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The Definition and Application of Pilates Exercise to Treat People With Chronic Low Back Pain: A Delphi Survey of Australian Physical Therapists

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Background. Pilates exercise is recommended for people with chronic low back pain (CLBP). In the literature, however, Pilates exercise is described and applied differently to treat people with CLBP. These differences in the definition and application of Pilates exercise make it difficult to evaluate its effectiveness.

Objective. The aim of this study was to establish consensus regarding the definition and application of Pilates exercise to treat people with CLBP.

Methods. A panel of Australian physical therapists who are experienced in treating people with CLBP using Pilates exercise were surveyed using the Delphi technique. Three electronic questionnaires were used to collect the respondents' opinions. Answers to open-ended questions were analyzed thematically, combined with systematic literature review findings, and translated into statements about Pilates exercise for people with CLBP. Participants then rated their level of agreement with these statements using a 6-point Likert scale. Consensus was achieved when 70% of the panel members strongly agreed, agreed, or somewhat agreed (or strongly disagreed, disagreed, or somewhat disagreed) with an item.

Results. Thirty physical therapists completed all 3 questionnaires and reached consensus on the majority of items. Participants agreed that Pilates exercise requires body awareness, breathing, movement control, posture, and education. It was recommended that people with CLBP should undertake supervised sessions for 30 to 60 minutes, twice per week, for 3 to 6 months. Participants also suggested that people with CLBP would benefit from individualized assessment and exercise prescription, supervision and functional integration of exercises, and use of specialized equipment.

Limitations. Item consensus does not guarantee the accuracy of findings. This survey reflects the opinion of only 30 physical therapists and requires validation in future trials.

Conclusion. These findings contribute to a better understanding of Pilates exercise and how it is utilized by physical therapists to treat people with CLBP. This information provides direction for future research into Pilates exercise, but findings need to be interpreted within the context of study limitations.



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Chronic low back pain (CLBP) is defined as back pain of more than 12 weeks' duration between the lower ribs and above the gluteal folds, with or without leg pain.¹ *Chronic low back pain* is a highly prevalent and disabling condition²⁻⁴ that places a significant economic burden on society due to costs associated with treatment and the difficulty people have in returning to work.³⁻⁵

Exercise has been shown to reduce pain and disability in people with CLBP.⁶⁻⁸ According to current evidence, improvements are similar regardless of the type of exercise.⁹⁻¹¹ It is recommended, however, to consider the rationale underlying exercise approaches when prescribing an exercise program for people with CLBP.¹² This approach will assist in individually tailoring exercise programs for maximal effectiveness.^{13,14}

Pilates is a form of exercise that may be appropriate for people with CLBP.¹⁵⁻¹⁹ Our recent systematic review of peer-reviewed literature described Pilates as a mind-body exercise that focuses on strength, core stability, flexibility, muscle control, posture, and breathing.²⁰ Several of these features of Pilates have been reported as effective in exercise programs for people with CLBP, such as mind-body therapies that encourage mental re-focusing and breathing and exercises that work on flexibility, strength, and motor control.^{12-14,21} Furthermore, people with CLBP may benefit from exercises that address the control of posture and stabilizing muscles of the trunk.^{12,22-25}

Our review of systematic reviews, however, suggested that evidence of the effectiveness of Pilates exercise in people with CLBP is inconclusive.²⁶ This finding was due to the limited number, variable method-

ological quality, and small sample sizes of primary studies.²⁶ The heterogeneity of primary studies in terms of the population, intervention, comparison, and outcome measures also limits the strength of research findings, as pooling results of these studies in a meta-analysis is inappropriate.^{26,27}

The validity of research findings trials in relation to Pilates exercise also requires examination.^{20,26} Clinical trials differ in their description of Pilates exercise and technique and in suggested program parameters, equipment, and levels of supervision for people with CLBP.^{16-18,26} These variations of the definition and application of Pilates exercise create confusion around essential identifying features of Pilates exercise and make it difficult to apply findings in clinical practice.²⁶

A Delphi survey of a panel of Australian physical therapists was consequently undertaken to establish consensus regarding the definition and application of Pilates exercise to treat people with CLBP. The findings of this study will assist in the design of future Pilates exercise trials and in interpretation of existing findings.^{20,26} The research questions of this Delphi survey were:

1. How is Pilates exercise defined in relation to people with CLBP?
2. What is the ideal Pilates exercise design, in terms of parameters, level of supervision, and equipment, for people with CLBP?
3. What principles are used to guide safe prescription and progression of Pilates exercise in people with CLBP?

Method Design Overview


A Delphi survey is a technique used to obtain group consensus from a

panel of experts.^{28,29} It involves a series of questionnaires, where panel members rank the relative importance or relevance of features under study. With each questionnaire round, panel members are provided with de-identified group feedback and a statistical summary of group findings. If desired, panel members can change their responses in subsequent rounds. Agreement among panel members is determined by consensus, voting, or through averaging of results.^{28,30,31}

Delphi surveys are frequently used in medical, health, and nursing research to explore topics with limited or conflicting research evidence.^{28,30} A Delphi survey minimizes group bias by providing relative anonymity, where only the researchers are aware of the source of panel member comments and direct interaction among panel members does not occur.^{28,29} National sampling also is convenient and cost-effective, as panel members can be surveyed in different locations at different times.^{29,30}

Recruitment

Participants were recruited via purposive sampling, where a panel of "experts" was selected based on their knowledge of and experience with the subject, their availability, and their interest and communication skills.³⁰ This method of recruit-

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- **eFigure:** Overview of Delphi Survey Process
- **eAppendix 1:** Delphi Survey: Questionnaire 1
- **eAppendix 2:** Delphi Survey: Questionnaire 2
- **eAppendix 3:** Delphi Survey: Questionnaire 3

ment ensured that Delphi survey findings were based on informed opinions and that maximal participation rates were achieved.³⁰ Snowballing techniques also were used to identify potential panel members. Snowballing consists of participants nominating or recommending others to be involved in the study based on knowledge of the inclusion criteria of the study.²⁹ Using snowballing techniques of recruitment can increase both the size and diversity of the population sample.

