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Artificial Intelligence and the Future of Clinical Care

The last 12 months have seen enormous technical strides in the field of artificial intelligence (AI) with innovative tools such as ChatGPT (language generator) and stable diffusion (image generator). Despite widespread worries about the rapid development of AI, this technology has a significant clinical potential to find ways to identify and diagnose diseases more accurately, select the best treatment options, monitor patient progress, and predict and prevent adverse outcomes.

Before talking more about contemporary AI as a clinical support tool, let us go back to the beginnings of AI. AI originates in the early 1940s but was fully established as a discipline in the 1950s (see Buchanan, 2005), with the most famous example being Alan Turing's proposal on whether *machines can think* (Turing, 1950). To this day, the definition of AI is centred around computers mimicking human behaviours. As seen in Figure 1, AI has broad definitions that encompass a range of computing techniques, e.g., machine learning, deep learning, and large language models (Pedersen et al., 2020). This intrinsically means that lots of *things* are 'AI', and can consequently lead to misconceptions about what AI is, and what AI can do. In clinical practice, including physiotherapy, AI is therefore likely to be implemented in a range of processes from computer software, phone apps, general equipment, and decision support. Specific examples include a wearable technology (Burns et al., 2018) combined with a motion analysis system for a home exercise programme that monitors accuracy and range of movement (Zsarnoczky-Dulhazi et al., 2024), or an inertial sensor that could predict injury risk through biomechanical patterns (Kianifar et al., 2017).

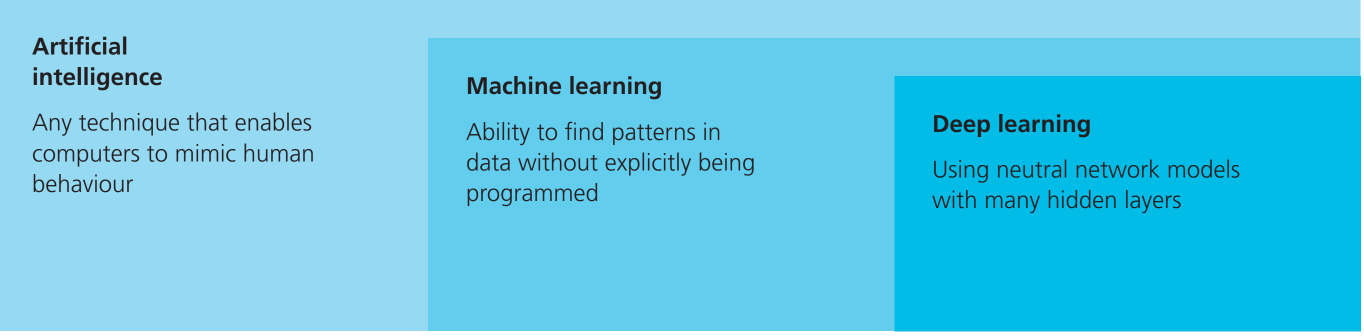
In the remainder of this editorial, I will focus on two issues believed to be important if we are to bring AI into clinical care: (a) how we can achieve 'augmented intelligence' rather than 'artificial intelligence', meaning that people and machines work together for the best possible outcomes, and (b) how we can establish better ethical frameworks for AI, particularly when working with clinical and often sensitive data.

Several applications of AI have algorithmic 'black box' properties, meaning we don't fully understand the inner workings of the algorithms and how the algorithm reaches its conclusion. This can be problematic in the clinical domain. A shift towards augmented intelligence is a good solution to this issue as it aims to transfer power from machines to people with domain-specific expertise. Augmented intelligence means that humans and machines should work together to reach the intended goals (Bazoukis et al., 2022). In other words, people with domain-specific skills should be a major part of the development and outcome of an AI model, meaning we have a greater chance that AI models will become support tools that make our jobs more accurate and effective. Not so long ago, physiotherapy practice faced a momentary ontological dilemma associated with a lack of adequate clinical data for accurate diagnosis and decision-making during the emergency response (Haines et al., 2023). Augmented intelligence offers the potential to advance clinical practice and patient access by assisting with health monitoring and feedback, clinical decision support, and data management and administration. Developing AI skills in clinics and hospitals will take time, but it is likely to become a vital skill for our future workforce. AI models also often require large amounts of data and extensive computational resources to provide reliable and generalisable predictions (for example, training ChatGPT required approximately 1 trillion parameters). In other words, the full introduction of AI in the clinic is likely to be stepwise and take time. Future-proofing our data governance policies and investing in secure data management infrastructure can help us become AI-ready.

For many people working in the field of AI, one of the main priorities is to ensure a safe introduction of AI into clinical care, as there are several ethical concerns (Pedersen et al., 2023). For example, if we fully rely on AI to make clinical decisions, who is then responsible for the potential implications clinical decisions have? Who owns clinical data used in large AI models? Can we

Figure 1

An Overview of Artificial Intelligence, and Approaches Such As Machine Learning and Deep Learning



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fully explain the outcome of AI models? Are there biases in the inherent data we are using to train AI algorithms?

In the end, these questions are non-trivial and require careful ethical consideration of what AI is and what it is not, and emerging research is needed to further understand its clinical implications (Braun et al., 2020). Beyond fields such as radiology (as AI is ideally suited to work with images) (Liu et al., 2020), there is currently little evidence to suggest that machines can do work to the level of, or better than, human experts. I do believe AI will improve our clinical care and hopefully make our work more effective so we can spend more time with patients. This may be needed, as a recent study shows that patients found ChatGPT 41% more empathetic than doctors (Ayers et al., 2023).

AI is developing, and it is exciting. With careful research and training of an AI-minded workforce, we can ensure AI makes a safe entrance in clinical care, to the benefit of our patients.

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Awareness, Knowledge, and Management of Long COVID Among a Small Cohort of Primary Care-based Physiotherapists in New Zealand

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ABSTRACT

Long COVID is an emerging condition predicted to have a high impact on the health system, with primary care often being the point of contact for people living with long COVID. However, there is currently very little known about primary care physiotherapists' assessment and management of long COVID in New Zealand. An online survey was distributed to New Zealand-based physiotherapists working in primary care via Physiotherapy New Zealand special interest group and branch networks, with the aim of exploring current knowledge and awareness of long COVID diagnosis, assessment, and management. Forty one responses were analysed and highlighted good recognition of long COVID symptoms and secondary effects. There was a limited degree of confidence in long COVID symptom management and a lack of consistency in assessment and management strategies currently being applied. Respondents perceived a lack of awareness by the public and other health professionals of the physiotherapist's role in long COVID, possibly creating a barrier to patients with long COVID accessing services. In the absence of validated long COVID treatments, symptom management is of vital importance. There is a need to support primary care-based physiotherapists and ensure access to up-to-date, evidence informed information to provide best patient care.

Rhodes, S., & Waite, E. (2023). Awareness, knowledge, and management of long Covid among a small cohort of primary care-based physiotherapists in New Zealand. *New Zealand Journal of Physiotherapy, 51*(2), 78–89. https://doi.org/10.15619/nzjp.v51i2.288

Key Words: Long COVID, Physiotherapy, Post-COVID-19 condition, Primary Care, Symptom Management

INTRODUCTION

Over 750 million people worldwide have been infected by coronavirus SARS-CoV-2 (COVID-19) (World Health Organization, 2022a), caused by a severe acute respiratory syndrome (Harenwall et al., 2021). Early in the COVID-19 pandemic there were an increasing number of reports of symptoms that persisted following the initial COVID-19 infection, subsequently known as long COVID (Callard & Perego, 2021).

Long COVID has an array of definitions and names including post COVID-19 syndrome, post-acute COVID-19, and chronic COVID (Ministry of Health, 2022b). The World Health Organization (WHO) uses the term post-COVID-19 condition and defines it as a history of probable or confirmed SARS CoV-2 infection, 3 months from the onset of COVID-19, with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis (World Health Organization, 2021). Long COVID affects multiple body systems (Kingstone et al., 2020). There are a wide range of symptoms, with the most common ones being fatigue, brain fog, and dyspnoea (Tran et al., 2022), and the condition can be extremely debilitating. It can impact people's ability to contribute to whānau, work, and community in the way they might have done previously. Long COVID can affect anyone following an acute COVID-19 infection (Yong, 2021) and the mechanism is not yet fully understood. Hypotheses include immune mediated pathogenesis (Sanyaolu et al., 2022), viral persistence, and hypercoagulability (Kichloo et al., 2020). Although there are little available data in New Zealand, overseas research suggests that older age, being female, and having obesity and other pre-existing health conditions are risk factors for developing the condition (Aiyegbusi et al., 2021).

Long COVID is predicted to have a high impact on an already stretched New Zealand health system. Over two million cases of acute COVID-19 infection have been reported in New Zealand (Ministry of Health, 2022a). It is estimated that one in eight people who have been infected with COVID-19 will develop long COVID (Ballering et al., 2022). In findings from the "Impacts of COVID-19 in Aotearoa" study, one in five respondents reported long COVID symptoms after their initial infection (Russell et al., 2023). These people could present to primary care with long COVID being their primary concern or secondary to pre-existing conditions (Baz et al., 2022; Greenhalgh et al., 2020). Physiotherapy is an established part of primary care in New Zealand, highlighting the need for physiotherapists to be knowledgeable in the diagnosis, assessment, and management of long COVID.

Due to its emerging nature, primary care physiotherapists' knowledge of long COVID management is not always well understood, as highlighted by a study undertaken in Austria (Scheiber et al., 2021). Findings from overseas may provide guidance for services in New Zealand, but upskilling of health professionals is required (Whittaker et al., 2022). There appears to be a lack of understanding and information among some health professionals (Russell et al., 2023). Understanding current knowledge and management may highlight any knowledge or skills deficits, directing future action on how to best support physiotherapists in managing long COVID. The aims of this study were to (a) explore the current knowledge and awareness primary care physiotherapists have of long COVID, and (b) investigate current management strategies used by physiotherapists with patients with long COVID in New Zealand.

METHODS

Study design

This study used an online cross-sectional survey to explore awareness, knowledge, and management of long COVID among physiotherapists working in primary care. Qualitative and quantitative data were collected and analysed within the study. Ethical approval was obtained from the School of Physiotherapy Ethics Committee, University of Otago (reference number D22/125).

Survey development

The survey was developed initially as a Word document by the student researcher and project supervisor, then sent to a third-party reviewer who provided feedback on ease of reading questions and flow, acceptability, questionnaire length, and design. Amendments were made to reflect this feedback. The survey took approximately 25 min to complete. The online survey was then created using QualtricsXM survey software (Qualtrics LLC, Provo, UT, United States). The survey was split into seven sections: survey information and consent, demographics, awareness and knowledge, management, return to physical activity, management confidence and resources.

The section on *awareness and knowledge* included questions regarding the respondent's current knowledge of long COVID. Definition, symptoms, risk factors, and confidence in managing long COVID symptoms were explored, using multiple choice questions, scales, and open text box answers to allow elaboration. Confidence was defined as an individual's (self-assessed) level of certainty in recognising the clinical condition of long COVID when a patient presented to them. The *management* section ascertained if respondents had encountered patients with long COVID and sought greater detail about treatments, referrals, and challenges. These questions were mostly answered with open text boxes, aimed at capturing a range of experiences in more detail. Respondents were directed to questions relating to level of exposure to patients with long COVID. If respondents had not encountered patients with long COVID, they were directed to general management questions with open text responses. The *return to physical activity* section consisted of two open text box questions regarding the advice given and potential consequences of an early return to physical activity. A five-point Likert scale was used to assess *confidence in management of different symptoms*, with one representing "not at all confident" and five representing "extremely confident". The last section investigated *resources* via open text boxes and a five-point Likert scale. Questions related to usage and usefulness of existing resources, workplace education, and preferences for future resources.

Before accessing the survey, potential respondents were directed to read the participant information sheet at the start of the survey and provide consent. All survey responses were anonymous, and no questions or demographic data allowed for personal identification of respondents.

Recruitment and survey distribution

New Zealand registered physiotherapists holding an annual practising certificate and working in primary care were invited to participate in this research. A link to the online survey was added to the research directory webpage on the Physiotherapy New Zealand (PNZ) website. Members of PNZ branches and special interest groups were contacted through the central PNZ office by the communications and marketing manager. The survey was available for 6 weeks from May 19 to June 30, 2022. A reminder email was sent 1 week after the original survey was sent out.

Data extraction and analysis

The collected data were stored securely in the Qualtrics^{XM} online system, with password protected access. Qualtrics data were exported to Excel on a password protected computer to analyse data; incomplete responses were excluded from analysis. Multiple choice data were analysed using simple descriptive statistics to calculate distribution, frequency, and mean. Open question responses were analysed using a simple conceptual context analysis. Concepts were grouped and coded for frequency. Quotes were selected based on representation of the overall concepts that had been revealed.

RESULTS

Response number

A total of 50 respondents enrolled in the survey. Nine responses were excluded due to incomplete data. In total, 41 respondents fully completed the survey, and these responses were included in the analysis.

Demographic data

Most survey respondents worked in musculoskeletal clinical practice, based in private practice clinics. Over half of the respondents (53.7%) had ≥ 20 years of physiotherapy experience, and 29.3% of total respondents held postgraduate qualifications (Table 1).

Long COVID awareness

Twenty four per cent of respondents reported feeling fairly confident in identifying patients with long COVID. Reasons included (a) keeping up to date with literature, (b) being able to diagnose from subjective history and personal experience, and (c) exposure to other similar conditions, such as myalgic encephalomyelitis/chronic fatigue syndrome. There was recognition that long COVID was likely to have a big impact in New Zealand.

Seventeen per cent of physiotherapists surveyed were not aware of any way physiotherapy could manage long COVID. In addition, 7% did not feel confident in being able to identify patients presenting with long COVID. Reasons given included the lack of exposure to the condition, limited diagnostic evidence, and long COVID not being an area of interest to them.

Table 1

*Demographic Data (*N *= 41)*

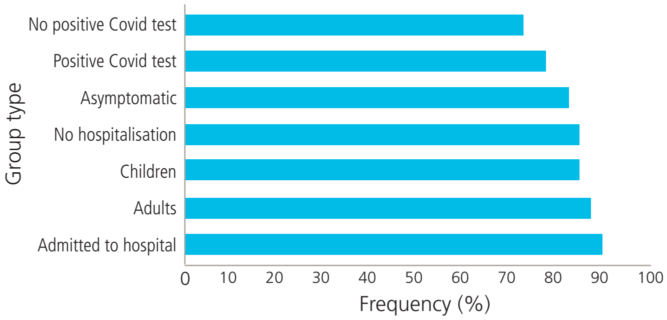
Variable	Frequency	
	n	%
Gender		
Male	5	12.2
Female	36	87.8
Age (years)		
20–29	6	14.6
30–39	9	22.0
40–49	14	34.1
50–59	10	24.4
60+	2	4.9
Ethnic group		
New Zealand European	31	75.6
Māori	2	4.9
Chinese	2	4.9
India	1	2.4
Other	8	19.5
Region of work		
Northland	3	7.3
Auckland	14	34.1
Waikato	7	17.1
Bay of Plenty	4	9.8
Hawkes Bay	1	2.4
Taranaki	5	12.2
Manawatu-Whanganui	1	2.4
Wellington	1	2.4
Marlborough	1	2.4
Canterbury	4	9.8
Otago	0	0.0
Geographical area of work		
Urban	20	48.8
Rural	7	17.1
Both	14	34.1
Area of practice		
Musculoskeletal	25	61.0
Sports physiotherapy	14	34.1
Area of practice		
Older adults	14	34.1
Community	13	31.7
Neurology	13	31.7
Long-term conditions	9	22.0
Cardiorespiratory	7	17.1
Paediatrics	4	9.8
Occupational health	4	9.8
Women's health	3	7.3
Men's health	1	2.4
Oncology	1	2.4
Mental health	1	2.4
Other	5	12.2
Usual location of work		
Private clinic	27	65.9
Public hospital	11	26.8
Primary care/community	8	19.5
Private hospital	4	9.8
School	1	2.4
Tertiary institution	1	2.4
Research	1	2.4
Other	3	7.3
Years practising as a physiotherapist		
0–5	4	9.8
6–10	6	14.6
11–15	2	4.9
16–20	7	17.1
≥ 20	22	53.7
Highest qualification		
Graduate diploma	13	31.7
Bachelor's degree	16	39.0
Postgraduate qualification	8	19.5
Master's degree	2	4.9
PhD or other doctorate	2	4.9

There was no clear consensus from respondents on timelines for when patients should be classified as having long COVID, with only 50% indicating symptoms needed to be present for over 12 weeks. Almost three-quarters (73%) of respondents identified that someone could be classed as having long COVID without having a positive COVID-19 test previously (Figure 1).

A wide range of symptoms were recognised (Figure 2), with fatigue, respiratory, and cardiovascular symptoms commonly listed. Over half of respondents indicated knowledge about long COVID being a multi-system condition (Figure 3). A list of all recognised symptoms is included in Appendix A.

Figure 1

Awareness of Who Can Develop Long COVID



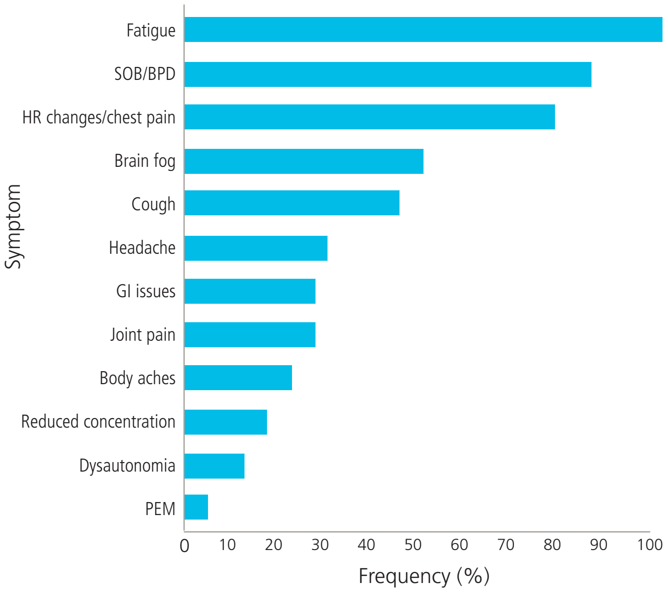
Seventy eight per cent of respondents indicated awareness of psychological symptoms secondary to long COVID, and the potential wider impact of these symptoms on health. This included shame and stigma associated with long COVID, anxiety, stress, and financial burden (Table 2).

Assessment and management of long COVID

Over half (56%) of primary care physiotherapy respondents had managed patients with long COVID but the number of patients seen was relatively low, with approximately two-thirds (64.7%) having seen fewer than five patients (Table 3). Half of all patients seen presented to physiotherapy with long COVID not being their primary concern. Responses indicated around 35% of patients with long COVID self-referred to physiotherapy. The number of sessions a patient with long COVID had was between one and ten (Table 3). Within these sessions a range of assessment, outcome measures, and management strategies were used (Tables 4 and 5). Eighteen per cent of physiotherapists reported using no tools to assess long COVID, possibly due to long COVID being secondary to the patient's clinical presentation.

Figure 2

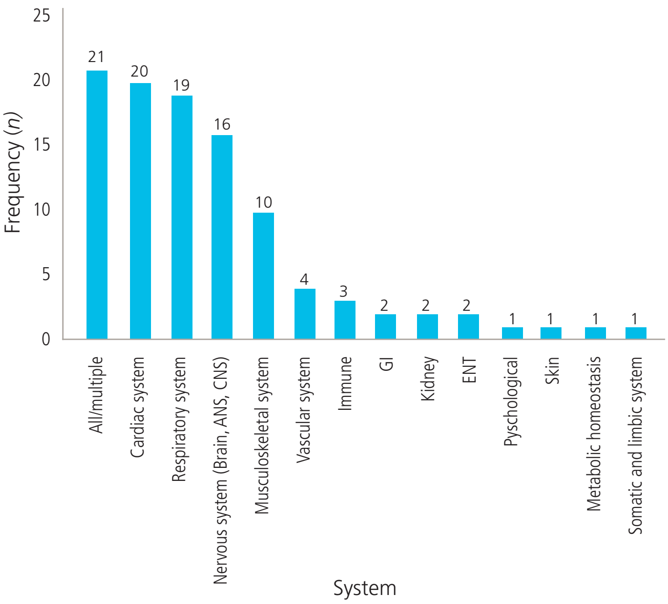
Recognised Symptoms of Long COVID



Note. BPD = breathing pattern disorder; GI = gastrointestinal; HR = heart rate; PEM = post-exertional malaise; SOB = shortness of breath.

Figure 3

Recognised Systems Involved in Long COVID



Note. ANS = autonomic nervous system; CNS = central nervous system; ENT = ear, nose and throat; GI = gastrointestinal.

Table 2

Quotes From Content Analysis on Perceived Secondary Effects of Long COVID by Physiotherapists

Theme	Example quote
Effects on mental health	"People's experience of acute infection can impact on their mental wellbeing, new anxiety or depression symptoms can be experienced as well as reoccurrence of previous health issues." "Can be the final straw for someone with mental health issues."
Impact on lives and function	"This condition handbrakes everything." "Can effect taha whānau and taha hinengaro when you are fatigued and not able to participate in activities with other people." "Significant disruption and ability to function in life."
Thoughts and perceptions	"Fear of not making a full recovery." "Often people who have mild symptoms and don't understand why they don't come right." "The psychological role in any health issue is well documented. People with a more 'positive' outlook on their situation usually do better/recover faster."
Shame and stigma of long COVID	"People don't understand. When I talk to people about my story, they visibly take two steps back from me." "Anxieties around stigma of condition."

Table 3

Current Exposure Statistics of Long COVID by New Zealand Primary Care Physiotherapists

Variable	Frequency	
	n	%
Have you seen patients with long COVID (*n* = 41)		
Yes	24	56.1
No	17	41.5
Patients with or suspected of having long COVID (*n* = 17)		
< 5	11	64.7
5–10	3	17.6
11–20	2	11.8
Patients referred from other services (*n* = 17)		
All	3	17.6
0	10	58.8
5	2	5.9
10	7	17.6
Referral source (*n* = 17)		
Self-referral	6	35.3
GP	2	11.8
Other physiotherapists	2	11.8
Emergency department	1	5.9
Respiratory specialist	1	5.9
Sports coach	1	5.9
In hospital	1	5.9
Average number of sessions for long COVID symptoms (*n* = 17)		
Not applicable	10	23.5
1–5	3	17.6
5–10	3	17.6
With other conditions	1	5.9
Symptoms respondents considered to be beyond scope of normal practice (*n* = 17)		
Cardiac symptoms	4	23.5
Neurological (headaches, brain fog)	3	17.6
Psychological aspect	2	11.8
Respiratory issues	1	5.9
Financial issues	1	5.9
Workplace management	1	5.9
Taste recognition	1	5.9
Monitoring excessive heart rate	1	5.9
Cold/’flu symptoms	1	5.9
Complex family dynamics	1	5.9
None	1	5.9
All	1	5.9

Table 4

*Current Assessment and Outcome Measure Tools Used by Physiotherapists for Patients With Long COVID (*N = 17*)*

Variable	Frequency	
	n	%
Assessment tools (*n* = 17)		
Timed sit-to-stand (1 min or 30 s)	3	17.6
Subjective history	3	17.6
None	3	17.6
SPO_2/pulse oximetry	2	11.8
Heart rate/blood pressure	2	11.8
Nijmegen Questionnaire	2	11.8
6 min walk test	1	5.9
Dyspnoea scale	1	5.9
Fatigue severity scale	1	5.9
Rate of perceived exertion	1	5.9
Self-evaluation of Breathing Questionnaire	1	5.9
DePaul Symptom Questionnaire–Post-exertional malaise	1	5.9
Depression, anxiety, and stress scale–21 items (DASS21)	1	5.9
Pain scores	1	5.9
Leister Cough Questionnaire	1	5.9
Hi-Lo breathing assessment	1	5.9
Functional medicine Medical Symptoms/Toxicity Questionnaire	1	5.9
Buffalo Concussion Treadmill Test	1	5.9
Patient Specific Functional Scale	1	5.9
Spirometry	1	5.9
Post-COVID-19 Functional Status Scale	1	5.9
COVID-19 Yorkshire Rehabilitation Scale	1	5.9
Observation	1	5.9
Outcome measurement tools (*n* = 17)		
Return to normal function (sport/work/activities of daily living/physical activity)	12	29.4
Goals	3	17.6
Nothing	3	17.6
Questionnaires	2	11.8
Patient Specific Functional Scale	2	11.8
Heart rate	2	11.8
Decrease amount of rest	1	5.9
Buffalo Concussion Treadmill Test	1	5.9
General symptom score	1	5.9
Timed up and go	1	5.9
6 min walk test	1	5.9
Rating of exertion/fatigue	1	5.9
Exercise tolerance outcome measure	1	5.9

Note. SPO_2 = peripheral capillary oxygen saturation.

Table 5

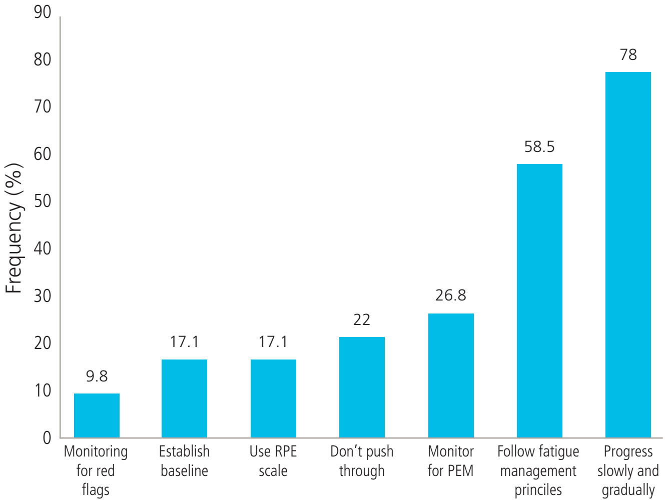
*Current Management Strategies Used by Physiotherapists in Long COVID Treatment (*N *= 17)*

Variable	Frequency	
	n	%
Fatigue management		
Pacing	12	29.4
Education	12	29.4
Rest	3	17.6
Fatigue management	2	11.8
Energy envelope	1	5.9
Modify activity	1	5.9
Return to exercise		
Graded return	2	11.8
Active recovery	2	11.0
Training load management	1	5.9
Postural orthostatic tachycardia syndrome		
Postural orthostatic tachycardia syndrome management	1	5.9
Respiratory management		
Breathing pattern retraining	3	17.6
Cough suppression	1	5.9
Breathing control	1	5.9
Active cycle of breathing technique	1	5.9
Pulmonary rehabilitation	1	5.9
Breathing positioning	1	5.9
Breathing exercises	1	5.9
Self-management		
Apps	1	5.9
Relaxation/mediate	1	5.9
Sleep hygiene	1	5.9
Musculoskeletal management		
Kinesio-tape	1	5.9
Acupuncture	1	5.9
Soft tissue work	1	5.9
Other		
Referral	3	17.6
Listen and validate	2	11.8
Nothing	2	11.8
Encourage acceptance	1	5.9
Email contact throughout the week	1	5.9

Seventy-one per cent of respondents recognised the risk of fatigue and post-exertional malaise in patients with long COVID returning early to activity and impacting long COVID recovery, and there was a range of advice given (Figure 4). An improvement in symptoms after using strategies to manage breathlessness and exercise capacity was reported by 55% of respondents, with 27% reporting improvements in cough and fatigue levels. Just under a quarter (23.5%) of respondents who had seen patients with long COVID referred onwards for cardiac symptoms such as chest pain, erratic heart rate, or for further investigations, such as an echocardiogram (Table 3).

Figure 4

Recommendations for Long COVID Patients by Physiotherapists on Return to Physical Activity

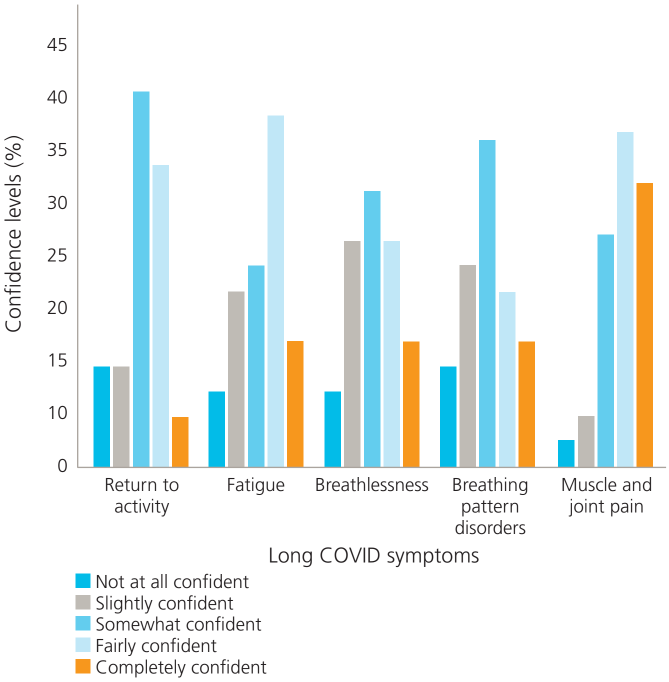


Note. PEM = post-exertional malaise; RPE = rate of perceived exertion.

Overall, respondents reported "least confident" about managing return to activity with only 5% reporting feeling "completely confident". Confidence was also low in managing breathing pattern disorders, with 13.5% reporting being "completely confident". A much higher proportion of respondents (30.6%) reported being "completely confident" in managing muscle and joint pain (Figure 5).

Figure 5

Physiotherapists' Confidence in Managing Different Long COVID Symptoms



Barriers identified to managing patients with long COVID were lack of funding, cost of physiotherapy services, alternative treatments sought, lack of resources, and lack of understanding of the role of physiotherapy within long COVID management.

Long COVID resources

There appears to be limited support provided on managing long COVID in physiotherapy workplaces. Approximately a quarter (27%) of respondents' workplaces provided some information for the management of long COVID, with 19% of respondents educating work colleagues about long COVID themselves. Physiotherapy education provided mainly comprised of discussions, handouts, and presentations.

The websites that respondents found most useful for long COVID information were the New Zealand Ministry of Health (Ministry of Health, 2022b), World Physiotherapy (World Physiotherapy, 2022), and World Health Organization (World Health Organization, 2022b). When prompted, respondents indicated the long COVID webinar by the Goodfellow Unit (Goodfellow Unit, 2022) and peoples' lived experiences were of great added benefit.

Respondents suggested a single website with all the information in one place, and options to select specific treatments and provide management plan resources to patients, would be useful. Booklets, interactive webinars, and short online videos with printable resources were also requested. Respondents indicated a desire for resources in different languages that could be given to patients with explanations of long COVID, as well as guidelines of physiotherapy interventions, and a list of health professionals who could help manage long COVID.

DISCUSSION

Physiotherapy awareness and uncertainty

Survey respondents had a high level of awareness of long COVID being a multisystem condition and good knowledge of common long COVID symptoms. This awareness is underlined by most respondents being confident in identifying patients with long COVID. There was a higher level of confidence in managing muscle and joint pain than other symptoms. Over half (57%; 3,421) of all registered physiotherapists in New Zealand work in private practice in primary care and the majority work in the musculoskeletal area (Physiotherapy Board of New Zealand, 2022). This is reflected by our survey respondents with 61% reporting musculoskeletal as their area of clinical practice. The level of confidence among physiotherapists within New Zealand compares favourably to a study of Austrian physiotherapists and physiotherapy students, where only 11% felt sufficiently informed about long COVID rehabilitation (Scheiber et al., 2021). However, respondents in our study reported less confidence around managing respiratory symptoms, which commonly present in long COVID; this may reflect the small number of respiratory physiotherapists working in primary care in New Zealand.

With initial classifications of long COVID being anywhere from 4–12 weeks (National Institute for Health and Care Excellence, 2020), the resulting variation in timelines has created uncertainty in providing a diagnosis of long COVID. This was reflected by some respondents reporting low levels of confidence in identifying long COVID, which mirrors the experiences of primary health care physicians overseas (Kingstone et al., 2020).

This uncertainty around diagnosis may also contribute to those living with long COVID feeling a lack of validation. Internationally, patients living with long COVID noted health professionals' lack of knowledge of their condition and felt it necessary to convince some health professionals that their symptoms were real rather than imagined (Au et al., 2022). Approximately a quarter (27%) of the survey respondents were not aware that those who had never returned a positive COVID-19 test could develop long COVID symptoms (Ziauddeen et al., 2022) and have a long COVID diagnosis. It is possible that those living with long COVID in New Zealand could have similar experiences to those living with long COVID overseas. These "long haulers" have described the hard work needed to prove their symptoms were real, in the face of standard medical tests returning normal results (Baz et al., 2022; Kingstone et al., 2020). Those without a positive COVID-19 polymerase chain reaction (PCR) test, antigen test, or antibody test, and therefore no formal COVID-19 diagnosis, have also struggled with accessing employment or income benefits overseas (Brown & Kelly, 2021). Additionally, in some cases, long COVID has forced these people to leave the workforce due to persistent symptoms impacting their ability to do their job. With primary care physiotherapists in New Zealand reporting good awareness of the wide range of symptoms of long COVID, it is hoped that those living with long COVID, who present to a physiotherapist in primary care, will receive the validation and support they deserve.

Primary care physiotherapists in New Zealand appeared to be aware of the secondary effects long COVID can have on daily lives. Among respondents, there was good awareness of the potential impact of living with long COVID, which has been highlighted elsewhere (Cabrera Martimbianco et al., 2021; Orrù et al., 2021). In a study of 507 individuals living in Italy during the COVID-19 pandemic, those who were at least 3 months post-COVID-19 infection had a lower self-reported quality of life ($M = 60.85$) than those who have never been infected ($M = 75.54$) using the EuroQol-5D Quality of life instrument (Orrù et al., 2021).

Social isolation, modified lifestyle, decreased activity, and financial and social burdens were all highlighted as factors that can contribute to psychological symptoms in our survey. This mirrors the psychological impact for those with long COVID overseas (Cabrera Martimbianco et al., 2021). Awareness of the psychological effects of the condition may mean primary care physiotherapists in New Zealand are more likely to offer a holistic approach to management of their patients with long COVID.

Although awareness was high regarding the psychological burden patients with long COVID might face, one respondent suggested a more positive outlook can aid in recovery, as indicated in Table 2. This "mind body" link has been shown to have a positive effect in reducing distress and helping cope within the myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS) population (Edwards et al., 2007), who experience similar symptoms to long COVID. However a note of caution is required when communicating strategies such as this to patients, as many patients living with long COVID have had their symptoms dismissed or labelled as "anxiety" (Miyake & Martin, 2021) and such advice could be misconstrued and harmful.

