and Study Design

A cross-sectional study was conducted, and undergraduate athletic therapy students studying in Ireland were recruited. Participants were eligible if they were over the age of 18 years and studying undergraduate athletic therapy in an ARTI-accredited third-level institution. Ethical approval was granted by the Dublin City University Research Ethics Committee. Students were required to read a plain-language statement and provide informed consent before completing the survey. A sample size calculation indicated a requirement of 199 athletic therapy students studying in Ireland. The calculation was completed with the confidence level set at 95% and the margin of error set at 5%, using an online sample size calculator (http://www.raosoft.com/samplesize.html).

Instrumentation

An anonymous 62-question survey was used. Section 1 examined demographic information including gender, year of study, educational history, student status (ie, mature student or not, with a mature student classified as over the age of 23 years at the commencement of the undergraduate degree), and completion and setting of clinical immersive placement. Section 2 examined metacognitive awareness using the Metacognitive Awareness Inventory (MAI), a 52-item, self-reported inventory (Table 1).[10] It consists of 2 subscales: KC (17 items) and RC (35 items) with

Table 1. Metacognitive Awareness Inventory

Metacognitive Awareness Inventory (MAI)			
Please use the rating scale provided to respond to each question below by indicating how true or false each statement is about you			
1 = always false, 2 = sometimes false, 3 = neutral, 4 = sometimes true, 5 = always true			
Domain Code	Domain ID		MAI Questions
Knowledge of cognition			
Declarative knowledge (DK)	DK1	Q5:	I understand my intellectual strengths and weaknesses.
	DK2	Q10:	I know what kind of information is most important to learn.
	DK3	Q12:	I am good at organizing information.
	DK4	Q16:	I know what the teacher expects me to learn.
	DK5	Q17:	I am good at remembering information.
	DK6	Q20:	I have control over how well I learn.
	DK7	Q32:	I am a good judge of how well I understand something.
	DK8	Q46:	I learn more when I am interested in the topic.
Procedural knowledge (PK)	PK1	Q3:	I try to use strategies that have worked in the past.
	PK2	Q14:	I have a specific purpose for each strategy I use.
	PK3	Q27:	I am aware of what strategies I use when I study.
	PK4	Q33:	I find myself using helpful learning strategies automatically.
Conditional knowledge (CK)	CK1	Q15:	I learn best when I know something about the topic
	CK2	Q18:	I use different learning strategies depending on the situation.
	CK3	Q26:	I can motivate myself to learn when I need to.
	CK4	Q29:	I use my intellectual strengths to compensate for my weaknesses.
	CK5	Q35:	I know when each strategy I use will be most effective.
Regulation of cognition			
Planning (P)	P1	Q4:	I pace myself while learning in order to have enough time.
	P2	Q6:	I think about what I really need to learn before I begin a task.
	P3	Q8	I set specific goals before I begin a task.
	P4	Q22:	I ask myself questions about the material before I begin.
	P5	Q23:	I think of several ways to solve a problem and choose the best one.
	P6	Q42:	I read instructions carefully before I begin a task.
	P7	Q45:	I organize my time to best accomplish my goals.
Information management systems (IMS)	IMS1	Q9:	I slow down when I encounter important information.
	IMS2	Q13:	I consciously focus my attention on important information.
	IMS3	Q30:	I focus on the meaning and significance of new information.
	IMS4	Q31:	I create my own examples to make information more meaningful.
	IMS5	Q37:	I draw pictures or diagrams to help me understand while learning.
	IMS6	Q39:	I try to translate new information into my own words.
	IMS7	Q41:	I use the organizational structure of the text to help me learn.
	IMS8	Q43:	I ask myself if what I'm reading is related to what I already know.
	IMS9	Q47:	I try to break studying down into smaller steps.
	IMS10	Q48:	I focus on overall meaning rather than specifics.
Monitoring (M)	M1	Q1:	I ask myself periodically if I am meeting my goals.
	M2	Q2:	I consider several alternatives to a problem before I answer.
	M3	Q11:	I ask myself if I have considered all options when solving a problem.
	M4	Q21:	I periodically review to help me understand important relationships.
	M5	Q28:	I find myself analyzing the usefulness of strategies while I study.
	M6	Q34:	I find myself pausing regularly to check my comprehension.
	M7	Q49:	I ask myself questions about how well I am doing while I am learning.
Debugging strategies (DS)	DS1	Q25:	I ask others for help when I don't understand something.
	DS2	Q40:	I change strategies when I fail to understand.
	DS3	Q44:	I re-evaluate my assumptions when I get confused.
	DS4	Q51:	I stop and go back over new information that is not clear.
	DS5	Q52:	I stop and reread when I get confused.
Evaluation (E)	E1	Q7:	I know how well I did once I finish a test.
	E2	Q19:	I ask myself if there was an easier way to do things after I finish a task.
	E3	Q24:	I summarize what I've learned after I finish.
	E4	Q36:	I ask myself how well I accomplish my goals once I'm finished.
	E5	Q38:	I ask myself if I have considered all options after I solve a problem.
	E6	Q50:	I ask myself if I learned as much as I could have once I finish a task.