The recruitment process began with the primary researcher (C.W.) e-mailing an invitation to participate to physical therapists who were likely to meet the selection criteria. This e-mail included research project information and informed consent and screening forms. Participants were invited to contact the primary researcher by e-mail or phone to discuss the project. Participants also were encouraged to forward the project information to interested physical therapists who they thought would meet the selection criteria. Interested participants then faxed or e-mailed their completed screening and consent forms to the principal researcher. Once screening and consent forms were received and checked, participants were formally recruited into the study. Data collection commenced once a minimum of 30 participants were recruited.

Selection Criteria

To be included in the expert panel, participants needed to:

1. *Be registered to currently practice as a physical therapist without restrictions in Australia with the Physiotherapy Board of Australia.* The decision to include only registered physical therapists in Australia was to guarantee similar standards of practice of

participants, as training and standards vary internationally.³²

2. *Treat people with CLBP with Pilates exercise at least weekly or have published research on Pilates exercise and CLBP in a peer-reviewed journal.* The decision to include people who were knowledgeable and experienced in using Pilates exercise to treat people with CLBP was to increase the usefulness of responses.^{31,33}
3. *Be able to commit to completing at least 3 rounds of the Delphi survey, which may span 4 months.* To do this, participants needed to be proficient in use of the English language, be computer literate, have access to e-mail and the Internet, and be able to commit time to complete the questionnaires.

Survey Process

The Delphi survey involved 3 electronic questionnaires provided over 4 months (March–July 2012) (eFigure, available at ptjournal.apta.org). An electronic survey was chosen over a paper-and-pen questionnaire due to the increased likelihood of greater participation rates and fewer missing data.³⁴ Conducting an electronic survey also provided an economical and efficient means of collecting data from a geographically dispersed sample.^{29,30,34} QuestionPro software (QuestionPro Inc, Seattle, Washington) was selected as the electronic survey tool.^{35,36}

Participants were e-mailed electronic links to each questionnaire and given individual login details to complete responses. Individual login details ensured security of information and prevented duplication of responses. Participants were requested to complete each questionnaire within 2 weeks. E-mail reminders were sent to participants who had not responded at 1 week

and the day before the due date. If participants were not able to complete the questionnaires within the 2 weeks, they were provided with additional reminders and extra time to respond. Once at least 30 responses to a questionnaire had been received, participants who had not provided answers were not given the opportunity to answer any subsequent questionnaires.

Questionnaire Development

Questionnaire 1. The first questionnaire consisted primarily of open-ended questions to allow participants to express opinions without the provision of leading information (eAppendix 1, available at ptjournal.apta.org). This method reduces response bias.³⁷ Multiple-choice questions (MCQs) were used to efficiently collect demographic information regarding the expert panel.³⁸

Responses to open-ended questions in the first questionnaire were summarized qualitatively using thematic analysis, “a method for identifying, analysing and reporting patterns (themes) within data.”³⁹ Two researchers (C.W., A.B.) were involved in this process to ensure validity and consistency of the approach. Themes identified from participant responses then were translated in statements about Pilates exercise and people with CLBP. These statements were utilized in the development of the second questionnaire.

Questionnaire 2. The second questionnaire was developed from consideration of themes identified within responses to the first questionnaire and findings from systematic reviews on the definition and effectiveness of Pilates exercise in people with CLBP (eAppendix 2, available at ptjournal.apta.org).^{29,40} Participants were requested to rank their level of agreement with a num-

ber of statements regarding Pilates exercise in people with CLBP using a 6-point Likert response scale (“strongly agree,” “agree,” “somewhat agree,” “somewhat disagree,” “disagree,” and “strongly disagree”). A 6-point Likert scale was selected because it has been shown to be valid, reliable, and suitable for use with educated individuals.^{41,42} The “neutral” category of the Likert scale was intentionally omitted from the scale to discourage ambivalence in responses.^{42,43}

The Likert scale of responses was used to identify areas of consensus or nonconsensus among the expert panel members. Prior to the commencement of this study, consensus was defined as when 70% to 100% of the panel members strongly agreed, agreed, or somewhat agreed (or strongly disagreed, disagreed, or somewhat disagreed) with an item. This definition of consensus was based on previously reported designs.²⁸⁻³⁰ If the percentage of agreement or disagreement was 60% to 69%, the panel was considered to be approaching consensus for that question, as 60% agreement is considered by some authors to be appropriate for consensus.⁴⁴ If the percentage of agreement or disagreement was less than 60%, however, it was concluded that consensus had not been reached.

Open-ended questions also were provided to ensure participants were able to express any further thoughts or opinions. Themes identified in these responses then were translated into questions for the third questionnaire. In addition, MCQs were used to collect information on exercise parameters and level of supervision in a time-efficient manner.³⁸

Questionnaire 3. The final questionnaire consisted only of questions requiring responses with the Likert response scale or MCQs (eAppendix

3, available at ptjournal.apta.org). These responses determined the final level of consensus regarding several items.^{28,30} Any questions that did not reach consensus during the second questionnaire were repeated in the final questionnaire.^{28,30} Those items that gained consensus, however, were removed. Additional themes identified in open-ended questions in the second questionnaire were included to ensure thorough exploration of participant opinions.

Participants also received a summary of de-identified responses from the second questionnaire. This summary was used to stimulate personal reflection on responses.³⁰ The summary of items with and without consensus was accompanied by percentages of agreement and disagreement.

Data Analyses

Participant information. The number of participant responses for each questionnaire was summated and monitored for dropouts. Participation rates, the time delay in returning questionnaires, and the number of reminders needed to maintain at least 30 responses in each round were monitored because they may indicate participant fatigue.³⁰ Demographic data regarding participants were summarized using descriptive statistics.

Open-ended questions. Responses to open-ended questions in the first 2 questionnaires were summarized qualitatively using thematic analysis.³⁹ The number of identified themes was noted, and these themes were used to generate questions for subsequent questionnaires.