Assessment and management

There was a lack of consistency in assessment and management tools used with those patients with long COVID who presented to physiotherapists in primary care. There are few validated outcome measures available for long COVID. However, recommendations have been made by the Center for Disease Prevention and Control and American Physical Therapy Association (American Physical Therapy Association, 2021; Martin, 2021) based on tools validated in either a population with long COVID or, more commonly, in other populations whom experience symptoms that are also associated with long COVID. These assessment tools include the Post-Covid-19 Functional Status Scale and EuroQol-5D for assessment of quality of life, and the 1 min sit-to-stand test and 6 min walk test for assessment of exercise capacity. Of all the assessment tools respondents reported using (Table 4), only seven linked to the 37 options suggested by the Center for Disease Prevention and Control and American Physical Therapy Association (American Physical Therapy Association, 2021; Dean & Olsén, 2022; Décary et al., 2021; Martin, 2021; Webber et al., 2021). The tools that did align with the recommendations included the Fatigue Severity Scale, 6 min walk test, and Timed Up and Go test, but a wide range of other assessment measures were also used (Table 4). This mirrors the experience of health professionals overseas, who, faced with the uncertainty surrounding long COVID report a reliance on the application of existing disease frameworks and assessment tools (Ladds et al., 2021). Given the current lack of specific and validated assessment tools for long COVID, coupled with the wide range of presenting symptoms, the lack of consistency of tools being used is unsurprising.

Drawing from other similar conditions to support those with long COVID was a strategy that appeared to be used when giving advice on returning to physical activity. Most of the advice given was around pacing, progressing slowly, and avoidance of over exertion, which mirrors the recommended advice given in the management of people with ME/CFS (Décary et al., 2021). The wide application of advice used for those with ME/CFS when returning to physical activity could be due to the respondents' knowledge around consequences of returning to physical activity too early. Seventy one per cent of respondents identified the prevalence and impact of post-exertional malaise and fatigue in long COVID. Close to 75% of patients with long COVID experience post-exertional malaise after 6 months, with the most common trigger being physical activity or exercise (Décary et al., 2021). With most of the exercise recommendations in current literature for post-acute COVID-19 rather than long COVID, it is reassuring that most respondents recognised the impact of post-exertional malaise and implemented evidence-based treatment for post-exertional malaise from ME/CFS guidelines. Very few respondents were completely confident in managing a return to physical activity for patients with long COVID (Figure 4) and this was highlighted by the wide range of responses given in our survey. The treatment approach for people with long COVID returning to exercise needs to be more consistent and evidence-informed, while still providing individualised advice (Humphreys et al., 2021).

There was good awareness of when symptoms were outside the scope of physiotherapy and referrals were warranted. Further development of clear referral pathways, to ensure access to timely and appropriate treatment for patients with long COVID is needed (Webber et al., 2021). Red flags that require onward referral include hypoxemia or oxygen desaturation detected during exercise, or the presence of chest pain (Chaplin, 2021; Scheiber et al., 2021). Respondents indicated an awareness of referrals for chest pain; however, no respondents had referred patients for hypoxemia or oxygen desaturation in this study. This may have been due to an absence of patients presenting with these symptoms, or it may reflect lack of awareness. The awareness of red flags in long COVID and appropriate onward referrals needs to become well established within the primary care physiotherapy population. An evidence-informed guideline would be beneficial to support physiotherapists in primary care to reliably screen for red flags within the long COVID population.

Role of physiotherapy

In our survey, respondents highlighted the importance of greater public awareness of the impact physiotherapy can have on managing long COVID. However, promotion of the physiotherapy role needs to go further than just public understanding. Other health practitioners' awareness of what physiotherapy can offer also needs to increase. With very few referrals to physiotherapy currently being received from other primary care providers, increasing the awareness of the physiotherapy role in long COVID management among other primary health care professionals is essential. Timely referrals and a multidisciplinary approach are being recommended as best practice for the management of long COVID within primary care (National Institute for Health and Care Excellence, 2020). Physiotherapy in primary care in New Zealand is a vital part of this approach, with our ability to support and manage many of the symptoms that people with long COVID present with. Long COVID management recommendations include daily life modifications and activity pacing underpinned by a holistic approach, which aligns with patient-centred care that is at the heart of physiotherapy (American Physical Therapy Association, 2021; Harenwall et al., 2021; Webber et al., 2021). The improvement in some long COVID symptoms noted by survey respondents suggests that the physiotherapy profession has the skills and capability to support long COVID management. These findings contrast to a study undertaken over a year ago highlighting a clear gap between the confidence and abilities of Austrian physiotherapists' in managing long COVID (Scheiber et al., 2021). Although global awareness of long COVID has developed over time, at the time our survey was distributed, long COVID was only just starting to emerge within New Zealand.

Increasing awareness of the roles of the different health professions within a management team, and what each can offer, is essential to providing the best care for people living with long COVID. Along with increased awareness by the public and other health care professionals, better understanding of the expertise different physiotherapy specialities offer is needed. There was a higher level of confidence in managing muscle and joint pain in those living with long COVID than in managing breathing pattern disorders. This is unsurprising given that most of our survey respondents identified as musculoskeletal physiotherapists. This lack of confidence in managing respiratory symptoms is mirrored in the study of Austrian physiotherapists, who had higher confidence with neuromuscular aspects of long COVID rehabilitation rather than respiratory (Scheiber et al., 2021). This highlights an increased need for specialised respiratory physiotherapists to be employed in primary care to support this aspect of long COVID management. Clear referral pathways between physiotherapists in different specialities could set up a more streamlined approach to patient management, giving those with long COVID the best chance of symptom resolution.

Future direction

Respondents highlighted the value of developing a singular resource, to have current literature and resources related to long COVID assessment and management in one place, such as an online repository. Funding is needed to support training for physiotherapists, and provision of more physiotherapists with respiratory experience, as part of a wider multi-disciplinary team to support the increasing numbers of patients with long COVID. In addition, funding to subsidise long COVID treatment would create more equitable access for all those living with long COVID in New Zealand.

Study limitations

A key limitation of the study was the low response number, which may have been influenced by the method of survey distribution. With only 41 completed responses, it provides a representation from a small cohort of primary care physiotherapists in New Zealand, and the results are therefore not generalisable to the wider physiotherapy profession working in primary care. These respondents may not accurately reflect the breadth of knowledge and clinical skills of those working in primary care, with most respondents based in musculoskeletal clinical practice. There were very few responses from physiotherapists working in the field of respiratory care, for example. Another point to note is that more than half of the survey population had over 20 years of physiotherapy experience and nearly a third reported having a post graduate qualification or higher. The results of the survey may therefore be skewed to those who are more informed and therefore may not accurately represent the knowledge and awareness of long COVID among all physiotherapists working in primary care.

CONCLUSION

This study describes the current awareness, knowledge, and management of long COVID by a small cohort of primary care physiotherapists in New Zealand. The findings indicate good awareness of long COVID and suggest some physiotherapists are drawing parallels to other conditions, such as ME/CFS. New Zealand physiotherapists faced similar challenges to overseas primary health care professionals with uncertainty in the diagnosis of long COVID and lack of validated tools, creating a lack of consistency in assessment and management of patients seen to date. Respondents identified one barrier within long COVID management as a lack of recognition of the potential role of physiotherapy in long COVID management by both the public and other health professionals. Findings indicated the growing importance of having access to key long COVID information and resources to support the physiotherapy workforce. Funding to increase the physiotherapy workforce in primary care has the potential to reduce the impact of long COVID on existing primary care services, such as GP practices, which are already overstretched (Royal New Zealand College of General Practitioners, 2023).

KEY POINTS

1. Primary care-based physiotherapists in New Zealand have good knowledge of the range of symptoms, systems, and secondary effects of long COVID.
2. Uncertainty around long COVID diagnosis continues to exist.
3. A lack of consistency exists in tools used in assessment and management of long COVID.
4. The role of primary care-based physiotherapists in long COVID management has not been fully recognised by the public or other health professionals.

DISCLOSURES

No funding was obtained for the completion of this study. There are no conflicts of interest that may be perceived to interfere or bias this study.

PERMISSIONS

Ethics approval was granted by University of Otago Ethics Committee (reference number D22/125).

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CONTRIBUTIONS OF AUTHORS

Conceptualisation and methodology – SR; Formal analysis and investigation – EW; Writing – original draft preparation – EW; Writing – review and editing – SR; Supervision – SR.

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Appendix A

Table A1

All Recognised Long COVID Symptoms by Physiotherapists (N = *41)*

Variable	Frequency	
	n	%
Systemic		
Fatigue	40	97.6
Weakness	8	19.5
Malaise	6	14.6
Pain	4	9.8
Sleep difficulties	3	7.3
Altered immune response	2	4.9
Post exertional malaise	2	4.9
Inflammation	1	2.4
Neuropsychiatric		
Brain fog	20	48.8
Headache	12	29.3
Cognitive decline + decreased memory + confusion	11	26.8
Anxiety	5	12.2
Reduced concentration	5	12.2
Depression	4	9.8
Low mood	3	7.3
Light/sound sensitivity	1	2.4
Recognised cardiovascular symptoms		
Heart rate changes/chest pain	31	75.6
Exercise intolerance	12	29.3
Dizziness	7	17.1
Fainting	2	4.9
Nausea	2	4.9
Vascular disorders	3	7.3
Dysautonomia	5	12.2
Pulmonary/respiratory		
Short of breath/Breathing pattern dysfunction	34	82.9
Cough	18	43.9
Ear, nose, and throat		
Loss of taste	9	22.0
Loss of smell	7	17.1
Sore throat	2	4.9
Tinnitus	2	4.9
Earache	1	2.4
Sneezing	1	2.4
Swallow/speech	1	2.4
Hearing loss	1	2.4
Musculoskeletal		
Muscle aches	9	22.0
Joint pain	7	17.1
Body aches	7	17.1
Gastrointestinal		
Gastrointestinal issues	11	26.8
Stomach pain	1	2.4
Other		
Cardiovascular symptoms	3	7.3
Vision issues	3	7.3
Lipids	1	2.4
Vestibular	1	2.4
Psychosocial	1	2.4
Vertigo	1	2.4
Opinions of COVID-19	1	2.4
Dermatological		
Skin rash	3	7.3
Endocrine		
Blood sugars	1	2.4

Volunteer-led Community-based Exercise Programme Impact on Health Outcomes in Patients with Chronic Obstructive Pulmonary Disease in New Zealand

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ABSTRACT

Pulmonary rehabilitation improves the health of people with chronic obstructive pulmonary disease (COPD). Community-based maintenance programmes led by health professionals maintain these benefits; however, limited information is available on volunteer-led community programmes. We investigated the impact of a post-rehabilitation volunteer-led programme on the health of people with COPD. Attendees ($n = 19$) and non-attendees ($n = 24$) completed questionnaires to assess anxiety and depression (Hospital Anxiety and Depression Scale), COPD symptoms (COPD Assessment Test), and health-related quality of life (EQ-5D-3L-3L); a sit-to-stand test, and oxygen saturation before and after the programme, and 1–2 years later at follow-up. In addition, both attendees and non-attendees completed a social connectedness questionnaire and participated in a qualitative interview at follow-up. No significant differences ($p > 0.05$) were found at follow-up between attendees and non-attendees. Additionally, attendees' depressive and COPD symptoms and all other health variables had returned to baseline (pre-rehabilitation) levels by follow-up. In contrast, qualitative analysis showed positive themes for attending the programme, with the most common benefit of engaging with others with COPD. Our findings suggest that the impact of COPD on health may be profound even in motivated and engaged people. Further research to develop optimal models for maintenance programmes would support effective practice in the community.

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Key Words: Chronic Obstructive Pulmonary Disease (COPD), Community-based Exercise, Pulmonary Rehabilitation, Volunteer

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a broad term used to categorise emphysema, chronic bronchitis, and chronic asthma (Asthma + Respiratory Foundation New Zealand, 2023; Mannino & Buist, 2007; Telfar Barnard & Zhang, 2021). Approximately 35,000 New Zealanders have severe COPD; however, the disease is often undiagnosed and potentially as many as 200,000 people could have COPD in New Zealand (Asthma + Respiratory Foundation New Zealand, 2023). The principal symptom of COPD is dyspnoea, which can lead to decreased activity levels and therefore diminished cardiovascular and muscular fitness (Asthma + Respiratory Foundation New Zealand, 2023). Consequently, pulmonary rehabilitation courses are often run to improve the overall health status, and cardiorespiratory and muscular fitness in people with COPD (Busby et al., 2014).

Pulmonary rehabilitation is a multi-disciplinary intervention or programme designed to improve the health of those affected by COPD. People typically participate in a 6–12-week exercise and education intervention to enhance their physical, mental, and social health (Grade A evidence) (Bolton et al., 2013). It is recommended that pulmonary rehabilitation programme sessions should be run at least twice weekly, with participants gaining the most benefit by attending 12 or more supervised sessions (Bolton et al., 2013). These interventions have been found to improve overall health status and physical endurance, decrease the number of exacerbations, decrease hospital admissions, and reduce the financial burden of COPD (Busby et al., 2014; Kjærgaard et al., 2020).

A recent study conducted in Denmark (Løkke et al., 2021) determined that the direct health cost of people living with COPD (€28,969) was almost three times higher than that in the control non-COPD reference group (€10,693) in the 12-month follow-up period during which the costs were calculated. The direct cost included the cost of treatment and care of those with COPD. The indirect cost, which was referred to as the foregone earnings for the people living with COPD, was assessed to be €6,773 in the 12-month period. The costs related to COPD were found to increase with increasing disease severity. Similarly, substantial costs associated with COPD have been reported in New Zealand. A strategic overview of respiratory disease in New Zealand (National Health Committee of New Zealand, 2013) reported the direct cost of the care of people living with COPD to be between $102 to $192 million per annum, with an estimated cost of $2,566 per person per year. Overall, COPD contributed to $54 million in hospital admission costs, which were 20.3% of the total respiratory hospitalisation costs for the year.

Despite the success of pulmonary rehabilitation, benefits decrease after the intervention and most people return to baseline health status 6–24 months post rehabilitation (Bestall et al., 2003; Bratås et al., 2012). These benefits, however, can be sustained through maintenance programmes that have been shown to increase physical endurance and reduce hospital admissions compared to no intervention or usual care (Busby et al., 2014; Jenkins et al., 2018; Güell et al., 2017).

Research on community-based maintenance programmes for those with COPD is minimal. However, studies in the area have found physical and mental health benefits of these exercise interventions (Güell et al., 2017; Ries et al., 2003; van Wetering et al., 2010). A one-year community-based programme for people with COPD that was supervised by trained fitness consultants who had received exercise training from a physiotherapist significantly increased strength and endurance at 6 and 12 months relative to an earlier 6–12-week pulmonary rehabilitation programme. The community-based programme also maintained the improvements in quality of health measures achieved in the post-pulmonary rehabilitation programme measured using the Chronic Respiratory Disease Questionnaire (Beauchamp et al., 2013). Furthermore, a 2-year randomised controlled trial to determine the efficacy of a community-based COPD programme (van Wetering et al., 2010) found that participants in a physiotherapist-led intervention had a significantly better health-related quality of life (HRQOL), increased functional exercise capacity, and less breathlessness compared to the usual care control group. A recent study also found significant benefits for physical function (6 min walking distance), HRQOL, and dyspnoea after 4 years of an ongoing supervised self-help maintenance programme in a community setting: individuals participated in exercise training (approximately 42 sessions/year), health education classes (6 hr per year), and psychological support (approximately 2.5 sessions per year) (Blervaque et al., 2021). Nevertheless, a Cochrane review suggested that the strength of evidence is limited to professional-led community-based programmes (Malaguti et al., 2021). While ongoing interventions supervised by healthcare professionals have been shown to be effective (van Wetering et al., 2010), resourcing to provide professionally-led support programmes may not be available (Beauchamp et al., 2013). Consequently, the efficacy of volunteer-led programmes compared to those led by healthcare professionals has been investigated.

Although research has not been conducted in people with COPD, similar improvements in physical function have been found during a weekly exercise programme conducted over a year for community-dwelling older adults in peer-led versus health professional-led programmes in New Zealand (Waters et al., 2011). A community-embedded, peer-led dual task exercise programme was also found to improve physical function and frailty status and reduce the number of falls and social isolation after 3 months (Merchant et al., 2021). Additionally, recent systematic reviews (Lim et al., 2021; Moore et al., 2021) and a meta-analysis (Moore et al., 2021) found that peer-led interventions improved both functional status (the ability to conduct activities of daily living and maintain independence) and physical function (this can be a range of measures including physical endurance, balance, strength, and flexibility) of older adults with a variety of health conditions. Peer-led exercise interventions for community-dwelling older adults have also found improvements in HRQOL (Izutsu et al., 2017; Lim et al., 2021) and perceived health (Merchant et al., 2021).

Additionally, from a patient perspective, qualitative studies indicate that a minimally supervised community programme increases feelings of accomplishment, achievement, and self-motivation, and is effective if interventions are well organised, structured, and specific to a patient's needs and disease (Desveaux et al., 2014a; Desveaux et al., 2014b). The need for programme specificity and belonging are common themes identified in these research studies, with patients expressing the importance of being with people of similar functional abilities, experiences, and conditions in the exercise programmes (Desveaux et al., 2014a; Desveaux et al., 2014b; Sinnerton & Gillen, 2009).

In New Zealand, pulmonary rehabilitation typically consists of 6–10-week interventions of twice-weekly exercise and education sessions, with some organisations also offering ongoing community-based exercise groups post-rehabilitation (Levack et al., 2012). In Canterbury, New Zealand, volunteer-led community-based exercise groups are offered to patients following pulmonary rehabilitation. While there has been some research on community-based programmes supervised by healthcare or fitness professionals (Beauchamp et al., 2013; Desveaux, et al., 2014a), to the best of our knowledge, no research has been undertaken on volunteer-led community-based exercise groups for those living with COPD, whereby the volunteers leading the programme have previously completed a pulmonary rehabilitation intervention. Therefore, the aim of this study was to determine the impact of a volunteer-led community-based exercise programme on health outcomes in people with COPD. The secondary aim was to identify reasons or themes for non-attendance and participation in the community-based exercise programme.

METHODS

Study design

This study used a mixed-methods design, with quantitative and qualitative data collected from attendees and non-attendees of the volunteer-led exercise group. People in the study had initially completed an 8-week pulmonary rehabilitation programme, which was integrated within the community in 2010. Following the programme, they chose to participate or not participate in a volunteer-led exercise group. The exercise groups were established shortly after 2010 when a gap in ongoing exercise and support groups in the community was identified. Data were collected one week prior to (pre) and one week following (post) the 8-week rehabilitation programme, and 1–2 years after the rehabilitation programme (follow-up), to determine the effectiveness of a volunteer-led community exercise group in maintaining the physical and mental health of people with COPD at follow-up (primary aim). Participants were also interviewed at the follow-up, contributing qualitative data to provide additional insights into the primary aim. The qualitative data also addressed the secondary aim of the research, to identify the reasons for attendance and non-attendance.

Participants

All participants completed 8 weeks of pulmonary rehabilitation between December 2016 and November 2017. Participants were excluded if they were medically unstable, had a recent (< 4 weeks) acute medical event, or attended a support group led by an instructor (i.e., not a volunteer-led group). In the context of pulmonary rehabilitation, acute medical events include cardiac events and unstable and/or uncontrolled cardiac conditions such as angina or arrhythmias. Participants were recruited at five volunteer-led community-based exercise groups (attendees) or by telephone (non-attendees) using information from medical records. Nineteen people who attended the volunteer-led exercise groups (attendees) consented to participate in the study. People who had completed pulmonary rehabilitation but did not attend community exercise groups (non-attendees, $n = 394$) were contacted and 24 consented to participate in the study. Therefore, in total, 43 people (attendees, $n = 19$; non-attendees, $n = 24$) participated in the study. Ethical approval was obtained from the Institutional Ethics Board at Ara Institute of Canterbury (project number 1833). All participants provided informed consent to participate and allowed the use of their retrospective data, and the study conformed to the Declaration of Helsinki, 1964.

Data collection

Data were primarily collected by a summer scholarship student from Ara Institute of Canterbury (TG), with support from a Canterbury Clinical Network physiotherapist (DC).

Quantitative

Demographic and pre- and post-pulmonary rehabilitation data were accessed retrospectively from the Pegasus Health data storage system. Demographic data included age, gender, and ethnicity. Approximately 1–2 years following the completion of the rehabilitation programme (*M* (*SD*) for attendees = 500 (139) days; non-attendees = 559 (141) days; $p = 0.10$), participants completed the same battery of tests as they did pre- and post-rehabilitation. The tests included three questionnaires relating to health measures: depressive symptoms (Hospital Anxiety and Depression Scale [HADS]; Breeman et al., 2015), impact of COPD symptoms (COPD Assessment Test [CAT]; Grufstedt et al., 2018), and HRQOL ([EQ-5D-3L]; Pickard et al., 2008); a 1 min sit-to-stand test; and resting oxygen saturation (SpO_2) was measured. The HADS, CAT, and EQ-5D-3L questionnaires are valid and reliable measures in COPD populations (Grufstedt et al., 2018; Jones et al., 2009; Mannino & Buist, 2007; Pickard et al., 2008; Yohannes & Alexopoulos, 2014). Physical function was measured using a 1 min sit-to-stand test, which simulates movements used in daily life and correlates well with clinical outcomes in patients with COPD (Crook et al., 2017; Morita et al., 2018; Spence et al., 2023).

At follow-up (1–2 years following pulmonary rehabilitation), an additional social connectedness questionnaire, based on the social connectedness domain of the 2016 Social Report (Ministry of Social Development, 2016), was administered. The questionnaire included eight questions related to access to information and support that were relevant to the COPD population in New Zealand. Five indicators were used to measure social connectedness: telephone and internet access, contact with family and friends, trust in others, loneliness, and voluntary work. An additional question relating to living situation was included in the questionnaire. The questions included both Likert scale and binary answers (yes/no) (see Appendix A).

Qualitative

A brief semi-structured, individual, interview (15–20 min) was conducted with all participants at follow-up. The aim of the interview was to establish themes for attendance and non-attendance at the volunteer-led community-groups. Interviews were conducted at the community venue (attendees) or at the participant's home (non-attendees) and were audio-recorded and transcribed verbatim for data analysis purposes. The interview questions for both groups can be found in Table 1.

Intervention

The volunteer-led community exercise groups involved in the current research were modelled on the original Christchurch Respiratory Relief Society support groups, which were physiotherapist-run exercise classes established in 1989 by a respiratory physiotherapist from Christchurch Hospital (Te Whatu Ora – Waitaha Canterbury). Participants met once a week on an ongoing basis to perform exercise at one of the five community groups. The group exercise sessions were 30–45 min long and consisted of low-impact aerobic exercises (such as "sit-to-stand"). Participants were encouraged to work between levels 3 and 5 on the modified Borg rating of perceived exertion, that is, from "moderate" to "severe" in terms of fatigue and breathlessness. The volunteer leaders selected from a variety of available equipment, such as stress balls, exercise bands, weights, and scarves, to make the exercise routine challenging and interesting for the attendees. The volunteers were encouraged and supported to attend a community exercise leader foundation course run by the Active Canterbury Network.

Table 1

Interview Questions

Group	Questions
Attendees	Can you outline the reasons why you took up the opportunity to attend a community respiratory support group? What are the benefits of attending the support group? Is there anything else you do (outside of the support group) to support your respiratory health? Is there anything about the support group that you would like to see changed/added/removed that you believe would further support your health?
Non-attendees	Can you outline the reasons why you did not take up the opportunity to attend a community respiratory support group? What activities do you currently take part in to support your respiratory health? Is there any alternative support that you would like to see provided by the community to benefit your respiratory health?

Following the exercise, participants connected through shared kai and kōrero. The groups were led by volunteers who also had a chronic respiratory illness and had previously completed the pulmonary rehabilitation programme or had been a support person to a participant in the class. They were mostly recruited due to having personally experienced positive changes following pulmonary rehabilitation. The volunteer-led group was designed to be an independent and self-sustaining way of assisting people living with chronic respiratory conditions in the community. The support groups often invited guest speakers, such as people from Work and Income New Zealand, Citizens Advice Bureau, and Energy Action groups, to connect those attending with their community and to keep attendees up to date with information on health and disability support services and local politics.

Analyses

Quantitative data

All quantitative data were entered in an Excel spreadsheet and analysed using SPSS Statistics (version 25.0). The Mann-Whitney U test was used to determine the difference in outcome measures between attendees and non-attendees of the volunteer-led community-groups. The Wilcoxon signed rank test was used to determine changes in outcome measures at pre- and post-pulmonary rehabilitation and the follow-up within each group (attendees and non-attendees). T-tests and chi-squared tests were used to determine any significant differences between the attendees and non-attendees for demographics and social connectedness. The significance level was set at 0.05.

Qualitative data

Interview audio recordings were transcribed verbatim into a Word document by the summer scholarship student. All transcriptions were anonymised, and then verified by another member of the research team for accuracy. After transcription, a thematic analysis was undertaken to identify main themes and important points with an inductive approach. Following in-depth discussions, a coding system was developed from the transcripts by identifying recurring themes that were considered particularly meaningful relative to the aim of identifying reasons or themes for non-attendance and participation in the community-based exercise programme.

RESULTS

Quantitative measures

Participant characteristics

There were no significant differences ($p \geq 0.05$) between attendees and non-attendees in mean (*SD*) age (attendees = 73.4 (7.4) years; non-attendees = 71.8 (6.5) years). Participants were mostly female (attendees = 74%; non-attendees = 63%) and of European ethnicity (attendees = 84%; non-attendees = 92%), respectively; $p \geq 0.05$ for both). Additionally, the duration between the completion of pulmonary rehabilitation and the follow-up was similar (*M (SD):* attendees = 500 (139) days; non-attendees = 559 (141 days)).

Pulmonary rehabilitation

There were no statistically significant differences between the attendees and non-attendees in pre-pulmonary ($p = 0.28$ to 0.68) and post-pulmonary ($p = 0.10$ to 0.96) rehabilitation measures for SpO_2, CAT, HADS, EQ-5D-3L, and sit-to-stand (Table 2). However, at post-pulmonary rehabilitation, a trend suggested that the attendees' CAT score was lower than that of the non-attendees (*M (SD)*: attendees = 16.7 (5.3); non-attendees = 20.1 (6); $p = 0.06$), indicating a greater improvement in this measure and potentially less impairment (Table 2). Within the groups, there were significant improvements in health measures following pulmonary rehabilitation. The attendee group had significantly reduced impacts of COPD symptoms and depression (improved CAT and HADS-Depression scores; $p = 0.03$), and improvements in physical function (sit-to-stand) ($p = 0.08$) and HRQOL (EQ-5D-3L) ($p = 0.09$) approached statistical significance from pre- to post-rehabilitation. In contrast, the only statistically significant change in the non-attendee group was an improvement in physical function (sit-to-stand, $p = 0.01$) (Table 2).

Follow-up

Anxiety, depression, COPD symptoms, and overall health status

There were no statistically significant differences in primary outcome measures ($p = 0.11$ to 0.82) at follow-up between attendees and non-attendees for SpO_2, CAT, HADS, EQ-5D-3L, and sit-to-stand (Table 2). The attendee group showed a statistically significant increase of 42% for depression (*p* = 0.04) and 31% for COPD CAT scores (*p* = 0.006) at follow-up, relative to post-pulmonary rehabilitation measurements (Table 2), returning to pre-rehabilitation values. Changes in other primary outcome measures such as SpO_2, HRQOL (EQ-5D-3L), and sit-to-stand were not significantly different (*p* = 0.24 to 0.81) in the follow-up relative to post-rehabilitation data in the attendee group. No significant differences (*p* = 0.17 to 0.98) were found in the non-attendee group at follow-up compared to post-rehabilitation (Table 2). In both groups, minimal differences for all quantitative primary outcome measures were found at follow-up compared to pre-pulmonary rehabilitation (*p* = 0.27 to 0.98).

Social connectedness

At follow-up, attendees were more trusting of other people (attendees = 7.4; non-attendees = 6.3; *p* = 0.02) and tended to be more likely to do volunteer work (attendees = 37%; non-attendees = 13%; *p* = 0.08). In contrast, a larger proportion of non-attending participants had internet access at home (attendees = 63%; non-attendees = 88%; *p* = 0.08). There were minimal differences between the groups for other social connectedness measures including living situation of living alone (attendees = 29%; non-attendees = 56%) or with a partner (attendees = 44%; non-attendees = 53%); phone access (100%); loneliness, with the majority reporting "none of the time" or "a little of the time"; and amount of contact with family and friends (the majority reported "about right"; attendees = 88%; non-attendees = 84%); *p* = 0.22 to 1.0).

Qualitative themes at follow-up

Attending group

We identified four key themes from the data (Table 3). The major themes identified by attendees were the psychological and physical benefits of attending the exercise groups. A common factor was that socialising with others who have the same condition was motivating and psychologically beneficial, for example: "Just understanding you're not alone and support and friendships just been absolutely amazing because a lot of family and friends don't understand how difficult it is to live with breathing problems on an everyday basis" (SU). The community exercise groups gave people a safe space to share information and talk about problems, while feeling comfortable coughing or taking it slow during exercise without being judged. Other reasons for participation were to maintain the health benefits gained through pulmonary rehabilitation, and classes motivated them to try harder in exercises and be more active at home. With regards to changes to the support group, many attendees indicated they were happy with the current volunteer-led groups. Participants also provided suggestions for change,

Table 2

Comparison of Pre- and Post-pulmonary Rehabilitation and Follow-up Outcome Measures for Attendees (N = *19) and Non-attendees* (N = *19) of a Volunteer-led Exercise Group*

Variable	Pre-pulmonary rehabilitation		Post-pulmonary rehabilitation		1–2 year follow-up	
	Attendees	Non-attendees	Attendees	Non-attendees	Attendees	Non-attendees
Sit-to-stand test						
M (*SD*)	19.7 (4.0)	17.7 (5.8)	21.8 (5.9)	21.9 (5.0) * [a]	19.6 (5.9)	18.0 (7.3)
Mdn [IQR]	19.5 [17.2, 23.0]	18.5 [14.8, 21.0]	21.5 [16.8, 24.5]	22.0 [19.0, 24.0]	19.0 [16.0, 22.0]	18.0 [14.2, 23.0]
SpO_2						
M (*SD*)	95.9 (2.1)	96.2 (1.8)	95.8 (2.3)	96.7 (2.2)	95.5 (2.0)	95.7 (2.3)
Mdn [IQR]	96.0 [94.5, 98.0]	96.0 [95.0, 97.2]	96.0 [94.0, 97.0]	97.5 [95.8, 98.0]	95.0 [94.0, 97.0]	96.5 [94.8, 97.0]
CAT score						
M (*SD*)	19.2 (6.4)	21.6 (6.4)	16.7 (5.3) * [a]	20.1 (6.0)	21.8 (5.7) ** [b]	21.0 (7.7)
Mdn [IQR]	19.0 [15.0, 24.0]	21.0 [17.2, 27.8]	16.5 [14.2, 20.0]	21.0 [17.2, 24.8]	23.0 [17.5, 26.0]	22.0 [16.0, 25.2]
HADS–Anxiety						
M (*SD*)	6.0 (3.2)	7.2 (4.4)	5.8 (2.6)	6.8 (4.5)	5.6 (2.5)	6.3 (4.2)
Mdn [IQR]	6.0 [4.2, 7.8]	7.0 [3.5, 9.5]	6.0 [4.0, 7.5]	6.0 [5.0, 9.0]	6.0 [4.0, 7.0]	6.5 [2.8, 8.0]
HADS–Depression						
M (*SD*)	4.2 (2.3)	4.8 (2.8)	3.1 (2.0) * [a]	4.2 (2.9)	4.4 (2.0) ** [b]	4.8 (3.5)
Mdn [IQR]	4.0 [2.2, 5.0]	4.0 [3.0, 7.5]	3.0 [1.5, 4.0]	4.0 [1.5, 7.0]	5.0 [2.5, 6.0]	5.0 [2.5, 6.2]
EQ-5D-3L						
M (*SD*)	6.6 (1.6)	6.0 (1.7)	7.4 (1.2)	6.5 (1.6)	6.9 (1.7)	6.2 (1.7)
Mdn [IQR]	6.8 [5.5, 8.0]	6.0 [4.8, 7.1]	7.0 [6.6, 8.0]	7.0 [5.0, 7.0]	7.0 [6.1, 8.0]	6.2 [5.0, 7.5]

Note. Computing exact *p* values was not possible in Wilcoxon Signed Rank Test due to ties. CAT = chronic pulmonary disease assessment test; EQ-5D-3L = European quality of life 5 dimensions 3 level version (standardised measure of health status); HADS = hospital anxiety and depression scale; O_2 = oxygen.

[a] significant change within group pre- versus post-pulmonary rehabilitation. [b] significant change within group post rehabilitation versus follow-up.

**p* < 0.05. ***p* < 0.01.

Table 3

Interview Themes and Subthemes

Theme	Subtheme
Attendees	
Perceived benefits of attending programme	Physical benefits Psychological benefits Motivation
Recommended improvements to programme	Health professional visits Better spaces
Non-attendees	
Reasons for not attending programme	Personal barriers Accessibility/transport
Activities to stay active	Active at present No energy for more activity

including periodic visits from pulmonary physiotherapists and larger spaces to host the bigger groups. Participant SU indicated that:

> The only thing I, that I've noticed is that on the days that we've been fortunate enough to have one of the tutors from the course such as [staff named] attend that's always more educating for us and very, very helpful so perhaps a little bit more support from the tutors on occasion would be great.

Other participants commented on the suitability of the space: "No there isn't enough space but that's nobody's fault" (PE) and "… we could do with a bigger room …" (JA).

Non-attending group

There was a wide range of reasons for not attending the exercise groups such as illness, lack of time due to work and family commitments, lack of awareness of the groups, or believing that they were not beneficial based on their experience of the pulmonary rehabilitation programme. However, many non-attendees indicated that a main barrier to participation was a lack of transport or transport options, for example: "Well, it's a matter of transport that's the only reason I haven't gone to any … I ended up with I have to get about three buses to get to one place" (AI). In terms of physical activity, approximately two-thirds of non-attending participants (n = 16) actively engaged in activities such as walking, housework, gardening, dancing, bowls, and exercising at home to support their respiratory health. Some participants mentioned that they felt that they were either already physically active enough, or that they had no spare energy for additional activities such as attending these groups. Those who did not participate in physical activity indicated reasons such as working full time, chronic illness, or disability.