8 defined subcategories. Knowledge of cognition was categorized into procedural (4 items), declarative (8 items), and conditional (5 items). Regulation of cognition included the subcategories of planning (7 items), information management strategies (10 items), monitoring (7 items), debugging strategies (5 items), and evaluation (6 items). For each item, participants rated their response using a 5-point Likert scale and indicated how true or false each statement related to them, ranging from 1 = *always false* to 5 = *always true*. Responses were summated to give a total MAI (ie, TMAI) with a maximum achievable score of 260.[29] The higher the scoring on the MAI, the better the individual's metacognitive ability.[10] The Cronbach α coefficients for TMAI (0.82) and Total knowledge of cognition (TKC; 0.78) and Total regulation of cognition (TRC; 0.82) subscales demonstrate good internal consistency.

Procedures

The survey was administered online (Qualtrics, LLC) and was open from February 2 to March 31, 2023. The survey was advertised by word of mouth and social media and distributed to the program chairs of all 3 ARTI-accredited universities via e-mail for distribution to all their undergraduate athletic therapy students (years 1–4).

Data Analysis

Responses were downloaded from Qualtrics and analyzed using SPSS (version 28; IBM Corp). Data were screened for missing data or invalid responses. Frequencies and descriptive statistics were examined from the eligible responses, including the mean, minimum, maximum, total score, and standard deviation. Means and standard deviations of each of the 8 subcomponents of metacognition were calculated. A total overall score for TKC and TRC were summated, and total mean overall score (TMAI) was calculated. Normality was examined, and data were found to be nonnormally distributed.

Spearman's rank correlation coefficient was used to examine the relationships between the main components of metacognition (TKC and TRC). The strength of the relationship was identified as small ($r = 0.10$–0.29), medium ($r = 0.30$–0.49), or large ($r = 0.50$–1.0).[30] Kruskal-Wallis tests were conducted to examine differences between the years of study and TMAI, TKC, and TRC scores. Mann-Whitney U tests were used to analyze differences between completion of a clinical immersive placement and gender for TMAI, TKC, and TRC scores. Effect sizes were classified as small ($r = 0.2$), medium ($r = 0.5$), and large ($r = 0.8$).[30] Significance for statistical tests was $P \leq .05$.

RESULTS

Participant Demographics

Two hundred and ninety-three undergraduate athletic therapy students studying in Ireland opened the survey. Sixty were excluded due to incomplete responses (ie, completed only demographic data). Thus, 233 participants were included in the analysis, representing a response rate of 56% from all eligible athletic therapy students. Participant demographics are presented in Table 2. A similar proportion of men (45.5%) and women (54.5%) completed the survey. A comparable number of students in years 2 (26.2%), 3 (31.3%), and 4 (26.2%) participated in the study, respectively, of which 8.2% were mature students.