Likert response scale questions. For questions with a Likert response scale, the number of responses of “strongly agree,” “agree,” or “somewhat agree” were summated and expressed as a percentage of agree-

ment. Similarly, the number of responses of “strongly disagree,” “disagree,” or “somewhat disagree” were summated and expressed as a percentage of disagreement.

MCQs. For MCQs related to exercise parameters and the level of supervision, the percentage of participants who selected each answer was interpreted as the percentage of agreement.

Items with and without consensus. Items with and without consensus were identified in the final 2 questionnaires, where consensus was defined as when the percentage of agreement or disagreement for questions was 70% or greater.^{28,30} Monitoring of any change in consensus for repeat questions in the 2 questionnaires was undertaken to observe any variation in the panel’s views over time.⁴⁵

Strength of agreement or disagreement. Responses on the 6-point Likert scale were translated into numerical scores to understand the strength of agreement of participants regarding different questions.⁴⁴ A score of 1 represented “strongly agree,” a score of 2 represented “agree,” and so on, until a score of 6 represented “strongly disagree.”

The median score and interquartile range of responses for these questions were then calculated. The median score was chosen over the mean due to the tendency of responses to converge with a Delphi survey.⁴⁰ Items where the median score indicated that participants “strongly agreed” were considered to be particularly important.

Results

Participant Recruitment

Survey participants were recruited over February and March 2012 using purposive and snowballing sampling

techniques.^{46,47} One hundred fifty-three invitations to participate were e-mailed to potential participants by the primary researcher. Nine potential participants e-mailed the researcher to decline to participate in the study, as they did not meet the selection criteria, and another invitation was returned due to an incorrect e-mail address. Thirty-seven physical therapists who met the selection criteria provided informed consent to participate.

Of the 37 participants who received the first questionnaire, 33 (89.1%) responded. Of the 33 participants who received the second questionnaire, 31 (93.9%) responded. Of the 31 participants who received the third questionnaire, 30 (96.7%) responded. A high participation rate, therefore, was achieved, where 30 (81.1%) out of 37 participants completed the 3 questionnaires.⁴⁶ The use of snowballing in recruitment, however, restricted our ability to calculate an initial response rate, as the number of e-mail invitations sent to potential participants was unknown.^{46,47}

By the final questionnaire, 5 reminders and a 6-week period were required to ensure 30 participant responses were received. One of the reasons for this finding might have been participant fatigue with the Delphi survey process.³⁰ The 7 participants who did not return questionnaires did not provide reasons for dropping out of the study.

Participant Demographics

Of the 37 individuals who consented to participate in the study, 33 returned the first questionnaire. As such, detailed demographics apart from the selection criteria information were not collected from the 4 participants who did not respond to this questionnaire. When examining the demographics, the majority of participants were female physical

therapists (91.0%) working in private practice (100%). The highest qualification held by the majority of participants was a bachelor's degree in physical therapy (54.5%) (a standard professional [entry-level] qualification required for registration as a physical therapist in Australia), and other participants had completed postgraduate qualifications in physical therapy (45.5%).

Thirty-one participants (94.0%) had undertaken formal Pilates training, including courses run by Dance Medicine Australia (52.0%) and Polestar Pilates (30.0%). The 2 participants (6.0%) who did not undertake specific Pilates training reported having significant physical therapy work experience (18+ years) and a physical therapy postgraduate degree. In terms of Pilates training, it is possible that these 2 participants had learned principles of Pilates exercise informally in the workplace or during their general university training.

The mean (SD) age of the 33 participants was 33.8 (8.1) years while their mean number of years of physical therapy postgraduate experience was 10.9 (7.7) years. Approximately 80% of the participants reported that 20% or more of their clients experienced CLBP. Moreover, 67% of participants reported use of Pilates exercise to treat people with CLBP greater than 50% of the time. Participants were drawn from those who practiced physical therapy in the 6 states of Australia: New South Wales (36.4%), Western Australia (27.3%), Queensland (12.1%), South Australia (12.1%), Victoria (9.1%), and Tasmania (3.0%).

Participants who completed all 3 questionnaires (n=30) and those who did not (n=3) had similar demographics, especially in relation to sex, workplace setting, qualifications, and usual clinical practice. Some differences were noted, how-

ever, in relation to the participants' age, years of physical therapy experience, location of practice, and Pilates training. For example, the mean (SD) age of participants who did not complete all 3 questionnaires was 27.0 (3.6) years compared with 34.4 (8.1) years for participants who completed all 3 questionnaires, and their mean (SD) years of physical therapy experience was 4.0 (2.0) compared with 11.6 (7.8). The majority of participants who did not complete all 3 questionnaires practiced in Western Australia (66.7%) and trained with Polestar Pilates (66.7%), whereas a greater percentage of participants who completed all questionnaires practiced in states other than Western Australia (96.7%) and trained with Dance Medicine Australia Pilates (53.3%) rather than Polestar Pilates (26.7%).

Thematic Analysis of Questionnaires

From 18 different open-ended questions, a total of 192 themes were identified. These themes were used to generate questions regarding Pilates exercise by people with CLBP for subsequent questionnaires.

Items of Consensus and Nonconsensus

After 3 questionnaires, consensus levels of agreement were reached in regard to 91.7% (176/192) of the questions. Consensus was not obtained, however, in regard to 8.3% (16/192) of the questions. A summary of items of consensus and non-consensus is provided below relative to research questions of this study.

How is Pilates exercise defined in relation to people with CLBP?

Consensus was reached on 97.1% (33/34) of questions related to identifying features of Pilates (Tab. 1). Identifying features of Pilates exercise that were particularly important included body awareness, breathing, control, education, individualized

exercises, movement control, and posture. Participants approached consensus regarding the question of “fatiguing” being part of Pilates exercise.

Consensus was reached on 78.9% (15/19) of essential components of Pilates exercise programs for people with CLBP (Tab. 2). Essential components of particular importance included the use of therapist encouragement and feedback, functional integration of Pilates principles, incorporation of home exercises, client self-correction, and therapist reassessment. Consensus was not reached in regard to the prescription of a set number of exercises and incorporation of rest and cool-down exercise.