DISCUSSION

We investigated the impact of attending or not attending a weekly volunteer-led community exercise programme on the health of people with COPD, 1–2 years after completing pulmonary rehabilitation. The 8-week pulmonary rehabilitation programme was retrospectively found to produce similar health benefits for the people with COPD as observed in previous research (Busby et al., 2014; Jenkins et al., 2018). However, in the follow-up 1–2 years post pulmonary rehabilitation, minimal differences were found for all health measures between participants who had attended and those who had not attended a weekly exercise group. A within-group comparison also found that the attendee group had significant increases in depressive (HADS) and COPD symptoms (CAT) at follow-up relative to post-rehabilitation (1.3 and 5.1, respectively), and these variables along with all other primary outcome measures had returned to pre-rehabilitation or baseline levels. The change in depressive (HADS) and COPD (CAT) scores may be clinically relevant as they were approaching, or were greater than, the minimally clinically significant difference in HADS (≥ 1.5) and CAT (≥ 5.1) scores (Kon et al., 2014; Puhan et al., 2008). The decrease in these measures was unexpected, as the attendee group had responded well to pulmonary rehabilitation, and previous research on fitness and/or health professionals-led community exercise programmes showed that the benefits from pulmonary rehabilitation were maintained above pre-rehabilitation (baseline) for 6 to 24 months (Beauchamp et al., 2013; Ries et al., 2003; van Wetering et al., 2010). Additionally, a systematic review and meta-analysis found that volunteer-led programmes may improve physical function, although participants had a range of chronic conditions and the certainty of evidence was low (Moore et al., 2021). It is possible that the volunteer-led programme did not have a sufficient training load to increase or maintain physical endurance and alleviate symptoms such as dyspnoea, anxiety, and depression, as participants typically only attended the group once per week, whereas the pulmonary rehabilitation intervention had exercise sessions twice a week, in line with the British Thoracic Society guidelines (Bolton et al., 2013). Moreover, all participants in the current study had high CAT and HADS scores, indicating greater impairment, compared to normative data (Breeman et al., 2015; Pinto et al., 2014). For example, the normative mean (*SD*) of the CAT score across all age groups was 6 (5.1) and a score of ≥ 10 is considered high. Our participants' scores were > 16 at all time points: pre-rehabilitation, post-rehabilitation, and at follow-up. This means that our sample experienced higher than average COPD symptoms, which may have influenced the results. Another limitation is that we used convenience sampling to recruit participants from the community exercise groups and medical records. This may have produced a biased sample in our groups and affected the validity of our findings. For example, when recruiting non-attendees, the researchers attempted to contact 394 people, of whom 24 or approximately 6% volunteered to participate; the most common reason for not participating was illness. The low response rate may have resulted in the non-attendee group being disproportionately healthy and not representative of non-attendees in general. This hypothesis is supported by the findings showing that two-thirds of the non-attendees indicated that they regularly participated in exercise. Irrespective of the non-attendee sample potentially not representing the population, our within-group findings for attendees indicated that participation in a weekly volunteer-led exercise group did not maintain the health benefits achieved in pulmonary rehabilitation.

In contrast to the quantitative data, qualitative data at the follow-up showed positive outcomes from attending the volunteer-led groups. The most common finding was the benefits of attending a group with others experiencing the same health condition. Attendance enabled participants to socialise, share information, talk about problems, feel comfortable coughing, and take it slow in exercises without embarrassment. A similar emphasis on socialisation was previously found to be reported by those who completed pulmonary rehabilitation, alongside the opportunity to share knowledge and support one another (Halding et al., 2010). Participation also motivated attendees to do better or try harder in the group exercises, be more active at home, and try to maintain health benefits from pulmonary rehabilitation. This is consistent with previous research, where participants voiced the importance of being with others of similar functional abilities, maintaining health benefits from rehabilitation, and peer-support provided motivation and encouragement to work through it together (Desveaux et al., 2014a; Desveaux et al., 2014b). Attendees also stated they would like pulmonary rehabilitation physiotherapists to visit them at the volunteer-led group sessions.

In the non-attendee group, the greatest barriers to participating in the exercise groups were illness, lack of time due to work and family commitments, transport difficulties, lack of awareness of the groups or the perception that they are not beneficial based on experience of the pulmonary rehabilitation programme, which are similar to barriers identified in previous research (Cox et al., 2017; Desveaux et al, 2014a; Desveaux et al., 2014b; Levack et al. 2018). Moreover, Candy et al. (2020) showed that increasing age, higher 6 min walk test distance at programme commencement, and European ethnicity were significant predictors of completion of the pulmonary rehabilitation programme. However, the authors found no difference in attendance by the distance from the centre, whereas transport was a major barrier for our participants. Patient belief about the effectiveness of pulmonary rehabilitation has been found to be a strong predictor of intervention attendance (Cox et al., 2017; Fischer et al., 2009). This may also be the case in our study, as some non-attendees did not think the initial rehabilitation programme was beneficial; consequently, attending the maintenance group was not perceived as worthwhile. Quantitative measures post-rehabilitation validate this perception. The non-attendee group responded well physically with a significant increase in sit-to-stand post rehabilitation; however, other measures of health status such as COPD, and anxiety and depressive symptoms did not change significantly after pulmonary rehabilitation. Therefore, the non-attendee group may have been comprised of participants who were non-responders and/or were less engaged in the rehabilitation programme. A limitation of the study is that attendance was not monitored in either the pulmonary rehabilitation or volunteer-led maintenance programmes. However, examining social connectedness in the attendee and non-attendee groups was a unique aspect of the study. The non-attendee group had significantly lower levels of trust toward other people compared to the attendee group. This could be another reason for the non-attendees choosing not to attend a group, as they would rather associate with people who they know rather than with a group of strangers. In contrast, attendees liked to socialise; for example, they participated in the community exercise group, and tended to be more likely to volunteer compared to the non-attendee group (attendees = 37%; non-attendees = 13%). The finding that attendees were more likely to volunteer is interesting, as research suggests volunteering is likely to have positive benefits on mental health (Jenkinson et al., 2013). Given that the attendees' measure for depression reverted to baseline, despite participating in a peer-led exercise group and some volunteering, the impact of COPD on mental health may be profound even in a motivated, engaged, and socially active cohort of people.

It is unclear why pulmonary rehabilitation health benefits were not maintained at follow-up, or why minimal differences in health measures were found between those who attended or did not attend a weekly exercise group. A lack of progressive loading in the attendees' exercise training programme, combined with most non-attendees maintaining an active lifestyle, could be a potential explanation. Due to the wide range of maintenance programme designs used in COPD research, optimal models for maintenance programmes remain unclear. Despite this, the positive experiences of spending time with others in a similar situation appear to be invaluable.

CONCLUSION

Pulmonary rehabilitation produced significant health benefits for people with COPD; however, improvements were not maintained by attending a weekly volunteer-led community exercise group. Despite this, attendees found participating in the exercise group beneficial as it enabled sharing experiences with other people with COPD and increased their motivation to exercise. Barriers to attending the groups included illness, transportation, and a lack of time. Non-attendees were found to be less trusting of others while attendees were more likely to do volunteer work. The attendees' quantitative health outcomes reverted to pre-rehabilitation levels for measures such as depression, despite participating in an exercise group and volunteering. Therefore, the impact of COPD on mental health may be profound even in motivated, engaged, and socially active people. It is unclear why the pulmonary rehabilitation health benefits were not maintained in the current study but could be related to an insufficient exercise load to maintain the acquired health benefits. However, the social connection with others in a similar situation was an important finding of the study. Further research to inform the development of optimal maintenance programmes would benefit the COPD community.

KEY POINTS

1. Pulmonary rehabilitation improves the health of people with chronic obstructive pulmonary disease; however, interventions led by healthcare professionals may not be cost-effective. Peer-led interventions have been shown to be as effective as maintaining health benefits following pulmonary rehabilitation compared to professional-led and are low cost.
2. We compared physical and mental health outcomes in people with COPD after a volunteer-led, community-based intervention post-pulmonary rehabilitation between attendees and non-attendees.
3. Improvements in COPD symptoms, depressive symptoms, and quality of life from pulmonary rehabilitation were not maintained by participants in a volunteer-led exercise group.
4. Group attendees found participating in the exercise group beneficial as it enabled sharing experiences with other people with COPD and increased their motivation to exercise.

DISCLOSURES

This study was supported by funding from Pegasus Health, Canterbury Clinical Network, and Ara Institute of Canterbury - Te Pūkenga. There are no conflicts of interest that may be perceived to interfere with or bias this study.

PERMISSIONS

Ethical approval was obtained from the Institutional Ethics Board at Ara Institute of Canterbury (project number 1833). All participants provided informed consent.

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CONTRIBUTIONS OF AUTHORS

HM, DCh, and DCa were primarily responsible for the design, conceptualisation, and research methodology. HM, TG and DCh managed the project administration, investigation, and data curation. HM, PO, MC, TG, and AH analysed the data. HM, TG, AH, and DCh prepared the original manuscript with review and editing undertaken by HM, TG, PO, and MC. Research supervision was provided by HM.

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Appendix A

SOCIAL CONNECTEDNESS QUESTIONNAIRE

Please circle one answer to each question below.

1. Living situation

   Circle the option below that best identifies your living situation:

   I live alone

   I live with my partner/spouse

   I live with my partner/spouse and one or more of my children

   I live with one or more of my children

   I do not live with a partner/spouse or any of my children

2. Do you have access to a telephone, either landline or cellphone, at home?

   Yes

   No

3. Do you have access to the internet at home?

   Yes

   No

4. Please think about all the contact you have with **family members** who help and support you.

   Help and support can include:

   Lending or giving you things

   Giving you emotional or moral support

   Helping you out with tasks and chores

   Giving you information or advice

   How would you describe the amount of contact you have with family members who you **do not** live with?

   Too much contact

   About right amount of contact

   Not enough contact

   Don't know

5. Please think about all the contact you have with **friends** who help and support you.

   How would you describe the amount of contact you have with friends who you **do not** live with?

   Too much contact

   About right amount of contact

   Not enough contact

   Don't know

6. In general, how much do you trust most people in New Zealand?

   0 = not at all

   1

   2

   3

   4

   5

   6

   7

   8

   9

   10 = completely

   Don't know

7. In the last four (4) weeks, how much of the time have you felt lonely?

   None of the time

   A little of the time

   Some of the time

   Most of the time

   All of the time

   Don't know

8. Have you done any voluntary work in the past 4 weeks for a group or organisation?

   Yes

   No

Thank you for taking the time to complete this survey!

The Accuracy of Coding for Sports-related Concussion in New Zealand: An Observational Study

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ABSTRACT

The aim of this study was to assess the accuracy of the Accident Compensation Corporation codes in a cohort of patients with sports-related concussion. Of particular interest were the codes registered by physiotherapists who may suspect sports-related concussion but are not permitted to diagnose it. Coding accuracy was assessed through review of Accident Compensation Corporation data, clinical notes, and referral letters for a cohort of patients seen in a New Zealand-based sports concussion clinic. Of 296 patients with a clinical diagnosis of sports-related concussion, 51.7% had a concussion-related code. General practitioners coded for concussion in 67.3% of cases for whom they submitted the Accident Compensation Corporation code, District Health Board health professionals (hospitalists) in 47.6%, and physiotherapists in 8.7%. A non-concussion-related code was used by physiotherapists in 87.5% of cases despite them suspecting sports-related concussion as per the study criteria. Use of the Accident Compensation Corporation codes to determine incidence and cost may substantially underestimate the true burden of sports-related concussion. There appears to be an opportunity to improve the accuracy of this coding. Engaging with physiotherapists and improving the process through which health providers are able to update codes are potential strategies.

Poloai, L., Fulcher, M., & Reid, D. (2023). The accuracy of coding for sports-related concussion in New Zealand: An observational study. *New Zealand Journal of Physiotherapy*, *51*(2), 100–104. https://doi.org/10.15619/nzjp.v51i2.349

Key Words: Concussion, Sports, Physiotherapy

INTRODUCTION

Sports-related concussion (SRC) is an important health issue (Harmon et al., 2019; Manley et al., 2017). It is estimated that up to 20% of SRCs are missed in New Zealand (Theadom et al., 2014). A commonly reported reason for this is athletes under-reporting symptoms of a possible SRC to medical staff (Delaney et al., 2018; Fraas et al., 2014; Longworth et al., 2021; O'Connor et al., 2020). In other cases, patients may present for an assessment and a SRC is not identified by their health care provider. This may be due to the inherent complexity of some SRCs, the lack of an objective marker, and the presence of other distracting injuries (Kutcher & Giza, 2014; McCrory et al., 2017). Another possible factor contributing to an underappreciation of the burden of SRC is inaccuracy of the coding systems used to record concussion diagnoses.

In New Zealand, the coding system used to record injuries is administered by the Accident Compensation Corporation (ACC). The ACC is a national taxpayer funded scheme that provides no-fault compensation to those who have suffered personal injuries as a result of an accident (ACC, 2022a). To receive funding from ACC, one must present to an ACC registered health provider, most often the patient's GP, physiotherapist, or a local hospital emergency department. Following an initial assessment, a standardised reporting form, the ACC45, is completed for all general injury claims. This form details the patient's clinical diagnosis using an ACC read code which is selected from a large list provided by ACC (ACC, 2022b). If the health provider is unable to find a code that matches the diagnosis, they can give a written diagnosis and ACC will select the best-matched code for the injury described (ACC, 2022b). If an International Classification of Diseases (ICD) code is used, ACC will convert this to a read code (ACC, 2022b). The most widely used ACC read code for concussion is S60 but there are additional related codes. Data from the coding system allows ACC to quantify the burden of injury and may be used in research and policy development (ACC, 2021a, 2021b; ACC Analytics & Reporting, 2022).

The ACC's national guidelines state that the assessment and diagnosis of SRC can only be made by a medical doctor (ACC SportsSmart, 2017). Many physiotherapists in New Zealand operate as primary care sports medicine providers and are frequently present at sports events. It has been shown in a New Zealand-based study that physiotherapists appear to have good knowledge, beliefs, and attitudes regarding SRC (Reid et al., 2020). It is possible that a proportion of patients with SRC initially present to a physiotherapist, and because the physiotherapist is not permitted to diagnose concussion, they register an alternate ACC code even if there is a high suspicion of SRC. This may result in inaccuracy of the ACC coding for SRC and an underappreciation of the SRC burden in New Zealand.

As ACC is capable of policy and strategy development, including injury prevention and management strategies, it is important to be aware of limitations of the coding system and make improvements where possible (ACC, 2021a, 2021b). An accurate understanding of the true extent of the problem is also needed to measure the effect of any policy and strategic changes (Van Mechelen et al., 1992).

The purpose of this study was to assess the accuracy of the ACC codes in a cohort of patients with a clinical diagnosis of SRC, as defined by the existing ACC guidelines. To our knowledge no prior study has explored this. Of particular interest was the ACC codes used by physiotherapists. The intended contribution of this study was to, depending on the findings, highlight aspects of the SRC coding process that could be improved to enable greater understanding of the true burden of SRC and help to better inform future prevention and management strategies.

METHODS

The Axis Sports Medicine Sports Concussion Clinic based in Auckland, New Zealand, has been running since 2017. The clinic incorporates a multi-disciplinary approach and aims to offer an early assessment and diagnosis to optimise the management of SRC. Patients can self-refer to the clinic, but are frequently referred by their GP, physiotherapist, or District Health Board health professional, usually an emergency department doctor. A prospective data set has been collected since the clinic commenced and has been used to answer a range of different clinical questions.

A database was reviewed of 312 consecutive patients seen in the Axis Sports Medicine Sports Concussion Clinic between 2017 and 2018, with a clinical diagnosis of concussion. All patients, irrespective of whether a diagnosis of SRC had already been made by the referring health provider, had been assessed using a standardised protocol in line with the 2017 Concussion in Sports Group Statement, thought to reflect the state of knowledge of SRC at the time (Kara et al., 2020; McCrory et al., 2017). This assessment occurred during the initial consultation at Axis and first involved taking a history to review the mechanism of injury, details of any previous SRC, and concussion modifiers such as history of a migraine or mental health disorder (Kara et al., 2020). Examination consisted of completion of an age-appropriate Sports Concussion Assessment Tool 5 (SCAT5), additional neurological assessment of the cranial nerve and peripheral nerves, vestibular and cervical spine examination, and a review of supine and standing blood pressure for autonomic dysfunction (Kara et al., 2020). In all cases the assessing doctor had been a sports medicine specialist at Axis who had either made or confirmed the clinical diagnosis of concussion and was involved in subsequent management. A total of 16 patients were excluded as the concussion was not sustained during sporting activity. The data from ACC was then reviewed on all 296 patients, which included date of birth, gender, ethnicity, sporting activity, and the ACC code related to the injury. The health provider type that submitted the ACC code was also reviewed. This did not always match the health provider referring to the clinic and some patients had self-referred. Where needed, missing data points were acquired through manual review of standardised clinic notes, referral letters, and by searching the ACC coding database, after which the data for all patients were complete.

A manual review of clinical notes was then completed for all patients whose injury was coded by a physiotherapist. The intended methods for this descriptive analysis were developed by the study authors and agreed upon by physiotherapists who refer to the clinic. Any referral letters that had been sent by physiotherapists for these patients were reviewed for use of the terms “concussion”, “SCAT”, or “head injury”. Use of any of these terms was taken to mean that a diagnosis of concussion was suspected. In cases where there was no referral letter, the referring physiotherapist was phoned once and emailed once and asked to review their own clinical notes for these terms. The purpose of this component of the study was to identify the proportion of physiotherapists who suspected a diagnosis of SRC but registered a non-concussion-related code. Cases were excluded where the source of referral to the clinic was unknown or not from a physiotherapist, or where there was no referral letter and no response from an email or phone call.

Ethics approval for this study was obtained via the Accident Compensation Corporation Research Ethics Committee (2019) as part of a larger, existing project.

RESULTS

Complete characteristics of the 296 patients included in the study are outlined in Table 1. The median age of patients in this study was 18.6 years and the majority (80.4%) were male. A total of 53.7% identified as European, 26.0% Pacific, 11.1% Māori, 4.7% Asian, and 4.4% were classified as “other”, which was not further specified. SRC was sustained across 36 unique sporting activities with rugby union responsible for 50.7% of all injuries. The ACC code was submitted by GPs in 55.7% of cases, physiotherapists in 23.3%, a District Health Board health professional (not further specified) in 14.2%, and a sports medicine specialist in 4.1%.

A descriptive summary of the specific codes used is outlined in Table 2. Just over half (51.7%) the patients had an ACC code related to SRC. GPs coded for concussion in 67.3% of cases for whom they submitted an ACC code, District Health Board health professionals in 47.6%, and physiotherapists in 8.7%. The most common non-concussion-related codes used were neck sprain (S570), head injury (S646), and contusion of face, scalp, and neck excluding eye(s) (SE0). These codes collectively accounted for 61.5% of the non-concussion-related codes used.

In the physiotherapy sub-analysis there was a total of 48 cases referred to the service by a physiotherapist in which we could access a relevant referral or information about the physiotherapist’s working diagnosis. A non-concussion-related code was registered with ACC by the physiotherapist in 42 of these 48 cases (87.5%), despite the physiotherapist suspecting SRC as per the study criteria. This accounted for 29.4% of all non-concussion-related codes registered in the study population. In 40 out of 42 (95.2%) cases the term used in the clinical notes was “concussion”. In four cases the S60 concussion code was stated on the physiotherapy referral letter but a non-concussion-related code was registered.

DISCUSSION

The results of the current study suggest that ACC data on the claims and costs related to SRC may reflect only half the

Table 1

Patient Characteristics

Characteristic	*n* [a]	%
Age (*Mdn,* range)	18.6 (8.0–71.6)	
Sex		
Male	238	80.4
Female	58	19.6
Ethnicity		
European	159	53.7
Pacific	77	26.0
Māori	33	11.1
Asian	13	4.4
Other [b]	14	4.7
Sport		
Rugby union	150	50.7
Rugby league	43	14.5
Soccer	38	12.8
Field hockey	8	2.7
Cycling	7	2.4
Netball	5	1.7
Other [c]	45	15.2
ACC code provider		
General practitioner	165	55.7
Physiotherapist	69	23.3
District health board	42	14.2
Sports medicine specialist	12	4.1
Other [d]	8	2.7

Note. ACC = Accident Compensation Corporation.

[a] Unless indicated otherwise. [b] Not specified. [c] 30 sports, all less than five cases. [d] Nurse, chiropractor.

Table 2

ACC Coding

Variable	*n*	%
Concussion code used		
Yes	153	51.7
No	143	48.3
Non-concussion codes		
Neck sprain	37	12.5
Head injury	30	10.1
Contusion of face, scalp, and neck, excluding eye(s)	21	7.1
Intracranial injury not otherwise specified, no open intracranial wound, no loss of consciousness	9	3.0
Contusion, forehead	7	2.4
Other [a]	39	13.2
Concussion code used by provider type		
General practitioner	111	67.3
Physiotherapist	6	8.7
District health board	20	47.6
Sports medicine specialist	12	100.0
Other	4	50.0

Note. The head injury code does not count towards concussion statistics as per personal correspondence with the Accident Compensation Corporation (ACC).

[a] 29 codes, all less than five cases.

injuries that have actually been sustained, even though many of these injuries have received ACC funded treatment (ACC Analytics & Reporting, 2022). This will likely be compounded by the previously identified issues relating to under-reporting by both patients and clinicians. We cannot reliably measure the effectiveness of strategies to prevent and better manage SRC if our understanding of the true burden of SRC on the health system is inaccurate (Van Mechelen et al., 1992). This has clinical, social, and economic significance given that a proportion of these patients will experience lingering symptoms that could impact their ability to return to school, work, and sport (Manley et al., 2017; Theadom et al., 2018).

One area where a specific focus is needed relates to physiotherapists and the ACC codes for SRC. Given that many physiotherapists have identified a potential SRC, but have registered a non-concussion-related code, there may be opportunities to better engage with this group to improve coding accuracy. One possible solution would be to encourage physiotherapists to use a "suspected concussion" code that could then be confirmed by a medical doctor. Such a code would first need to be created by ACC. This could then be followed by education of physiotherapists that this is an option, for example, through updating the ACC national guidelines for SRC. There are data suggesting that physiotherapists who have good engagement with SRC in New Zealand have an excellent understanding of SRC. The majority (98%) in one cohort correctly identified symptoms of SRC and 99–100% correctly recognised who would possibly present with SRC in short scenarios in a questionnaire (Reid et al., 2020). Furthermore, physiotherapists are frequently in attendance at sporting events, commonly work with sporting teams, and are often involved in the treatment of patients seeking care for symptoms of SRC (Maxtone et al., 2020; Reid et al., 2020). Whether they are able to distinguish between patients who present with symptoms due to concussion and those who have a more significant brain injury is not known but the patient could be referred to a medical doctor to confirm the diagnosis as per the current ACC guidelines (ACC SportsSmart, 2017). Improving the coding process for physiotherapists in relation to SRC may increase the accuracy of the ACC codes by almost a third as per the findings in our study.

Another approach to improving the coding accuracy may be to focus on updating ACC codes, particularly when a diagnosis is confirmed by a specialist. In our study the sports medicine specialist submitted an ACC code in only 4.1% of cases. Given the percentages of GPs and District Health Board health professionals who used non-concussion-related codes, the sports medicine specialist likely made the clinical diagnosis of SRC in a significant proportion of cases but the ACC code was not added. We are not aware of any study assessing how often health providers update an ACC code. ACC state that adding or changing a code can be done in a variety of ways such as through a built-in change code option in some practice management systems, the ACC18 medical certificate and via the ACC32 approval for prior treatment form (ACC, 2022c). The updated code must include a description to support this change and clinical records may be required (ACC, 2022c). There is no statement on the relevant ACC page regarding standard processing times. Anecdotally, the time taken for an ACC code to be added can be weeks. It may also be possible that some health providers are not up to date on the different ways that a code can be added. In raising awareness of the inaccuracy of the codes for SRC, we emphasise the importance to health providers of reviewing the ACC code for the patients they are seeing with SRC and changing the code when inaccurate or when a suspected case is medically confirmed. Improving the process through which health providers are able to add codes, perhaps through introducing a dedicated form just for this purpose, and providing education on the various options, may yield further benefit in improving SRC coding accuracy.

Finally, we recognise that the reliability of diagnostic coding in general can be affected by errors during the administrative process (Lucyk et al., 2017). In the current study we are unable to quantify the proportion of health professionals who submitted a written diagnosis that was subsequently allocated a code by ACC. Previous research has highlighted that the quality of a health professional's documentation can affect subsequent coding by administrative staff, and that there can also be variability in interpretation (Lucyk et al., 2017). There has been previous commentary on the difficulty these factors create in establishing the health and economic burden of SRC in Australia (Thomas et al., 2020). These factors may be affecting the accuracy of SRC coding in New Zealand.

This study has several limitations. First, the selection of consecutive patients from a single clinic increases the risk of sampling bias and so the clinic population may not be representative of the general population with SRC in New Zealand. Second, the data are several years old and so the trends described may have subsequently changed. We note, however, that at the time this article was published, the ACC SRC guidelines remain the same and there have been no major changes to the ACC coding system. Third, selection of the term concussion for the sub-analysis of physiotherapy referral letters may have introduced bias in that the referral letter was to a concussion clinic and thus there was potentially a degree of suspicion in the majority of cases. Finally, the study is descriptive only and so, while physiotherapists appear to regularly use non-concussion-related codes despite suspecting SRC, there are no inferential statistics to support this at this stage.

CONCLUSION

The current study suggests that only half of patients with a clinical diagnosis of SRC have a concussion-related ACC code. As a result, use of the ACC codes to determine incidence and cost may substantially underestimate the true burden of SRC. We cannot reliably measure the effectiveness of strategies to prevent and better manage SRC if our understanding of the true burden of SRC on the health system is inaccurate. There appears to be an opportunity to create better processes to help clinicians improve the accuracy of this coding. Engaging with physiotherapists and improving the process relating to viewing and changing coded diagnoses are potential strategies.

KEY POINTS

1. Use of the ACC codes to determine incidence and cost may substantially underestimate the true burden of SRC. Many physiotherapists used a non-concussion-related code despite suspecting SRC, likely due to the current SRC guidelines.
2. One possible solution to improve coding would be to introduce the option of a "suspected concussion" code for physiotherapists to use, which could then be confirmed by a medical doctor.
3. Improving the process through which health providers are able to update codes and providing education on the various options to do so may also yield benefit in improving coding accuracy.

DISCLOSURES

No funding was obtained for the study. There are no conflicts of interest.

PERMISSIONS

Ethics approval for this study was obtained via the Accident Compensation Corporation Research Ethics Committee as part of a larger, existing project. All patients included in the study consented to the potential use of the clinical notes for future research.

CONTRIBUTIONS OF AUTHORS

MF initiated the research, secured ethics approval, and led the data collection supported by LP. LP analysed the data and drafted the paper with review and editing by MF and DR. LP was responsible for the final version and responding to peer review and editorial committee comment.

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Feasibility of Ballistic Strength Training to Improve Mobility of Inpatients with Traumatic Brain Injury

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ABSTRACT

The objective of this study was to investigate the feasibility of ballistic strength training (BST) to improve the mobility of individuals recovering from traumatic brain injury (TBI) in an inpatient rehabilitation centre. Participants had a maximum of eight usual physiotherapy sessions substituted with BST sessions. The feasibility of BST was assessed in terms of recruitment, attendance, adverse events (AEs), and participant acceptability of the intervention. The clinical aspects of feasibility were assessed by recording the ability of participants to complete the exercises and acquire skills. Secondary measures included the 10-metre walk test, the 6-minute walk test, and the Global Rating of Change scale. Fourteen of 22 eligible individuals with TBI in an inpatient rehabilitation centre consented to participate in the study, of whom two were excluded. No intervention-related AEs occurred. Participants attended 97% (71/73) of the total sessions. Participants positively accepted the intervention as rated on a visual analogue scale, *M* (*SD*) = 9.2 (0.9). All participants were able to complete the BST exercises. Participants significantly improved comfortable walking speed and walking capacity ($p < 0.01$). Participants perceived a meaningful change in walking ability. BST appears to be a promising rehabilitation method that may improve the walking outcomes of individuals with TBI in an inpatient rehabilitation setting. Larger-scale clinical trials are warranted.

Gilfillan, I., Mothabeng, D.J., & van Heerden, A. (2023). Feasibility of ballistic strength training to improve mobility of inpatients with traumatic brain injury. *New Zealand Journal of Physiotherapy, 51*(2), 105–116. https://doi.org/10.15619/nzjp.v51i2.355

Key Words: Ballistic Strength Training, Locomotion, Mobility, Rehabilitation, Traumatic Brain Injury

INTRODUCTION

Traumatic brain injuries (TBIs) are a major cause of mortality and long-term disability, often with complex clinical presentations (Vella et al., 2017), including mobility limitations (Walker & Pickett, 2007; Williams & Willmott, 2012). Mobility limitations include reduced walking speed, reduced walking distance, and impaired quality of gait (McFadyen et al., 2003). Mobility limitations are also associated with poor community participation and reduced health-related quality of life (Williams & Schache, 2010).

Evidence suggests that early intensive rehabilitation may speed up recovery (Zhu et al., 2007) and mitigate deficits following TBI (Archer et al., 2012). Rehabilitation should include intensive practice and task specificity to attain improvements following central nervous system injury (Hornby et al., 2020; Kleim & Jones, 2008; Peters et al., 2014).

The recovery of walking ability is considered a key aspect of TBI rehabilitation (Katz et al., 2004; Walker & Pickett, 2007; Williams et al., 2009). Greater walking capacity enhances a person's activities of daily living, enables them to cross roads or access their community (Charrette et al., 2016), and facilitates participation in recreational activities (Katz et al., 2004; Wilson et al., 2019).

Individuals with neurological conditions struggle to walk mainly because of muscle weakness and/or reduced power production (Nadeau et al., 1999; Williams et al., 2013), necessitating strength training as a core component of physical rehabilitation. Despite the importance of strength training for people with neurological conditions, optimal methods and best practice have not been identified. Slow and heavy progressive resistance training programmes have been shown to improve muscle strength (the maximum force a muscle can produce) but fail to translate into function, such as improved walking ability (Dorsch et al., 2018; Williams, Kahn, et al., 2014). One reason for this could be that muscle function for walking requires rapid force generation or muscle power (the rate at which a force is produced) (Williams et al., 2019; Williams, Kahn, et al., 2014).

Ballistic (i.e., fast) strength training (BST) is a form of strength training aimed at improving muscle power generation (Williams et al., 2019), which is relevant for walking in the field of neurorehabilitation (Hendrey et al., 2018; Van Vulpen et al., 2017). BST commonly includes a jump or non-contact phase. The benefits of BST for improving task-specific performance were acknowledged in a recent systematic review on the effects of BST in TBI and other neurological populations, such as stroke, Parkinson's disease, and multiple sclerosis (Cordner et al., 2020). The review highlighted that, although BST seems promising for improving muscle strength, power generation and mobility, the results were inconclusive and warranted further investigation. To the best of our knowledge, the effects of BST in the TBI population have only been studied in a later recovery phase in outpatient settings (Cordner et al., 2020; Williams & Ada, 2022; Williams, Clark, et al., 2014) and cannot be generalised to inpatient rehabilitation settings. The potential benefits of BST for motor learning and neuroplasticity (Williams et al., 2019) warrant further investigation, particularly in the early recovery phase following TBI.

This study primarily determines the feasibility of a BST-based treatment approach in an inpatient TBI rehabilitation setting. As a secondary objective, we investigated the impact of BST on improving walking outcomes. We hypothesised that the intervention would be feasible and that individuals with TBI in an inpatient rehabilitation centre would show improved mobility.

MATERIALS AND METHODS

Study design and participants

This feasibility study followed a quasi-experimental single-group pre-test–post-test non-randomised design. The study was conducted in a New Zealand specialist acquired brain injury inpatient rehabilitation setting. All participants provided written informed consent before participating in the study. Reporting was conducted in accordance with CONSORT recommendations for pilot and feasibility studies (Eldridge et al., 2016). The study procedures followed the principles of the Declaration of Helsinki. The study was registered with the Australian New Zealand Clinical Trials Registry (trial registration number ACTRN12621000107389).

Physiotherapists who were familiar with the study protocol identified potential participants. The severity of brain injury was classified according to the Glasgow Coma Scale (GCS, as documented on arrival to the emergency department) and the duration of post-traumatic amnesia. Moderate TBI was indicated with an initial GCS of 9 to 12 out of 15 and a post-traumatic amnesia duration of 1 to 6 days. Severe TBI was indicated by an initial GCS of 3 to 8 out of 15 and a post-traumatic amnesia duration of 7 or more days. If there was a difference between the severity level for the GCS and the duration of post-traumatic amnesia, the more severe category was used (New Zealand Guidelines Group, 2006).

Ambulatory individuals with moderate to severe TBI, admitted for inpatient rehabilitation, were screened for eligibility and recruited consecutively. The eligibility criteria were (a) first-ever diagnosis of moderate to severe TBI, (b) less than 6 months post-injury, (c) 18–65 years of age, (d) independent, unaided baseline mobility before TBI, and (e) able to walk with standby assistance of one person for 14 m or longer with or without assistive devices and orthoses. Individuals were excluded if they (a) were unwilling or unable to consent, (b) had severe cognitive or behavioural problems that prevented assessment, (c) were medically unstable (preventing cardiovascular exercise), (d) had had spinal surgery in the last 6 weeks or had recent orthopaedic injuries restricting weight bearing, (e) had lower limb muscle weakness from a peripheral cause, (f) had any previously diagnosed central nervous system disorders, (g) if walking was not their preferred mode of indoor mobility, or (h) if they were able to walk independently, unaided with a comfortable walking speed faster than 1.55 m/s after the TBI. We recruited participants over 6 months, from February to July 2022.

Ballistic strength training

Following enrolment and baseline assessments, participants had two 30 min BST sessions instead of two 30 min conventional physiotherapy sessions per week. Participants attended BST sessions for at most 4 weeks (maximum of eight sessions), representing the typical inpatient length of stay. Discharge planning from the rehabilitation centre was not influenced by study participation.

The BST sessions were held in the therapy gym located at the rehabilitation centre. Sessions were individually supervised by a physiotherapist or physiotherapy assistant trained in the BST programme. The BST intervention was based on the theoretical framework designed and tested by Williams et al. (2019). The BST intervention aimed to improve muscle power generation, targeting the main muscle groups responsible for forward propulsion when walking (Hendrey et al., 2018; Williams et al., 2019). The exercises focused on quick movements with light loads at high repetition. Each training session followed a two-part structure. Part A was completed on a slide-board (jump trainer, Total Gym), and part B was completed within parallel bars using a mini-trampoline and a 10 cm high step. Each part was composed of four exercises, 2 min in duration, with a 2 min rest break between each part. Participants alternated between starting each session with part A or part B. Therapists were allowed to give hands-on assistance if necessary to provide mediolateral ankle stability and to facilitate push-off if required. Participants were monitored closely and guided with feedback. Rest breaks were initiated by the participant or the therapist. This was to ensure the correct quality of movement if the technique deteriorated.

The progression of exercises depended on the participant's ability to perform the correct movement at the target velocity. The target velocity was guided by a metronome set at one repetition per sec, the typical time for a usual gait cycle, for five of the eight exercises in the programme. The load was increased once the participant met the performance criteria. The exercise programme and progression principles are available in Appendix A.

