10-1-2023

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10.1016/j.jpsychores.2023.111462
Jones, M. D., Casson, S. M., Barry, B. K., Li, S. H., Valenzuela, T., Cassar, J., . . . Sandler, C. X. (2023). elearning improves allied health professionals' knowledge and confidence to manage medically unexplained chronic fatigue states: A randomized controlled trial. Journal of Psychosomatic Research, 173, article 111462. https://doi.org/10.1016/j.jpsychores.2023.111462

Journal of Psychosomatic Research 173 (2023) 111462

Contents lists available at ScienceDirect

Journal of Psychosomatic Research

journal homepage: www.elsevier.com/locate/jpsychores

eLearning improves allied health professionals' knowledge and confidence to manage medically unexplained chronic fatigue states: A randomized controlled trial

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ARTICLE INFO

Keywords:
Cancer-related fatigue
Chronic fatigue syndrome
Cognitive behavioural therapy
eLearning
Graded exercise therapy
Post-infective fatigue

ABSTRACT

Objectives: To evaluate the impact of eLearning by allied health professionals on improving the knowledge and confidence to manage people with medically unexplained chronic fatigue states (FS).

Methods: Using a parallel randomized controlled trial design, participants were randomized 1:1 to a 4-week eLearning or wait-list control group. Knowledge and self-reported confidence in clinical skills to implement a therapeutic intervention for patients with FS were assessed at baseline, post-intervention and follow-up. Secondary outcomes (adherence and satisfaction with online education, knowledge retention) were also assessed. Data was analyzed using intention-to-treat.

Results: There were 239 participants were randomized (*eLearning* $n = 119$, *control* $n = 120$), of whom 101 (85%) *eLearning* and 107 (89%) *control* participants completed baseline assessments and were included in the analysis. Knowledge (out of 100) improved significantly more in the *eLearning* group compared to the *control* group [mean difference (95% CI) 8.6 (5.9 to 11.4), $p < 0.001$]. Knowledge was reduced in the *eLearning* group at follow-up but was still significantly higher than baseline [6.0 (3.7 to 8.3), $p < 0.001$]. Median change (out of 5) in confidence in clinical skills to implement the FS intervention was also significantly greater in the *eLearning* group compared to the *control* group [knowledge: *eLearning* (1.2), *control* (0); clinical skills: *eLearning* (1), *control* (0.1); both $p < 0.001$)]. Average time spent on the eLearning program was 8.8 h. Most participants (80%) rated the lesson difficulty as at the "right level", and 91% would recommend it to others.

Conclusions: eLearning increased knowledge and confidence to manage FS amongst allied health professionals and was well-accepted.

Registration: ACTRN12616000296437 https://anzctr.org.au/Trial/Registration/TrialReview.aspx?id=370222&isReview=true.

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https://doi.org/10.1016/j.jpsychores.2023.111462
Received 5 March 2023; Received in revised form 8 August 2023; Accepted 14 August 2023
Available online 16 August 2023

1. Introduction

The term 'medically unexplained chronic fatigue states' (hereafter referred to as FS) describe conditions characterized by persistent and debilitating fatigue that are diagnosed through a process of medical exclusion [1]. Common FS include chronic fatigue syndrome (CFS), post-infective fatigue syndrome (PIFS) and post-cancer fatigue (PCF). Despite differences in the precipitating factors (e.g. viral infection, cancer), FS often share the same perpetuating factors (e.g. sleep disturbance [2], reactive mood disorder [3], and aberrant activity patterns [4]) that can worsen symptoms. FS are commonly accompanied by musculoskeletal pain and neurocognitive difficulties (e.g. problems concentrating, poor memory) [5], as well as worsening of symptoms after even modest levels of physical or cognitive activity (often called post-exertional malaise) [6,7]. Together, these symptoms significantly affect quality of life [1,7], cause substantial disability, and require effective management.

In the absence of curative treatments, supportive care options for management of FS usually focus on reducing symptoms through pharmacotherapy (e.g., analgesics for pain), and by targeting perpetuating factors (e.g. sleep disturbance, mood disturbance, 'boom-bust' or 'avoidant' activity patterns) to improve function and quality of life. It is recommended this is done using a person-centred approach [8]. Regarding perpetuating factors, graded exercise therapy (GET) and cognitive behavioural therapy (CBT) are the only Level 1 evidence-based interventions for managing symptoms and improving function for CFS [1]. While the benefits of GET and CBT are not apparent in all people with CFS and vary in magnitude from negligible to clinically significant, these interventions are safe when applied appropriately [9–12].