What is the ideal Pilates exercise design, in terms of parameters, level of supervision, and equipment, for people with CLBP?

Consensus was reached within a range of values on 100% of questions regarding ideal Pilates exercise parameters and supervision for people with CLBP. Participants agreed that supervised exercise sessions for people with CLBP should last between 30 and 60 minutes (100% agreement), should be undertaken at a frequency of 2 sessions per week (73.3% agreement), and should be conducted for a period of 3 to 6 months (83.4% agreement).

The rationale reported by participants that underlie these parameters was to ensure clients remember their exercises, use the correct technique, successfully correct motor patterns, strengthen weak muscles, and achieve functional goals. These parameters also were thought to enable the reduction, prevention, and self-management of symptoms and fear-avoidance behavior and to maximize client enjoyment, motivation, and adherence within the con-

Table 1.

Identifying Features of Pilates Exercises in Relation to People With Chronic Low Back Pain

Item	Percentage of Agreement	Median (Q1, Q3) ^a	Strength of Agreement ^b
With Consensus^c			
1. Body awareness	96.8	1.0 (1.0, 1.0)	Strongly agree
2. Breathing	100	1.0 (1.0, 2.0)	Strongly agree
3. Control	96.8	1.0 (1.0, 2.0)	Strongly agree
4. Education	100	1.0 (1.0, 2.0)	Strongly agree
5. Individualized	100	1.0 (1.0, 1.0)	Strongly agree
6. Movement control	100	1.0 (1.0, 2.0)	Strongly agree
7. Posture	96.8	1.0 (1.0, 1.0)	Strongly agree
8. Measured	96.7	1.5 (1.0, 2.8)	Strongly agree/agree
9. Mindfulness	90.0	1.5 (1.0, 2.8)	Strongly agree/agree
10. Concentration	83.9	2.0 (2.0, 3.0)	Agree
11. Coordination	96.8	2.0 (1.0, 2.5)	Agree
12. Core stability	90.3	2.0 (1.0, 3.0)	Agree
13. Direction preference	96.8	2.0 (2.0, 3.0)	Agree
14. Endurance	93.5	2.0 (2.0, 2.5)	Agree
15. Flexibility	96.8	2.0 (2.0, 3.0)	Agree
16. Goal orientated	96.8	2.0 (1.0, 2.0)	Agree
17. Graded	96.8	2.0 (1.0, 2.0)	Agree
18. Low impact	100	2.0 (2.0, 3.0)	Agree
19. Mind-body connection	90.3	2.0 (1.0, 3.0)	Agree
20. Muscle balance	90.3	2.0 (1.0, 2.0)	Agree
21. Precision	90.3	2.0 (2.0, 3.0)	Agree
22. Proprioception	96.8	2.0 (1.0, 2.0)	Agree
23. Relaxation	90.3	2.0 (2.0, 3.0)	Agree
24. Self-paced	83.9	2.0 (2.0, 3.0)	Agree
25. Supervised	96.8	2.0 (1.0, 2.5)	Agree
26. Structured	90.3	2.0 (2.0, 3.0)	Agree
27. Cognitive-behavioral therapy	80.6	3.0 (2.0, 3.0)	Somewhat agree
28. Flow	77.4	3.0 (2.0, 3.0)	Somewhat agree
29. Functional	93.3	3.0 (2.3, 4.0)	Somewhat agree
30. Holistic	87.1	3.0 (2.0, 3.0)	Somewhat agree
31. Pain-free	73.3	3.0 (2.0, 3.8)	Somewhat agree
32. Specific exercise	90.0	3.0 (2.0, 3.8)	Somewhat agree
33. Strength	83.9	3.0 (2.0, 3.0)	Somewhat agree
Approaching Consensus^d			
34. Fatiguing	60.0	3.0 (2.3, 4.0)	Somewhat agree

^a Q1=25th percentile, Q3=75th percentile. Scores are on a scale from 1 to 6, where 1=“strongly agree,” 2=“agree,” 3=“somewhat agree,” 4=“somewhat disagree,” 5=“disagree,” and 6=“strongly disagree.”

^b Qualitative descriptor of median score.

^c 70%–100% of participants agreed.

^d 60%–69% of participants agreed.

Definition and Application of Pilates Exercise to Treat Chronic Low Back Pain

Table 2.

Essential Components of Pilates Exercises for People With Chronic Low Back Pain

Item	Percentage of Agreement	Median (Q1, Q3) ^a	Strength of Agreement ^b
With Consensus^c			
1. Encouragement	100	1.0 (1.0, 2.0)	Strongly agree
2. Feedback on technique ^d	100	1.0 (1.0, 1.0)	Strongly agree
3. Functional integration	96.7	1.0 (1.0, 1.0)	Strongly agree
4. Home exercises	100	1.0 (1.0, 2.0)	Strongly agree
5. Reassessment	100	1.0 (1.0, 1.0)	Strongly agree
6. Client self-correction	100	1.5 (1.0, 2.0)	Strongly agree/agree
7. Balance exercises	93.3	2.0 (1.0, 2.0)	Agree
8. Contraction of stabilizing muscles of the lower back	83.3	2.0 (2.0, 3.0)	Agree
9. Education	96.7	2.0 (1.0, 2.0)	Agree
10. Equipment use	83.3	2.0 (2.0, 3.0)	Agree
11. Low load, high repetitions	96.7	2.0 (2.0, 2.0)	Agree
12. Pelvic-floor screening	96.7	2.0 (1.0, 3.0)	Agree
13. Strengthening exercises	93.3	2.0 (2.0, 3.0)	Agree
14. Stretching exercises ^d	83.3	2.0 (2.0, 3.0)	Agree
15. Warm-up exercises ^d	73.3	3.0 (2.0, 3.8)	Somewhat agree
Approaching Consensus^e			
16. Minimum of 5 different exercises ^d	63.3	2.5 (2.0, 4.0)	Agree/somewhat agree
17. Rest between exercises ^d	63.3	3.0 (3.0, 4.0)	Somewhat agree
Without Consensus^f			
18. Cool-down exercise ^d	50.0	3.5 (3.0, 4.0)	Somewhat agree
19. Maximum of 10 different exercises ^d	56.7	3.0 (2.3, 4.0)	Somewhat agree

^a Q1=25th percentile, Q3=75th percentile. Scores are on a scale from 1 to 6, where 1="strongly agree," 2="agree," 3="somewhat agree," 4="somewhat disagree," 5="disagree," and 6="strongly disagree."