Table 2. Descriptive Statistics

	No. (%)
Gender	
Man	106 (45.5)
Woman	127 (54.5)
Nonbinary	0 (0.0)
Prefer not to say	0 (0.0)
Other	0 (0.0)
Type of previous education before studying undergraduate athletic therapy[a]	
Leaving certificate	190 (81.5)
National Framework Qualification Level 6	27 (11.6)
National Framework Qualification Level 7	8 (3.4)
National Framework Qualification Level 8	5 (2.1)
Year of study	
1	38 (16.3)
2	61 (26.2)
3	73 (31.3)
4	61 (26.2)
Mature student	
Yes	19 (8.2)
No	24 (91.8)
Completion of year 4 semester-long clinical immersive placement	
Yes	82 (35.2)
No	151 (64.8)
Location of completion of immersive placement	
Ireland	23 (9.9)
America	13 (5.6)
UK	8 (3.4)
EU	2 (0.85)
Australia	2 (0.85)
Total	48 (20.6)
Settings for clinical immersive placement	
Clinical	69 (29.6)
Pitch side	77 (33)
Sport organization	43 (18.5)
Hospital	1 (0.4)
Occupational	0 (0.0)
Military	1 (0.4)
Placement integrated into a module	
Yes	127 (54.5)
No	94 (40.3)

[a] The National Framework of Qualifications has 10 levels of qualifications available in Ireland. A leaving certificate is level 5, typically awarded after 2 y of full-time education, prescribed by the Department of Education and Science. Level 6 has advanced and higher certificates. Level 7 is an ordinary bachelor's degree. Level 8 is an honors bachelor's degree ("QQI National Framework of Qualifications." 2021; webpage can be accessed at: National Framework of Qualifications | Quality and Qualifications Ireland).

Total Metacognitive Awareness Inventory

The overall TMAI score was found to be 183.9 ± 49.0. A summary of the mean MAI scores and all 8 subcomponents of metacognitive awareness are presented in Table 3. A significant and positive correlation was found between TKC and TRC ($r = 0.69$, $P < .001$). No statistically significant

Table 3. Scoring of Metacognitive Awareness Inventory (MAI) Questions

Scoring of MAI Questions by Subcomponents	N	Mean ± SD	Total Mean ± SD	Range[a]
Total declarative knowledge	225	3.7 ± 0.5	29.8 ± 7.5	1.4–5.0
Total procedural knowledge	225	3.6 ± 0.6	14.4 ± 3.6	2.0–5.0
Total conditional knowledge	223	3.6 ± 0.5	18.0 ± 4.6	2.0–4.8
Total planning	200	3.3 ± 0.6	23.0 ± 7.0	1.7–4.7
Total information management	204	3.6 ± 0.5	36.2 ± 9.6	2.2–4.8
Total monitoring	203	3.4 ± 0.5	23.4 ± 6.5	2.1–4.6
Total debugging strategies	225	3.8 ± 0.5	19.2 ± 4.5	2.4–5.0
Total evaluation	194	3.3 ± 0.5	19.9 ± 5.8	2.0–4.8
Total knowledge of cognition[b]	215	3.7 ± 0.4	62.2 ± 15.7	2.1–4.9
Total regulation of cognition[b]	159	3.5 ± 0.4	121.7 ± 33.3	2.3–4.4
Total MAI[b]	159	3.6 ± 0.4	183.9 ± 49.0	2.3–4.5

[a] Range: 1 = strongly false; 5 = strongly agree.

[b] The total mean scores of each of the 8 subscale components of the MAI, overall total knowledge of cognition, overall total of regulation of cognition, and overall total MAI scores were calculated.

difference was evident across the 4 years of study in athletic therapy for TMAI scores ($P > .05$).

Significantly higher TMAI scores with a small effect size were observed in those that did not complete a clinical immersive placement (Md = 3.67) compared with those who did (Md = 3.51, $P = .03$, $r = 0.17$). No significant difference was found between completion of placement and TKC scores ($P > .05$). No significant differences in the TMAI scores between men and women were noted ($P > .05$). No significant gender differences were observed for TKC and TRC scores ($P > .05$).