Emerging evidence also shows these interventions are effective in reducing the burden of other FS such as PCF [13] and PIFS [12]. The United Kingdom National Institute for Health and Care Excellence (NICE) has published guidelines for CFS that recommend it be managed using a multidisciplinary approach with a core team of allied health professionals who have expertise in managing fatigue [14]. Similar recommendations have been made for PCF [15]. Yet, uptake of evidence-based FS management programs delivered by allied health professionals is low [16,17]. This research-practice gap is at least partially due to clinicians lacking the knowledge and skills to provide appropriate care and may be due to insufficiencies in undergraduate training regarding FS [18,19]. Thus, there is a need for allied health professionals to be upskilled in FS management so that they can provide evidence-based care.

Online education (eLearning), described as any educational intervention delivered electronically via the internet [20], has been steadily growing in popularity since the 1990s when the internet was first introduced. Medical schools and allied health programs have slowly been integrating eLearning into their curricula over the last decade [21]. However, changes to tertiary education necessitated by COVID-19 resulted in a rapid uptake of eLearning for health professionals, including those in the allied health disciplines [21,22]. This has been met with a surge of recommendations to support the development and delivery of effective eLearning, adding to the established evidence base supporting this style of learning to improve health professionals' knowledge, clinical practice behaviours and patient outcomes [23].

The impact of eLearning for health professionals has been investigated in multiple areas of health care [23], including in conditions with medically unexplained symptoms that overlap with FS (e.g. pain, cognitive symptoms and sleep disturbance) [24–26]. However, to our knowledge, there has only been a single previous qualitative evaluation in FS [27]. Therefore, there exists an obvious gap in this regard. The aim of this study was to evaluate the effect of eLearning on allied health professionals' knowledge about FS interventions, their level of confidence to deliver these interventions, and the anticipated effect on clinical practice behavior.

2. Methods

2.1. Trial design

A parallel randomized trial with a wait-list control was conducted to evaluate the effect of eLearning on allied health professionals' knowledge and confidence to manage people with FS. Data was also combined from the study groups to investigate self-reported success in treating people with FS and practice behaviours. The trial was developed according to the Recommendations for Interventional Trials (SPIRIT) [28] and reported in line with the Consolidated Standards of Reporting Trials (CONSORT) statement [29]. The eLearning intervention is reported in line with the Template for Intervention Description and Replication (TIDieR) checklist [30]. The trial was pre-registered (ACTRN12616000296437) and the study protocol published [31]. The study was approved by the UNSW Human Research Ethics Committee (HC16419). All participants provided written informed consent. Due to the nature of the research due to ethical restrictions, supporting data is not available.

2.2. Eligibility criteria

Participants were eligible if they were fully registered allied health professionals, including psychologists, exercise physiologists, physiotherapists, and occupational therapists practicing in Australia. Individuals who were not currently practicing were excluded.

2.3. Recruitment

Allied health professionals were recruited via advertisements placed in continuing education newsletters of professional organizations and distributed to mailing lists of relevant organizations (e.g., Exercise and Sports Science Australia, Australian Physiotherapy Association, Australian Psychology Society, Australian Clinical Psychology Association, Occupational Therapy Australia). The recruitment advertisements contained a link to the study information and allowed the individuals to consent to take part.

2.4. Randomization

Participants were randomly allocated in a 1:1 ratio to the eLearning group (4-week immediate access to the eLearning program) or a wait-list control group. A computer-generated random number sequence with randomly permuted block sizes of 2–6 was used to ensure a balance between groups while different allied health professionals were successively enrolled. Randomization was conducted by an investigator not involved in recruitment or data analysis to ensure concealment of allocation. Participants were not blinded to their group allocation.

2.5. eLearning group

The eLearning program was delivered using SmartSparrow™ (an eLearning platform), and was an interactive, self-paced activity developed from a FS treatment manual previously created and tested for efficacy by the research group from the UNSW Fatigue Clinic [13,32]. The content contained an introduction to FS including symptoms, assessment and diagnosis, and seven intervention modules including: psychoeducation, activity pacing and GET, interventions for sleep disturbance, interventions for cognitive disturbance (i.e., cognitive remediation), and for depression, anxiety and coping. Participants were required to complete all content within a 4-week period. The eLearning intervention is fully described in the study protocol [31] and Table 1. Access to the eLearning intervention is available on request to the corresponding author.

Table 1
Description of the eLearning intervention.