^b Qualitative descriptor of median score.

^c 70%–100% of participants agreed.

^d Asked in second and third questionnaires.

^e 60%–69% of participants agreed.

^f 0%–59% of participants agreed.

of availability and budget (100% agreement).

The level of supervision recommended by participants was 1 client per therapist at the start of the program (80.0% agreement) and 2 to 4 clients per therapist after 2 weeks (100% agreement). Participants agreed that these supervision levels allowed individual exercise prescription, progression, and monitoring of technique and ensured prevention of pain and injury, client self-management, and a reduction in

dependence on the therapist over time (100% agreement).

Consensus was reached on 67.9% (19/28) of questions related to essential Pilates equipment (Balanced Body, Sacramento, California) for people with CLBP (Tab. 3). The Reformer and mirror were considered to be especially important. Consensus was not reached in regard to use of Chi, Franklin, massage, and prop balls, Ladder Barrel, Magic Circle, suspension trainer, vibration machine, and video analysis.

There was 90.9% agreement (10/11) regarding the rationale underlying the use of Pilates equipment for people with CLBP. Participants agreed that Pilates equipment provides proprioceptive and visual feedback, assists in the maintenance of spinal posture, and increases the functional relevance and variation of exercises. Pilates equipment also can provide adjustable resistance, opportunities for progression, and complement home exercises. Participants did not reach consensus regarding the cost of equipment influencing use.

What principles are used to guide safe prescription and progression of Pilates exercise in people with CLBP? Participants reached consensus on 100% of questions related to individualization of programs for people with CLBP (Tab. 4). Factors that are particularly important to consider included client goals, functional requirements, irritability, specific movement or activity fears, and body awareness.

Participants also reached consensus on 100% of questions related to exercise progression for people with CLBP (Tab. 5). Participants agreed that progression of exercises should primarily involve an increase in exercise complexity, replication of a relevant sport or functional activity, and functional integration of exercise principles.

Participants reached consensus on 94.7% (18/19) of questions regarding the principles of Pilates exercise prescription for people with CLBP (Tab. 6). Principles of particular importance included conducting an initial assessment; educating clients regarding the purpose of Pilates exercise and chronic pain mechanisms; prescribing functionally relevant exercises according to client needs, ability, irritability, and pathology; supervising sessions, monitoring quality of technique, and encour-

aging breathing with movement; challenging fear-avoidance belief systems; and regularly reassessing symptoms and functional outcomes. Consensus was not reached in regard to teaching traditional Pilates principles.

There was 100% consensus by participants that following prescription principles will ensure treatment outcomes (eg, improved posture, movement control, and function; decreased fear of movement; correction of maladaptive movement patterns; increased activation of appropriate muscles) are reached.

Repeated Questions

Items where consensus was not obtained in the second questionnaire were repeated in the third questionnaire. A total of 15 items that related to the essential components of Pilates exercise (n=7), exercise parameters (n=3), Pilates equipment (n=4), and prescription principles (n=1) were repeated (Tabs. 1, 2, 3, and 6). With repeat questioning, consensus of these items was obtained for 40.0%, including items relating to essential components (n=3) and ideal parameters of Pilates exercise for people with CLBP (n=3).

Concluding the Delphi Survey

The decision was made to finish the Delphi survey after 3 questionnaires. This decision was based on the analysis of the number and importance of items without consensus (16/192) and potential participant fatigue in responding to multiple questionnaires.³⁰

Discussion Findings

In this Delphi survey, 30 physical therapists reached consensus on the majority of items relating to the definition and application of Pilates exercise in people with CLBP (Tabs. 1, 2, 3, 4, 5, and 6). After 3 rounds of

Table 3.
Ideal Pilates Exercise Equipment for People With Chronic Low Back Pain

Item	Percentage of Agreement	Median (Q1, Q3) ^a	Strength of Agreement ^b
With Consensus^c			
1. Mirror	96.8	1.0 (1.0, 1.0)	Strongly agree
2. Reformer	96.8	1.0 (1.0, 2.0)	Strongly agree
3. Exercise sheet	90.0	2.0 (2.0, 3.0)	Agree
4. Fitball	87.1	2.0 (2.0, 3.0)	Agree
5. Foam rollers	90.3	2.0 (2.0, 3.0)	Agree
6. Mat	86.7	2.0 (1.0, 3.0)	Agree
7. Pillows	90.0	2.0 (2.0, 3.0)	Agree
8. Raised bench/step	83.9	2.0 (2.0, 3.0)	Agree
9. Real-time ultrasound	74.2	2.0 (2.0, 3.5)	Agree
10. Resistance bands	96.8	2.0 (1.0, 2.0)	Agree
11. Towels	86.7	2.0 (1.3, 3.0)	Agree
12. Trapeze table	93.5	2.0 (1.0, 2.0)	Agree
13. Wunda chair	74.2	2.0 (2.0, 3.5)	Agree
14. Balance disk	77.4	3.0 (2.0, 3.0)	Somewhat agree
15. Educational books	70.0	3.0 (2.0, 4.0)	Somewhat agree
16. Hand weights	90.3	3.0 (2.0, 3.0)	Somewhat agree
17. Pressure biofeedback pillow	74.2	3.0 (2.0, 3.5)	Somewhat agree
18. Step barrel/spine corrector	71.0	3.0 (2.0, 4.0)	Somewhat agree
19. Balance board	86.7	3.0 (2.0, 3.0)	Somewhat agree
Approaching Consensus^d			
20. Ladder Barrel ^e	60.0	3.0 (2.0, 4.0)	Somewhat agree
21. Magic Circle ^e	60.0	3.0 (3.0, 4.0)	Somewhat agree
22. Massage ball	63.3	3.0 (2.0, 4.0)	Somewhat agree
23. Prop ball ^e	66.7	3.0 (2.0, 4.0)	Somewhat agree
Without Consensus^f			
24. Chi ball	53.3	3.0 (3.0, 4.0)	Somewhat agree
25. Franklin ball	60.0	3.0 (2.0, 4.0)	Somewhat agree
26. Suspension trainer	43.3	4.0 (3.0, 4.0)	Somewhat disagree
27. Vibration machine ^e	53.3	3.0 (3.0, 4.0)	Somewhat agree
28. Video analysis	56.7	3.0 (3.0, 4.0)	Somewhat agree