Assessments and outcome measures

Feasibility and acceptability

We measured feasibility by assessing the ability to recruit participants, participants' attendance of BST sessions, the safety of the BST sessions, and whether participants found the intervention acceptable. A screening log Excel spreadsheet was used to record the rate at which participants were recruited to the study. We kept an exercise log for each participant, recording session attendance, adverse events, the order of the exercise programme followed (starting with part A or with part B), the progression of exercises (whether the correct movement pattern was performed, if the target speed of movement was met, and if the load such as the level of incline on the jump trainer applied), orthoses used, and whether manual assistance was required from the therapist during the exercises. Skills acquisition was determined by a participant's ability to accurately complete all BST exercises under supervision only. Safety was determined by recording any adverse events (AEs) using the Common Terminology Criteria for Adverse Events (National Cancer Institute, 2017). We monitored AEs during BST sessions and during the trial period.

Participants' acceptability of the intervention was evaluated after completion of the BST intervention (Lamontagne et al., 2014; Tverdal et al., 2018). Participants were asked to rate their agreement with the following statement: "I find the BST programme acceptable" on a visual analogue scale (10 cm line) (Lamontagne et al., 2014; Tverdal et al., 2018). Higher scores indicated greater acceptability of the intervention.

Walking outcomes

Walking outcomes were measured using the 10-metre walk test (10MWT) and the 6-minute walk test (6MWT). The 10MWT is a standardised measure of walking speed (m/s). In TBI, this test shows excellent test-retest and interrater reliability (Tyson & Connell, 2009; van Loo et al., 2003). Participants walked along a 14 m track, and we recorded the time taken to walk the middle 10 m at a comfortable pace. The average speed was calculated from two trials. We used a minimally clinically important difference of 0.175 m/s for comfortable walking speed in the stroke population (Fulk et al., 2011).

The 6MWT measures distance (m) walked over 6 min as a sub-maximal test of aerobic capacity and walking endurance. The test shows excellent test re-test reliability for the TBI population (Mossberg, 2003; van Loo et al., 2004). Using a 50 m pathway, participants were instructed to walk as safely and quickly as possible. The study used a minimally important clinical difference of 34.4 m for the stroke population (Tang et al., 2012). These assessments (the 10MWT and 6MWT) were performed with shoes on and with their usual gait aid or orthosis. A physiotherapist, trained and accredited to use the Functional Independence Measure (FIM), completed the locomotion item of the FIM at baseline (pre-test) and repeat assessment (post-test).

Following the intervention, we measured whether participants perceived a change in walking ability using the Global Rating of Change scale (GRoC), which is a 15-point ordinal scale (Kamper et al., 2009). The GRoC scale ranges from negative seven (a very great deal worse) to positive seven (a very great deal better).

Data analysis

Data were analysed in consultation with an independent statistician using Microsoft Excel and R Windows Version 4.2.1 (R Core Team, 2018). The level of significance was set at 0.05. Baseline characteristics and feasibility measures were summarised using descriptive statistics, namely mean and standard deviation, or median and interquartile range. We adapted the traffic light system from Campbell et al. (2020) to assess the feasibility of the BST intervention and to decide whether the intervention should be evaluated in a full trial. Green indicated implementation was feasible and the study design will require minor or no change. Amber indicated an element would require major modification before progressing, and red indicated it would not be feasible to progress to a full trial with the study design (Gilfillan et al., 2023). Baseline and post-intervention walking outcomes were compared using a t-test or Wilcoxon test. Incomplete datasets were excluded from the analysis (Figure 1).

RESULTS

Feasibility for progression to a full-scale trial

Recruitment capability

Over a 6 month period, 28 participants were screened, of whom 22 individuals met the inclusion criteria. Of these 22 individuals, 14 consented to participate, while six were not approached (due to short length of stay or staff shortages), and two declined to participate because they were afraid of delayed discharge despite being assured otherwise. Of eligible individuals (n = 22), 14 (64%) consented to participate. Participants' demographic information is summarised in Table 1.

Of the 14 initial participants, 12 completed the study protocol. One participant was lost before the baseline assessment due to government COVID-19 isolation regulations. One participant was lost to post-intervention assessment due to a medical complication unrelated to the study (Figure 1). The traffic light stop-go criteria were amber for recruitment capability over the trial period.

Attendance, participant safety, and intervention acceptability

Overall, attendance rates were excellent (71 of 73 total possible training sessions across all the participants, 97%). One participant could not attend two gym sessions during their time of participation due to being a household contact of someone with COVID-19, which at the time required mandatory isolation for one week. Participants attended a M (SD) of 5 (2) of 8 potential training sessions. There were no AEs during the trial period. All the participants positively evaluated the acceptability of the BST intervention (visual analogue scale, M = 9.0, SD = 0.9).

The traffic light stop-go criteria results were green for training attendance, participant safety, and intervention acceptability.

Clinical aspects of feasibility

All participants were able to complete the BST programme. The majority of the 71 completed sessions were performed under supervision only (n = 49, 69%). Participants required manual assistance to the ankle from a therapist to ensure correct movement while performing exercises in 22 sessions (31%). Most participants achieved skills acquisition during the trial period. Eleven participants acquired the desired skills for all four exercises in part A (slide-board exercises; progression ranged from 30% to 50% of body weight), and eight participants acquired skills for all four exercises in part B (full bodyweight exercises). Skills were acquired sooner in part A of the programme. The traffic light stop-go criteria were green for clinical aspects of feasibility.

Preliminary changes in walking outcomes

Compared to baseline measures, participants improved significantly ($p < 0.01$) in both the 10MWT and 6MWT after the intervention (Table 2 and Figure 2). All the participants achieved independent mobility and were able to walk unaided by the end of the intervention. Changes between baseline and post-test walking parameters are captured in Table 2. Participants

Figure 1

CONSORT Flow Diagram Representing the Flow of Participants

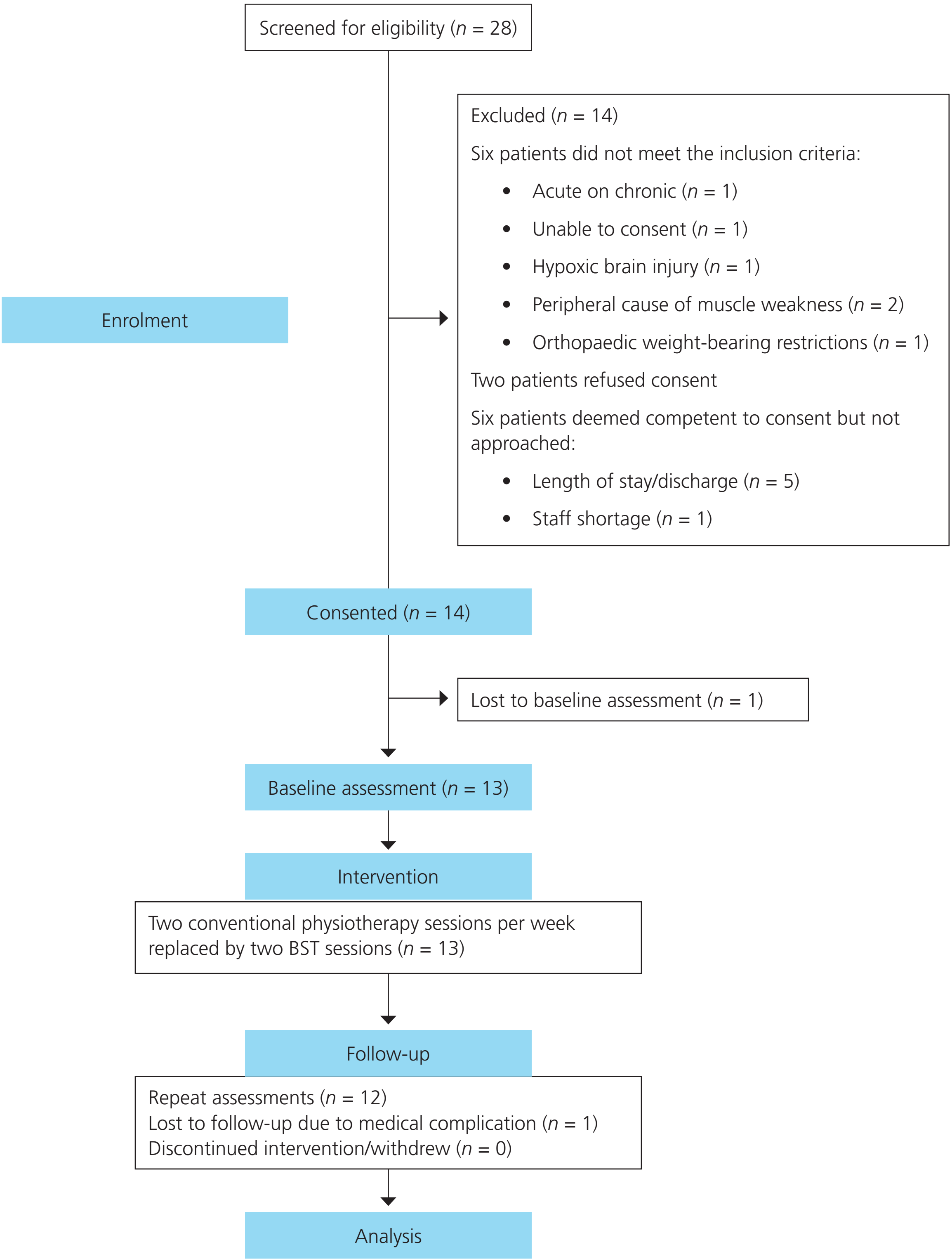


Table 1

*Demographic Characteristics of Ballistic Strength Training Study Participants with Traumatic Brain Injury (*N *= 14)*

Characteristic	n [a]	%
Age, in years (*M*, *SD*)	43 (15)	
Gender		
Male	13	93
Female	1	7
Ethnicity		
Asian	4	29
European-New Zealander	4	29
Māori	4	29
Other European	2	14
TBI classification		
Moderate	0	0
Severe	14	100
Glasgow Coma Scale (out of 15)		
3–8	3	21
9–13	8	57
14–15	3	21
Length of PTA, in days (*Mdn* [IQR])	26 [16, 49]	
Length of stay, in days (*Mdn* [IQR])	29 [22, 52]	
Mechanism of injury		
Recreational activities	5	36
Assault	4	29
Vehicle	3	21
Fall	1	7
Pedestrian	1	7
Orthopaedic injuries		
Skull fractures	8	57
Upper limb fracture	5	36
Rib fractures	3	21
Spinal fracture/subluxation	2	14

Note. PTA = post-traumatic amnesia; TBI = traumatic brain injury.

[a] Unless otherwise indicated.

Table 2

*Participant Pre-test–Post-test Walking Parameters (*N *= 12)*

	Pre-test	Post-test
10MWT in m/s (*Mdn* [IQR])	1.2 [1.0, 1.3]	1.4 [1.4, 1.6]
6MWT in m (*Mdn* [IQR])	473 [373, 511]	575 [499, 614]
FIM locomotion score (*n*, %)		
4 (minimal assist)	3 (25)	0 (0)
5 (supervision)	7 (58)	0 (0)
6 (modified independence)	0 (0)	1 (8)
7 (independent)	2 (17)	11 (92)

Note: 10MWT = 10-metre walk test; FIM = functional independence measure.

perceived a positive change in walking ability (GRoC, *M* = +5, *SD* = 1). The traffic light stop-go criteria were green for the effects of BST on walking outcomes. Table 3 provides a visual representation of the results according to the traffic light progression criteria.

DISCUSSION

In this study, we investigated the feasibility of implementing BST to improve the walking outcomes of individuals with moderate to severe TBI in an inpatient setting. We found that BST combined with usual care is safe and feasible when delivered in a cohort of individuals with TBI. The traffic light stop-go criteria indicated that it would be feasible to scale up this study to a larger trial but that future studies should consider modification of the recruitment process to improve enrolment.

In our study, recruitment capability was influenced by various factors. The number of participants that could be recruited was limited by the short recruitment period of 6 months. Once an eligible individual was able to provide informed consent, the remaining length of stay was often too short to allow for participation in the study. The proportion of eligible participants was further affected by the COVID-19 pandemic, which affected admissions and discharges from the rehabilitation centre, as well as staff availability.

Training attendance was excellent, with participants attending 71 of 73 total sessions. Two participants missed one session each, one due to COVID-19 isolation regulations and one due to non-COVID-19-related illness. The high attendance rate suggests that BST was well tolerated by participants and that individuals recovering from TBI in an inpatient rehabilitation centre are motivated to improve their walking ability.

In our study, participants did not experience any AEs, suggesting that BST is safe for individuals in early recovery from TBI. Although not tested, therapist supervision and hands-on assistance likely contributed to the safety of the intervention. One participant reported mild abdominal discomfort unrelated to the study and was able to continue using a supportive abdominal binder, which was in keeping with the training protocol. Few AEs have been reported in other studies on strength training in people with neurological conditions (Cordner et al., 2020; Taylor et al., 2005).

In our study, participants positively accepted the intervention, showing that a challenging intervention such as BST is suitable alongside usual care to promote early neuroplasticity in the inpatient recovery phase of TBI. All the participants adhered to the protocol demonstrating the practicability of the BST intervention. The absence of voluntary withdrawals of participants signified that our eligibility criteria were appropriate and that the BST intervention, focusing on fast movement at low load and high repetitions, was viable. All the participants were able to perform all eight of the prescribed exercises, demonstrating that the exercises were targeted at an appropriate level. Participants acquired skills more quickly and were able to progress at a faster rate for the four exercises performed on the slide-board in part A of the exercise programme. These exercises were all performed below body

Table 3

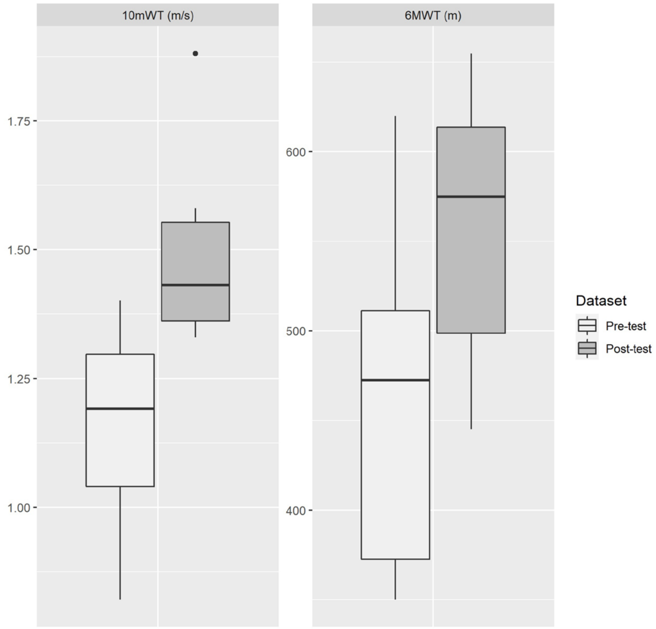
Traffic Light Progression Criteria Used to Decide if the Ballistic Strength Training Feasibility Trial Could Be Up-Scaled to a Full-size Trial

Progression criteria Measurement	Green (Proceed)	Amber (Consider changes)	Red (Stop)	Results
Recruitment capacity				
Number of participants recruited	15–20	10–14	< 10	14
Proportion of eligible participants consented	> 70%	50–69%	< 50%	64% Amber
Attendance				
Number of BST sessions attended per participant	> 75%	50–75%	< 50%	97% Green
Participant safety				
Adverse events: incidence, type, and severity	Minor modifications made to BST to accommodate discomfort.	AEs in a large proportion of the sample size.	Occurrence of serious AEs.	No AEs Green
Acceptability				
Intervention acceptability: Visual analogue scale	Most participants (> 50%) find BST acceptable (> 5/10).	Conflicting views on the acceptability of BST, or major revisions needed.	Most participants (> 50%) find BST unacceptable (< 5/10), or changes required are not feasible.	100% Green
Clinical feasibility				
Participants' ability to complete BST (yes/no)	Most participants can complete BST.	Participants can participate with minor adjustments.	Most participants are unable to complete BST.	100% Green
Skills acquisition: Assistance and speed of movement. Data collected from participant exercise logs (part A and part B)	Most (> 50%) participants require supervision. Most participants achieve skills acquisition during the intervention period.	< 50% of participants require assistance. Conflicting results on skills acquisition.	Most (> 50%) participants require assistance. Amount of assistance required is not feasible. Changes required are not feasible.	Supervision only (69%) Skills acquisition Part A (92%), part B (67%) Green
Indication of effect on mobility outcome measures				
Self-selected walking speed	Clinically important change between pre-test and post-test.	Minimally clinically important change between pre-test and post-test.	No change between pre-test and post-test.	10MWT ($p < 0.01$)
Walking capacity	Clinically important change between pre-test and post-test.	Minimally clinically important change between pre-test and post-test.	No change between pre-test and post-test.	6MWT ($p < 0.01$)
Participants' perception of change in walking ability: GRoC	Most GRoC scores between +5 to +7.	Most GRoC scores between +3 to +4.	Most GRoC scores are < 3.	75% scored ≥ 5 Green

Note. AEs = adverse events; BST = ballistic strength training; 6MWT = 6-minute walk test; 10MWT = 10-metre walk test; GRoC = global rating of change scale.

Figure 2

Boxplots Comparing Pre-test–post-test Values for the 10-metre Walk Test (10mWT, in m/s) and 6-minute Walk Test (6MWT, in m) (N = 12).



weight, potentially making them easier to perform accurately. In our study, not all of the participants were able to achieve the desired skills, which is possibly due to not having enough time to perfect the exercises prior to discharge. It is likely that continuing with these exercises after discharge may further aid in the rehabilitation process. BST exercises, without the need for specialised equipment, could be explored as an option for continued rehabilitation in the community, which could also improve the generalisability of the intervention (Williams & Ada, 2022).

All participants were able to achieve normal comfortable walking speeds for people aged 20 to 69 years of age of between 1.2 m/s and 1.55 m/s (Bohannon & Andrews, 2011). Walking speed, also called the sixth vital sign (Fritz & Lusardi, 2009), is associated with community walking ability (Andrews et al., 2010). Walking efficiency is directly related to the energy cost of walking. Gait impairments may increase energy expenditure, leading to fatigue and affecting walking capacity (Awad et al., 2015; Bae et al., 2018). We used both the 10mWT and the 6MWT to provide a comprehensive picture of walking ability. Both walking speed and distance were markedly improved following the BST intervention, indicating that the selection of outcome measures was appropriate.

Additionally, participants perceived that their walking ability had improved, validating the objectively measured walking speed and walking endurance. One participant struggled to compare pre-test and post-test performance using the GRoC scale due to short-term memory difficulties caused by the TBI. External compensatory strategies such as video feedback or participant diaries may mitigate short-term memory and self-awareness difficulties (Nowell et al., 2020; Schmidt et al., 2013).

Our findings are limited by the small sample size and by being conducted at a single rehabilitation centre. Also, due to the study design, the secondary outcomes cannot be fully attributed to BST. The results on the treatment effect should thus be interpreted with caution, as our study was not powered for secondary outcomes (Cordner et al., 2020).

Our results contribute to research and clinical practice. This feasibility study lays the foundation for future larger definitive trials testing the BST intervention (Harvey, 2018; Orsmond & Cohn, 2015). Our results support the current literature on the safety and feasibility of BST training in neurological conditions (Cordner et al., 2020). This feasibility study, to our knowledge, is the first to evaluate BST intervention in the early inpatient rehabilitation phase, diversifying the inpatient intervention toolbox for clinicians treating ambulatory individuals with TBI.

To verify the efficacy of BST intervention in individuals with TBI in an inpatient rehabilitation centre, it is proposed that the intervention is compared with a dose-matched control in a randomised controlled trial (RCT) with a large, adequately powered sample size. All objectives, except for recruitment capability (due to unforeseen circumstances), point towards proceeding with a full-scale trial. Future trials might want to consider a multi-centre study design. We also recommend a follow-up time point to examine the lasting effects of the intervention, which could include the effects of the BST on quality of life.

CONCLUSION

This feasibility study indicates that BST could be used in a regular inpatient rehabilitation programme on ambulatory adults within 6 months following moderate to severe TBI. Although preliminary, our results suggest that BST may assist in improving walking outcomes. This study further highlights the saliency of BST as a therapeutic tool in neurorehabilitation. Our results support an RCT to explore the efficacy of BST on the function and quality of life of individuals with TBI.

KEY POINTS

1. BST is a feasible and promising rehabilitation method to improve the walking outcomes of individuals with moderate to severe TBI in an inpatient rehabilitation setting.
2. Larger clinical trials are warranted to assess the efficacy of BST in this population group.

DISCLOSURES

The research project received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The authors report no conflicts of interest that may be perceived to interfere with or bias this study. The author(s) disclose receipt of equipment sponsorship for a Total Gym Jump Trainer from HQH Fitness. The equipment sponsor had no role in the study design, data collection, analysis, interpretation, writing of the manuscript, or decision to submit for publication.

PERMISSIONS

The trial was approved by the New Zealand Health and Disability Ethics Committee (reference 21/CEN/238) and the institutional Faculty of Health Sciences Research Ethics Committee (reference 399/2021).

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CONTRIBUTIONS OF AUTHORS

Conceptualisation and methodology, IG; Statistical analysis (with statistical support), IG and AvH; Writing – manuscript drafting and original draft preparation, IG; Writing – review and editing, IG, DJM, and AvH: Supervision, DJM and AvH.

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Appendix A

INTERVENTION: BALLISTIC STRENGTH TRAINING EXERCISE PROGRAMME

Prescription protocol

- Frequency: 2 sessions per week.
- Duration: approximately 30 min each.
- Time: maximum of 4 weeks (8 sessions), dependent upon date of discharge from the rehabilitation centre.
- Level of intensity:
    - Similar to a recent protocol for a post-stroke population (Hendrey et al., 2018), the level of intensity is set to the maximum level the participant can manage while maintaining the correct lower limb alignment, using the correct technique and desired range of motion.
- Dosage:
    - The exercise programme is divided into two parts, each consisting of four exercises. Part A is completed on a reclined jump trainer (below body weight) and part B uses body weight with or without upper limb support and resistance. There is a 2 min rest break between each part.
    - Each exercise is performed for 2 min (timed by stopwatch).
    - Rest breaks are allowed as required throughout each exercise, being participant or therapist initiated. The participant is encouraged to complete as many repetitions as possible during each exercise, with emphasis on the quality of movement.
    - Recovery time of at least 48 hr between each ballistic exercise session.
- Progression principles (similar to those of Hendrey et al., 2018):
    - First, the aim is to ensure the correct movement pattern is achieved.
    - Second, the speed of movement is increased as a progression once the correct movement pattern is achieved. A metronome provides auditory feedback, with a target speed of 60 beats per min for five of the exercises.
    - Third, increased loads are added as a progression (either by increasing the amount of body weight by increasing the incline or adding external resistance) without altering speed and quality of movement. For exercises in part A (using the jump trainer), resistance is increased by increasing the incline of the leg sled by one increment as marked on the machine (ranging between 30% of body weight at level 1 and 65% of body weight at level 7, using the physiotherapy setting) at a time. Once the maximum incline is achieved (65% of body weight), additional resistance is added using the resistance bands on the jump trainer itself if necessary. Additional resistance of up to 31.75 kg is available through resistance bands integrated within the machine. For exercises in part B (body weight or more), resistance is gradually added by using TheraBand, ankle weights, or a weight-stack pulley system.
- Motivational or prompting strategies:
    - A metronome set at 60 beats per min is used as an auditory prompt to guide the target speed of movement for exercises 2, 3, 5, 6, and 7.
    - A printed and laminated jump height metre provides a visual prompt, combined with verbal feedback on the jump height achieved (every 5 cm represents a different colour, as measured on the jump trainer) for exercises 1 and 4.
    - A moveable yellow line is marked on the floor to mark the longest distance achieved during the bounding exercise (exercise 8).
- Exercise log:
    - Each participant has an exercise log to record the attendance, amount of assistance, load, and any reported adverse effects.
- Use of orthosis (such as knee range of motion brace to prevent knee hyperextension, which allows free knee flexion) or therapist hands-on stabilisation is permitted.

Exercises – Part A

Exercise 1: Double leg jump squats

- Instructions: Go down into a squat and jump as high as you can pushing through your toes (Figure A1).
- Target: Jump height.

Figure A1

Double Leg Jump Squats on Jump Trainer

Exercise 2: Bilateral calf-raises

- Instructions: Rise up onto your toes keeping your knees straight, then lower back down. Rise back up as quickly as you can (Figure A2).
- Target: Movement speed of 60 beats per min.

Figure A2

Bilateral Calf Raises on Jump Trainer

Exercise 3: Double leg extension jumps

- Instructions: Hop on the spot pushing through your toes, while keeping your knees straight. Hop as quickly as possible (Figure A3).
- Target: Movement speed of 60 beats per min.

Figure A3

Double Leg Extension Jumps on Jump Trainer

Exercise 4: Staggered jump squat

- Instructions: Place one foot higher than the other. Go down into a squat and jump as high as you can – alternate your foot position with every jump (Figure A4).
- Target: Jump height.

Figure A4

Staggered Jump Squat on Jump Trainer

Exercises – Part B

Exercise 5: Alternate knee release on mini-trampoline

- Instructions: Bend one knee while keeping the other knee straight and alternate between the two. Your toes should remain in contact with the mini-trampoline at all times. Try to alternate raising each heel as quickly as possible keeping your knees soft (Figure A5).
- Target: Movement speed of 60 beats per min.

Figure A5

Alternate Knee Release on Mini-trampoline

Exercise 6: Scissor jumps on mini-trampoline

- Instructions: Alternate your feet as quickly as possible pushing through your toes, while keeping your knees straight (Figure A6).
- Target: Movement speed of 60 beats per min.

Figure A6

Scissor Jumps on Mini-trampoline

Exercise 7: Hip and knee flexion from extension (affected and less affected leg)

- Instructions: Stand with one leg extended behind you. Keeping hips and back still, bend your hip and knee up as quickly as possible. Switch legs after 1 min (Figure A7).
- Target: Movement speed of 60 beats per min.

Figure A7

Hip and Knee Flexion from Extension

Exercise 8: Bounding (step descent with affected and less affected leg)

- Instructions: Push through one leg and jump as far as you can, coming to land on your other leg. Use the rail for balance if needed, but don’t pull on it. Switch legs after 1 min (Figure A8).
- Target: Bounding distance.

Figure A8

Bounding From a Step

Conservatively Treated Distal Radius Fractures. Who Is Referred?

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ABSTRACT

This was a retrospective review of 394 patients with distal radius fractures referred to hand therapy from a fracture clinic service provided by a 24 hr acute medical care facility. Only those fractures treated conservatively with closed reduction and cast immobilisation were included. Age, gender, and the number of treatments received prior to discharge from hand therapy were identified, as well as whether patients received hand therapy treatment alone or if they were referred for specialist opinion. Men with conservatively managed distal radius fractures received significantly less treatment than women (rate ratio 0.67; 95% confidence interval [0.60–0.75]; $p < 0.001$) and there was a significant difference between the number of treatments received by those who were referred to a specialist and those who were not ($p < 0.001$). Both genders received an increasing number of treatments with age, with a peak in the number of treatments for patients aged 40–60 years, followed by decline. Global trends of an ageing population signal that the incidence of distal radius fracture will continue to increase. The findings of this study suggest relatively low rehabilitation timeframes and treatment numbers for uncomplicated, conservatively managed fractures. Results give some insight as to which patients are accessing rehabilitation post distal radius fracture but further research is warranted to understand the criteria that trigger referral to hand therapy and how best to provide equitable care for men.

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Keywords: Age, Complications, Distal Radius Fracture, Gender, Hand Therapy, Incidence, Treatment

INTRODUCTION

Distal radius fractures (DRF) are one of the most common fractures sustained in the body (Handoll & Elliott, 2015). The top five fracture sites in adults are the distal radius, proximal femur, ankle, proximal humerus, and metacarpals (Bergh et al., 2020). In the elderly population, vertebral, hip, and distal radius fractures make up the three most commonly broken bones (Southerland et al., 2014). New Zealand data suggest that for children aged three to 15 years the incidence of DRF is approximately 20 per day (Jones et al., 2000). Distal radius fractures account for around 25% of fractures in the paediatric population and up to 18% of all fractures in the elderly age group (Nellans et al., 2012).

For reasons not yet fully understood, the incidence of DRF appears to be on the rise. Data from the past 40 years have documented a trend towards an overall increase in the prevalence of this injury (de Putter et al., 2011; Thompson et al., 2004). Population ageing is a global phenomenon and virtually every country in the world is experiencing growth in the number and proportion of older persons in their population (United Nations, 2019). The growth of the elderly population and a rise in the number of active older people are thought to be responsible for the increased incidence of DRF seen in this age group.

The focus of rehabilitation post DRF is to help people achieve the best possible recovery from their injury by restoring range of motion, reducing swelling, pain, and other complications and restoring function. In a cohort of 87,313 patients, researchers found that only 21% of patients received hand therapy (HT) following primary DRF treatment (Trinh et al., 2021). To date, there appears to be no research investigating what criteria is utilised in referral of patients to HT or the number of HT treatments patients are receiving post DRF. The purpose of this study was to analyse the data of patients referred to a HT fracture clinic service for rehabilitation post DRF, with the goal of identifying trends in age, gender, number of treatments received and number of patients referred onwards for specialist opinion.

METHODS

A retrospective review was conducted of patients who were referred to HT from a fracture clinic service provided by a 24 hr acute medical care facility. This multidisciplinary service was provided by emergency medicine specialists, nursing staff and a registered hand therapist. Radiography was available on-site. The period of inclusion was from April 2015 to December 2020. Patients included in the study were those treated conservatively with closed reduction and cast immobilisation. The first HT consult was provided after cast removal and medical review. This appointment was conducted on-site, at the fracture clinic service. Subsequent HT appointments were scheduled at a hand therapy clinic. Patients referred for surgical fixation of their DRF were excluded from this review as they were referred directly to the orthopaedic department at the local public hospital for treatment and follow-up.

Age, gender and the number of treatments received prior to discharge were identified from the data collected. It was also recorded whether patients received only HT or whether they were referred for specialist opinion (orthopaedic or plastic surgeon, or pain specialist). Types of treatment received and patient and/or radiographic outcomes were beyond the scope of this study and were not investigated.

A scatter plot and summary statistics were used to describe the associations between the number and duration of treatments and patient demographics. The categorical variables were tested using logistic regression and continuous variables were assessed using the Wilcoxon Mann Whitney test. Poisson regression was used to further explore these associations, including the effect of age and sex on the mean number of treatments. Natural splines (using the ns() function in R, with knots at the 25th, 50th, and 75th centile of the data) were used to permit flexible specification of the association between age and the outcome of interest. The Akaike Information Criterion was used to identify the most parsimonious model that adequately described the data. Logistic regression was used to explore associations between demographic variables and referral for specialist treatment. A *p* value of < 0.05 was considered statistically significant. Statistical analysis was performed in *R* (version 4.2.2 (2022-10-31)) implemented in the RStudio IDE (2022.07.2 Build 576 for MacOS); figures were produced using the ggplot2 package.

RESULTS

A total of 394 patients with DRF were referred to HT over the study period. Thirty-two percent (*n* = 125) of those referred were male and 68% (*n* = 269) female. Seventy percent of patients referred were over the age of 40 years. Overall 178 (45%) patients were aged 60 years or older, 97 (25%) were between 40 and 59 years of age, 51 (13%) were aged 20–39 years old and 68 (17%) were under the age of 20 (see Table 1). The median number of HT treatments received post DRF was four, with a median treatment duration of 31.5 days or one month. The vast majority of patients (91%, *n* = 359) received HT input only.

Exclusion of those lost to follow-up from data analysis had a negligible effect on associations between age, number of treatments and duration of treatment (see Table 1). A total of 81 patients (20.6%) were lost to follow-up. Of those, 49 (60.5%) did not attend their scheduled follow-up appointment (reason unknown), 15 (18.5%) failed to schedule another appointment, 13 (16%) were referred to a HT clinic in their home town or to a clinic more conveniently located and four (5%) had their treatment disrupted by COVID lockdown and were lost to follow up. A total of 263 patients (66.8%) completed treatment and a further 50 (12.7%) were provided with a splint and home exercise programme and asked to return for review if they had any problems or concerns.

Table 1

Characteristics of Patients with Distal Radius Fracture Referred to Hand Therapy

Variable		*Mdn* [a]	IQR
Patients referred to HT		*n* = 394	
Age (years)		57.0	[31.0, 72.0]
Treatment duration (days)		31.5	[4.0, 73.5]
Number of treatments		4.00	[1.25, 7.00]
Patients referred to HT, excluding those lost to follow-up		*n* = 313	
Age (years)		57.0	[31.0, 72.0]
Treatment duration (days)		31.5	[4.5, 73.5]
Number of treatments		4.00	[2.00, 7.00]
HT appointments prior to specialist review [b]		8.00	[6.00, 12.00]
HT appointments after specialist review [b]		1.00	[0.00, 4.00]
		n	%
Referred to specialist		35	8.9
Referred to HT only		359	91.1
Gender (*n* = 394)			
All patients	Female	269	68.3
	Male	125	31.7
< 20 years (17%)	Female	30	7.6
	Male	38	9.6
20–39 years (13%)	Female	23	5.8
	Male	28	7.1
40–59 years (25%)	Female	69	17.5
	Male	28	7.1
> 60 years (45%)	Female	146	37.1
	Male	32	8.1

Note. HT = hand therapy; IQR = interquartile range.

[a] Except where indicated. [b] Only refers to patients who were referred for specialist review (*n* = 35).

Table 2 summarises cohort characteristics according to loss to follow-up status. There was no association between lost to follow-up status and age ($p = 0.50$) or gender ($p = 0.38$). As expected, there was strong evidence that those lost to follow-up received fewer treatments ($p < 0.001$) and had a shorter duration of treatment ($p < 0.001$). The median number of treatments received by those lost to follow up was 1.00 [interquartile range (IQR) 1.00, 2.00] compared to 5.00 [IQR 3.00, 7.00] for those completing treatment and median treatment duration was 1.00 [IQR 1.00, 10.00] versus 45.00 [IQR 17.00, 93.00] days.

Thirty-five (8.9%) patients were referred onwards for specialist opinion. The three most common conditions that required referral were carpal tunnel syndrome (*n* = 10), ulnar sided wrist pathology (*n* = 8), and post-traumatic de Quervain's tenosynovitis (*n* = 4). Others included complex regional pain syndrome (CRPS) (*n* = 3), first carpometacarpal joint aggravation (*n* = 3), trigger finger (*n* = 2), and one case each of extensor pollicis longus rupture, flexor pollicis longus rupture, scapholunate ligament high grade tear and loss of forearm supination.

There was a significant difference between the number of HT treatments received by those who were referred to a specialist and those who were not ($p < 0.001$). Patients who required specialist opinion received four times more treatment than those who did not (see Table 3). The median number of treatments received by patients who received HT input only was 3 (range 1–27). The median number of treatments of patients referred for specialist opinion was 12 (range 4–50). Time to discharge from HT was also significantly longer for those referred to a specialist (138 days) compared to those who were not (28 days) ($p < 0.001$). The median age of those receiving HT alone was 57 years [IQR 27.5, 72.0], while the median age of those referred to a specialist was 60 years [IQR 51.5, 73.5] ($p = 0.13$). Female patients accounted for 66.9% (*n* = 240) of patients receiving HT only and 82.9% (*n* = 29) ($p = 0.08$) of those referred for specialist opinion. Male patients accounted for 33.1% (*n* = 119) of those receiving HT alone and 17.1% (*n* = 6) ($p = 0.06$) of those referred to a specialist. Therefore, no statistically significant difference was identified in the age and gender of those referred to a specialist versus those who were not.