Brief name	eLearning for allied health professionals on management of medically unexplained chronic fatigue states (FS).
Why	The intervention was designed based on a manual developed by the research group that drew on Cochrane reviews of cognitive behavioural therapy (CBT) and graded exercise therapy (GET) interventions for chronic fatigue syndrome. Additionally, a large review of eLearning indicated online education interventions are as effective as traditional training methods but have the advantage of being easily accessible.
What materials	The eLearning program was delivered via SmartSparrow and was presented as a mix of text, audiovisual resources (including training videos) and interactive activities.
What procedures	The eLearning comprised of the following modules: *Introduction* - defines fatigue states; fatigue assessment tools *Module 1: Psychoeducation* - rationale underlying the intervention approach *Module 2: Activity pacing and GET* - activity pacing and gradual progression of physical activities (GET) *Module 3: Interventions for sleep-wake cycle disturbance* - symptoms of sleep-wake cycle disturbance - sleep hygiene and CBT interventions for sleep-wake cycle disturbance *Module 4: Interventions for neurocognitive disturbance* - pacing of cognitive activities - gradual progression of cognitive activities (cognitive exercise therapy) *Module 5: Interventions for mood disturbance* - how to distinguish between depression and FS - psychoeducation and CBT for mood disturbance Module 6: Interventions for anxiety - anxiety symptoms and CBT interventions for anxiety *Module 7: Interventions for coping* - effective coping strategies
Who provided	The eLearning was designed and developed by five clinical psychologists, one research psychologist, five exercise physiologists and a medical specialist, all with significant clinical experience in the management of people with FS.
How	The eLearning was delivered as a self-paced online activity using SmartSparrow.
Where	Participants were able to access the eLearning wherever they had a device with internet access.
When and how much	Each participant had access to the eLearning for 4 weeks. The intervention was self-paced and collected data on how long participants spent on each module and assessment activity.
Tailoring	The eLearning content was the same for all participants.

2.6. Wait-list control group

The wait-list control group completed the baseline and post-intervention assessments at the same time-points as the eLearning group. The wait-list control group did not have access to the eLearning materials between the baseline and post-intervention assessments but received access for 4 weeks on completion of the post-intervention assessment.

2.7. Outcomes

All outcomes were collected via online questionnaires within the learning management system. At baseline, information regarding participant profession type, years of practice and work sector were collected. Both study groups completed assessments at baseline (week 0) and post-intervention (week 5). Follow-up outcomes were also collected at week 12 for the eLearning group and week 16 for the wait-list control group (i.e., 8 weeks after cessation of access to the eLearning for both groups). Data regarding adherence to, and satisfaction with, the eLearning was collected post-intervention for the eLearning group only.

The study had three primary outcomes: 1) participants' knowledge about FS and FS interventions, 2) participants' self-reported confidence in their knowledge and clinical skills to implement evidence-based FS interventions, and 3) participants' self-reported success in treating people with FS. Outcomes one and two were the primary outcomes for the randomized controlled trial analysis and outcome three was the primary outcome for the cohort study analysis.

Randomized controlled trial primary outcome measures

1. Between-group difference in change in participants' knowledge about FS and management interventions: Knowledge about FS symptoms, differential diagnoses, management strategies and interventions were assessed using multiple choice and short answer questions integrated with case vignettes. The scores from the multiple choice and short answer questions were combined to give a total knowledge score out of 100. The questions and case vignettes were designed to test knowledge across a range of allied health professions and were developed by an expert group of clinician-researchers including physicians, exercise physiologists and clinical psychologists including academics experienced in eLearning design, delivery and evaluation. Short answer responses were graded in duplicate by markers blinded to the study group using standardized marking criteria. To reduce possibility for contamination, feedback regarding correct responses to the questions and case vignettes was not provided so it could not be shared between individual participants and study groups.
2. Between-group differences in changes in participants' self-reported confidence in their knowledge of FS (e.g. diagnosis, pathophysiology and rationale for evidence-based management strategies) and confidence in clinical skills (e.g., to conduct an assessment, provide education, and implement evidence-based interventions): The data was collected using a 5-point Likert scale (1-“not at all confident” to 5-“very confident”). The items related to participants' self-reported confidence in knowledge and clinical skills for FS are shown in Appendix A and B, respectively.

Secondary outcome measures (eLearning group only)

1. Knowledge about FS and FS interventions as well as self-reported confidence in knowledge and clinical skills for FS at follow-up were assessed as described above.
2. Adherence to, and satisfaction with, the eLearning was tracked using in-built features of the learning management system, which monitored: total time spent on the eLearning, time spent on each module, total time spent on the integrated formative assessment tasks (‘activities’), and response rate on these tasks for each professional group. In the post-intervention assessment, participants were asked to rate their agreement with statements related to their satisfaction with the eLearning using a 5-point Likert scale (1-“strongly disagree” to 5-“strongly agree”). The statements were “The online lesson contained information I needed”, “The flexibility of this online activity was helpful” and “I would recommend this course to other health professionals”. Participants were also asked to rate the difficulty of the eLearning (too easy, fairly easy, right level, fairly difficult, too difficult) and to provide open-ended responses to questions about what they liked about the eLearning and what could be improved.