^a Q1=25th percentile, Q3=75th percentile. Scores are on a scale from 1 to 6, where 1="strongly agree," 2="agree," 3="somewhat agree," 4="somewhat disagree," 5="disagree," and 6="strongly disagree."

^b Qualitative descriptor of median score.

^c 70%–100% of participants agreed.

^d 60%–69% of participants agreed.

^e Asked in the second and third questionnaires.

^f 0%–59% of participants agreed.

questionnaires, consensus levels of agreement were reached for 91.7% (176/192) of questions. Items that did not reach consensus related to identifying features of Pilates (1/34), essential components of Pilates

(4/19), essential forms of equipment (9/28) and rationale for use (1/11), and exercise prescription principles (1/19) (Tabs. 1, 2, 3, and 6).

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Table 4.

Individualization of Pilates Exercise Programs for People With Chronic Low Back Pain

Item	Percentage of Agreement	Median (Q1, Q3) ^a	Strength of Agreement ^b
With Consensus^c			
1. Body awareness	96.8	1.0 (1.0, 2.0)	Strongly agree
2. Client goals	100	1.0 (1.0, 1.0)	Strongly agree
3. Functional requirements	100	1.0 (1.0, 1.0)	Strongly agree
4. Irritability	96.8	1.0 (1.0, 2.0)	Strongly agree
5. Specific movement or activity fears	100	1.0 (1.0, 2.0)	Strongly agree
6. Chronicity of symptoms	90.3	2.0 (2.0, 3.0)	Agree
7. Client availability	90.3	2.0 (1.0, 2.0)	Agree
8. Client commitment	96.8	2.0 (2.0, 3.0)	Agree
9. Client financial capacity	83.3	2.0 (1.0, 2.0)	Agree
10. Client motivation	100	2.0 (1.5, 2.5)	Agree
11. Flexibility	90.3	2.0 (2.0, 3.0)	Agree
12. Functional limitations	100	2.0 (1.0, 2.0)	Agree
13. Intensity of pain	96.8	2.0 (1.5, 2.5)	Agree
14. Movement control	100	2.0 (1.0, 2.0)	Agree
15. Muscle strength	93.5	2.0 (2.0, 3.0)	Agree
16. Pain management	93.3	2.0 (2.0, 2.8)	Agree
17. Pain-relieving exercise	96.7	2.0 (1.0, 2.0)	Agree
18. Pathology	100	2.0 (1.0, 2.0)	Agree
19. Pelvic-floor muscle dysfunction	93.3	2.0 (1.0, 2.0)	Agree
20. Posture	96.8	2.0 (1.0, 2.0)	Agree
21. Previous Pilates experience	90.3	2.0 (2.0, 3.0)	Agree
22. Previous treatment and effect	93.3	2.0 (1.3, 2.0)	Agree
23. Psychosocial factors	93.5	2.0 (1.0, 2.0)	Agree
24. Cardiovascular fitness	77.4	3.0 (2.0, 3.0)	Somewhat agree
25. Medications	83.3	3.0 (2.0, 3.0)	Somewhat agree
26. Previous exercise or sports experience	80.0	3.0 (2.0, 3.0)	Somewhat agree
27. Time of day	76.7	3.0 (2.0, 3.0)	Somewhat agree

^a Q1=25th percentile, Q3=75th percentile. Scores are on a scale from 1 to 6, where 1="strongly agree," 2="agree," 3="somewhat agree," 4="somewhat disagree," 5="disagree," and 6="strongly disagree."

^b Qualitative descriptor of median score.

^c 70%–100% of participants agreed.

Definition of Pilates exercise.

Participants agreed that the 7 components of Pilates exercise identified in a recent systematic review of the literature (ie, breathing, posture, flexibility, movement control, strength, core stability, and a mind-body connection) were relevant to people with CLBP.²⁰ Breathing, movement control, and posture were considered to be particularly

important, as indicated by the high median score of agreement. The relative importance of other identifying features and essential components, however, warrants further examination (Tabs. 1 and 2).

Exercise parameters, levels of supervision, and equipment.

Consensus findings provide specific guidelines for using Pilates to treat

people with CLBP. When comparing these parameters with those used in research trials, the length and frequency of Pilates exercise sessions have often been appropriate; however, the duration of exercise programs (ie, 6–8 weeks) has been too short.^{16–18,26} Given that the total number of sessions and exercise hours may be associated with effect sizes in exercise trials for people with CLBP, it may be important that future trials maximize outcomes by ensuring Pilates interventions are 3 to 6 months in duration.⁴⁸

Consensus findings also provide direction regarding the essential equipment and levels of supervision for using Pilates to treat people with CLBP. The majority of Pilates exercise trials have not utilized equipment in their programs for people with CLBP.^{16–18,26} Given survey findings, however, future research should investigate the benefits of programs with and without use of equipment (Tab. 3). Similarly, supervision levels need to be carefully considered in future trials, as they may influence exercise effectiveness in people with CLBP.^{14,49}

Prescription principles. Participants agreed on several principles for prescription of Pilates exercise that are similar to principles of other exercise approaches that are effective in people with CLBP. For example, participants agreed that exercises should be individually tailored and supervised and include stretching and strengthening.^{13,14} Pilates exercises also should focus on trunk muscle strength, endurance, and coordination; respect the directional preferences of clients; and include cognitive-behavioral therapy, education, and feedback.^{12,13,50,51} The importance of other items of consensus relating to the individualization, prescription, and progression of exercises needs to be verified by sub-

sequent clinical research (Tabs. 4, 5, and 6).