Table 2

Cohort Characteristics According to Loss to Follow-up Status

Variable		Not lost to follow-up (*n* = 313)		Lost to follow-up (*n* = 81)		*p*
		Mdn [a]	IQR	*Mdn* [a]	IQR	
Age (years)		58.0	[31.0, 72.0]	54.0	[27.0, 73.0]	0.50
Gender, *n* (%)	Female	217 (69.3)		52 (64.2)		0.38
	Male	96 (30.7)		29 (35.8)		
Treatment duration (days)		45.00	[17.00, 93.00]	1.00	[1.00, 10.00]	< 0.001
Number of treatments		5.00	[3.00, 7.00]	1.00	[1.00, 2.00]	< 0.001

Note. IQR = interquartile range.

[a] Except where indicated.

Table 3

Comparison of Patients Treated by Hand Therapy Alone Versus Specialist Referral

Variable		Referred to specialist				*p*
		No (*n* = 359)		Yes (*n* = 35)		
		Mdn [a]	IQR	*Mdn* [a]	IQR	
Age (years)		57.0	[27.5, 72.0]	60.0	[51.5, 73.5]	0.13
Gender, *n* (%)	Female	240 (66.9)		29 (82.9)		0.08
	Male	119 (33.1)		6 (17.1)		0.06
Treatment duration (days)		28.0	[1.0, 60.0]	138.0	[100.5, 234.0]	< 0.001
Number of treatments		3.0	[1.0, 6.0]	12.00	[7.0, 14.5]	< 0.001

Note. IQR = interquartile range.

[a] Except where indicated.

A non-linear association between age and the number of treatments is displayed in Figure 1, showing gender and mean number of HT treatments received with 95% confidence intervals, based on the natural spline model. Both male and female patients show an increasing number of treatments with age, with a peak in number of treatments between 40 and 60 years of age, followed by a decline. This was supported by the data in Table 4, which show that the median number of treatments peaks at approximately 8.0 for women between the age of 40–50 years, and at 5.4 for men in the 50–60 years of age category.

There was strong evidence of a difference in the number of treatments according to gender, with male patients receiving an average of 33% fewer treatments than females (rate ratio 0.67; 95% confidence interval [0.60–0.75]; $p < 0.001$). Treatment numbers received by age group and gender are displayed in Table 4. The mean number of treatments received was higher in female patients versus male patients for every age range (e.g., 6.4 versus 3.2 in the 20–30 age group). The number of HT treatments received post DRF was highly correlated with duration of treatment (see Figure 2).

DISCUSSION

Patients over the age of 60 years were the largest group to be referred to HT for rehabilitation post DRF, accounting for 45% of study participants (37% female, 8% male). Women are known to have a significantly greater risk of sustaining this injury than men in the over 65 age group (Baron et al., 1996; Handoll & Elliott, 2015). Research has also shown that women over 65 years are almost five times more likely than men to sustain a DRF (Baron et al., 1996; Brogen et al., 2007; Raudasoja et al., 2022). Results of this study support these findings, showing that in the over 60 age group women referred for HT outnumbered men by 4.6 to 1, which matches published incidence rates.

Figure 1

Gender and Mean Number of Treatments Received

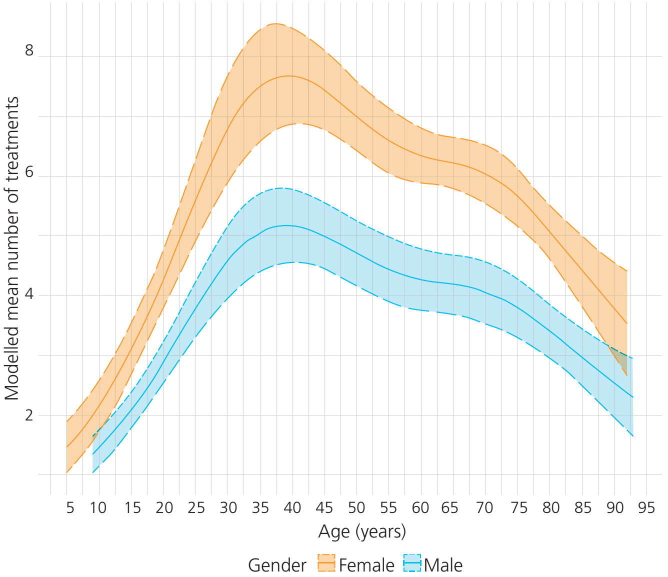

Figure 2

Number of Treatments Versus Duration of Treatment

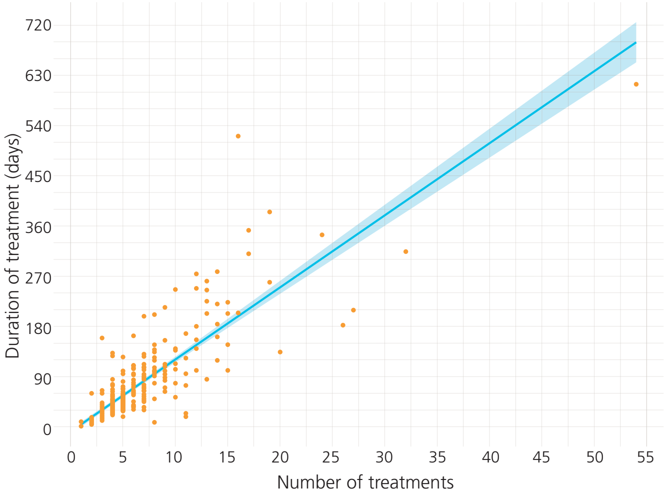

Table 4

Comparison of Gender, Age, and Number of Treatments to Discharge From Hand Therapy

Age (years)	Female				Male			
	M	*Mdn*	25th percentile	75th percentile	*M*	*Mdn*	25th percentile	75th percentile
0–10	1.40	1	1	1.75	1.00	1	1	1
10–20	2.96	2	1	3.5	2.37	1	1	3
20–30	6.36	6	3	9.5	3.18	3	2.5	4
30–40	4.75	4	2	5.75	4.56	3.5	1	6
40–50	8.05	4	3	6.25	3.63	3	2.75	3.25
50–60	6.58	4.5	2	9	5.38	6	3	7
60–70	6.43	6	3	8	3.33	3	2	4
70–80	5.57	5	2	8	4.62	3	1	8
80–90	4.44	4	3	6	1.67	1	1	1
90+	2.00	1.5	1	2.5	1.00	1	1	1

Men in this study received significantly fewer treatments than women across all age groups and while the reasons for this are not clear, one hypothesis is that men have less severe fractures, meaning they are quicker to recover. Research results are inconclusive. A study by Brogen et al. (2007) utilising the AO fracture classification found that the Type-A simple extra-articular fractures accounted for 79% of the fractures in women and 64% in men. This would seem to indicate women are more likely to sustain simple extra-articular fractures versus their male counterparts. In comparison, Harper et al. (2014) found that men sustained less severe fractures than women (a Type-C fracture rate of 20% for men compared with 40% for women; $p = 0.014$). However, Type-C fractures (complete articular) are generally treated by open reduction and internal fixation (Twigt et al., 2013) and patients with these fractures would not have been included in this study. Future research could further explore fracture classification by gender, treatment (conservative versus surgical management), complication rate, patient outcomes and time to discharge.

Another hypothesis is that men with DRF are under-treated. Research has shown that significantly fewer men (over the age of 50 years) receive evaluation for osteoporosis following a DRF, with rates of evaluation unacceptably low according to published guidelines (Harper et al., 2014; Trinh et al., 2021). While 53% of the women had a bone density scan after injury, only 18% of the men were evaluated ($p < 0.001$) (Harper et al., 2014). Not only are men under-screened for osteoporosis compared with women, but they are also less likely to receive medical treatment for osteoporosis (Alswat, 2017). This is of concern because DRF in the active elderly population can signal underlying osteoporosis and presents a perfect opportunity for screening and intervention. As clinicians striving to achieve equitable and fair treatment, it is important to be aware of this imbalance.

Twenty percent (n = 81) of patients in this study were lost to follow-up. Of those, 80% received only one treatment (60.5% did not attend their scheduled follow-up appointment and 18.5% failed to schedule another appointment). Therefore, it would appear that loss to follow-up will most likely occur after the initial consult. Data show that 16% of those lost to follow-up were referred to a HT clinic in their hometown or to one more conveniently located to their home or place of work, but it is not known is how many of the patients who failed to attend a scheduled follow-up went on to receive further HT or physiotherapy input from another clinic. Further research could help identify whether these patients went on to self-manage their rehabilitation or if they sought follow-up elsewhere.

Results of this study show that both genders received an increasing number of treatments with age, with a peak in number of treatments in middle age, followed by a decline (Figure 1). Those under 20 years of age are rarely referred to HT and appear to require and receive very little treatment. A peak in treatment numbers that occurs between the ages of 40 to 60 years (Figure 1, Table 4) likely correlates with active, working adults who are still heavy users of their hands. This group may be more invested in rehabilitation of their injury for practical reasons such as work, sport and participation in activity. As patients become more elderly, they tend to place less functional demand on their wrists. While elderly patients may take longer to heal and recover following fracture, their functional demands are less, so they appear to receive less rehabilitation.

A small number of patients required significantly more HT treatment post DRF, due to complications. A total of 8.9% of patients referred to HT post DRF required a specialist opinion. These patients received on average four times more treatment, over a much longer period (138 days) than those who did not need specialist input (28 days). The higher percentage of women referred for specialist review of complications reflects existing data that middle-aged women are more likely to be affected by carpal tunnel syndrome (Stephenson & Barry, 2014), trigger digits (Jeanmonod et al., 2022) and de Quervain's tenosynovitis (Sheppard & Barry, 2014). Therefore, it would be difficult to conclude whether these were all complications of the DRF or occurred through natural causes.

A report published by the Accident Compensation Corporation (ACC) states that carpal tunnel syndrome has an estimated prevalence in the general population of 3.7–5.8% and may be up to three times more common in women than men, with the prevalence highest in the 40–55-year-old age group (Stephenson & Barry, 2014). The incidence of acute carpal tunnel syndrome post DRF has been reported in the literature as affecting 4.3% of patients (Leow et al., 2021). In the current study the incidence of patients with carpal tunnel syndrome referred to a specialist was 2.5% ($n = 10$; out of 394 total). The total incidence of acute carpal tunnel syndrome may have been higher as night splinting can be sufficient treatment for some patients with nocturnal symptoms (Halac et al., 2015; Lewis et al., 2020). Therefore, this incidence represents only those patients who did not respond to night splinting and conservative management, requiring onward referral to a specialist. Failure to record total incidence of acute carpal tunnel syndrome is a limitation of this study.

A study by Pons (2019) of the physiotherapy management of CRPS found that fractures were the inciting event for CRPS in 42% of patients, followed by soft tissue injury (36%), and surgery (21%). The incidence of CRPS reported in this study was low (0.8%). The estimates of the incidence of CRPS after radius fracture vary widely, from 1% to 37% (Dijkstra et al., 2003; Jellad et al., 2014; Mathews & Chung, 2015; Sane et al., 2021). The fracture clinic service in this study follows guidelines published by Gillespie et al. (2016). In that study a hospital department reduced the incidence of CRPS post DRF from 25% to less than 1% through staff and patient awareness, vigilance for warning signs and minor modifications to the traditional management of DRF. These include avoiding excessive or unnecessary immobilisation, ensuring that plasters are well-fitting and there is no restriction to metacarpophalangeal joints, hourly full range composite grip/release exercises to control swelling in elevation, light function and attention to limb while in plaster, supporting all verbal information given with a patient information leaflet, documentation of advice given in patient notes, change of cast for patients reporting tight and/or restrictive plasters and patients requesting repeated change of plaster or reporting "claustrophobia in plaster" to trigger immediate referral to HT. It was not the purpose of this study to investigate CRPS post DRF, but adherence to published guidelines (Gillespie et al., 2016) appears to have reproduced a similar (low) incidence of CRPS.

Opportunities for further research

This study has raised many questions. Men in this study received significantly less (33% less) HT treatment post DRF. Further research could look towards the experiences of men in a HT treatment setting to further inform clinicians of disparities that may exist. Potential contributing factors to consider include availability of appointment times outside of working hours, ability to attend appointments during working hours and a "she'll be right" attitude – a frequently used idiom in New Zealand culture that expresses the belief that "whatever is wrong will right itself with time" (Keyworth, 1990).

During the time of the COVID-19 pandemic, stress placed on health systems globally caused some to recommend that all DRFs be treated conservatively (non-operatively), irrespective of the fracture geometry or age of the patient and to question the feasibility and/or need for physiotherapy sessions for non-life-threatening fractures like DRF (Bhan et al., 2021). There are no highly powered studies to support this recommendation and no studies on the long-term impact, outcomes, or complications resulting from treating all fractures this way. However, it is well recognised that DRF can result in long-term functional impairment, pain, and deformity (Edwards et al., 2010; Handoll & Elliott, 2015). This study identified that an average of four HT treatments were received post DRF, with an average treatment duration of 31.5 days. This reflects relatively low rehabilitation timeframes and treatment numbers for uncomplicated DRFs and is important to present to external stakeholders (such as ACC and accredited employers) in order to advocate for HT services. Should future research be undertaken that replicates these results, it would add to strength of evidence.

It has been reported that only 21% of patients receive HT after primary DRF treatment (Trinh et al., 2021). The percentage of patients referred to HT via fracture clinic was not able to be established in this study and there was no definitive criteria triggering referral to HT. Referral was at the discretion of the attending emergency medicine specialist. Criteria triggering referral to HT could include high pain scores, swelling, reduced active range of motion, the requirement for further splint support, suspicion of early CRPS or reduced function on removal of cast. Further studies could investigate what percentage of patients are referred to HT post DRF and identify the triggers/criteria for referral.

The majority of DRFs are treated conservatively with closed reduction and cast immobilisation (Lee et al., 2019; Rundgren et al., 2020). Surgical treatment commonly involves open reduction and internal fixation for difficult to reduce, or unstable fractures (Lee et al., 2019). Future research could establish HT treatment numbers and duration for patients treated surgically with open reduction and internal fixation and compare them with the results of HT treatments received following closed reduction of DRF. In addition, further research into the duration of cast immobilisation periods could be analysed with regards to the number of treatments received and time to discharge from HT.

A Cochrane review (Handoll & Elliott, 2015) states there is currently insufficient evidence from randomised controlled trials to determine how best to manage rehabilitation following DRF. It is yet to be determined what rehabilitation intervention is necessary, who should provide this care, how long this care should be provided for or in what circumstances it should be provided. Further research could investigate the outcomes of patient groups managed by HT versus physiotherapy versus no treatment. While it was beyond the scope of this study to investigate the types of treatment provided and patient outcomes at discharge, the results give insight as to which patients are accessing rehabilitation post DRF, the average duration of treatment received and variables affecting duration of treatment.

Limitations

This study was conducted at a single site, and it may not be possible to generalise the results to other 24 hr acute medical care clinics across New Zealand, which have different patient demographics.

Referral onwards to a specialist was at the discretion of the treating therapist. This could have led to unintended biases in decision-making or implicit bias. Research suggests that implicit bias can contribute to health care disparities by shaping physician behaviour and producing differences in medical treatment along the lines of race, ethnicity, gender or other characteristics (Chapman, 2013). A study by Harris et al. (2018) found implicit and explicit ethnic bias favouring New Zealand Europeans was apparent among medical students, although overall this was not associated with clinical decision-making. Race and ethnicity were not tracked variables in this study.

A high percentage of patients were lost to follow-up (20.6%). The outcomes for these patients is unknown. Patients who missed scheduled appointments were sent a message and asked to reschedule. A telephone call to these patients may have reduced the number lost to follow-up. Similarly, there was no record of how many patients cancelled appointments because they had returned to a functional status and treatment was no longer required. Recording reasons for cancellation would have helped establish reasons patients were lost to follow-up.

The total incidence of patients presenting with acute carpal tunnel syndrome following DRF was not recorded; rather the incidence reported here represents only those who required referral to a specialist. The neural symptoms of some patients will have settled with night splinting alone. Hence, this was a limitation of the study that could have been addressed by recording incidence of all patients presenting with median neuropathy on removal of cast post DRF and comparing it with those later requiring referral to a specialist.

Types of treatment received were not investigated in this study. However, the higher percentage of women referred for specialist review of complications post DRF reflects existing data that middle-aged women are more likely to experience comorbidity such as carpal tunnel syndrome, first carpometacarpal osteoarthritis, trigger digits and de Quervain's tenosynovitis. Treatment for associated sequelae would increase treatment numbers and skew data in regard to rehabilitation from DRF. This is a potential confounder to the study results.

Similarly, the fact that men received significantly less treatment post DRF could be attributable to the fact middle-aged women experience more comorbidities such as carpal tunnel syndrome. However, men received less treatment across all age brackets and not just from middle age onwards, which indicates that comorbidity alone cannot account for the differences found.

CONCLUSION

The highest number of referrals to HT from the fracture clinic following DRF were women over the age of 60 years. The number of treatments received peaked in the middle-aged population (40–60 years) and gradually declined with age. Men receive significantly less (33%) treatment post DRF among all age groups. A small percentage of patients with complications post DRF (8.9%) required significantly more rehabilitation, over a longer period.

Global trends of an ageing population signal that the incidence of DRF will continue to increase. Despite acknowledgment that these injuries can result in long-term functional impairment, pain and deformity, the pressure placed on health systems globally has resulted in some questioning the need for physiotherapy sessions for non-life-threatening fractures like DRF. The relatively low rehabilitation timeframes and treatment numbers provided by HT for uncomplicated DRFs in this study indicates timely and cost-effective intervention to our external stakeholders. The results give insight as to which patients are accessing rehabilitation post DRF, the average duration of treatment received, and variables affecting duration of treatment. Further research is required to understand the criteria that trigger referral to HT and how best to provide equitable care for men.

KEY POINTS

1. Sixty-eight percent of patients referred to HT post DRF were female and 70% of all patients referred were over the age of 40 years.
2. The median number of treatments received was 4 and median treatment duration was 31.5 days.
3. Men received significantly less (33%) treatment than women across all age groups.
4. Nine percent of those referred to HT had complications requiring specialist referral. These patients received on average four times more treatment, over a much longer time period (138 days).

DISCLOSURES

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PERMISSIONS

Observational study (retrospective review). Out of scope and not requiring ethical approval.

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Drivers and Barriers to the Development of Musculoskeletal Advanced Physiotherapy Practitioner Roles in New Zealand

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ABSTRACT

Faced with the burden of musculoskeletal care in New Zealand, this study explores 19 participants' views on the drivers and barriers to developing musculoskeletal advanced physiotherapy practitioner (APP) roles in New Zealand. An exploratory case study methodology was applied, and semi-structured interviews were conducted as one of the multiple data sources. A purposive sampling strategy was used. Data were analysed using qualitative content analysis. This publication primarily focuses on the results of the semi-structured interviews. The results of this research identify unique drivers for the APP role development in the New Zealand context, such as surgeon engagement, legislative requirements, and profession-led issues, in addition to global drivers. Interviewees identified that the barriers relate to New Zealand's dual healthcare system and its nuances that impact patients and physiotherapists. Additional barriers include a lack of title and recognition, funding and career pathway, training, and inter-professional and intra-professional barriers. This research explores the reasons for the limited uptake of APP roles in the New Zealand context despite strong drivers. Interviewees advocate the development of APP roles as first-contact practitioners for patients presenting with musculoskeletal complaints to improve patient journey, streamline services, and provide timely, effective, and efficient care. They recommend that APP roles are tailored to meet New Zealand's unique healthcare drivers.

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Key Words: Advanced Physiotherapy Practitioner, Barriers, Drivers, Role Development, New Zealand, Qualitative Study

INTRODUCTION

Musculoskeletal conditions are the world's fourth-largest disease burden (Briggs et al., 2016). They represent 12% of the non-communicable diseases in New Zealand (Ministry of Health, 2020b), affecting one in four New Zealanders (Bossley & Miles, 2009) and accounting for 23% of New Zealand's total annual health spending (Deloitte Access Economics, 2018). Research highlights that 59% of health expenditure is related to non-communicable diseases, and neurological and musculoskeletal conditions contribute to the largest healthcare costs and morbidity (Blakely et al., 2019). The New Zealand healthcare system has significant ongoing challenges in delivering equitable and consistent care within its current resources (Ministry of Health, 2020a). These challenges are driven by increasing demand for healthcare due to several factors, such as economic constraints, workforce shortages, health inequalities, an increasingly ageing population living with long-term conditions, and new expensive technologies and medications (Ministry of Health, 2016).

The current management strategies for long-term conditions such as arthritis can sometimes result in unnecessary investigations and hospitalisation (National Health Committee, 2015). Globally, the same drivers have prompted a rethink of the approaches to improve access to care and reduce the burden of musculoskeletal disease. One such strategy is the establishment of an advanced physiotherapy practitioner (APP), who has been employed to reduce waiting times for medical consultations and improve the cost-effectiveness of services (Hussenbux et al., 2015; Trøstrup et al., 2020). International literature covers (Marks et al., 2017; Thompson et al., 2017; Trøstrup et al., 2020) multiple facets of this role; however, little is known about the APP role development in the New Zealand context.

APP terminology

There is ambiguity around the terminology used to describe APP roles. The most common terms, "APP" and "extended scope practitioner" (ESP), are often used interchangeably (World Physiotherapy, 2019). The term advanced physiotherapy practitioner (APP) will be used for this paper, as this is the most prevalent term used worldwide. However, it should be noted that the term advanced practice physiotherapist, as per the Physiotherapy Board of New Zealand (PBNZ) scope of practice will be spelt out in full to avoid confusion.

International context and APP roles

The United Kingdom (UK) has been a forerunner in developing the APP role (Blackburn et al., 2009). In the 1980s, APP roles naturally evolved, initially due to the collaborative work with orthopaedic surgeons in the National Health Service in an attempt to manage long waiting lists and free up surgeon time to perform more surgery (Byles & Ling, 1989; Hockin & Bannister, 1994). This role was later underpinned by health legislation (injection, prescribing) changes and government policies. In the UK, the APP roles are more prevalent in orthopaedics, rheumatology, and musculoskeletal settings than other sub-specialities within physiotherapy, such as cardiorespiratory, neurology, or pelvic health (Burn & Beeson, 2014). Australia has developed APP roles primarily in the emergency department and musculoskeletal settings (Crane & Delany, 2013; Morris et al., 2015). In Canada, APP roles have evolved in arthritis care management, joint arthroplasty, and orthopaedic triage (Desmeules et al., 2012; Norman et al., 2015).

Internationally, APPs can undertake advanced clinical practice and manage complex case workloads across various settings (Chartered Society of Physiotherapy, 2016; National Health Service, 2017). APPs possess the clinical skills and capability required to act as first specialist assessors for musculoskeletal conditions (de Gruchy et al., 2015; Marks et al., 2017). In the UK, APP clinicians can autonomously request radiological investigations and blood tests, inject, prescribe, and refer patients for appropriate specialist assessments, such as orthopaedics, rheumatology, and neurology (Durrell, 1996; Marks et al., 2017). However, the scope of practice of an APP in Canada and Australia is dependent on their jurisdictional legislative regulations (Martinello et al., 2017).

Research into APP roles suggests that instigating the APP role within a secondary or primary care framework allows health sectors to access clinically effective, cost-efficient services, deliver appropriate healthcare, and meet health targets (Goodwin & Hendrick, 2016; Oakley & Shacklady, 2015). Studies suggest that APPs are 88% clinically concordant with their medical colleagues (diagnosis, investigative choices, and management options) (Desmeules et al., 2013), and they can direct the entire spectrum of care from triage to discharge (Burn & Beeson, 2014; Thompson et al., 2017). These roles have also been shown to reduce waiting times by 26%–87% (Hussenbux et al., 2015; Razmjou et al., 2013; Trøstrup et al., 2020). Additionally, patient satisfaction with these roles was reported to be high across many musculoskeletal service settings (Thompson et al., 2017; Trøstrup et al., 2020).

New Zealand health context and physiotherapy

Since 1938, New Zealand has offered government-funded healthcare. State-owned hospitals deliver public hospital services through the entity of Te Whatu Ora – Health New Zealand. This entity was developed in 2022 by combining all the District Health Boards (DHB) in New Zealand (Ministry of Health, 2022). In contrast, primary health services are provided by self-employed private practitioners (e.g., GPs, physiotherapists) (Ashton et al., 2005). Consequently, the health system in New Zealand is dichotomous (a situation unique to New Zealand), commonly described as a “dual system”, in which hospital care is predominantly publicly funded by the Ministry of Health, and primary care is mainly private, albeit subsidised by the Ministry of Health (Starke, 2010). New Zealand has another unique entity embedded within its healthcare system: the Accident Compensation Corporation (ACC). ACC was established in 1974 as a no-fault accident compensation scheme for work and personal injuries sustained in New Zealand, and is a quasi-government social insurance scheme predominantly funded by employer levies (McNaughton & McPherson, 2000). Other schemes, like the accredited employer scheme, also deliver injury compensation and rehabilitation.

In the current model of musculoskeletal healthcare delivery in New Zealand, patients with a diagnosis of injury-related care are generally referred to ACC. Patients managed under the ACC scheme have been shown to have shorter waiting times for their specialist assessments and treatment than those not covered by the Act, as they can access care through the private sector (Accident Compensation Corporation, 2022, 2023a, 2023b). In contrast, non-accident-related conditions such as osteoarthritis are managed through Te Whatu Ora and experience longer waiting times (National Health Committee, 2015). Referrers choose multiple pathways and providers, resulting in multiple entry points into the Te Whatu Ora system. Patients referred to the orthopaedic surgeons in Te Whatu Ora have sometimes failed to optimise conservative treatment to its fullest potential (Abbott et al., 2022); hence, they are allocated low priority for orthopaedic assessment. This leads to increasing volumes of patients on a waiting list to see a surgeon, where surgery may not be the best option (Abbott et al., 2022). Waitlists cause inefficiencies in service delivery and adds to the chronicity of symptoms.

Workforce analysis in New Zealand indicates that 58% of physiotherapists work in the private sector as primary care providers, 25% work in the public sector, and 17%, work in academia and other institutions (Reid & Dixon, 2018). Physiotherapists working in the private sector have a significant part of their work funded by ACC (Reid & Larmer, 2007).

The fundamental role of the Physiotherapy Board of New Zealand (PBNZ) is to define scopes of practice and regulate the physiotherapy profession to safeguard the public. The PBNZ currently recognises three scopes of physiotherapy practice (generalist, specialist, and advanced practice physiotherapist scope) based on key competencies. Until 2012, all physiotherapists had a generalist scope of practice. The New Zealand College of Physiotherapy was created in 1989 to promote and coordinate continuing education for physiotherapists and establish a route to specialisation in physiotherapy. The New Zealand College of Physiotherapy membership comprised accredited APPs, honorary life members, and fellows. This entity dissolved in 2015. The PBNZ then undertook the work on the specialisation that originated with the New Zealand College of Physiotherapy, and the physiotherapy "specialist scope" was gazetted in 2012. Specialists are accredited by the PBNZ depending on their clinical, leadership, and research competencies. The PBNZ approved the advanced practice physiotherapist scope in October 2020 and created its key competencies in 2022 (Physiotherapy Board of New Zealand, 2020, 2023b). Of the 7,556 physiotherapists registered with the PBNZ on 1 April 2022, 13 were registered as specialists, but currently, the PBNZ has no registered advanced practice physiotherapists (Physiotherapy Board of New Zealand, 2022).

Rationale for study

There is little published literature on APP roles and delivery models in the various service sectors in New Zealand. Generally, these roles appear to have been created on an ad-hoc basis, depending on individual organisational needs and funding (Naik, 2016, 2021). APP roles were first piloted in a public hospital in New Zealand in 2002 (Hames & Exton, 2010) to assist orthopaedic services in reducing their spinal waiting lists. The *Musculoskeletal Workforce Service Review* in 2011 (Ministry of Health, 2014) also recommended the development of APP roles to improve musculoskeletal healthcare delivery; however, none have been established to date. It is unclear why these roles have not gained traction in New Zealand. Therefore, this study explored the *drivers and barriers to the development and recognition of APP roles in New Zealand.* A better understanding of drivers and barriers will facilitate the establishment of APP roles and reap the benefits reported from analysis of the impact of these roles in other countries.

METHODS

Ethical approval was granted by Auckland University of Technology Ethics Committee (reference 19/141).

Methodology

A case study methodology was chosen (Merriam & Tisdell, 2016; Yin, 2018). Semi-structured interviews were utilised as one of the multiple data sources. This multi-perspective, in-depth approach enabled the researcher to interpret multiple realities and construct meaning from participant voices (Sandelowski, 1995).

Reflexivity

The research team comprised an orthopaedic physiotherapy practitioner, who was the first author and completed this research in partial fulfilment of her doctoral studies (LN), a professor of physiotherapy (DR), a senior lecturer in physiotherapy (SW), and a professor of nursing (SN). LN has lived experience of APP roles, having worked in two countries in a similar role. The academic physiotherapy team provided insights into the content of the APP role, whereas the academic nursing author provided qualitative research experience and support with methodology. Research meetings and information sharing enabled discussion, sharing of perspectives, and drawing of threads shaping the data interpretation and development of insightful rich analysis.

Sampling

Purposive sampling was chosen to identify participants who would best contribute to the research question's complexity, depth, and context surrounding the phenomenon. Participants were chosen to provide a broad perspective on the APP role and included those implementing (for their lived-in experiences), influencing, legislating, or providing governance to the role. Two cohorts of participants, group A (physiotherapists) and group B (stakeholders), were selected based on the inclusion/exclusion criteria in Table 1.

Recruitment

Semi-structured interviews were conducted with an initial 20 participants; however, one dropped out due to perceived risk of identification, leaving a final sample of 19. Physiotherapy New Zealand (PNZ) advertised the research to New Zealand College of Physiotherapy accredited APPs. PBNZ specialists were approached directly. The DHB leadership special interest group were asked to advertise the research to their members. Some participants also suggested suitable participants to interview.

Table 1

Inclusion and Exclusion Criteria

Group A – Physiotherapists	Group B – Stakeholders
Inclusion criteria	
Consenting physiotherapists with current PBNZ annual practising certificate. All PBNZ accredited musculoskeletal specialist physiotherapists. Physiotherapists accredited by the former COP as musculoskeletal APP. The generalist physiotherapists working in APP roles or undertaking an extended or advanced practice.	Consenting stakeholders. Medical or surgical clinicians working alongside APP roles. Managers of health services, ACC with knowledge of their individualised services and knowledge of APP roles. Representatives of the legislative or professional physiotherapy body with knowledge of their individualised services and APP roles.
Exclusion criteria	
Medical consultants and DHB managers from the organisation that the researcher worked for to avoid any conflict of interest. Other allied health professionals who were not physiotherapists.	

Note. ACC = Accident Compensation Corporation; APP = advanced physiotherapy practitioner; COP = College of Physiotherapy; DHB = District Health Board; PBNZ = Physiotherapy Board of New Zealand.

A participant information sheet (detailing the background of LN and credentials of coauthors, the purpose for conducting research and sampling, the process of participation and withdrawal, research process, and protection of privacy and confidentiality) and a consent form were provided to each participant before the interview. All participants signed their consent forms.

An interview protocol template was designed by LN and discussed with the rest of the research team. This protocol template was utilised to ensure all aspects of the interview were covered (including the completion of the consent form and the interviewee's consent for recording the interview) (Appendix A). Questions were designed by LN and discussed with the research team to capture the multiple facets within the APP role (inclusive of: knowledge of current literature, the current practice of APP clinicians in New Zealand, participants' opinions on the advanced scope of practice, training requirements for APP role, recognition and career pathway, governance, and niche for the APP role).

Five in-person interviews were carried out in the interviewee's workplace, and 14 individual interviews were conducted with a video conferencing service (either Skype or Zoom). Interviews lasted 60–90 min. In person interviews were recorded using audio recording, and video conferencing interviews were recorded using audio and visual recording. The video recording was deleted after transcription. Two initial pilot interviews were included in the final data. LN transcribed the interviews, and the transcripts and coding were shared with the other three researchers. The interview transcripts were returned to the interviewees for review. Interviewees checked these to verify that the transcripts were accurate interview records both contextually and literally. LN kept a diary to note specific characteristics, information, and inferences that guided the interpretation of findings. Data saturation was reached when participants reiterated concepts; therefore, further data collection was deemed unlikely to add new insights. Participants' data were anonymised (due to the small sample size and risk of identification in a small country) using pseudonyms for data analysis. The Consolidated Criteria for Reporting Qualitative Studies (COREQ) (Tong et al., 2007) was used to demonstrate all requisite qualitative details of research are noted.

Analysis

Data analysis utilised an interpretivist approach to understand the socially constructed meaning of the APP role in its current context based on local and international knowledge while recognising the evolutionary changes in New Zealand (Sandelowski, 1995, 2000). Data were analysed using qualitative content analysis (Priest et al., 2002). Qualitative content analysis involves condensing and distilling qualitative data into categories based on valid inferences and interpretations. It uses the process of inductive reasoning and constant comparison that enables the researcher to develop categories and themes. Data were coded by LN using Graneheim et al.'s (2017) template. The use of the template enabled the researcher to make transparent the process of deriving the results from the raw data. LN shared the coded data and derived categories with the whole research team. The team's insight and collective knowledge contributed to the inductive and deductive interpretation of the findings.

The data underwent two cycles of coding, distillation, and condensation before three overarching categories and sub-categories were derived. The categories were created to capture the drivers and barriers to APP role at strategic, organisational, and professional levels.

RESULTS

Out of the 19 participants included in the study, 14 were physiotherapists (six specialists accredited by PBNZ, two were New Zealand College of Physiotherapy accredited APPs (note that this accreditation system is now obsolete), two physiotherapists from sports, one from the emergency department, and three from musculoskeletal outpatient settings). Five participants were stakeholders (a surgeon, sports medicine specialist, ACC manager, and one representative each from PBNZ and PNZ. Quotes from participants have been categorised into APPs (all of who were generalist physiotherapists working in an advanced role), New Zealand College of Physiotherapy APPs, Physiotherapy Board of New Zealand designated specialists (Physiotherapy Specialist) and stakeholders (ST).

Findings related to sub-categories drivers and barriers for APP role in New Zealand were spread across the three categories: "workforce development", "service development", and "professional development", as seen in Figure 1.

Workforce development

The *workforce development* category addresses APP workforce development and alignment with the strategic drivers. Workforce development is driven by healthcare expenditure, service demand, workforce shortages, and an inadequate skill mix (Ministry of Health, 2006). The key drivers within the category workforce development relate to improvement in patient outcomes, access to care, strategic drivers, and legislative drivers. The barriers within this category relate to the duality of the health system and its impact on physiotherapists and patients.