2.8. Cohort study outcomes

The primary outcome in the combined study groups was assessed at baseline and follow-up:

1. Participants' self-reported success in treating people with FS was measured using a 5-point Likert scale (1-“completely unsuccessful” to 5-“completely successful”).

The secondary outcome in the combined study groups was also assessed at baseline and follow-up:

1. Changes in the proportion of clinical practice devoted to the management of FS was collected to provide a preliminary indication of the impact of the eLearning on clinical practice. This part of the questionnaire also asked participants to indicate the percentage of their clinical practice that was devoted to management of people with FS.

2.9. Statistical analysis

The power analysis revealed that 128 participants were required to detect a moderate effect size ($d = 0.5$) between study groups of improvement in knowledge of FS management and confidence to implement evidence-based interventions, with 80% power and a two-tailed alpha of 0.05. Allowing a 30% attrition rate, the study aimed to recruit 180 participants. These estimates of attrition and effect size were based on a similar previous study investigating eLearning for allied health professionals [33].

All data were analyzed using Statistical Package for Social Sciences (version 28) by an experimenter blinded to group allocation. The effect of eLearning on knowledge and confidence was analyzed using intention-to-treat analysis. Missing data (<10%) were carried forward from previous results. Between-group differences in change scores from baseline to post-intervention were analyzed with independent *t*-tests for knowledge, and with Mann-Whitney *U* tests for the participant's self-reported confidence in knowledge and clinical skills. Retention of knowledge was analyzed using a dependent t-test comparing post-intervention and follow-up assessment knowledge for the eLearning group only. Data was not carried forward for this analysis so that retention of learning was not artificially inflated. Participant adherence to, and satisfaction with, the eLearning were analyzed descriptively.

For each participant, changes in the proportion of clinical practice devoted to the management of FS from baseline to follow-up was analyzed using a dependent *t*-test. Participant's self-rated success in treating FS was analyzed using a Wilcoxon signed rank test comparing the sum of participants who rated themselves as 'somewhat successful'/'successful' from before the intervention compared to follow-up. The range in proportion of clinical practice devoted to FS at baseline for both groups was also described to account for potential biases in sampling. The threshold for statistical significance for all tests was set at $p < 0.017$ to account for the three primary outcomes. Open-ended responses regarding participant feedback with the eLearning was analyzed thematically. One researcher (SC) reviewed all participant responses, grouped them according to similarities and then derived themes which were confirmed by consensus with another reviewer (CXS). Outcomes for the eLearning are discussed with regard to the Kirkpatrick Framework for evaluation of training [34].

2.10. Methodological differences to the protocol

We performed an exploratory analysis to assess the reliability the multiple choice and short answer question marking. The Kuder-Richardson Formula 20 was used to assess the internal consistency of the multiple-choice questions. Scores for the Kuder-Richardson 20 range from 0 to 1 with scores closer to 1 representing higher internal consistency. Cohen's kappa was used to assess the inter-rater agreement for the vignette short answer marking and 95% confidence intervals were calculated using the asymptotic standard errors. Values for Cohen's kappa were interpreted as slight (0.1–0.2), fair (0.21–0.4), moderate (0.41–0.6), substantial (0.61–0.8), near perfect (0.81–0.99) or perfect agreement (1).

3. Results

3.1. Participant characteristics

The flow of participants through the study protocol is shown in Fig. 1. A total of 300 potential participants expressed interest in the trial. Of these, 265 were screened and 239 were randomly allocated to the eLearning group ($n = 119$) or wait-list control group ($n = 120$). Randomization and enrollment occurred between October 2016 and June 2017 and all follow-up assessments were completed by October 2017. The primary reason for ineligibility was participants not currently working as an allied health professional ($n = 24$). Nine participants from the eLearning group and seven from the wait-list control group withdrew consent from the study. Ultimately, 101 participants from the eLearning group and 107 participants from the wait-list control group completed the baseline assessment and were included in the intention-to-treat analysis. There was missing data for 22/208 (10%) participants at post-assessment ($n = 4$ control and $n = 18$ eLearning) and 50/208 (24%) participants at follow-up ($n = 30$ control, $n = 20$ eLearning). Participants were primarily exercise physiologists or psychologists, had similar years working clinically (group mean (SD) 9.6 (9.3) years), and mostly (59%) worked in the private sector (Table 2).