Participants did not reach consensus on the importance of teaching people with CLBP traditional Pilates principles. Our systematic review of the literature showed that traditional Pilates principles, such as centering, concentration, and precision, were not mentioned in published studies of CLBP participants, suggesting they may not be important.²⁰ Nevertheless, when examining consensus findings regarding identifying features of Pilates exercise, traditional principles of concentration, precision, flow, control, and breathing were included.^{52,53} Although the traditional principle of centering was not specifically mentioned by participants, it could be that it is incorporated in the idea of “core stability.”^{20,53} Future research should clarify the importance of traditional principles for people with CLBP, given this conflicting finding.

Strengths

This is the first Delphi survey, to our knowledge, that has developed consensus on the definition and application of Pilates exercise in people with CLBP according to 30 Australian physical therapists. Although there are no universal guidelines in the literature regarding appropriate sample sizes for Delphi surveys, a sample size of 30 participants can be argued as adequate, given the participants were homogenous.^{30,54} It also has been reported that having more than 30 participants may not increase the quality of results but instead may increase management or attrition problems.⁵⁵ In this study, findings were minimally affected by attrition, as 4 of the 7 participants who dropped out did not return any questionnaires.⁴⁵

In Delphi surveys, the representativeness of samples is indicated by the qualities of the expert panel

Table 5. Methods of Progression of Pilates Exercises for People With Chronic Low Back Pain

Item	Percentage of Agreement	Median (Q1, Q3) ^a	Strength of Agreement ^b
With Consensus^c			
1. Increase in exercise complexity	96.8	1.0 (1.0, 2.0)	Strongly agree
2. Functional integration of exercise principles	96.8	1.0 (1.0, 1.5)	Strongly agree
3. Replicate functional tasks or sport	93.3	1.0 (1.0, 2.0)	Strongly agree
4. Activation of stabilizing lower back muscles combined with limb movement	93.5	2.0 (1.0, 2.0)	Agree
5. Activation of stabilizing lower back muscles combined with breathing	90.3	2.0 (1.0, 3.0)	Agree
6. Decrease base of support	83.3	2.0 (2.0, 3.0)	Agree
7. Include movements outside of movement direction preference of client	96.8	2.0 (1.0, 3.0)	Agree
8. Incorporate segmental spinal movement	96.8	2.0 (1.0, 2.5)	Agree
9. Increase in exercise duration	93.5	2.0 (1.0, 2.5)	Agree
10. Increase in exercise load or resistance	87.1	2.0 (2.0, 3.0)	Agree
11. Increase in exercise repetitions	96.8	2.0 (1.5, 2.0)	Agree
12. Progress toward feared movements	100	2.0 (1.0, 2.0)	Agree
13. Reduce supervision and feedback	96.7	2.0 (1.0, 2.0)	Agree
14. Increase speed of exercise	70.0	3.0 (2.0, 4.0)	Somewhat agree

^a Q1=25th percentile, Q3=75th percentile. Scores are on a scale from 1 to 6, where 1=“strongly agree,” 2=“agree,” 3=“somewhat agree,” 4=“somewhat disagree,” 5=“disagree,” and 6=“strongly disagree.”

^b Qualitative descriptor of median score.

^c 70%–100% of participants agreed.

rather than its numbers.³¹ This finding is because nonprobability sampling, such as purposive and snowballing techniques, is used to recruit participants who can provide well-considered responses based on specialized knowledge and experience.⁵⁶ The credibility of findings in this survey, therefore, is enhanced by participants’ training, education, and experience in prescribing Pilates exercise to treat people with CLBP.^{28,30,31}

All participants were registered to practice physical therapy in Australia, which ensured similar baseline university education and competency in treating people with CLBP.³² Several physical therapists (45.5%) also had undertaken further

postgraduate physical therapy study, which may indicate advanced physical therapy knowledge and skills.^{57,58} The average length of physical therapy work experience was greater than 10 years, which may indicate expert physical therapy status.^{59,60}

To be involved in this study, participants needed to use Pilates exercise at least weekly to treat people with CLBP. The majority of participants reported that at least 20% of their clients per week presented with CLBP and that they used Pilates to treat these clients more than 50% of the time. Although there was likely to be variation among participants in terms of formalized Pilates training and experience, 94.0% of the participants had undertaken some form of

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Table 6.

Principles of Pilates Exercise Prescription for People With Chronic Low Back Pain

Item	Percentage of Agreement	Median (Q1, Q3) ^a	Strength of Agreement ^b
With Consensus^c			
1. Conduct an initial assessment	100	1.0 (1.0, 1.0)	Strongly agree
2. Consider client irritability	100	1.0 (1.0, 1.5)	Strongly agree
3. Consider client pathology	100	1.0 (1.0, 2.0)	Strongly agree
4. Educate regarding purpose of Pilates exercises	100	1.0 (1.0, 2.0)	Strongly agree
5. Educate regarding chronic pain mechanisms	96.7	1.0 (1.0, 2.0)	Strongly agree
6. Encourage breathing with movement	100	1.0 (1.0, 2.0)	Strongly agree
7. Monitor quality of technique	96.8	1.0 (1.0, 2.0)	Strongly agree
8. Prescribe exercises according to client needs and ability	100	1.0 (1.0, 1.0)	Strongly agree
9. Prescribe functionally relevant exercise	96.8	1.0 (1.0, 2.0)	Strongly agree
10. Regularly reassess symptoms and functional outcomes	100	1.0 (1.0, 2.0)	Strongly agree
11. Supervise exercise sessions	100	1.0 (1.0, 2.0)	Strongly agree
12. Challenge fear-avoidance belief systems	96.7	1.0 (1.0, 2.0)	Strongly agree
13. Consider movement direction preference of client	93.5	2.0 (1.0, 3.0)	Agree
14. Encourage muscle balance	96.7	2.0 (1.0, 2.0)	Agree
15. Ensure exercises do not increase or cause pain	93.5	2.0 (1.0, 2.0)	Agree
16. Gradually increase difficulty of exercises	96.8	2.0 (1.0, 2.0)	Agree
17. Start exercises in neutral spine position	74.2	2.0 (2.0, 3.5)	Agree
18. Ensure exercise variation	71.0	3.0 (2.0, 4.0)	Somewhat agree
Approaching Consensus^d			
19. Teach traditional Pilates exercise principles ^e	63.3	3.0 (3.0, 4.0)	Somewhat agree