DISCUSSION

Metacognitive awareness is a critical skill for athletic therapy clinicians. Therefore, it is incumbent on athletic therapy educators to develop this skill in athletic therapy students. No previous researchers have examined metacognitive awareness in undergraduate athletic therapy students studying in Ireland or how it is influenced by year of study, completion of semester-long clinical immersive placement, or gender. In this study, we found that athletic therapy students studying in Ireland during all 4 years of their undergraduate degrees demonstrated moderately good metacognitive awareness, with TMAI score of 183.9 ± 49.0, TKC scores of 62.2 ± 15.7, and TRC scores of 121.7 ± 33.3, respectively.

The MAI scores in this study are lower than other undergraduate health care professional student cohorts in psychology (TMAI scores = 192.13 ± 16.63, TKC = 63.15 ± 6.34, and TRC = 128.99 ± 12.49) and nursing (TMAI scores = 189.76 ± 20.04, TKC = 61.71 ± 6.60, and TRC =128.05 ± 13.76).[6,31] Due to different reporting procedures evident in the literature, mean metacognitive awareness scores were also examined in this study (TMAI = 3.6 ± 0.4, TKC = 3.7±0.4, and TRC = 3.5 ± 0.4). The mean metacognitive awareness scores in this study were comparable with social and humanity undergraduate students (TKC = 3.75 ± 0.58 and TRC = 3.12 ± 0.67) and higher than undergraduate psychology students (TMAI = 3.48 ± 0.53, TKC = 3.61±0.56, and TRC = 3.39 ± 0.55).[17,32] The lower scores in TMAI demonstrated slightly poorer overall metacognitive awareness ability in the present study, resulting from lower TRC. This is suggestive of a poorer ability to regulate metacognitive components such as planning, monitoring, and evaluating (Table 3). The ability to self-regulate is a key component in lifelong learning and is an essential skill required for a career in athletic therapy as an autonomous health care professional.[33] Overall, poorer metacognitive awareness can result in ineffective study strategies, thus affecting academic performance and clinical success and expertise.[16,18]

Facilitating Metacognitive Teaching Strategies

Athletic therapy programs in Ireland should be reviewed to consider where metacognitive strategies can be effectively implemented. Educators need to be familiar with the appropriate teaching methods to facilitate metacognitive awareness.[34] This should allow students to take active participatory roles in their learning, both inside and outside the classroom to enhance learning. Knowledge of cognition and regulation of cognition can be improved with the use of teaching strategies that have been proven to be effective.[16,23] These include think-aloud protocols, reflection, judgments of understanding (asking learners to make prospective or retrospective judgments on their learning), problem-based learning, concept mapping, exam wrappers (reflective questions posed before and after assessments), and structured debriefing prompts (What went well in the clinical encounter? What didn't go well? Next time, what would you do differently?).[7,34,35] In this study, TRC values were lower in than those of Rivas et al and Chan et al findings in psychology and nursing students.[6,31] Regulation of cognition can be specifically improved by the implementation of strategies that promote substantial reflective evaluation such as case-based learning and standardized patients or simulation. These teaching strategies allow educators and clinical preceptors to ask reflective and debriefing questions so that students can identify gaps in their knowledge and remediate these gaps through planning and goal-setting tasks. This facilitates students' regulatory control of their learning.[11,24,36,37]

In our research, we observed no differences in metacognitive awareness between the 4 different years of study, like a study by Welch et al in medical students.[38] This is contrary to what many educators and researchers expect, ie, metacognitive awareness develops as students progress through their formal education. This may be suggestive of insufficiently developed metacognitive awareness, resulting in students needing to be

explicitly taught metacognition.[25] The development of metacognitive awareness is proposed to start early in life, continues into adolescence and adulthood, and becomes more explicit and effective under the conscious control of learners as they age.[9,25,33,39] However, these metacognitive skills can remain incompletely developed, resulting in poor metacognitive awareness.[25] Student learners need to be consciously aware of how to think about their thinking and be able to manage it.[33] Metacognition is an essential educational tool to do this. Educators also need to be cognizant to explicitly teach it in their curricula as an essential cognitive skill, to prevent a theory-to-practice gap from occurring, whereby the theory of metacognition exists evidently in the literature but may not be practiced within the classroom setting, to optimize student learning.[7,24,40]