3.2. Primary outcomes: knowledge score and confidence in knowledge and clinical skills

Participants' knowledge scores at baseline and post-intervention are shown in Fig. 2a. Knowledge (mean ± SD) was unchanged in the wait-list control group from baseline (63.7 ± 10.6%) to post-intervention (64.1 ± 10.6%) but increased significantly in the eLearning group from baseline (63.2 ± 10%) to post-intervention (72.2 ± 11.7%, $p < 0.001$). This corresponded to a between-group difference of 8.6% (95% CI: 5.9–11.4; $p < 0.001$), representing a large effect size (Cohen's $d = 0.85$, 95% CI: 0.56–1.13).

The data regarding confidence in FS knowledge and clinical skills before and after the intervention are shown in Fig. 2b, Fig. 2c and Table 3. The change (median (min-max)) in self-reported confidence in knowledge and clinical skills (out of 5) were both significantly higher ($p < 0.001$) in the eLearning group compared to the control group (*confidence in knowledge* – eLearning group: 1.2 (−0.4 to 2.8); wait-list group: 0 (−1.2 to 1.0); *confidence in clinical skills* – eLearning group: 1 (−0.8 to 2.3); wait-list group 0.1 (−1.2 to 1.4).

3.3. Secondary outcomes: knowledge retention and confidence at follow-up (eLearning group only)

From the post-assessment to follow-up, knowledge in the eLearning group decreased (−4.9% (95% CI: −3.0 to −6.9), $p < 0.001$, representing a moderate effect size (Cohen's $d = 0.56$, 95% CI = 0.32–0.79)). However, the level of knowledge at follow-up was still significantly higher compared to baseline (6.0% (95% CI: 3.7 to 8.3), $p < 0.001$, representing a moderate effect size (Cohen's $d = 0.57$, 95% CI = 0.33–0.80; Fig. 2a).

3.4. Adherence to, and satisfaction with, the eLearning (eLearning group only)

Eighty-eight of 101 (87%) participants from the eLearning group completed the end of lesson evaluation survey. On average, the total time spent on the intervention was 8.8 h (Appendix C). Because of the way the lesson was configured, the most time was spent on content related to activity pacing and graded exercise therapy and the least time was spent on content related to psychoeducation and coping. Participants 'agreed'/'strongly agreed' that the lesson contained information that was needed (82%), was flexible (93%) and that the eLearning was appropriate in length (64%). Moreover, 91% indicated they would recommend the lesson to other allied health professionals. The difficulty of the lesson was rated as at the "right level" by most participants (80%). No participants rated it as "too easy" or "too difficult" (Appendix D). Participants' feedback regarding what they liked about the lesson and what they believed should be changed is outlined in Appendix E.