^a Q1=25th percentile, Q3=75th percentile. Scores are on a scale from 1 to 6, where 1="strongly agree," 2="agree," 3="somewhat agree," 4="somewhat disagree," 5="disagree," and 6="strongly disagree."

^b Qualitative descriptor of median score.

^c 70%–100% of participants agreed.

^d 60%–69% of participants agreed.

^e Asked in second and third questionnaires.

Pilates training outside of their entry-level university physical therapy study.

The Delphi survey design also enhanced the quality and integrity of participant responses. Participants had several opportunities to express and qualify their opinions with multiple rounds of questionnaires, repetition of questions without consensus, and use of open-ended, multiple-choice, and Likert response

scale questions.^{30,31} In addition, the provision of de-identified group summary responses and the relative anonymity of participant responses encouraged participants to reflect on their answers and respond honestly without pressure from other group members.^{28,30}

The validity of findings also was enhanced by the clear, methodical, and consistent manner by which participant responses were summa-

rized, analyzed, and interpreted. The accuracy of thematic analysis of open-ended questions was improved by more than one researcher being involved.³⁰ Consensus was clearly defined a priori as 70% participant agreement or disagreement, which is similar to other levels of consensus in the literature.^{28,30} A comparison of median scores for questions with a Likert response scale assisted in organizing items of consensus in order of importance.^{44,61}

Finishing the survey after 3 rounds was supported by the relatively small number and importance of items without consensus (16/192). For example, obtaining consensus about all 28 potential forms of equipment is unlikely to be helpful, particularly when 19 pieces of equipment have had already been confirmed as ideal by the participants.

Limitations

These Delphi survey results reflect the perspectives of 30 physical therapists registered to practice in Australia who use Pilates exercise at least weekly to treat people with CLBP. The external validity of findings, therefore, is limited, as physical therapists from other countries and non-physical therapist Pilates practitioners may have different but equally important views that have not been incorporated.²⁹ Moreover, inclusion of a more heterogeneous sample of experts, including alternative medicine Pilates practitioners, may have ensured that a greater spectrum of opinions were considered.³⁰

Only 30 physical therapists participated in this Delphi survey, which means that findings may be skewed, as only a proportion of Australian physical therapists experienced in the use of Pilates exercise in people with CLBP gave their opinion.³⁰ Selection and response bias are likely to be present where physical thera-

pists who met the selection criteria were not invited to participate, did not agree to participate, or did not follow through in completing questionnaires.^{29,30} It also should be noted that 2 of the participants had not undertaken any formalized Pilates training, which may limit the validity of their responses. Their extensive physical therapy experience and postgraduate physical therapy training, however, suggest expert status in treating people with common musculoskeletal conditions such as CLBP.²⁻⁵

The findings of this study also could be compromised due to different definitions of CLBP and aspects of Pilates exercise being used by participants. For example, CLBP is usually described as pain in the lumbar region lasting more than 12 weeks; however, at times subacute and recurrent LBP have been classified together with CLBP.^{62,63} Similarly, the “mind-body” feature of Pilates exercise could refer to the psychological impact of physical exercise, or a combination of behavioral, psychological, social, and spiritual approaches to treatment.^{64,65} Future research, therefore, should provide definitions of terms to be used by participants in a Delphi survey.

The Delphi technique itself has inherent limitations. The iterative and de-identified group feedback process has the potential of encouraging participants to agree, even though participants do not directly interact with each other.^{30,31} This process can lead to researcher and participant bias. Delphi survey findings can only be considered as expert opinion and are not considered high in the hierarchy of evidence compared with primary studies.⁶⁶ Finally, a consensus of findings does not mean the group conclusion is correct.³⁰ These findings, therefore, need to be validated and tested in subsequent clinical research.

Implications

This Delphi survey provides potentially valuable information for interpreting the results of clinical trials that investigate the effectiveness of Pilates exercise in people with CLBP. For example, the validity of definitions of Pilates exercise and the optimization of exercise design and prescription can be evaluated through comparison with consensus items. This comparison may provide an indication of the ecological validity of evidence available, from the perspective of 30 Australian physical therapists who regularly use Pilates exercise to treat people with CLBP.

Items of consensus relating to the definition and application of Pilates exercise could be used to direct future research and clinical practice. The efficacy of Pilates exercise in people with CLBP then could be evaluated in a consistent manner according to the perspectives of Australian physical therapists expressed in this survey. Future research also should examine items without consensus, such as the use of different types of equipment, and those that are conflicting, such as ensuring Pilates exercises are pain-free and challenge fear-avoidance behavior.

It must be remembered, however, that findings of this Delphi survey represent the opinions of 30 Australian physical therapists who are experienced in the use of Pilates exercise to treat people with CLBP. Exploration into how physical therapists define and use Pilates exercise to treat people with CLBP differently across the globe may provide interesting insights, as would investigation into how non-physical therapist Pilates practitioners use Pilates exercise to treat people with CLBP.

Ms Wells, Dr Kolt, and Dr Bialocerkowski provided concept/idea/research report. All authors provided writing. Ms Wells provided data collection. Ms Wells and Dr Bialocerkowski provided data analysis. Ms Wells and Dr Marshall provided project management. Dr Kolt, Dr Marshall, and Dr Bialocerkowski provided consultation (including review of manuscript before submission).

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