Improvement in patient outcomes

A dominant theme from the interviews focused on developing APP roles as an important area of workforce growth in New Zealand to help reduce wait times for orthopaedic services. There was consensus on the need to deliver clinically effective, cost-effective, accessible, and timely healthcare to patients. Some ($n = 6$) PBNZ specialists and New Zealand College of Physiotherapy APPs stated that decreasing waiting times (from the onset of symptoms to access appropriate healthcare) reduced downstream effects on patients, such as disability, pain, time off work, and psychosocial impact. Most ($n = 17$) interviewees emphasised that seeing the right clinician in a timely manner improved patient outcomes and experience.

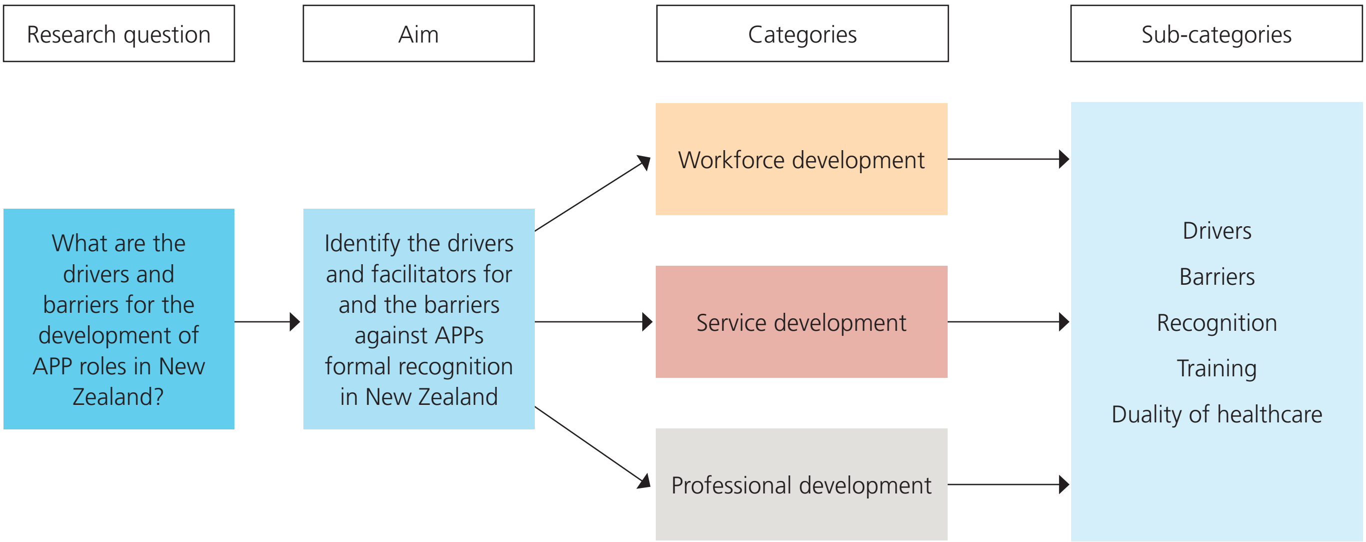
> Where can we and what can we do to lead to a significant piece of [patient] outcomes? So, whether that is an improvement in the timeliness of services they receive, workforce gap, the quality of care, or better outcomes. (ST5)

Access to care

Some ($n = 6$) interviewees acknowledged that due to the geography of New Zealand and workforce shortages of orthopaedic specialists, long waiting lists affected early

Figure 1

Diagram of Research Question, Its Aim, Development of Categories and Sub-categories



and timely access to musculoskeletal care. The two medical stakeholders working with an APP and a New Zealand College of Physiotherapy APP respectively, recognised the added value they provided due to their unique clinical and communication skill sets and ability to manage care across various settings. These interviewees perceived the clinical skills of the APP as equivalent to a senior registrar and that the APPs would provide timely non-surgical care to patients until they required surgical intervention.

> Not so much in Auckland, but there is a long wait to see the orthopaedic specialists in other parts of the country. … Advanced scope practitioners would probably lessen the time for some of these people being seen, being imaged, being investigated, and determine whether they can go down the surgical or non-surgical pathway. (ST4)

Strategic drivers

Some ($n = 4$) PBNZ specialists and stakeholders highlighted that the Ministry of Health policies such as *Better, Sooner, More Convenient Health Care* (Ministry of Health, 2011), *New Zealand Health Strategy* (Ministry of Health, 2016), and *Musculoskeletal Workforce Service Review* (Ministry of Health, 2014) documents supported upskilling of the allied health workforce to meet the healthcare needs and deliver equity within services.

> The 2016 New Zealand health strategy is looking for innovation. The resources available to deliver healthcare are not increasing at the same pace as our population … So, I think being able to reimage the health system and how that is delivered and pushing care from inside hospitals to more being dealt with within the community. (ST3)

One New Zealand College of Physiotherapy APP stressed the importance of matching the population's cultural needs with the appropriate APP from Māori, Pacific, or other cultural backgrounds to deliver equity of care "We are a multicultural society … we should be thinking about potentially something that we could have advanced practitioners with a Māori ethnic background and Pacific as well" (New Zealand College of Physiotherapy APP1).

Legislative driver

There was consensus among all interviewees that the PBNZ as a regulator would define the new APP scope to safeguard the public. Most ($n = 9$) interviewees stated that a regulated recognition of scope would direct its standards and governance. Physiotherapy interviewees believed that recognising APP as a distinct scope could facilitate a structured career pathway and tiered funding from all funders. For example, one participant stated that "I think certainly a regulated role; a separate scope of practice would provide more safety for the public around the roles … It may also facilitate the funding streams if we look at a tiered funding structure" (Physiotherapy Specialist 1).

Duality of healthcare and its impact

A strong theme related to the duality of the unique New Zealand health structure and its impact was evident throughout the interviews. Several ($n = 13$) interviewees identified a significant barrier to APP development related to the unique New Zealand dual health structure. Physiotherapy interviewees discussed this barrier through its impact on physiotherapists and patients. Some ($n = 5$) interviewees stated that since ACC was created in the 1970s, most injury-related cases were transferred to the private sector. They believed this had altered the physiotherapy structure in New Zealand, resulting in private physiotherapists focusing on delivering injury-related care through ACC. This enabled Te Whatu Ora to transfer its injury-related cases to ACC while managing its non-injury-related workload. They thought that this had led to the fragmentation of services.

> One can see clearly from the UK perspective what the drivers are … Yes, there are drivers from within the public health system here, but we do have a dual system, particularly in musculoskeletal, because of the ACC. Having ACC completely changes the structure of regular physiotherapy in New Zealand. They did that back in the 70s. So basically, because the public health service could literally divorce itself away from musculoskeletal conditions and hand them over to the private sector. It did. Therefore, the vast majority of musculoskeletal services … things that can be put down to some sort of accident are handled by the private sector. You will notice that there is no real major waiting list problem. (Physiotherapy Specialist 6)

Impact on physiotherapists

Several (*n* = 11) physiotherapy interviewees highlighted that the two sectors in New Zealand had two distinct career paths for physiotherapists. A few stakeholders (*n* = 2) expressed bewilderment at the expectation of a unified career pathway for physiotherapists working in the two sectors as each sector presented its unique environment. A few (*n* = 3) physiotherapy interviewees stated that Te Whatu Ora had a well-structured and remunerated managerial pathway but lacked a similar clinical path. Several (*n* = 10) physiotherapy interviewees and stakeholders perceived that Te Whatu Ora had a defined salary scale and designated roles for APP; however, this pathway was lacking in the private sector.

> The majority of our profession in New Zealand works in private practice, not in the DHBs. The DHBs, now all have these roles, which they call advanced roles in terms of the description on the MECA [multi-employer collective agreement]. Nothing like that exists in private practice, so what the private practitioners are saying is that we want recognition and a career structure … For many private practitioners, the only way they can get that recognition is by having that scope of practice. (ST2)

Meanwhile, the few (*n* = 3) clinicians working in Te Whatu Ora reported a lack of sustainability within their role, lack of recognition (within the organisation and by medical and wider healthcare professionals), and limited funding budgets (dependant on funding for roles being reapproved), which led to a cycle of the roles being created and disestablished.

Impact on patients

Most (*n* = 9) interviewees reported that the Te Whatu Ora sector's long outpatient and surgical waiting times compounded a patient's disability and wellness compared to ACC patients. ACC patients had shorter waits than patients seen in Te Whatu Ora and were entitled to specific treatment session allocation through ACC. However, through ACC funding, there was a restriction on treatment modalities, sometimes limiting the patient's options. If ACC did not cover a patient, there were financial implications if a patient used private physiotherapy. Interviewees (*n* = 12) felt that musculoskeletal patients were grouped and treated depending on whether they fulfilled accident-related criteria. Interviewees stated that this duality encouraged unhealthy behaviours (accessing healthcare systems and treatment), in both the patients and clinicians: "This [dual healthcare system] drives behaviours, and that goes for the professionals, the patients, the users, and the services are driven by the funding models and the structures that we put in place" (APP5).

Reservation about the needs and benefits of APP role

Some (*n* = 5) interviewees stated that they could see the reasons for role development in the UK due to a predominant public-funded universal healthcare. While they agreed there were reasons to justify these roles in Te Whatu Ora, they failed to see how this could add value in the private sector, as it had no waiting lists. One interviewee felt that APP filling medical roles was not the way forward as the underlying issues needed to be addressed. This interviewee believed the physiotherapy workforce should focus on their key role as a physiotherapist rather than engaging in task or role substitution. Some (*n* = 5) interviewees considered the APP role should be developed; however, they expressed concern about the role being used without the appropriate recognition and remuneration.

Service development

The *service development* category highlights the APP engagement in the broader health context, delivering organisational service objectives. The key drivers in this category relate to the individual sectors' service needs and the surgeon as a driver; meanwhile, the barriers relate to inter-professional pushbacks and reservations.

Service needs in Te Whatu Ora

Several (*n* = 11) interviewees highlighted that the Te Whatu Ora requirements to meet the Ministry of Health objectives (waiting times, service quality, and patient-driven targets) were drivers for creating APP roles. The majority (*n* = 12) of interviewees considered that the APP's ability to provide a "one-stop shop" to differentiate surgical versus non-surgical conditions and manage non-surgical patient care would improve patient outcomes. These interviewees felt that this would streamline the patient journey, reduce the number of professionals seen, and shorten wait times or lengths of stay. Some (*n* = 6) stakeholders emphasised that the increased demand for healthcare in a Te Whatu Ora setting versus shortages of medical doctors (creating a lack of access to care, unmet need) and lack of surgical space provided an impetus for establishing an APP role. One participant stated: "What would be the drivers for it [APP]? I think the overwhelming need for medical treatment and the under-resourcing of medical staff and resources of theatre space" (ST4).

Some (*n* = 5) interviewees identified that APPs were necessary in the emergency department to triage and support the discharge of complex hospital admissions and reduce repeated admissions and presentations. Additionally, some (*n* = 6) interviewees recognised the inherent complexity of Te Whatu Ora patients and considered the ability to manage complex, long-term conditions essential for Te Whatu Ora clinicians.

Service needs in the private sector

Most (*n* = 8) interviewees stated that the drivers for creating APP roles in the private sector seemed to relate to the insurer's (ACCs) service needs. Interviewees thought other drivers for APPs in the private sector stemmed from patients seeking improved care outcomes, stakeholders seeking second opinions, and PBNZ specialists referring patients for rehabilitation (specialist ACC contract primarily funds assessment). Most (*n* =

9) interviewees believed that medical professionals (i.e., doctors) were striving for better standards of care for their patients.

> So, there is a driver to improve standard of care for their patients from an insurance company provider. Also, drivers, I guess from outside our profession but within the medical community looking for better standards of care for the patients. I think then there are probably drivers from the patients themselves … who have had substandard levels of care and they are looking for experts. (Physiotherapy Specialist 4)

Inter-professional barriers

Several (*n* = 15) interviewees suggested that APPs could complement surgeons and GPs to manage their musculoskeletal workload and improve the quality of patient care. However, they also highlighted that sometimes their medical and other health colleagues felt challenged by their skill sets and had concerns about their extension of scope of practice.

> Other barriers may be from other health professionals such as GPs or maybe specialists if they do not have the confidence in physiotherapists taking on more extended roles … I know that there were issues in terms of GPs concerned about patients going directly to physios that potentially they were going to miss a diagnosis and red flags. (New Zealand College of Physiotherapy APP1)

All interviewees described the pushbacks and attitudes of medical and non-medical professionals. A few (*n* = 3) interviewees expressed that the medical professionals possibly felt comfortable referring patients to another doctor rather than an APP. They also felt that integrating new APP roles into the existing teams could be perceived as disruptive. Two Te Whatu Ora physiotherapy interviewees reported institutional barriers in the form of rejection of non-medical prescribing for high-tech medical imaging. In contrast, interviewees with medical backgrounds were more supportive of APPs' investigative and injection scope of practice, provided this was appropriately supervised. They expected good governance and strong academic and supervisory underpinning of these advanced skills. The two medical stakeholders discussed the importance of these roles being complementary to the current medical roles as opposed to "instead of" to avoid pushbacks and resistance from medical practitioners concerned about encroachment on their scope of practice.

> There will always be resistance to people wanting to extend scope if you are going into what is seen as a scope of someone else because there is an automatic threat to that professional group's role and their identity and purpose and then ultimately their financial security around that. (ST5)

Surgeon drivers and barriers

All Te Whatu Ora interviewees identified the surgeon as an important driver of change. In their experience, the surgeon advocated for the role within the medical profession and supported the establishment and development of these roles: "At this stage, the individual surgeon is the driver. Judging by the other centres doing it, it has one surgeon who has an interest or assumes that role of supervising, and they must be willing to take that time" (APP3).

In contrast, the surgeons' lack of willingness to engage in an alternative care model was also flagged as one of the main barriers: "Some surgeons are very open to it, and some are not very open to it and, in fact, are overtly obstructive to the process" (Physiotherapy Specialist1).

Professional development

Professional development explores the physiotherapy profession's views on APP roles at a professional development level. The key drivers and barriers for the category professional development were the development of/or lack of a career pathway, training opportunities, and recognition. A unique intra-professional barrier was also identified.

Career pathway

Several (*n* = 10) interviewees stated that the current specialist pathway was unachievable for some senior clinicians due to its academic and research requirements. They outlined that the APP role development would provide recognition for clinicians with considerable experience and qualifications striving to excel clinically, create career pathways for the profession, and provide clinical leadership opportunities. They believed that developing a career framework within both sectors with an additional scope of APP would reduce attrition in the profession. However, barriers in the form of lack of recognition, career pathway, funding, and title limited the opportunities for growth and development of the physiotherapy workforce in New Zealand. One participant noted: "Our job description is … physio, so it is given that these people need title recognition. …There is hopefully a career progression and pay scale as well" (APP1).

Training opportunities and barriers

Most (*n* = 16) interviewees considered an APP role the epitome of clinical competence. They believed robust training, such as master's level training was essential for critical thinking and reasoning. Additionally, on-job training and bespoke standardised APP courses would further augment the role. However, the lack of relevant master's and targeted accredited post-graduate courses limited the APP role development.

> Currently, there appears to be on-the-job training, which obviously is very variable between DHB or whoever is providing the training for us. None of it is standardised. I think there needs to be a specific course set up for training these [APP] roles. (APP3)

Difficulties in accessing continuing education, funding, and time for this commitment and the ability to do research were also reported as barriers.

Recognition

Nearly all interviewees indicated that different stakeholders expected different things from role recognition. In their opinion, physiotherapists wanted recognition of their skills, but patients wanted clarity on advanced physiotherapy skills; on the other hand, funding bodies wanted cost-effective physiotherapists with advanced skills who would deliver on health targets. Interviewees thought that recognition of the APP by the medical profession might give the APP credibility.

> So, hearing from the medical fraternity that we strongly support the ESP [extended scope practitioner] pathway, we are part of it, we communicate with it, we agree with it, and these

> people are trusted and knowledgeable, and experts in the area are all types of things that would be very helpful. (APP4)

All interviewees perceived that legislative titling of the APP role would offer it recognition in the wider healthcare, with stakeholders and the public. They also believed that APP role recognition by key funding bodies Te Whatu Ora, insurers, and ACC would align it with appropriate remuneration.

Intra-professional barrier

Some (*n* = 10) interviewees expressed an unexpected, unique barrier to the APPs' role; they believed some physiotherapists resisted seeking second opinions from APPs or specialist physiotherapists as they feared colleagues and patients would lose confidence in their skills.

> There is always that fear in the process that if I send the patient to another physio, they will keep hold of the person, and I will lose them as a patient. Possibly again, that fear of passing somebody to someone else that person is going to lose their confidence in me and then might not come back and see me. (APP4)

Several (*n* = 7) interviewees warned of the potential for professional jealousy and turf wars within the profession if the APP role was established, as they perceived a rift over remuneration.

DISCUSSION

This research is the first to investigate the drivers and barriers to developing musculoskeletal APP roles in New Zealand. The findings from semi-structured interviews with 19 purposively sampled interviewees provide a unique multi-perspectival insight into the APP roles and their working practices, which may be valuable to stakeholders, organisations, and physiotherapists. This research identified various drivers and barriers to APP role development in New Zealand. Most drivers echoed international drivers (Desmeules et al., 2012; Kersten et al., 2007); however, some country-specific drivers, such as surgeon as a champion, legislative requirements, and profession-led catalysts, were identified. Similarly, the unique New Zealand barriers were related to structural barriers in terms of the duality of the health system and intra-professional barriers. There was consensus that barriers to APP role development currently outweighed the drivers. Nevertheless, most interviewees supported the development of the APP role as a solution to its evolving musculoskeletal health needs. They attributed this to the APP's clinical expertise, their ability to work across sectors and manage patients holistically (through the application of non-pharmacological pain management strategies, non-surgical rehabilitation approaches, knowledge of indications for surgical options, and escalation of care) using a biopsychosocial lens. Interviewees emphasised that addressing barriers to APP role development may enable APPs to optimise their impact on the healthcare burden by reducing waiting times, freeing surgeons' time, and improving access to care.

The findings of this research show that APPs could potentially add value to the musculoskeletal patient pathway by providing holistic care to patients, supporting acute and chronic illness management, and delivering continuity of care in a timely manner. These findings echoed the opinions of the international community of physiotherapists, who state that APP role development aims are patient-focused (World Physiotherapy, 2019). World Physiotherapy's recent policy statement stated that the growing body of evidence for APP roles suggested the role is clinically effective, economical, and delivers desirable improved patient outcomes (World Physiotherapy, 2019). Interviewees argued that new APP roles should be created, to complement the musculoskeletal work undertaken by surgeons and GPs.

Improving access to care and meeting patient needs were identified as key drivers for developing APP roles in New Zealand. Stakeholders highlighted that the shortage of GPs and specialists impacted patients' access to care and created a service need. This is supported by findings from the Association of Salaried Medical Specialists, which indicate that the estimated shortfall of medical specialists in Te Whatu Ora in 2019 was 21.8% (Association of Salaried Medical Specialists, 2019). Internationally, this workforce shortage and lack of access to GPs and specialists have been demonstrated to be a main driver for developing the APP role (Desmeules et al., 2012; Goodwin & Hendrick, 2016).

New Zealand's unique dual health system was identified as a key structural barrier as it shaped each sector's operational and funding streams, influencing its physiotherapist's practices, patient behaviours, and expectations of care in individual sectors. A lack of funding negatively impacts the APP role's establishment, implementation, and sustainability in both sectors. Factors such as a lack of recognition, lack of career pathway, and lack of title for senior clinicians across both sectors were further identified as organisational barriers. Some of these findings are congruent with international literature, which states that the development of APP roles is hindered by structural, cultural, and administrative barriers (existing legislation, organisational rules, regulations, and differences between professions and organisations) (Wiles & Milanese, 2016). Nevertheless, an intra-professional barrier is unique to New Zealand and not mentioned in international literature.

Inter-professional barriers from some GPs, consultants, and other medical specialists were also identified. Interviewees recognised the medico-legal concerns, working practices, and reservations of the medical and wider workforce to the development and implementation of the APP role; nevertheless, they also identified the possible impact of the APP role on their medical colleagues' professional identity and financial security. While interviewees recognised this might sometimes be the case, they also recognised the surgeon as a champion of the APP role. This is comparable to the evidence from a review by (Dawson & Ghazi, 2004), which identified that physiotherapists reported the surgeon as both a mentor and a barrier.

A lack of relevant education for the "advanced aspects" of the APP role impacts the creation of APP roles and was identified as another barrier. The findings from the research suggest that establishing accredited tailored post-graduate education courses would result in greater credibility for the role. This supports the findings of Pryor (2012) and Fennelly et al. (2020).

In New Zealand, the regulatory role of the PBNZ to protect public health and safety generates a legislative driver. The PBNZ defines scopes of practice and regulates them and accordingly has created a scope for the advance practice physiotherapist. Governance of APP roles was identified as a vital regulation standard to counteract the intra-professional barriers identified in this research. This contrasts with the UK's Health & Care Professions Council (HCPC), which has not regulated the APP scope since its inception over the last 30 years (Health & Care Professions Council, 2020). Nonetheless, similar to the PBNZ, HCPC is now considering regulating the APP roles in the UK. In their independent report, HCPC identified that advanced practice reflected the complexity of scope. Some participant groups advocated regulation to assure practice standards and reduce the risk of misuse of titles. However, there was an equal lack of appetite for regulation, which inhibited the profession from rapidly responding to evolving healthcare and advanced scope practice (Hardy et al., 2021). The HCPC perceives it may have a central role in unifying the four UK countries concerning future APP role expectations, educational standards, and governance at advanced levels.

In summary, there is a dominant theme of a perceived need to create an APP role in the New Zealand health context as it adds value to patient care across various settings. However, there were a few reservations. These reservations are related to the task or role substitution by the APP. Some interviewees clearly understood the scope of the APP role and identified a lack of structured career pathways, mentoring, or training to develop the advanced practice. Others identified the lack of recognition for these clinicians. Nevertheless, interviewees in this study believe the clinical expertise of APP practitioners in New Zealand positions them to function as a single point of entry for musculoskeletal services to reduce fragmentation, streamline services, and provide timely, effective, and efficient care.

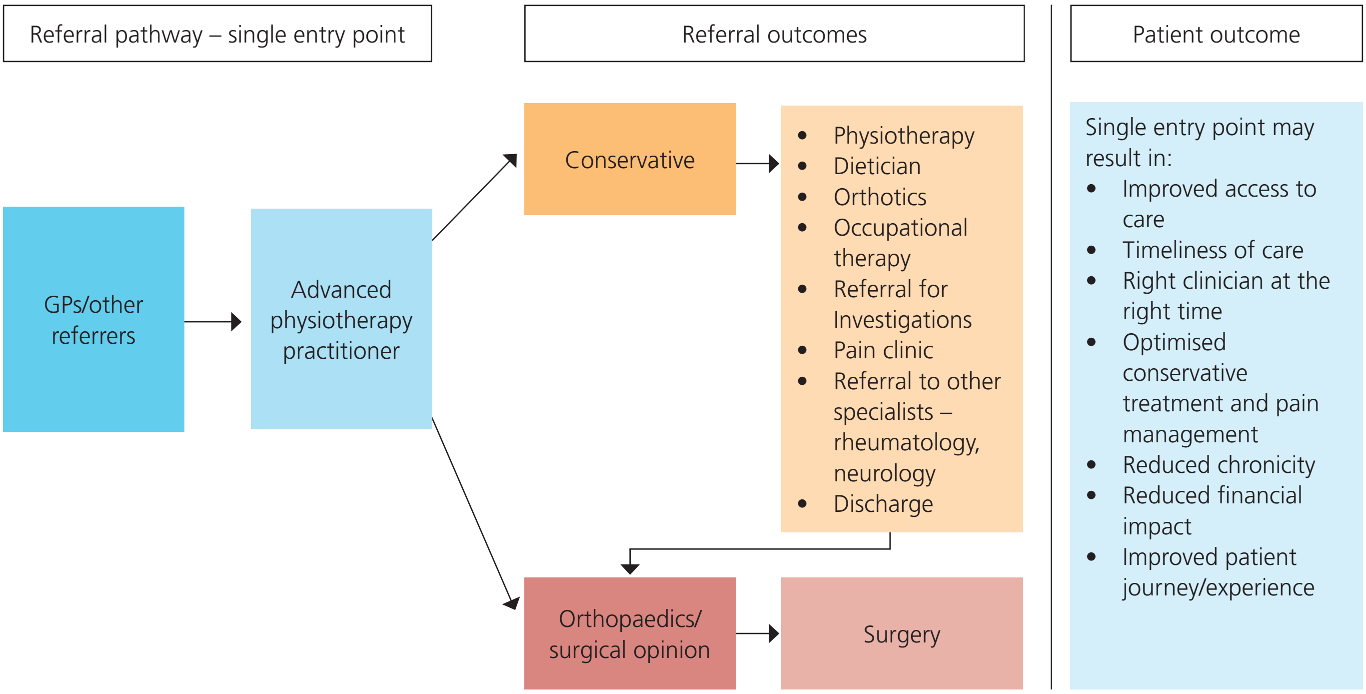
Recommendations

Based on the research findings and recent development of the Advanced Practice Physiotherapist scope by the PBNZ, the following recommendations are made for the success of the APP role in the New Zealand context. This research has explored the reasons for the limited uptake of APP roles in New Zealand despite strong drivers and these findings need to be considered by the stakeholders when considering the development and implementation of APP roles. Complementary working and development of strong partnerships with medical and the wider healthcare workforce, and organisational stakeholders are recommended. This would ensure sound mentoring and clinical governance for the role, development of appropriate funding streams for the sustainability of the position, and organisational and operational support for the APP. A change in practice and delivery of a new model of care with APP as a first-contact practitioner working in collaboration with the orthopaedic surgeon is recommended. The proposed model is depicted below in Figure 2.

Advocacy of the APP role by PNZ is suggested to improve its recognition. Further research is recommended to be carried out into advanced delivery models in New Zealand in varied specialities, clinical and cost-effectiveness of these APP services and education needs of APP. Developing tailored post-graduate courses in conjunction with universities and PNZ is recommended. Finally, to overcome the intra-professional barrier, a peer-review framework for the physiotherapy profession is recommended to augment APP roles across sectors. Utilising the APP in a supervision model and as a source of second opinion would support the generalist physiotherapists.

Figure 2

Proposed Model for Delivery of Musculoskeletal Healthcare with APP as a First-Contact Practitioner



Strengths and limitations

The strengths of this study lie in its purposive sampling, interviewee checks of transcripts, diary, and use of a template to guide multi-perspectival analysis of the research question. This research purposively sampled APPs (generalist physiotherapists working in advanced roles but not accredited by the PBNZ as Advanced Practice Physiotherapists), New Zealand College of Physiotherapy accredited APPs, and PBNZ Physiotherapy Specialists. All participants interviewed worked in the area of musculoskeletal physiotherapy. Therefore, the findings of this research are limited to the population sampled and cannot be applied to other specialities in physiotherapy or differing health systems. This research had a relatively small sample of medical or operational stakeholders, APPs working within Te Whatu Ora, and no patients, which is a limitation and a bias. Lastly, as this case study is qualitative research, the researcher's assumptions associated with having worked as an APP must be acknowledged, and they may be a strength and limitation of this study.

CONCLUSION

This timely study provides a thought-provoking analysis of APP roles in New Zealand by examining their drivers and barriers. Currently, the drivers for creating the APP roles are much stronger in a government-funded system due to inherent issues of long waiting lists, unmet needs, and staff shortages. These drivers are not applicable to the private sector. Instead, the profession visualises the APP role in the private sector to offer a second opinion and backfill the void created by the ACC-PBNZ specialist contract, which primarily funds assessment. This study also highlights the shortcomings of the current model of care offered to musculoskeletal patients in New Zealand, contributing to compromised access to care leading to long wait times, increased chronicity, and financial burden to the country. Interviewees believe introducing an APP role as a first contact practitioner would improve patient flow, patient journey, and associated patient experience. Stakeholders, policymakers, and professional and legislative bodies need to recognise these findings when considering developing and implementing the APP roles in the New Zealand context. In conclusion, there are strong drivers for the creation of APP roles, such as improving patient outcomes, timely access to musculoskeletal care, and being responsive to patient needs; nevertheless, the structural, intra-professional lack of recognition and training barriers need to be overcome to adopt these roles widely in New Zealand.

KEY POINTS

1. There are drivers and barriers to developing APP roles in New Zealand.
2. The APP role adds value within New Zealand's unique healthcare context.
3. The APP role in New Zealand can improve outcomes for patients presenting with musculoskeletal complaints by being the right clinician in the right place at the right time.

DISCLOSURES

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. There are no conflicts of interest that may be perceived to interfere with or bias this study.

PERMISSIONS

Ethical approval for this research was granted by the Auckland University of Technology Ethics Committee (reference number 19/141).

CONTRIBUTIONS OF AUTHORS

Design conceptualisation and methodology; validation; formal analysis, LN, DR, SW, and SN; Data curation, LN; Writing – original draft, LN; Writing – review and editing, LN, DR, SW, and SN.

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Appendix A

INTERVIEW PROTOCOL

Starting the interview

- Check consent
    - Written and verbal consent form.
    - To record and transcribe interview.
- Inform about duration of interview.
- Provide overview of project and purpose.

Interview

Indicative interview questions for physiotherapists:

1. Tell me about your current extended/ advanced physiotherapy practitioner role/ practice.
2. Tell me your thoughts about the extended/ advanced physiotherapy practitioner role/practice.
3. What do you think should be included in the scope of practice of an extended/advanced physiotherapy practitioner role?
4. What are the facilitators to this role development in New Zealand context?
5. What are the barriers to this role development in New Zealand context?
6. How do you foresee the clinical pathway for this role development?
7. Do you anticipate the extended/advanced physiotherapy clinician needing additional training? If so, how should the training be delivered?
8. What are your thoughts on recognition of the role?
9. How do you envisage the clinical governance for this role?
10. How do you envisage the legislative governance for this role?
11. How should the clinical liability in this role be managed?
12. How should the autonomy in this role be managed?
13. Do you perceive a niche for this role in New Zealand? If yes, state where; if no, explain why?
14. What are your thoughts on remuneration for the role?

Ending interview

- Thank participant.
- Check:
    - Anyone else who I should talk to about this topic.
    - specific documents that participant recommend.
    - Participant aware of verbatim transcript.
    - Transcript will be sent to participant for correction and approval.
    - Can I come back to you if I need further clarification?

A Developmental Perspective of Influences on the Onset and Early Trajectory of Chronic Pain in Children Attending Physiotherapy in Primary Health Care Settings: An Integrative Review

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ABSTRACT

Chronic pain in childhood leads to long-term social, emotional, physical, and financial impacts, with lifelong heightened pain sensitivities. The prevalence of chronic pain in children has increased over the past 20 years. Physiotherapy is often the place of initial intervention for a child in pain, and initial treatment is predictive of chronic pain and can predict outcomes. Children's pain experiences and responses are thought to be more modifiable than those of adults; therefore, quality physiotherapy interventions have the potential to positively influence the onset and early trajectory of chronic pain. Using a childhood developmental lens, this integrative review aimed to draw together research literature about biopsychosocial factors influencing chronic pain onset and early trajectory in primary-school-aged children. The results of the review contribute novel understandings for physiotherapists in primary healthcare. A range of biopsychosocial concerns including age at onset and pain duration, neuro-biological aspects, psychological influences, parental impacts, sleep quality, trauma history, and stress interact with children's learning and development. Taken together, these factors have potential to influence chronic pain onset and early trajectory in children. Adopting a holistic understanding of childhood development in the early management of childhood chronic pain would promote positive physiotherapy interventions and may avoid pathologising what is developmentally normal.

Meys, A., & Jones, M. (2023). A developmental perspective of influences on the onset and early trajectory of chronic pain in children attending physiotherapy in primary health care settings: An integrative review. *New Zealand Journal of Physiotherapy, 51*(2), 138–158. https://doi.org/10.15619/nzjp.v51i2.352

Key Words: Child, Development, Management, Pain, Physical Therapy

INTRODUCTION

Childhood is a period of extensive growth and learning. When physiotherapists are working with children and young people there needs to be an understanding of the developmental physical, cognitive, and psychosocial changes that children undergo (Cech et al., 2019). Despite this need, current literature informing practice within children with chronic pain gives little consideration to developmental factors that can influence the onset and trajectory of this condition. Additionally, research to date has typically focused on various, discrete aspects of children's pain including sleep quality (Kanstrup et al., 2014; Pavlova et al., 2020), gender influences (Kaczynski et al., 2009) and threat or fear responses (Flack et al., 2017; Heathcote et al., 2017). A more cohesive picture of the influences is needed to support practice.

Studies suggest a trend towards increasing prevalence of chronic pain in childhood (Coffelt et al., 2013; King et al., 2011; Roy et al., 2022). The term chronic pain typically describes pain of longer than 3 months duration or pain that has exceeded expected tissue healing timeframes, without evidence of ongoing injury or biological markers (Abu-Arafeh & Abu-Arafeh, 2016; Campos et al., 2011; Collins et al., 2017). Chronic pain is not just continuous pain, and children may also experience intermittent, yet reoccurring episodes of pain over long periods (Bhatia et al., 2008; King et al., 2011). Chronic pain is often, but not always, precipitated by an injury or tissue damage. However, the onset and progression of a chronic pain course is complex, and a wide range of biopsychosocial factors may contribute to its presentation (Swain & Johnson, 2014). A consistent pattern of childhood chronic pain negatively affects pain sensitivities and nociceptive thresholds into adulthood, creating a lifelong pain influence (Bhatt et al., 2020; Hassett et al., 2013; McClain & Suresh, 2009; Tan et al., 2009).

The biopsychosocial model is widely accepted to guide clinical practice in people with chronic pain (McGrath et al., 2014). The model provides a theoretical framework whereby the complex, non-linear interplay of an individual's mind, body, and social environment are identified as valid contributors to a person's overall health experience (Engel, 1977). The separation of chronic pain into compartments of physical or psychological factors has now been systematically excluded from research and clinical practice guidelines (Bursch et al., 1998). Nonetheless, a dualistic concept of mind–body remains, and seeking an organic and physical explanation for a child's pain has been thoroughly embedded within healthcare (Dell'Api et al., 2007; Hinton & Kirk, 2016). Unfortunately, healthcare practitioners' disregard for a more holistic view of pain management contributes to tension in the practitioner–family relationship (Hinton & Kirk, 2016).

Frustrations are reported by children, parents, and their healthcare providers when endeavouring to understand and manage chronic pain conditions (Hinton & Kirk, 2016). Dismissal of children's pain concerns is extensively reported in qualitative research (Carter, 2002; Dell'Api et al., 2007; Newton et al., 2013; Quintner et al., 2008). A lack of training in managing child-specific pain conditions (Defenderfer et al., 2018), a lack of knowledge of developmental consequences of pain (Bhatia et al., 2008), and a lack of clinical guidelines are highlighted as reasons for delays in diagnosis and subsequent tertiary referrals for children with chronic pain (Abu-Arafeh & Abu-Arafeh, 2016; Hinton & Kirk, 2016). Prior to arriving at tertiary, interdisciplinary team management for a child's chronic pain, families have reported low expectations for future interventions due to disappointment from earlier healthcare interactions (McGrath et al., 2014).