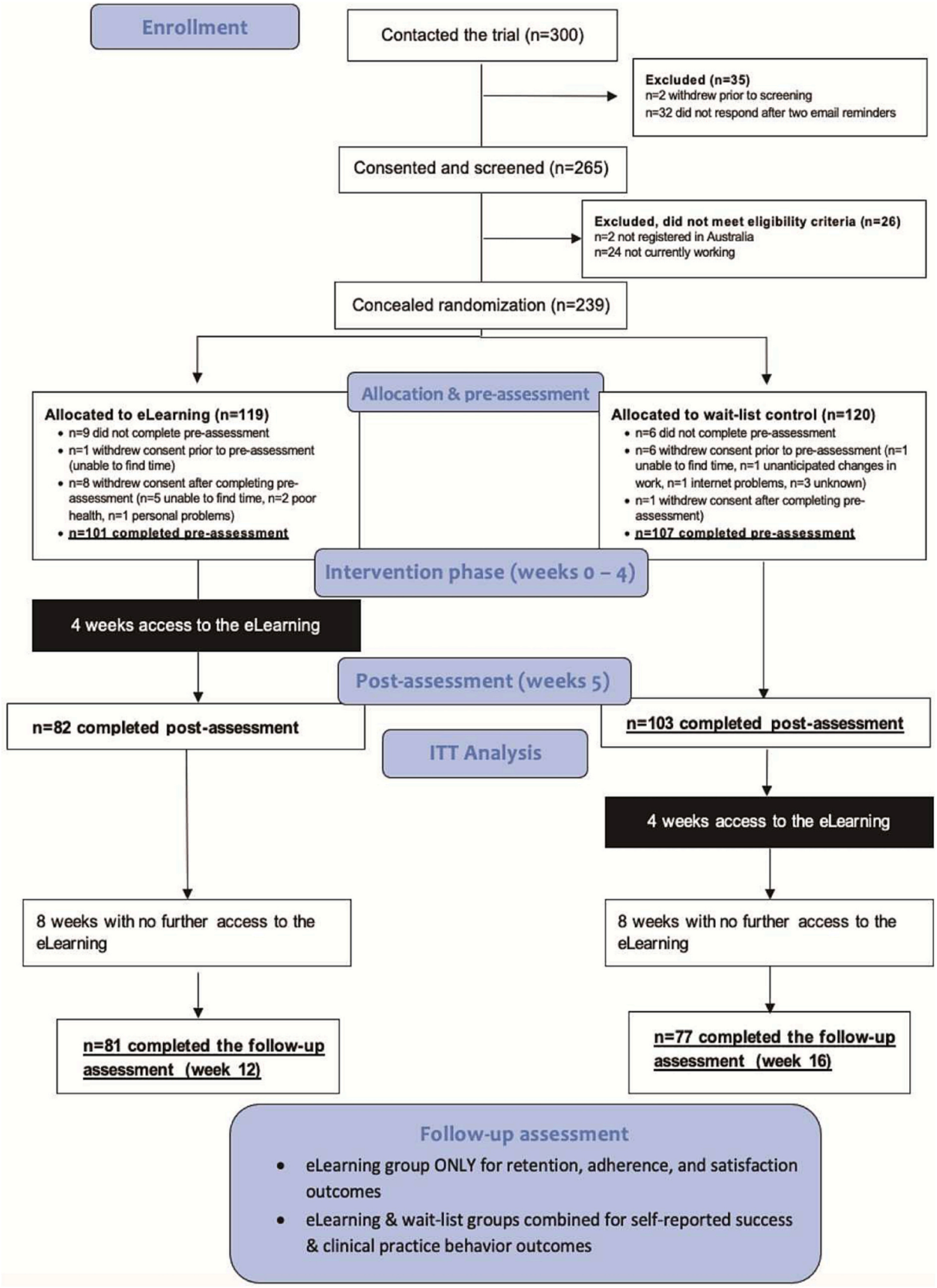

Fig. 1. Consolidated Standards of Reporting Trials (CONSORT) diagram.

Table 2
Participant characteristics.

	Wait-list control ($n = 107$)	eLearning ($n = 101$)
Profession n (%)		
Psychologist	45 (42%)	35 (35%)
Exercise physiologist	38 (36%)	43 (43%)
Physiotherapist	22 (21%)	22 (22%)
Occupational therapist	2 (2%)	1 (1%)
Years registered/working mean (SD)		
Years registered	10.3 (10.4)	8.9 (7.9)
Years working clinically	9.9 (10.2)	8.1 (7.7)
Work sector n (%)		
Private practice	59 (55%)	64 (63%)
Public hospital	20 (19%)	14 (14%)
Government	11 (10%)	10 (10%)
University	7 (7%)	7 (7%)
Private hospital	6 (6%)	5 (5%)
Corporate	2 (2%)	0 (0%)
Other (defence, disability employment service, elite sport)	2 (2%)	1 (1%)

3.5. Cohort study outcomes

The self-rated success in treating people with FS increased from 54% at baseline to 59% at follow-up, $p = 0.002$. The median proportion of clinical practice devoted to FS at baseline was 3% (range 0–80%). The median proportion of clinical practice devoted to FS at follow-up was 5% (range: 0–80%). This was not significantly different compared to baseline ($p = 0.92$).

3.6. Exploratory analysis: reliability of multiple choice and short answer question marking

The Kuder-Richardson 20 score for the reliability of the multiple-choice questions was 0.42 at baseline ($n = 210$). At post-intervention, scores were 0.50 for the eLearning group ($n = 86$) and 0.53 for the wait-list group ($n = 103$). At follow-up, scores were 0.44 for the eLearning group ($n = 81$) and 0.46 for the wait-list group ($n = 76$). Cohen's kappa values for the inter-rater agreement of the short answer question marking are shown in Appendix F. Briefly, most scores were between 0.2 and 0.4, indicating fair agreement.

4. Discussion

This study demonstrated that eLearning significantly increased the knowledge and confidence to manage FS amongst allied health professionals compared to a wait-list control group. Knowledge and confidence then decreased in the eLearning group between the post-intervention and follow-up assessments (i.e., from week 5 to week 12) but remained significantly higher at follow-up compared to baseline, indicating retention of the content. The eLearning increased participants' self-reported success in the management of FS and was also rated as useful and the right level of difficulty by most participants.