No gender differences in metacognitive awareness were observed in this study, suggesting no need to adapt metacognitive teaching strategies based on gender. In the past, researchers have been inconsistent and inconclusive regarding the examination of gender and metacognitive awareness.[41] In addition, metacognition is a very individualized process in which educators must be cognizant of providing student learners many different metacognitive strategies to aid their own individualized development of metacognitive awareness.

Clinical Immersive Placement and Metacognitive Awareness

Learners in this study that had not yet completed a clinical immersive placement displayed significantly higher TMAI than those that had, with a small effect size. Further analysis revealed no significant differences in TKC and TRC between the groups. The results are surprising, as one would expect the immersive experiential learning experience to enhance metacognitive awareness, as reflective practice is an essential component to athletic therapy practice and metacognition. Many questions remain as to what type of reflective practice is being practiced by athletic therapy students; is it superficial reflection or deep and meaningful reflection? Even more critically, are the students actively engaging in this process to further develop their metacognitive awareness? Other questions remain regarding preceptors' metacognitive awareness and the role it plays during supervision of clinical immersive experiences.

Educators and clinical preceptors are responsible for exemplifying their own metacognitive awareness by being metacognitive role models.[42] This can be demonstrated in a number of ways such as through think-aloud and reflective discussions, by describing their thought processes explicitly for students to develop these metacognitive skills. Students may have difficulty reflecting on their own learning processes or have a lack of knowledge of their own strengths and weaknesses regarding learning, ultimately affecting the strategies they could use to improve their learning.[7,17] Students must be adequately equipped, guided, and taught what metacognitive learning strategies are and how, when, and why to implement them.[8,17] This should be completed in both the classroom and during clinical immersive placement experiences. This will foster learning environments that promote metacognitive awareness.[7]

Limitations

Some limitations to this study exist. First, the use of self-reported questionnaires (MAI) have limitations such as social desirability bias and central tendency bias.[29,43] This may have led to issues with honesty and accuracy of responses. As metacognition is not directly observable, self-reporting measures such as the MAI are needed to measure metacognitive awareness, limiting researchers to a small number of suitable ways to measure metacognitive awareness. Convenience sampling was used in this study; however, a large response rate of 56% was recorded. In this study, we examined athletic therapy undergraduate students studying in Ireland only, thus limiting the generalizability of the results to other health care students and some athletic therapy students internationally.

Future Directions

Future researchers should explore postbaccalaureate athletic therapy metacognitive awareness. In addition, future researchers should seek to investigate athletic therapy educators' understanding, knowledge, and implementation of metacognitive awareness as an educational framework and toolkit. Future investigators could examine if metacognition is embedded and taught in athletic therapy curricula and the establishment of best practices for implementing and developing metacognitive awareness in higher education. Finally, investigating athletic therapy clinical supervisors' and preceptors' understanding and use of metacognitive awareness during clinical immersive placement experiences is recommended.

CONCLUSIONS

Metacognitive awareness among student athletic therapy learners in Ireland is lower than other health care student cohorts. Thus, the explicit teaching of metacognitive strategies in higher education is required to enhance this. No significant differences were found between metacognitive awareness and years of study and gender. Learners that had not yet completed a clinical immersive placement had significantly higher metacognitive awareness than those who had; however, the effect size was small. A challenge for researchers and educators alike is how to practically inform and reform educational practice in athletic therapy both nationally and internationally, when the literature on metacognitive awareness is limited in this field.

Declaration of Interest

The authors report no financial or business interests in this research.

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