Primary care (PC) practitioners, such as physiotherapists, are key to managing the onset and interrupting the trajectory of chronic pain for this group. The effectiveness of the first treatment is predictive of reducing chronic pain risk in children (Simons et al., 2018; Wager et al., 2019). Additionally, children's pain perception is thought to be relatively more "plastic" than adult populations, indicating that in the preliminary stages their pain may be more modifiable with appropriate intervention (Bhatt et al., 2020; Campos et al., 2011; Zernikow et al., 2018). Furthermore, a longer time to diagnosis has been associated with a greater level of functional disability (Carter, 1998; Tian et al., 2018). Simply, untreated or poorly managed pain in children is a risk factor for chronicity (Finley et al., 2014).

Developmental theory provides frameworks for explaining a process of change in people over time (Miller, 2016). These theoretical frameworks are relevant for understanding children's responses to pain and how the responses are shaped over time. Human development involves not only biological processes, but also environmental experiences and social reinforcement (Bergen, 2008). Tenets from social cognitive theory (SCT) (Bandura, 1986), sociocultural developmental theory (SCDT) (Vygotsky et al., 1978), and understandings about children's neuropsychological development may better our understanding of ways that children learn about pain experiences and their responses to factors that potentially influence pain.

Social cognitive theory

Social cognitive theory (SCT) highlights that children learn, not solely through teaching, but by observing and modelling others' behaviour (Bandura, 1986). SCT focuses on interactions between the situation, emotions, social interactions, and people's behaviour and how these things are perceived by the child (Miller, 2016; Smith, 2013). Learnings are appraised over time, and with reinforcement, particular behaviours and responses develop (Miller, 2016).

Self-efficacy is a central acquisition of social cognitive observations (Miller, 2016), enabling a child to believe in their abilities and determine their capacity to cope with adversities (Page & Blanchette, 2009) or threat (Steck & Steck, 2016), such as pain. Self-efficacy and resilience only develop as positive personality characteristics if the child can learn the skills required through social learning constructs (Bandura, 2003; Miller, 2016; Steck & Steck, 2016).

SCT is a key framework to guide understanding of the influences on a child's pain within their family and wider social system (Levy et al., 2007). Such influences are often hypothesised as the reason for the clustering of chronic pain conditions within a family (Stone et al., 2018).

Sociocultural developmental theory

Sociocultural developmental theory (SCDT) varies from SCT in acknowledging the central role of adults and cultural contexts in children's development. SCT holds that a child develops skills through interactions and problem solving with more cognitively advanced individuals around them (Koenig & Sabbagh, 2013; Miller, 2016; Vygotsky et al., 1978). The "culture context" relates to the wider values, beliefs, and history associated with the child's environment and their social setting (Miller, 2016; Vygotsky et al., 1978). In this way, childrens' understandings about the diverse facets of a pain experience may be seen as being actively shaped by their sociocultural environment, including their ideas about the causes of pain, adoption of management strategies, their responses, and communication.

Neurobiological and neuropsychological development

Neurobiological and neuropsychological developmental changes are also an important basis for a child's learning and development, and likely play a role in the ways they respond to pain over childhood. Children's brain regions have been found to have lower levels of connectivity that improve throughout development, and cortical changes associated with neuroplasticity result in, and support, adaptive learning, and neural network modifications (Fine & Sung, 2014). Exaggerated responses to pain have been reported due to immaturity of neurotransmitters, increased neural excitability, and less neural inhibitory pain control (Hathway, 2014). From a developmental neuropsychology perspective, these exaggerated responses may, therefore, be a normal response due to still-developing executive brain functions needed to exhibit stability over supraspinal controls (Feinstein et al., 2017; Hathway et al., 2012). Likewise, children's cognitive and emotional understanding of pain, their appreciation of others' pain behaviour, and insights into the social implications of pain behaviours are not refined until early adolescence (Esteve & Marquina-Aponte, 2012).

Understandings from SCT, SCDT, neurobiological, and neuropsychological theories collectively suggest that various developmental influences will be relevant to the onset and early trajectory of chronic pain in children. This review aimed to apply a childhood developmental lens to draw together and critically analyse the existing research literature about the biopsychosocial factors potentially influencing chronic pain onset and early trajectory in children. An integrative review methodology (Russell, 2005; Whittemore & Knafl, 2005) was employed to synthesise and gain new insights into the literature through application of developmental theoretical understandings.

METHODS

A thorough search strategy was implemented, utilising online databases CINAHL, MEDLINE, Scopus, and AMED. Published studies from January 2000 to January 2021 were included. A manual search of the reference lists of the included studies was also undertaken. The search terms Boolean operators, limits, and numbers of hits are presented in Table 1.

Inclusion and exclusion criteria

Using the Covidence tool (Veritas Health Innovation, 2020), all identified published studies were initially screened by their title and abstract (AM & MJ), then a full text review was conducted to check relevance against the inclusion and exclusion criteria outlined in Table 2.

In line with the need to draw together relevant but often disparate information, the inclusion criteria were broad to generate new insights about the topic from diverse perspectives (Whittemore & Knafl, 2005). Not only were studies included that specifically explored relationships between biopsychosocial factors and pain outcomes, but also those that shed light on the prevalence and characteristics of factors that could potentially influence pain.

Search outcomes

The initial search provided 678 abstracts and 47 articles were included in the final review.

Data evaluation and analysis

The focus of an integrative review is on merging diverse understandings about a topic to provide a more cohesive knowledgebase (Torraco, 2016). Systematic critical appraisal is not always the focus of an integrative review (Kirkevold, 1997; Whittemore & Knafl, 2005). As the present review aimed to use a child development theoretical lens to draw together and critically analyse research literature about the factors influencing chronic pain onset and trajectory in children, all included studies were analysed and reported (Torraco, 2016; Whittemore & Knafl, 2005). While a formal, critical appraisal or scoring system was not applied, the methodological quality of the diverse research was critically considered in light of design features and ability to represent the population (Whittemore & Knafl, 2005), and is discussed in this report.

Information was extracted from the articles about the study designs, population demographics, pain duration, and findings relevant to answering the research question (Table 3). Similar themes in the findings were grouped together in consideration of their focus and were then critically considered and integrated with paediatric developmental literature (Appendix A).

REVIEW FINDINGS

Studies that met the inclusion criteria were primarily observational, with 20 cross-sectional, 13 cohort, seven case control, one epidemiological prevalence study, and three individual case reports included for review. Three qualitative studies were also obtained (Carter, 2002; Dell'Api et al., 2007; Pate et al., 2019) and provided the voice of chronic pain experience from children themselves and their parents.

There were various limitations shared by the majority of studies in this review. Limitations included use of parent proxy-reports, a risk of recall bias, and cross-sectional methodologies that limited insights into changes in children's pain trajectories over time. Many studies did not provide or analyse data about variables such as age at onset of chronic pain, pain duration (Lynch et al., 2007), and interventions children may have received. Generalisability of study findings to primary health care settings and to younger children was constrained; most studies were undertaken in tertiary care and had a low representation of children under the age of 10 years, with some studies containing primarily adolescent data (Table 3).

Table 1

Literature Search Strategy

Search terms	Limits used	Database and sites searched	Number of hits
Child* OR [a] pediatric* OR paediatric* OR adolescen* OR youth OR "school age*" OR "school-age" OR kid* OR young AND Risk* OR predict* OR influence* OR contribut* OR factor* OR cause* AND "persistent pain" OR "chronic pain" OR "complex regional pain syndrome" OR "neuropathic pain" OR "pain syndrome*" OR "secondary hyperalgesia" OR "central hyperexcitability" OR CRPS OR "somatoform pain" OR "unexplained pain" NOT Scoliosis OR "juvenile idiopathic arthritis" OR "cerebral palsy" OR haemophilia OR hemophilia OR "sickle-cell" OR cancer	English language Published date 2000–2020	EBSCO- Cinahl Medline	550
		Scopus	119
		AMED	3
		Manual search	3

[a] AND, NOT, and OR are the Boolean operators that were used in the search.
*Denotes truncation.

Table 2

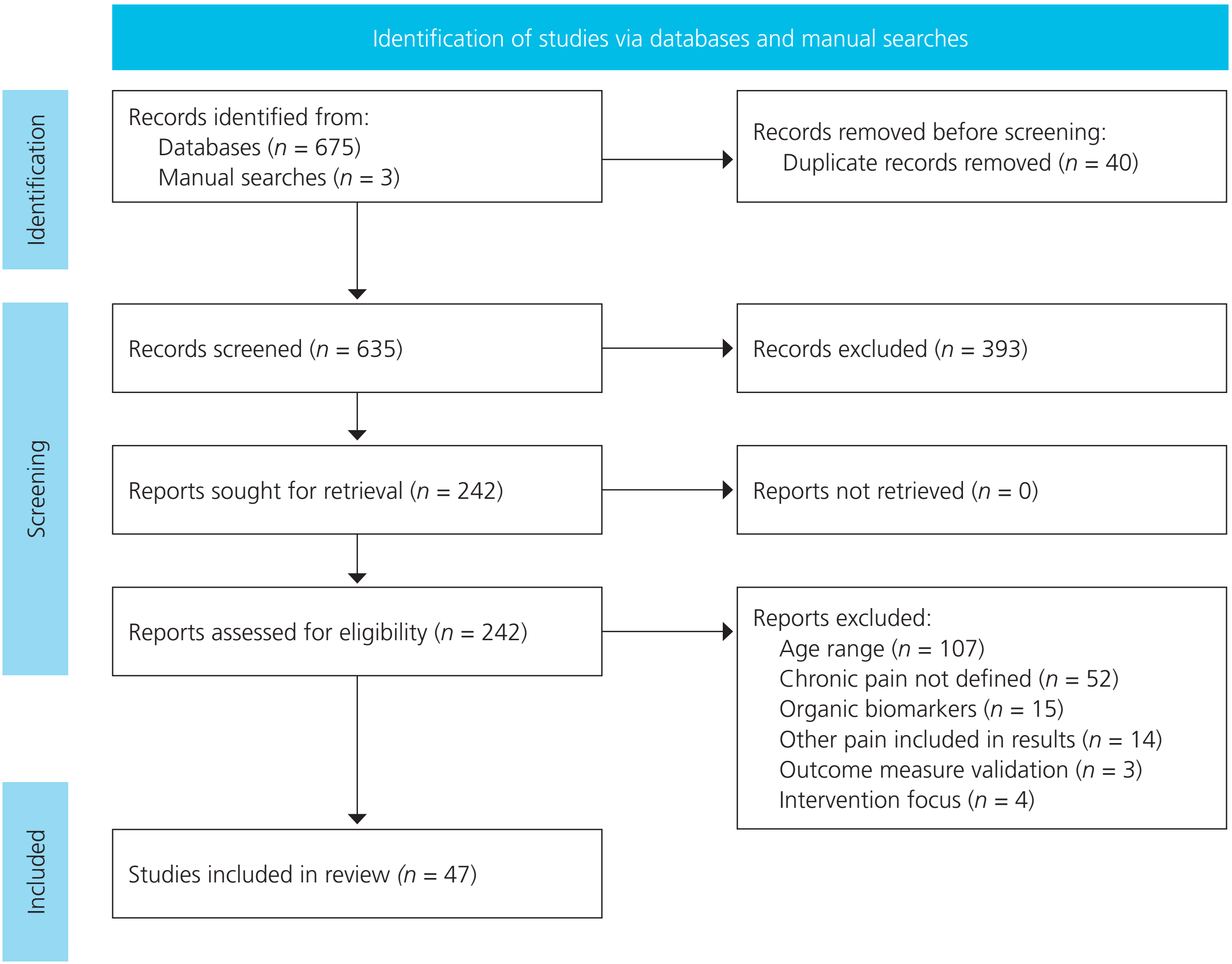
Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Primary research	Secondary studies
Chronic or recurrent pain > 3 months or met strict diagnostic criteria [a]	Organic, biomarkers for pain
Unknown organic aetiology	Scoliosis surgery, juvenile idiopathic arthritis, cerebral palsy, haemophilia, and sickle-cell disease.
Participants aged 5–11 years	Studies involving adults (>18 years of age)
Parents with children aged 5–11 years	Intervention only studies

[a] Diagnostic standards included: Complex regional pain syndrome (CRPS), International Association for the Study of Pain criteria (Stanton-Hicks et al., 1995) or Budapest Criteria (Harden et al., 2007); Juvenile primary fibromyalgia syndrome according to the Yunus and Masi criteria (Yunus & Masi, 1985); and Functional abdominal pain (FAP) as per the International Headache Society classification (ICHD) (Olesen, 2018) and Rome III criteria for FAP (Shih & Kwan, 2007).

Figure 1

PRISMA Diagram. Systematic Diagram of Identification of Studies for Integrative Review (Page et al., 2021).



Influences on the onset and early trajectory of children's chronic pain

Analysis of the study findings identified a number of potential child-related and social influences on the onset and early trajectory of children's chronic pain. The influences either reflected or had implications for children's development (Figure 2).

Child age-related influences

Data about children's ages can provide a general indication of their development (Bergen, 2008), but age was only analysed as a factor in a small number of studies, with mixed findings reflecting different study foci. In one study, children's age showed little relationship to the extent of functional disability as measured through physical domains of a quality of life

Table 3

Summary of Included Articles

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Abu-Arafeh and Abu-Arafeh (2016)	Prospective observational study Community sample through Scottish paediatric surveillance Scotland	26 5.5–15.4 (*M* = 11.9) years CRPS	Not stated	No	Average 22 missed school days, 23 stopped participating in sports, 19 cancelled social engagements. CRPS incidence measured 1.2/100,000. Legs more frequently affected than arms with second body site present in 40%. Mean onset 11.9 years, primary onset after trauma, and affecting girls 3:1 ratio. Right side more affected than left. Higher functional disability and somatic symptoms. Normal depression and anxiety scores. Parental effects of work adjustments and cancelling holidays.
Agrawal et al. (2009)	Cohort retrospective chart review Outpatient tertiary pain clinic USA	32 11–15 years CRPS	Not stated	No	Movement disorders/dystonia present with CRPS at similar rates to with adults. Mainly lower limb affected.
Akbarzadeh et al. (2018)	Cross-sectional, convenience sampling Two outpatient tertiary clinics and a private clinic Iran	132 children (72 girls, 60 boys) 212 parents (120 mothers, 92 fathers) *M* (*SD*) = 9.83 (2.77) Chronic headaches	20.56 months	No	Differences between maternal and paternal pain catastrophising with mothers higher reporting for their child on pain intensity, anxiety, depression in relation to their child's headache pain. Greater parental catastrophising mothers than fathers, increasing attention to their child's pain. Parents central mediators to their child's pain.
Bayle-Iniguez et al. (2015)	Case-control, retrospective Single centre outpatient clinic Not stated	73 (64 girls, 9 boys) 5–16 (*M* = 11.5) years CRPS	Not stated Time to diagnosis, 0–120 months (*M* = 14.2)	No	Excellent school results (*OR* = 8.4, 95%CI), perfectionist behaviours (*OR* = 4.3, 99.5% CI); Issues falling asleep (*OR* = 6.9, 95% CI); Anxiety and CRPS strongest association (*OR* = 44.9, 95% CI). Psychosocial stress in 51% cases including family conflict, medical issue or death of family member, school problems, sexual abuse. Physical trauma 49% (92% minor injuries). CRPS type 1 mostly affecting younger pre-adolescent age group, lower limb (89%) and predominantly girls.
Beeckman et al. (2020)	Cohort study Two outpatient tertiary clinics USA	65 (54 girls, 11 boys) *M* (*SD*) = 14.41 (1.95) years Mixed chronic pain conditions	*M* (range) = 27.05 (3–96) months	No	Pain related fear predicts function better than pain intensity. Possible bi-directional relationship between pain related fear and catastrophising. Psychological flexibility predicted lesser pain levels and less avoidance behaviours.
Birnie et al. (2020)	Cross-sectional Outpatient pain clinic USA	108 children 8–12 years 340 adolescents 13–18 years *M* (*SD*) = 14.57 (2.38) years Mixed chronic pain conditions	Children, *M* = 2.53 years Adolescents, *M* (*SD*) = 30.41 (35.04) months	Analysis of children and adolescents separately	Links created of integrative model of parental health with fear-avoidance in children with chronic pain. Greater pain interference associated with increased age. Poorer parental global health indirectly related to child pain interference through higher parent pain catastrophising, then greater parent protective behaviours and child pain catastrophising.

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Carter (2002)	Qualitative research Outpatient clinic Nominated families from nurse practitioner Not stated	3 7–13 years *M* = 12.7 years Mixed chronic pain conditions	≥ 3 months	No	Main themes: (a) searching for a diagnosis, (b) professional dismissal, and (c) medical communication. Families less focus on child's pain but more on difficulties with healthcare professionals. Parents used to communicate about their child's pain than the child themselves.
Conte et al. (2003)	Case control study Single outpatient clinic USA	16 with JPFMS 16 with arthritis 16 healthy controls 7.4–17.4 years	3–36 (*M* = 12) months	No	JPFMS group lower mood, high anxiety and depression, irregular daily structure, withdrawal, somatic complaints, highly distractible when compared to the other two group. Significantly greater behavioural issues. Parents of children with JPFMS had higher levels of depression, anxiety. Parents reported for their children greater pain sensitivity than the other two groups.
de Tommaso et al. (2017)	Cross sectional study Single outpatient tertiary clinic Italy	151 8–15 years Chronic headache or migraine	≥ 3 months	No	Muscle pain/peri-cranial tenderness intensity related to reduced duration of sleep. Loss of sleep may contribute to central sensitisation. Allodynia symptoms correlated to anxiety.
Dell'Api et al. (2007)	Qualitative semi-structured interviews Single outpatient tertiary clinic Canada	5 (2 boys, 3 girls) 10–17 years Mixed chronic pain	6 months to ≥ 4 years	No	Main theme: Participation limitations. Main subthemes: Seeking understanding of pain, invisibility of pain, impact of encounters, future fears, negative perceptions of pain; Children felt disbelieved and dismissed. Lack of information regarding their pain, more likely to perceive pain as life threatening in children 10–12 years.
Dunn et al. (2011)	Cohort study Prospective, community sample USA	1336 11 years–11 years 10 months, initial sampling Prevalence and trajectories of chronic pain measured	Not stated, observational prevalence study	Pubertal development scale and age controled	12% of sample had persistent pain for at least one pain site. Persistent pain group primarily female, high baseline levels somatisation and depression at age 11 and at end of study at 14 years.
Erpelding et al. (2014)	Case control Outpatient clinic USA	12 (9 females, 3 males) 10–17 years *M* = 14.1 years with unilateral CRPS Healthy controls (9 females 3 males) *M* = 13.8 years	*M* = 13 months	No	Habenula involvement in modulating responses of stress, reward-punishment and pain modulatory process, which may contribute to CRPS symptoms including affective, cognitive, pain inhibition and motor processing. Reductions in functional magnetic resonance imaging between Hb and pain inhibitory systems.
Fales et al. (2014)	Cross sectional study Outpatient clinic USA and Canada	210 (73.9% female) 10–17 years M (*SD*) = 14.23 (1.59) Mixed chronic pain conditions	≥ 3 months	No	Low agreement between child and parent in regard to miscarried helping. Child and parent more likely to report miscarried helping with dysfunctional and less cohesive family network reports, greater reports of child depression.

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Finniss et al. (2006)	Case report Primary care Australia	Single case study 10-year-old male CRPS	7 weeks	No	Pain, colour, swelling and temperature changes in foot. Nil trauma.
Flack et al. (2017)	Cross sectional study Inpatient and outpatient Germany	40 11–18 years Chronic headache and chronic abdominal pain	IHSC, ICD-10 and Rome III criteria	No	Proximal interoceptive sensations caused greater fear-avoidance in chronic abdominal pain group. Lower task performance time in the associated threat task in both groups. Fear-avoidance behaviours were elicited when benign-threat tasks are applied near to the primary pain region. Attention bias is anticipatory, not responsive.
Heathcote et al. (2017)	Case control study Outpatient tertiary pain clinic, patient group Two secondary schools, controls UK	66 (55 female, 11 male) 10–18 years M (*SD*) = 13.97 (2.13) years 74 controls (42 female, 32 male) 11–18 years M (*SD*) = 14.95 (1.71) years Mixed chronic pain conditions	5–170 (*M* = 45.7) months	No	Interpretation bias of ambiguous body threat tasks in chronic pain group, more likely to perceive threat. 87.9% had widespread musculoskeletal pain vs 12.1% single location.
Ho et al. (2009)	Cross-sectional study Consecutive referrals tertiary pain service Canada	57 (46 females, 11 males) 8–18 years *M* (*SD*) = 14.64 (2.39) years Mixed chronic pain conditions	*M* (*SD*) = 46.98 (34.92) months	No	Above average scores on all cognitive and academic assessment measures.
Huguet and Miró (2008)	Prevalence cross-sectional study Community sample Spain	561 8–16 years *M* (*SD*) =11.89 (2.00) years	Prevalence study	No	Lower social QoL scores; Lower limb chronic pain more common in boys (57% vs 19.65%) and multiple site chronic pain more common in girls (50.6% vs 22.2%). Lower physical QoL scores. Abdominal pain, headache, and lower limb complaints most common location of chronic pain. Prevalence of chronic pain increased with increasing age: Chronic pain, *M* (*SD*) = 11.49 (2.08) years; Without chronic pain, *M* (*SD*) = 10.53 (1.86). Age did not impact functional disability or QoL measures in chronic pain sample. 37.3% with chronic pain, 29.3% had pain in multiple sites. Only 5.1% with moderate/severe problems.
Hunfeld et al. (2002)	Cross sectional study Community sample from larger prevalence study Netherlands	85 (56 girls, 29 boys) 5–11 years *M* (*SD*) = 8.4 (2.1) years (boys) *M* (*SD*) = 8.4 (2.4) years (girls) Unexplained chronic pain	*M* (*SD*) = 3.1 (2.3) years	No	School absence, days per month, *M* = 0.5 day, no gender differences. Abdominal, limb pain and headaches most common reported areas of pain. High intensity of perceived pain of the child had a higher social impact on family, especially mothers. Chronic pain impact on families reported to be mild.

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Kaczynski et al. (2009)	Cross sectional study Outpatient clinic USA	266 (female 66.5%) 8–17 years M (SD) = 13.3 (2.55) years Chronic abdominal pain and headaches	M (SD) = 32.68 (32.53) months	No	Pain rating associated with depression in boys and girls; related with depression and anxiety in girls, not boys. Depression more readily reported by girls than boys. Passive coping linked to increased internalising behaviours. Protective parenting correlated with functional disability in boys not girls, but not statistically significant. Internalising symptoms associated with protective parenting.
Kanstrup et al. (2014)	Cohort study Outpatient pain clinic Sweden	154 10–18 years M (SD) = 14.57 (2.02) years Mixed chronic pain conditions	3–192 months M (SD) = 52.46 (43.44) months	Age correlations only	31.5% reported one per week absence from school due to pain, and 44.3% reported wide or total absence from school. Pain is a predictor of functional disability with insomnia a mediator. Insomnia contributed more variance than pain intensity to the association of depression and functional disability. Girls reported higher prevalence of depression (M = 25.6 vs 20.0; p = 0.011) and depression symptoms increased with age (p = 0.038). Pain duration longer in boys than girls (M = 67.0 vs 47.7; p = 0.022). No significant age-related differences between functional disability, intensity or duration of pain.
Kashikar- Zuck et al. (2008)	Cross sectional study Outpatient pain clinic USA	76 (female 86.8%) 11–18 years M = 14.89 years JPFMS	≥ 3 months	No	67.1% had a current psychiatric disorder and 30.1% had more than one disorder. 71.2% had a history of psychiatric disorder. Most common diagnosis of anxiety.
Kashikar- Zuck et al. (2010)	Cross sectional study Outpatient pain clinic USA	102 (87.3% female) 11–18 years M (SD) = 14.96 (1.82) years JPFMS	M (SD) = 35.77 (27.83) months	No	School days missed, M = 2.88 days/month; 12.7% home- schooled due to their JPFS. High level anxiety conditions. 24% attentional disorder, 19% depression. High level of school absence linked to greater depression (p = 0.03). Mothers reported M = 5 pain conditions.
Konijnenberg et al. (2005)	Cross sectional study Outpatient pain clinic Netherlands	149 8–18 years M (SD) = 11.8 (2.6) Unexplained chronic pain	M (range) = 12 (3–144) months	No	Highest social functioning inference with headache (50.9 headache, 73.48 abdominal pain, 77.7 musculoskeletal pain). Children who had a poor view of their own health had significantly higher levels of pain related impairment and this was predictive of significant impairment.
Lebel et al. (2008)	Cohort study Outpatient tertiary pain clinic USA	8 (all female) 9–18 years M (SD) =13.5 (1.6) years CRPS, lower extremity unilateral	M (SD) = 13.3 (2.4) months	No	Increased BOLD signal in parietal lobe, bilateral primary sensory cortex, anterior and middle cingulate, anterior insula. Decreased BOLD signal in frontal lobe and parietal lobe, middle cingulate, middle temporal lobe, parahippocampus and hippocampus. Decreased signals in pain inhibition pathways. Contralateral/unaffected limb had almost double the increased BOLD signal and few regions showing decreased BOLD signal. Findings were similar when pain state had resolved. Notable central processing changes that are maintained after symptom resolution may be related to the developmental plasticity and have long lasting effects.

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Libby and Glenwick (2010)	Cross sectional study Outpatient tertiary rheumatology clinics USA	57 10–18 years *M* = 15.5 years JPFMS	Not stated	No	School absence 2.5 days in past month (range 0–31 days). Daily hassles not related to pain ratings. Poor pain ratings, QoL, and depression scores with catastrophising. Self-efficacy positively influenced QoL, catastrophising, pain, and depression scores. Social support from family and peers improved QoL and improved pain. 16% had a parent with fibromyalgia, 56% had a parent who had chronic pain. No significant differences existed between age group analysis of 10–14-year-olds and 15–18-year-olds and variables of pain, perceived social support, coping strategies, depression, or self-efficacy.
Linnman et al. (2013)	Cohort study Outpatient pain clinic USA	8 9–18 years *M* (*SD*) =13.5 (1.6) years CRPS	Not stated	No	Symptomatic and persistent cortical reorganisations – significant increased connectivity alterations anterior cingulate, postcentral gyrus, putamen, amygdala, caudate, and thalamus. Alterations in multiple sensory, emotional and cognitive processing regions. The amygdala showed transient increased connectivity in BOLD signal analysis to the primary cingulate cortex.
Logan et al. (2013)	Retrospective, cross-sectional case control study Single outpatient pain clinic USA	101 7–18 years *M* (*SD*) = 13.41 (0.24) years CRPS Comparisons 103 abdominal pain, 291 headache, 119 back pain	CRPS, 13 months Headache, 32.60 months Abdominal pain, 28.14 months Back pain, 23.25 months	No	CRPS group fewer missed school days than other groups. CRPS group no greater anxiety, depression and relative to normative values. More females with CRPS proportionately than the other pain groups. CRPS group reported more somatic symptoms.
Lynch et al. (2007)	Cross sectional study Outpatient pain clinic USA	272 (66% girls) 8–18 years Mixed chronic pain	3–24 months	Analysis of children and adolescents separately	Boys more likely to participate in physical activity as a distraction from pain. Girls sought social support more than boys and expressed their pain and feelings more. Older children had longer pain duration and become increasingly distressed and anxious with the long duration of their pain. Younger children rely heavily on social supports for pain related strategies and affirmations.
Noel, Beals-Erickson et al. (2016)	Cross sectional study Outpatient pain clinic USA	46 caregivers of children (41 mothers, 1 grandmother) aged 10–18 years *M* (*SD*) = 13.51 (2.00) years Mixed chronic pain	3 to ≥ 60 months	No	Orientation with acceptance of diagnosis unresolved diagnosis beliefs showed correlation to resilience or distress cluster groups of parents. Parents in resilience narrative cluster were more likely to show humour, positive outlook, and benefits with their child's pain. Parents reported higher levels of depression and anxiety. Extent of the child’s functional disability did not explain the degree of parental distress levels.

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Noel, Wilson et al. (2016)	Case control study Outpatient pain clinic USA	95 10–17 years *M* (*SD*) = 15 (2.1) years Chronic pain 100 controls *M* (*SD*) = 14.3 (2.1) Mixed chronic pain conditions	≥ 3 months	No	QoL lower in children with chronic pain compared to controls. Chronic pain group reported death and abuse as their most traumatic life event.
Pas et al. (2019)	Case control study Inpatients Belgium	39 FAP, 36 controls 6–12 years *M* = 9 years	*M* = 24 months *Mdn* = 28 months	No	Pressure pain thresholds significantly lower than controls, proposed lower endogenous pain control. No differences boys to girls chronic pain task; Parents of FAP group had greater pain-related fear, catastrophising, avoidance, helplessness, rumination ($p < 0.001$) and magnification ($p < 0.012$) about their child's pain. Children in FAP group significantly more likely to have a parent with chronic pain history.
Pate et al. (2019)	Qualitative semi-structured interviews Community sample Australia	8 chronic pain, 8 healthy peers 8–12 years *Mdn* [IQR] = 10 [8.8–11.0] years	Chronic pain group, 1–2 years (63%) 3–5 years (25%) 6–10 years (13%)	8–12 years [a] Age analysis	Social constructs shown to have large impact on child's pain perception. Pain knowledge no different between groups. Less certainty with 8- and 9-year-old participants and less abstract understanding. Children focus on fixing the pain. Children with chronic pain more able to focus on the psychological, emotional and social impacts of pain.
Pavlova et al. (2020)	Cohort study Tertiary pain program past participants Western Canada	138 (75% female) 9–18 years *M* (*SD*) = 14.29 (2.30) years Mixed chronic pain conditions	*M* (*SD*) = 39.17 (38.66) months	No	Older age poorer sleep, insomnia and shorter sleep duration. Older age greater pain interference and PTS. PTS associated with increased pain interference over time, decreased duration of sleep. Multiple pain areas in 47.2%. PTS greatest driver of pain interference. Worsening pain interference due to poor sleep quality
Pavone et al. (2011)	Case series, Outpatient pain clinic Italy	30 (12 female) 3–14 years *M* = 8 years Growing pains	≥ 3 months	No	Massaging pain site mostly relieved pain. Family history of growing pains in 20%. Bilateral symptoms in 80% and linked to physical activity in 20%.
Pearson et al. (2011)	Case report Primary case Not stated	Single case report 8-year-old female CRPS	6–12 weeks	No	Periods of excessive emotional vulnerability. Parental anxiety increased, stepfather to be deployed on overseas duty.
Perquin et al. (2000)	Cross sectional prevalence study Community sample Netherlands	5423 questionnaires completed and returned 0–18-year-olds	Prevalence study	Responses by age group categorised	25.0% reported chronic pain most commonly in age 12–15 years. Prevalence and multiple pain sites increased with age. Children up to 8 years, FAP was most common pain. Half of children with chronic pain reported more than one location of pain.

Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Seshia et al. (2008)	Cohort study Outpatient tertiary pain clinic Canada	70 (48 females, 22 males) 6–18 years *M* = 12 years (male) *M* = 14 years (female) Headaches	3–144 (*M* = 36) months	No	Sleep disruption 23%; Multiple environment stressors reported by 46%; Isolation 7%; School stress 10%; Family history of recurrent chronic headaches 70%, anxiety 7%, mood disorder 31%.
Sieberg et al. (2011)	Cross sectional study Outpatient pain clinic USA	157 (87% female) 8–17 years *M* (SD) = 12.7 (2.43) years Multiple chronic pain conditions	*M* (*SD*) = 25.92 (13.79) months	No	Parental factors: 30% reported significant global distress. Significant protective behaviours reported. Parental global stress, depression or anxiety did not directly influence level of child chronic pain disability, only parental pain related stress.
Sinclair et al. (2020)	Cross sectional study Outpatient pain clinic Australia	114 75 adolescents (68 girls, 7 boys) 13–18 years 39 children (30 girls, 9 boys) 8–12 years Multiple chronic pain conditions	≥ 3 months or CRPS criteria	Analysis of children and adolescents separately	Sensory modulation associated with attachment low registration linked to anxious and avoidant attachment. Higher sensory sensitivity related to lower anxious attachment and higher functional disability.
Soltani et al. (2020)	Case control study Outpatient pain clinic Canada	155 102 (71% girls) *M* (*SD*) =14.20 (2.29) years Chronic pain group 53 controls (50% girls) 10–18 years *M* (*SD*) = 13.49 (2.71) years Mixed chronic pain conditions	*M* (*SD*) = 3.38 (3.25) years	No	Initial and sustained attentional bias for high-level pain faces, high in both groups; whereas, chronic pain group gave more attention to low pain faces. Eye fixation measured on pain faces; fixation described as attentional bias to pain.
Tan et al. (2008)	Cross sectional study Outpatient pain clinic Netherlands	78 children (85.9% female) 5–16 years *M* = 13 years 951 adults CRPS type 1	*M* = 11.9 weeks	No	Time from injury to symptoms 0.57 weeks (longer than adults). Children specific results: 23.3% one upper extremity, 72.6% lower extremity, and both extremities 4.1%. 28.2% had renewed CRPS type 1 and many due to a new injury, 60% in the same extremity. CRPS type 1 more likely to develop after minor injury in comparison to adults.