Health professionals currently lack the necessary knowledge and clinical practice skills to deliver evidence-based care for patients with FS [35,36]. The reasons for this are unclear but are likely due to a lack of appropriate training in FS at university. Tertiary education regarding FS for allied health professionals has seldom been examined, but studies of medical curricula have revealed inadequacies in teaching and assessment regarding FS [18], with calls for increased undergraduate and postgraduate training [19]. Recent clinical guidelines for CFS also recommend that health professional staff delivering care are trained in diagnosis and management [1,14]. Thus, there is a clear need for accessible and effective professional education regarding FS. This controlled study is the first to show the benefit of eLearning for allied health professionals regarding management of FS. The readily

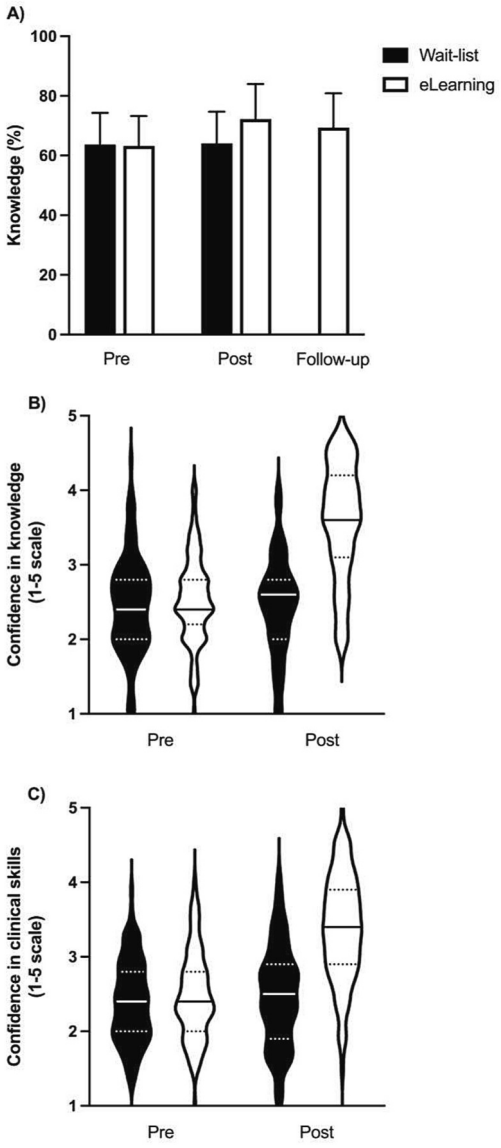

Fig. 2. A) Knowledge of FS (mean and standard deviation) for the eLearning and wait-list control groups at pre-, post- and follow-up assessment (eLearning group only). B) Violin plot (median, interquartile range and distribution) showing self-reported confidence in knowledge of FS for the eLearning and wait-list groups pre- and post-intervention. C) Violin plot (median, interquartile range and distribution) showing self-reported confidence in clinical skills for FS for the eLearning and wait-list groups pre- and post-intervention.

Table 3
Self-reported confidence in knowledge and clinical skills to implement the intervention.

	Self-reported confidence in knowledge		Self-reported confidence in clinical skills	
	Baseline	Post	Baseline	Post
Wait-list (n = 107)	2.4 (1.0–4.4)	2.6 (1–4)	2.4 (1.3–3.9)	2.5 (1–4.1)
eLearning (n = 101)	2.4 (1.0–4.0)	3.6 (2–4.8)	2.4 (1–4.0)	3.4 (1.5–5)

Self-reported confidence rated on a 5-point Likert Scale. 1 - 'not at all confident', 2 - 'not very confident', 3 - 'somewhat confident', 4 - 'confident' and 5 - 'very confident'. Data are median (range).

distributable eLearning intervention could be implemented within tertiary allied health training programs, provided to professional health service staff, and made available as a professional development course to improve the capacity of allied health professionals to provide effective management for FS.

In the absence of curative treatments for FS, clinical guidelines recommend multidisciplinary approaches to manage symptoms and improve patient function [14,15,37]. Reflective of this, our eLearning intervention was developed for, and tested on, the range of allied health professionals who may provide care for patients with FS. All participants were provided the same eLearning despite likely differences in their background experience and training. For example, exercise physiologists and physiotherapists were likely to be more familiar with activity pacing and GET components, or at least the principles of these management interventions. By contrast, psychologists were more likely to be familiar with elements such as psychoeducation and the CBT strategies targeting depression and anxiety, or at least the management principles in these modules. Despite this, most participants agreed that the eLearning contained useful information and would recommend it to others. The analysis did not seek to identify the extent to which the participant's professional background influenced their performance, adherence to, or satisfaction with the eLearning. However, given the modular content, it would be possible to refine the program to tailor it more to the health professions' scope of practice and baseline knowledge. In addition to shortening the overall length of the program, this individually tailored approach would likely lead to even better engagement with, and outcomes from, the intervention.

The inclusion of GET and CBT in our eLearning may be controversial to some, particularly in the context of CFS. At the time our eLearning intervention was developed, GET and CBT were recommended by NICE guidelines [38]. However, the NICE guidelines were recently updated to recommend a more cautious approach to the use of GET and CBT for people with CFS [8], although this change still has clear antagonism from the clinical and academic research sector in the field internationally [39]. Importantly, the GET advocated for in our eLearning is consistent with the updated guideline recommendations where people with FS who want to be more physically active are encouraged to establish a conservative baseline level of activity and maintain this successfully for a period before gradually increasing. Adjustments to activity upward or downward can also be made based on individual symptom threshold/exacerbation [8]. This differs to other types of GET, including that no longer recommended by the NICE guidelines, which use fixed incremental increases in activity somewhat regardless of the person's symptoms. The description of CBT in our eLearning was also consistent with the revised guidelines where it is not described as curative, but rather as a way of helping the person manage symptoms and reduce distress [8]. Thus, the GET and CBT advocated for in our eLearning is consistent with current clinical guidelines.

According to the widely used Kirkpatrick Framework for evaluation of education interventions [34], the primary outcomes of knowledge, and confidence in knowledge and clinical skills would be designated at Level 1 (reaction), Level 2 (learning) and to some extent, Level 3 (behaviour). In this framework the ultimate aim for evaluation of education interventions is to reach Level 4 (results), which in the current context would be recorded changes to clinical practice and improved patient outcomes. eLearning for health professionals has been demonstrated to positively impact practice and improve patient outcomes for other health conditions [23] but was not assessed here. Instead, participants' self-rated success in treating people with FS was assessed, which improved only slightly following eLearning and was modest overall. The median proportion of clinical practice devoted to FS also remained very low, but it is unclear whether this is due to low confidence of allied health professionals, low referrals from general practitioners, or both. Given the prevalence of FS in Australia [40], general practitioners need to be confident that their patients will receive evidence-based care when referred for multi-disciplinary care with allied health professionals. Thus, there is a strong need for allied health professionals to upskilled and confident in the management of FS.

It is also evident that there is a clear need to extend the eLearning intervention beyond allied health professionals to general practitioners. Indeed, the UK NICE guidelines stress that FS should be managed in primary care [8]. However, undergraduate medical education of general practitioners often does not equip them with the necessary skills to provide guideline-based diagnosis and management for FS [27]. Consequently, there is reticence by many general practitioners to diagnose the conditions and initiate care, which can lead to harms from missed or delayed diagnoses, and inadequate management [41]. General practitioners are central to provision of well-coordinated patient-centred care, including referral to allied health professionals for delivery of evidence-based interventions. In conjunction, patients should also be provided with accessible education to support their decision making in managing their care. Thus, it is reasonable to suggest that coordinated, integrated, wraparound care (patients/general practitioners/allied health professionals) is needed to improve outcomes for FS, and that extension of this eLearning to both general practitioners and people with FS is warranted.

The limitations of the present study were that recruitment was confined to Australia, and the participants were mostly exercise physiologists or psychologists. Therefore, the findings may not generalize to other countries or health professions (e.g., occupational therapists or primary care nurses). Further, the measures of clinical practice behaviour were based on self-report, not prospective data extraction from health records, and without data on patient outcomes. Thus, it is not clear if the intervention actually improved the higher levels of 'behaviour' and 'results' as per Kirkpatrick's framework for effective training [34] (noting that this was not a key study outcome). Additionally, it is unclear whether the approximate 9% improvement in clinician knowledge is clinically relevant, particularly given the time it took participants to complete the training. The observed effect size observed was comparable to the large effects observed in previous eLearning interventions [23], and data relating to the participants' satisfaction with the intervention and improvements in confidence and clinical skills to manage FS suggest it was relevant to them. However, participants were not directly asked how much of a change in knowledge (or subsequent change in their practice) they would need to consider the intervention worthwhile, so this could be investigated in future. The follow-up outcome for knowledge retention was also based only on data for the eLearning group, limiting our ability to determine the effect of eLearning on this outcome compared to control. Finally, while the multiple choice and short questions were designed by clinician-researchers with experience in tertiary education and assessment, the internal reliability statistics were modest. This may have impacted the assessment of participants' knowledge scores, but likely would have done so similarly for the eLearning and wait-list control groups.

In conclusion, eLearning was shown to be effective in improving knowledge and confidence to manage FS amongst allied health professionals. Future studies should focus on implementation of more tailored eLearning to improve uptake, reach, and changes in practice and behaviour for all the key stakeholders (general practitioners, allied health professionals and patients).

Declaration of Competing Interest

All authors have completed the Unified Competing Interest Form at http://www.icmje.org/coi_disclosure.pdf and the authors have no competing interests to report.

Acknowledgements

This work was supported by JJ Mason & HS Williams Memorial Foundation [Grant number: MAS2015F040]. CXS is supported by a Cancer Institute New South Wales Early Career Fellowship [2021/

ECF1310]. ARL is supported by a National Health and Medical Research Council Practitioner Fellowship [1041897].

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychores.2023.111462.

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