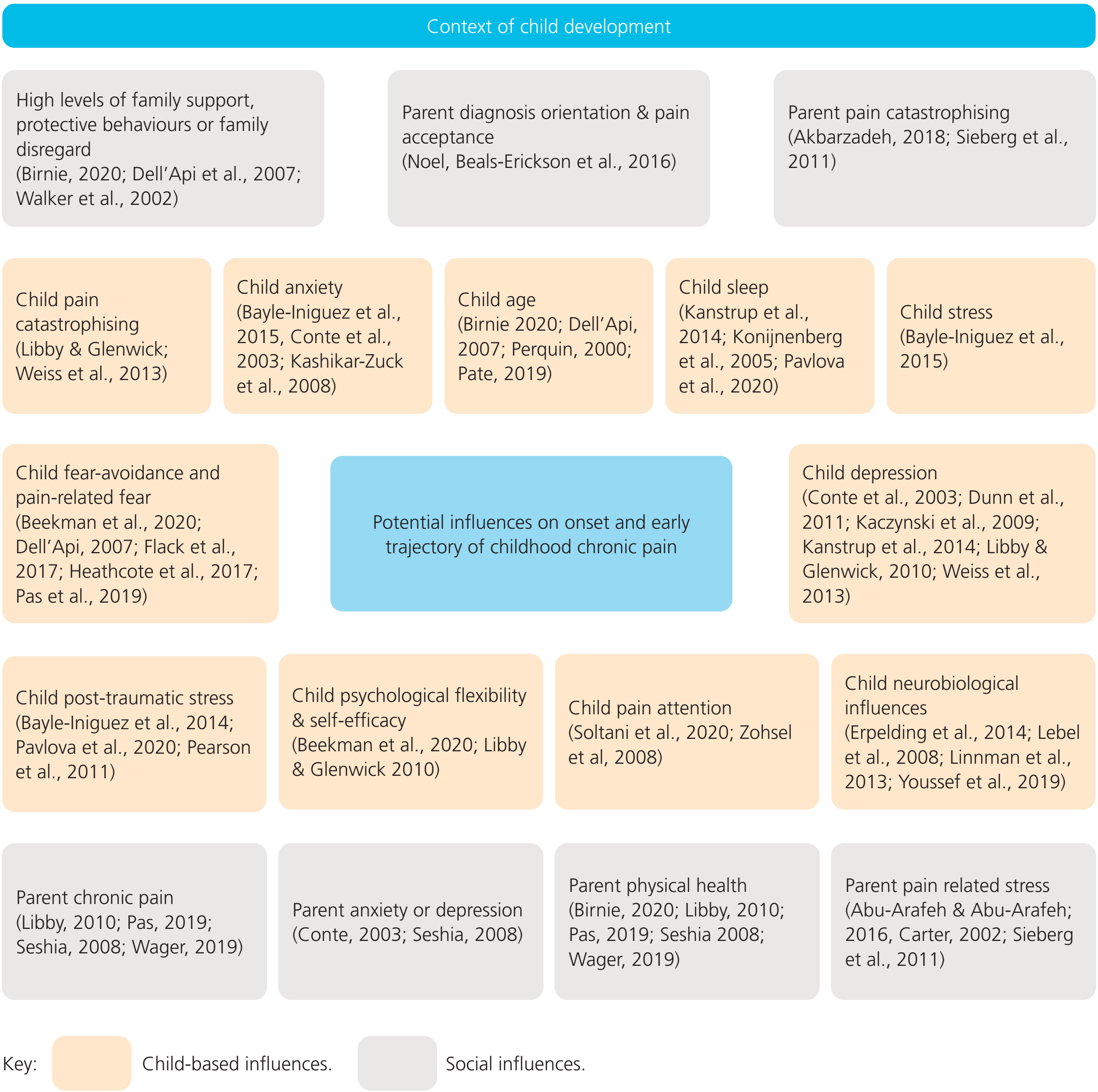
Author (date)	Methodology Participant recruitment Country	Participants *N* (sex) Age Diagnosis	Pain duration	Developmental framework	Primary findings
Wager et al. (2019)	Prospective cohort study Primary care Germany	266 6–17 years *M* (*SD*) =11.2 (3.1) years Prospective of persistent pain	54.4 weeks	No	Poor pain perception at initial consult predicted treatment failure in primary care. Anxiety/depression did not predict treatment failure but emotional burden did. 23.3% of cohort reported disabling chronic pain at 3 months and continued to 6 months. Poor long-term prognosis is poor response to treatment 3 months in primary care. Older children at greater risk for persistent pain. Half of mothers and a third of fathers reported chronic pain.
Walker et al. (2002)	Cohort study Tertiary pain clinic USA	151 8–18 years (57% female) *M* (*SD*) = 12.1 (2.5) years Chronic abdominal pain	≥ 3 months	No	Reduced self-worth and low perceived academic performance increased symptom maintenance in combination with activity restriction. Punishment or pain disregard increased symptom maintenance. Activity avoidance not directly linked to pain intensity.
Weiss et al. (2013)	Cohort study Outpatient pain clinic USA	112 (76% female) 11–18 years *M* (*SD*) = 15.47 (1.83) years Mixed chronic pain conditions	3–144 months *M* (*SD*) = 37 (28) months	No	Low pain acceptance, catastrophising, and depression predictive of functional disability and less goal orientated behaviours.
Youssef et al. (2019)	Case control study Outpatient tertiary pain clinic USA	52 and 52 controls Paediatric chronic cohort 16 (10 females, 6 males *M* (*SD*) = 14.3 years CRPS	*M* =15 months	No	Shift in resting state circuits from sensory alterations in paediatric cases with widespread brain variations, including issues with sensory processing and descending pain inhibition. Grey matter atrophy in right anterior cingulate cortex region and thalamus connections.
Zohsel et al. (2008)	Case control study Tertiary paediatric pain clinic and tertiary services Germany	16 *M* (*SD*) = 12 (1.5) years Chronic migraine Controls *M* (*SD*) = 12.3 (1.5) years 10–14 years	*M* (*SD*) = 5.7 (1.7) years	No	Attentional bias to painful and potentially harmful stimuli. Increased pain intensity at shorter latency in migraine group.

Note. BOLD = blood-oxygen-level-dependent; CRPS = complex regional pain syndrome; FAP = functional abdominal pain; JPFMS = juvenile primary fibromyalgia syndrome; ICD = International Classification of Diseases; PTS = post-traumatic stress; QoL = quality of life.

[a] Explained that 8–12 years inclusion criterion was for developmental reasons.

Figure 2

Integrated Potential Influences on Onset and Early Trajectory of Childhood Chronic Pain



Context of child development

High levels of family support, protective behaviours or family disregard (Birnie, 2020; Dell'Api et al., 2007; Walker et al., 2002)

Parent diagnosis orientation & pain acceptance (Noel, Beals-Erickson et al., 2016)

Parent pain catastrophising (Akbarzadeh, 2018; Sieberg et al., 2011)

Child pain catastrophising (Libby & Glenwick; Weiss et al., 2013)

Child anxiety (Bayle-Iniguez et al., 2015, Conte et al., 2003; Kashikar-Zuck et al., 2008)

Child age (Birnie 2020; Dell'Api, 2007; Perquin, 2000; Pate, 2019)

Child sleep (Kanstrup et al., 2014; Konijnenberg et al., 2005; Pavlova et al., 2020)

Child stress (Bayle-Iniguez et al., 2015)

Child fear-avoidance and pain-related fear (Beekman et al., 2020; Dell'Api, 2007; Flack et al., 2017; Heathcote et al., 2017; Pas et al., 2019)

Potential influences on onset and early trajectory of childhood chronic pain

Child depression (Conte et al., 2003; Dunn et al., 2011; Kaczynski et al., 2009; Kanstrup et al., 2014; Libby & Glenwick, 2010; Weiss et al., 2013)

Child post-traumatic stress (Bayle-Iniguez et al., 2014; Pavlova et al., 2020; Pearson et al., 2011)

Child psychological flexibility & self-efficacy (Beekman et al., 2020; Libby & Glenwick 2010)

Child pain attention (Soltani et al., 2020; Zohsel et al, 2008)

Child neurobiological influences (Erpelding et al., 2014; Lebel et al., 2008; Linnman et al., 2013; Youssef et al., 2019)

Parent chronic pain (Libby, 2010; Pas, 2019; Seshia, 2008; Wager, 2019)

Parent anxiety or depression (Conte, 2003; Seshia, 2008)

Parent physical health (Birnie, 2020; Libby, 2010; Pas, 2019; Seshia 2008; Wager, 2019)

Parent pain related stress (Abu-Arafeh & Abu-Arafeh; 2016, Carter, 2002; Sieberg et al., 2011)

Key: 🟧 Child-based influences. ⬜ Social influences.

measure (Huguet & Miró, 2008). However, increased age was associated with greater prevalence (Huguet & Miró, 2008) and pain interference (Birnie et al., 2020; Perquin et al., 2000). Neuropsychological developmental theory suggests that throughout childhood and adolescence, there are progressions in the ability to think and reason in abstract, in the development of insight into ones' own feelings, and in development of self-regulation skills (Anderson, 2002; Best & Miller, 2010). It is unclear how such neuropsychological development relates to increased pain interference with age. However, consistent with such theory, in a qualitative study that took account of children's ages, younger children had less understanding of the abstract concept of pain and its purpose, and many children had difficulty communicating about the emotional aspects of pain (Pate et al., 2019).

Child neuro-biological influences

Neuroplasticity is the dynamic, neural variation in cortical networks. The cortical changes associated with neuroplasticity are related to adaptive learning (Fine & Sung, 2014). Studies of neurobiological circuits in children with complex regional pain syndrome (CRPS) utilising functional magnetic resonance imaging reported evidence of cortical reorganisation (Erpelding et al., 2014; Lebel et al., 2008; Linnman et al., 2013; Youssef et al., 2019) and grey matter atrophy (Youssef et al., 2019) that was concurrent with CRPS symptoms. Specifically, blood-oxygen-level-dependent (BOLD) signal alterations were found in areas representing descending pain inhibition, conditioned fear, and associated sensory processing regions (Erpelding et al., 2014; Lebel et al., 2008; Linnman et al., 2013). Youssef et al. (2019) meanwhile report prevalent grey matter atrophy in general sensory-emotional, motor, cognitive, and sensory-descending modulating brain regions, and describe a high degree of plastic cortical reorganisation in the thalamus connections in this population.

BOLD signal increases were also reported between the primary somatosensory cortex and the thalamus both in symptomatic and recovered CRPS groups (Lebel et al., 2008; Linnman et al., 2013). Mechanisms proposed for this persisting increase in connectivity in the children included learning processes from the trauma of CRPS symptoms and ongoing nociceptive recognition (Linnman et al., 2013). Concerningly, no known studies in children have ascertained the period over which these connective changes commence or resolve (Lebel et al., 2008; Linnman et al., 2013).

Child psychological factors exerting negative influences

Psychological factors play a key role influencing childhood chronic pain. Affective pain behaviours and the emotional aspects of pain experience were the strongest predictors of early treatment failure for children (Wager et al., 2019). Various baseline affective symptoms identified in this review that negatively affected outcomes included depression (Conte et al., 2003; Dunn et al., 2011; Kaczynski et al., 2009; Kanstrup et al., 2014; Libby & Glenwick, 2010; Weiss et al., 2013), anxiety (Bayle-Iniguez et al., 2015; Conte et al., 2003; Kashikar-Zuck et al., 2008), stress (Bayle-Iniguez et al., 2015); somatisation (Dunn et al., 2011), catastrophising (Libby & Glenwick, 2010; Weiss et al., 2013), pain-related fear (Flack et al., 2017; Heathcote et al., 2017; Pas et al., 2019), and fear-avoidance (Beeckman et al., 2020).

Depression or mood-related conditions, attention issues, greater behaviour-related problems, somatic symptoms, and anxiety were reported as pre-existing factors associated with chronic pain (Conte et al., 2003; Kashikar-Zuck et al., 2008). Anxiety was also associated with increased allodynia symptoms (de Tommaso et al., 2017). Children with chronic pain showed higher than average school functioning (Bayle-Iniguez et al., 2015; Ho et al., 2009), but along with this had perfectionist tendencies, general anxiety, and increased psychosocial stress (Bayle-Iniguez et al., 2015).

The review findings highlighted some variability, particularly in relation to children with a CRPS diagnosis. Retrospectively, CRPS participants self-reported fewer anxiety and depression symptoms (Abu-Arafeh and Abu-Arafeh, 2016; Logan et al., 2013). However, it is plausible that the fewer psychological symptoms were primarily due to lower average pain duration and chronicity of symptoms of children in these two studies.

It is a common human process for pain to capture attention above other emotions (Soltani et al., 2020). Qualitative evidence reports that younger children interpreted their unexplained pain as life threatening (Dell'Api et al., 2007), with children's interpretation of their pain creating protective avoidant behaviours (Flack et al., 2017; Heathcote et al., 2017). Children with chronic pain were also more perceptive to all aspects of pain display, showing difficulty realigning their attention away from a painful sensation (Zohsel et al., 2008), described as an attentional bias (Soltani et al., 2020). Children's pain avoidance and attention bias was also described as anticipatory to the potential of pain, and not typically responsive to the sensation itself (Flack et al., 2017).

It is possible that avoidance behaviour in children with chronic pain is acquired via social or sociocultural learning. Consistently, neither activity avoidance nor participation levels were directly linked to pain intensity or symptoms (Beeckman et al., 2020; Walker et al., 2002). Instead, pain-related fear was the most central factor of activity avoidance and overall function (Beeckman et al., 2020). However, children with chronic pain who rated their self-worth poorly, similarly responded with greater functional disability and activity limitations, especially with activities they expected themselves to perform poorly in (Walker et al., 2002). This concept of low self-worth may be related to self-efficacy (Bandura, 2003).

Children's sleep

Children with chronic pain were shown to wake more frequently (Konijnenberg et al., 2005; Pavlova et al., 2020), with insomnia more common in older children and adolescents (Kanstrup et al., 2014; Pavlova et al., 2020). Insomnia explained the variance between chronic pain and functional disability, pain interference, and depression symptoms (Kanstrup et al., 2014; Pavlova et al., 2020). Higher ratings of baseline pain interference influenced greater sleep disturbances, and poor sleep quality was considered a major factor of pain symptom maintenance (Pavlova et al., 2020).

Child trauma and stress

Traumatic experiences can influence children's pain and stress response systems (Turner-Cobb, 2014). Various stressors were identified as preceding CRPS diagnosis (Bayle-Iniguez et al., 2015; Pearson & Bailey, 2011). The combined occurrence of poor-quality sleep and post-traumatic stress (PTS) are linked to chronic pain (Pavlova et al., 2020). Additionally, PTS correlated with increased pain intensity, pain impact, reduced quality of life (Noel, Wilson et al., 2016), and poor sleep (Pavlova et al., 2020). Further, both children with chronic pain and their parents presented with high levels of PTS (Noel, Wilson et al., 2016; Pavlova et al., 2020). This highlights the relevance of social learning models, whereby modelling or family influences may shape children's stress levels, and behavioural responses to pain and adversity. Sustained trauma is likely to influence children's long-term stress responses and emotional regulation (Davies, 2011; Steck & Steck, 2016), lending insight into the way PTS might be associated with the onset and early trajectory of chronic pain.

Child psychological factors exerting positive influences

While many psychological factors are associated with the development of chronic pain, there are also psychological factors that positively influence chronic pain. Psychological flexibility is a personal value of adaptability and resilience and was found to govern activity participation more than pain itself (Beeckman et al., 2020). Psychological flexibility was also found to positively affect daily activity participation for older children with chronic pain through fewer fear-avoidance behaviours, by shifting cognitive attention to something else. Additionally, psychological flexibility was a mediator of goal orientated behaviours, decreased depression, and reduced functional disability (Beeckman et al., 2020). Psychological flexibility is reflective of neuropsychological development of executive function skills, where children gain increasing control over their ability to maintain and shift their attention (Best & Miller, 2010). Developmentally, this would not be as evident in younger children as it is a skill that develops with neuropsychological maturity (Best & Miller, 2010).

Self-efficacy, as theorised within SCT (Bandura, 2003) is another key resilience component of chronic pain and was a positive psychological factor highlighted by Libby and Glenwick (2010). Pain-related self-efficacy was positively associated with health-related quality of life measures in child chronic pain and was an identified moderator of depression and daily stress, and predicted pain ratings (Libby & Glenwick, 2010).

Social influences

Participation and peer interaction is an integral part of childhood developmental learning (Hoffnung, 2019), but unfortunately, the social consequences of reduced participation by children with chronic pain was highlighted in this review. Children with chronic pain had frequent school absenteeism (Kanstrup et al., 2014; Kashikar-Zuck et al., 2010). School absences were reported to be enabled by families, reinforcing illness behaviours, and creating positive attention for children's pain, thereby encouraging symptom maintenance (Walker et al., 2002).

Higher perceived support from family increased pain intensity (Libby & Glenwick, 2010), but negative support, in the form of disregard, also increased pain symptoms (Walker et al., 2002). Both findings can be explained by SCT, whereby incentive or disregard may prompt behaviour such as maintenance of symptom presentation (Miller, 2016).

Children who interacted more with healthcare professionals while continuing to seek resolution for their pain were reported to have poorer physical health and overall health satisfaction (Dell'Api et al., 2007). Notably, 40% of parents also had unresolved diagnosis orientation or a perception of incorrect diagnosis pertaining to their child's chronic pain symptoms (Noel, Beals-Erickson et al., 2016). From a SCT perspective, children observe and model their parents' behaviour (Miller, 2016). It is possible parents may reinforce children's low pain-acceptance behaviours (Weiss et al., 2013) through positive attention (Bandura, 2003), permitting withdrawal from unfavourable activities (Walker et al., 2002) or through the child observing the parent's low pain acceptance beliefs regarding the child's pain (Noel, Beals-Erickson et al., 2016).

Consistent with developmental learning theories, parents were central mediators to childhood pain behaviours (Akbarzadeh et al., 2018). Children rely more strongly on their social support systems than themselves for pain related strategies and affirmations (Lynch et al., 2007). Vygotsky's SCDT posited that parents' interpretation of events determines a child's response to an event (Bergen, 2008). Aligning with SCDT tenets, several studies reported the concurrence of parental chronic pain or psychological mood disorders and their influence on their child's chronic pain onset (Conte et al., 2003; Kashikar-Zuck et al., 2010; Libby & Glenwick, 2010; Noel, Beals-Erickson et al., 2016; Pas et al., 2019; Seshia et al., 2008; Wager et al., 2019). Further, if a family member experienced chronic pain, children were more likely to catastrophise their own pain (Dell'Api et al., 2007). In 2020, Birnie et al. identified significant relationships between parent's physical and psychological health, protective behaviours, and child pain interference. Additional mediating factors such as parental pain catastrophising (Akbarzadeh et al., 2018), parental protective behaviours, and parent pain-related stress (Birnie et al., 2020; Sieberg et al., 2011) have also been shown to influence childhood chronic pain.

Higher levels of maternal pain catastrophising increased the mother's report of their child's pain intensity, anxiety, and depression. In contrast, high levels of a father's pain catastrophising only showed correlation to reports of their child's anxiety. Measures of mothers' catastrophising were significantly higher than those of fathers (Akbarzadeh et al., 2018). Drawing from SCT (Bandura, 1986, 2003) parental behaviours that relate to their own pain, or associated affective factors, are likely modelled, and could be readily assumed by their children (Steck & Steck, 2016).

Further adding to the complexity of these influences (see Figure 2), it appears that a child's pain impacts adversely on parent wellbeing (Carter, 2002; Hunfeld et al., 2002), which, in turn, mediates the child's functional ability (Sieberg et al., 2011). Parents did report increased stressors deriving from their child's pain (Abu-Arafeh & Abu-Arafeh, 2016); however, this stress was not present prior to the child's presenting pain complaint (Carter, 2002). A main stressor reported by these parents were the encounters with medical professionals, medical misinterpretations, and lack of diagnosis or treatment plans for their child's pain (Carter, 2002).

DISCUSSION

To our knowledge, this is the first study to integrate information about biological, psychological, and social influences with childhood developmental theories in relation to childhood chronic pain. The review findings provide an initial basis to inform practice for physiotherapists working with younger children with pain conditions in PC.

The literature in the review suggested that diverse biopsychosocial aspects including age at onset and pain duration, neuro-biological factors, psychological factors, parental impacts, sleep quality, trauma history, and stress interact with children's learning and development to collectively influence chronic pain onset and early trajectory in children. Although the biopsychosocial model has served well as a basis for generating evidence about adult chronic pain, this review implies that, for children, the addition of a more nuanced, developmentally informed view of the influences may be appropriate. SCDT and SCT suggest children's learning about pain develops through observation and appraisal of situations, emotions, social interactions (Bandura, 2003; Miller, 2016; Smith, 2013), problem solving, and support from others (Koenig & Sabbagh, 2013; Miller, 2016; Vygotsky et al., 1978). From this learning comes complex and increasingly advanced abstract thinking about concepts such as pain, and insight into one's own and others' behaviours, including those relating to pain (Miller, 2016; Smith, 2013). While the review findings indicate developmental factors likely shape children's experiences of, and responses to, a pain event, children's early pain experiences also have potential to interrupt their development, through their impact on participation in childhood activities (Kanstrup et al., 2014; Kashikar-Zuck et al., 2010; Walker et al., 2002).

Implications for physiotherapy practice

The prognosis of chronic pain is thought to be determined from initial treatment effectiveness (Simons et al., 2018; Wager et al., 2019; Zernikow et al., 2018), where PC is the most common initial point of contact (Mallen et al., 2007). Physiotherapists working in PC are, therefore, ideally placed to provide quality, developmentally informed services early in a child's presentation where there are concerns over continuing pain, thereby interrupting the progression of the condition.

The findings from this review suggest that PC practitioners, but particularly physiotherapists, should understand that pain is experienced, not only through the physical realm, but also psychologically and socially, with all aspects needing to be appropriately managed for successful outcomes (Gatchel et al., 2007), as well as careful consideration given to children's development and factors that affect their learning. Furthermore, the influences of parental health, catastrophising, and protective or pain related behaviours need consideration (Birnie et al., 2020; Sieberg et al., 2011). To ensure a comprehensive and holistic evaluation of child and family factors in the early stages of a child's pain trajectory, an interprofessional approach is indicated. Physiotherapy service delivery in the PC setting should, therefore, be complemented by services provided by other professionals such as a paediatric psychologist and/or occupational therapist.

Since pain is a personal experience (Hinton & Kirk, 2016), and given the child influences identified in this review, it should be the child who is addressed in a consultation, while acknowledging the significant social support and information from parents. Recognising younger children's difficulty with understanding the abstract concept of pain (Pate et al., 2019), consultations should also draw on the opportunity to educate the child and their relevant social network, at cognitively appropriate levels, about the factors that can influence the child's pain experience and strategies that can be used. Parents may benefit from support in their interactions with their child (Noel, Beals-Erickson, et al., 2016).

From a learning perspective, it is possible that pain catastrophising (Dell'Api et al., 2007; Libby & Glenwick, 2010; Weiss et al., 2013) and fear-avoidance behaviours (Beeckman et al., 2020; Flack et al., 2017; Heathcote et al., 2017) communicate children's uncertainty and reflect their prior observations of others in pain. In terms of effective practice for physiotherapists and other primary care practitioners, catastrophising and fear avoidance might usefully be reconceptualised as worry or anxiety and searching for reassurance and understanding from parents and healthcare professionals (Levy et al., 2007). Therefore, physiotherapists should seek to understand what fears are creating anxiety, catastrophising, or avoidance behaviours.

Neuroscientific research and fMRI have advanced the understanding of pain experience (Steck & Steck, 2016). These imaging advances have also shown the variations of cortical connectivity networks and grey matter adaptations in children with CRPS (Bhatt et al., 2020; Lebel et al., 2008; Linnman et al., 2013). It is, therefore, imperative that these neurological adaptations are understood by all practitioners providing care in the onset and early trajectory of chronic pain in children.

Consistent with SCDT and SCT, parents are central mediators of children's pain responses, suggesting that at least some of children's responses are learned as part of a process involving their social and socio-cultural contexts (Akbarzadeh et al., 2018; Birnie et al., 2020). A family history of chronic pain can influence childhood chronic pain (Kashikar-Zuck et al., 2010; McKillop & Banez, 2016; Pas et al., 2019; Wager et al., 2019). Parents may assist a child in learning about activities to avoid (Walker et al., 2002) or reinforce avoidant behaviours through being extra-attentive to their child's pain (Sinclair et al., 2020), inadvertently increasing the child's functional disability.

It is plausible that parental protective behaviours are an adaptive response to their child's suffering, and feelings of failure to fix their child's pain (Carter, 2002; Maciver et al., 2010; Vasey et al., 2019). It is essential, therefore, that parents are not blamed by practitioners for their child's pain (Maciver et al., 2010), and learning theories suggest that parent's responses offer a means of supporting children to learn more adaptive responses to pain early in the trajectory. Parent pain responses in terms of how to feel and respond to pain, and the potential of reinforcement of pain are delicate, but potentially modifiable factors (Evans et al., 2008) and important treatment considerations for physiotherapists.

Limitations of the review

The findings of this review are constrained by the quality of studies that were included. There were various methodological limitations present within a large portion of the studies. For example, cross-sectional methodology was used in many studies in this review, and such studies provide limited insights into changes in children's pain trajectories and developmental influences over time. Additionally, there were limitations in terms of the included studies' ability to represent the population. Analysis of the age-related data relied, for the most part, on broad age-group means, and many of the studies involved, largely, adolescent populations. Analysis of children's developmental cognitive skills, essential to learning, were only present in a small number of studies (Lynch et al., 2007; Pate et al., 2019), limiting knowledge about younger children and their understandings about pain. Generalisability of study findings to younger children attending PC settings was also constrained by the studies' predominant involvement of tertiary and specialist pain centre settings with children who had longstanding durations of their pain.

Relating to such concerns, it is a limitation of the review that a systematic, critical appraisal of the studies was not conducted, a requirement that is increasingly recognised within integrative review methodology and process (Toronto & Remington, 2020). While critical analysis and integration of the research in light of developmental theory was the basis of this review, further systematic review of the methodological quality of literature in this field remains an important next step.

Future research

Research into childhood chronic pain remains in its infancy. There is limited research investigating pain interpretation or pain experience in relation to development, especially in pre-adolescent children. As a result of this review, childhood pain researchers need to embrace the complexity of childhood development to assist in establishing robust practice guidelines. A formal interplay between research and developmental theory is required to urgently advance our clinical knowledge in this area (Huguet et al., 2011).

Future studies should acknowledge the range of factors associated with the onset and early trajectory of childhood chronic pain. Research is needed to ascertain whether associated central cortical changes resolve, whether there are variances in psychological influences with increased chronicity, and to establish optimal timelines for intervention effectiveness. There is a need for longitudinal research in primary healthcare settings, commencing in the early stages of children's pain conditions.

CONCLUSION

Younger children's pain is encompassed within continually changing cognitive, physical, and affective developmental stages. Children's social and family systems add further complexity to their pain experience. Adopting a conceptual understanding of children's pain in relation to their development would generate evidence that is better placed to inform practice. From a primary healthcare perspective, it is imperative that physiotherapists have a thorough understanding of the biopsychosocial influences and relevant developmental understandings to positively influence or interrupt children's chronic pain trajectories.

KEY POINTS

1. Physiotherapists play a key role in managing the onset and early trajectory of chronic pain in children with initial treatment effectiveness affecting childhood chronic pain outcomes.
2. Research suggests physical, psychological, and social factors interact to influence the early onset and trajectory of childhood chronic pain.
3. Parental health, catastrophising, and protective behaviours exert specific influences on a child's pain interference and should be assessed.
4. Theory suggests children's cognitive development and learning shape their responses to pain.

DISCLOSURES

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PERMISSIONS

None.

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CONTRIBUTIONS OF AUTHORS

Conceptualisation and methodology – AM and MJ; Formal analysis and investigation – AM and MJ; Data curation – AM; Writing – original draft preparation – AM; Writing – review and editing – MJ; Supervision – MJ.

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Appendix A

Table A1

Supporting Childhood Development Texts

Assessment and development of executive function (EF) during childhood (Anderson, 2002).
Bandura's social cognitive theory: An introduction (Bandura, 2003).
Human development: Traditional and contemporary theories (Bergen, 2008).
A developmental perspective on executive function (Best & Miller, 2010).
Child development: A practitioner’s guide (Davies, 2011).
Handbook of resilience in children (Goldstein & Brooks, 2013).
Lifespan development (4th Australasian ed.) (Hoffnung, 2019).
Theories of developmental psychology (6th ed.) (Miller, 2016).
Theories of human development (2nd ed.) (Newman, 2016).
A clinician's guide to normal cognitive development in childhood (Sandberg & Spritz, 2010).
Understanding children and childhood: A New Zealand perspective (5th ed.) (Smith, 2013).
Brain and mind: Subjective experience and scientific objectivity (2nd ed.) (Steck & Steck, 2016).
Child health psychology: A biopsychosocial perspective (Turner-Cobb, 2014).

Gender Disadvantage in Physiotherapy

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ABSTRACT

Gender inequality exists in healthcare, resulting in a gendered division of labour where women generally receive lower pay and status in the industry than male health professionals. This critical review will examine the state of gender disadvantage in health work and physiotherapy using feminist theories and exposing social norms and beliefs that allow these practices to be perpetuated. Gender disadvantage within the physiotherapy profession is explored, demonstrating gender disparity permeating through career lifespans from training to retirement, including, among others, differences in career specialisation, workplace violence, and unequal treatment of patients. Using historical references, the evolution of gender discrimination and disruption is reviewed. In understanding these factors, a pathway can be exposed to move towards gender equality within our profession.

Cullen, J. (2023). Gender disadvantage in physiotherapy. *New Zealand Journal of Physiotherapy, 51*(2), 159–166. https://doi.org/10.15619/nzjp.v51i2.351

Key Words: Gender, Inequality, Physiotherapy, Wage Gap

INTRODUCTION

Gender norms and inequalities exist in healthcare, contributing to a gendered division of labour where women generally receive lower pay and status in the industry than male health professionals (Hay et al., 2019). Workplace structures, cultures, and social norms can contribute to gender disadvantage, leading to trends such as pay and promotional advantage for men, fewer job offers for mothers while men experience a fatherhood 'bonus', and medical dominance (Fuller & Cooke, 2018; Stamarksi & Son Hing, 2015; Templeton et al., 2020). Combined with the impact of family workload and expectations, issues faced in the workplace seem only to reflect the wider disadvantage women face in our society. The Covid-19 pandemic hindered progress in reaching gender equality in the workplace, instead highlighting just how common gender bias is (Zamarro & Prados, 2021). Yet considerable changes have taken place both socially and professionally towards gender equality over the past century. These developments call into question the role gender plays in the lived experience of a physiotherapist in Aotearoa New Zealand today, and the extent to which gender bias within physiotherapy currently impacts on patients in the clinical setting.

This critical review will examine the state of gender disadvantage in health work and physiotherapy using feminist theories. Understanding how gender roles have developed historically and been disrupted can lay the pathway for further change, so the next generation of women will not face inevitable discrimination in their own careers and personal lives.

HOW FAR HAVE WE COME? A BRIEF HISTORY OF FEMINISM

In 1910, several hundred women protested at Downing Street, demanding economic and political equality, the right to vote, and social reform. At the time, protestors were fighting a universal assumption that women belonged at home as wives and mothers. Women had no legal existence, no property rights, or control over inheritance or custody (Donovan, 2012). The end of the 19th century was the high point of first-wave feminism, a movement that sought to open opportunities to women with a focus on the right to vote. Early activists included influential figures such as Olympe de Gorges, who argued, among other topics, that women should have the same rights as men, and Mary Wollstonecraft, who called for men and women to be educated equally (Cokely, 2018; Wollstonecraft, 1845). When suffrage was achieved (albeit for women of a certain age and status), this was largely considered the end of this period. The first wave, however, has been criticised for its focus primarily on the rights of white women (Breines, 2007).

This first wave of feminist activism disrupted the gender norms of the time, and further gains were made in the 1960s to 1970s with the second wave of feminism, including to women's rights over their own bodies (Hilden, 1982; Reger, 2015). Following the third wave of feminism in the 1990s, which explored the interrelations of gender, race, and class in women's lives and sought to change the narratives on women's sexuality, female physiotherapists today face fewer barriers in the workplace than previous generations (Braithwaite, 2002; Mahoney, 2016). Yet a continued theme of gender difference, gender bias (receiving different treatment based on stereotypes of a person's real gender or perceived gender), discrimination, and disadvantage both professionally and personally continue for women (both trans and cis).

THEORIES OF GENDER DISADVANTAGE

Exploring the evolution and theory of gender norms can explain how we arrived at the point where this societal structure seems to be taken for granted (Germov, 2013). Mainstream family sociology in the 1950s and 1960s argued a biological basis for 'women's roles' (Targ, 1989). This is of course relevant to the professional sphere, as if the woman's role is in the home, then her economic role is not the primary one, if it exists at all. Earnest Burgess and Talcott Parsons (Burgess, 1926; Parsons, 1959; Parsons & Bales, 1955) theorised that the role of husbands and wives were biologically based, complementary and necessary for a healthy functioning society. The wife's role was expressive, nurturing, and in the home, while the husband was the breadwinner, primarily based out of the home in the economic sphere. All this was deemed necessary in order that children were socialised and would develop healthily and 'correctly'.

'Women's work' is an extension of this biological narrative, where kindness, patience, and caring were the typical characteristics expected in female careers such as nursing and physiotherapy, which were also poorly paid and of low status (Carter, 1994). Women were thought to enter 'caring' and lower status / paid roles professionally, as their 'longing' for social connectedness resulted in a 'feminine' motivational force, where relationships and community were the focus, not power and status (Freedberg, 1993; Gilligan, 1982; Gino et al., 2015).

This biological narrative was critiqued and challenged by feminists, along with a view that the position in society white male sociologists occupied led them to make sexist conclusions. Ann Oakley specifically described sociology as male-orientated and male-biased, lacking a feminine perspective and rendering women inconspicuous (Oakley, 1974; Smit, 2016). Feminists challenged the concept of a harmonious family unit, noting it had different effects on men and women, and not all of these were positive. 'Family responsibility' usually fell to the mother, and the family home could be a mentally and physically dangerous place for some women (Gavron, 1966; Oakley, 1974; Targ, 1989).

Oakley (1974) challenged the view that the 'woman's role' was biologically driven, instead explaining this as a socialisation process that girls learn from their mothers. In her study she analysed women's experiences of housework, and demonstrated how this work stood in striking contrast to the male sociologist view of women fulfilling a biologically expressive and caring role. Rather than simply being part of a caring woman's role, Oakley highlighted housework as 'real work', a clear form of unskilled manual labour, defended as involving hard work and long hours (Smit, 2016).

While Oakley's theory that challenges biology as the basis of 'women's roles' has merit, her study faced criticism and included a number of limitations. These included a small sample size and phrasing of questions that may have elicited a negative response (Smit, 2016). However, the non-biological basis for women finding themselves in a caring role is further supported by research arguing that women were not staying at home raising children and doing housework because they are biologically wired to be more loving, but because they were shut out of higher education, and discriminated against in paid labour (Crompton, 1987; Fillion, 1996).

Ann Witz's (1992) research into feminist sociology gives insight into this exclusionary process. She describes how social norms serve to continue male domination of women, with a focus on sociology of the professions and occupational closure with a gendered lens. Her work documents how medical men used exclusionary strategies to maintain their male dominance and position of high status and power, by unpicking neo-Weberian theory and gender relationships. Female medical roles such as nursing were required to be subordinate to doctors, to show them unreciprocated respect and to ask their permission to treat, an experience that can still occur (Carter, 1994; Hay et al., 2019).

The central role women's unpaid labour plays in a capitalist society was highlighted more recently by Silvia Federici (2010). She noted that by reducing the economic cost of overall work through women's unpaid domestic labour, profits, surplus profits, and the power they afford are then directed principally to men. Extending this gendered dynamic to healthcare, the lower pay and status of female 'caring' professions such as nursing and allied health allow contrasting power and financial reward to dominant 'elite' professions such as medicine (Adams, 2010; Nicholls, 2022). Such roles are more often male, particularly highly paid specialist 'heroic' roles such as orthopedics, surgery, and intensive care (Dua, 2010; Medical Council of New Zealand, 2019). In addition, by viewing women's caring roles as innate, and objective/scientific knowledge as masculine, women experience further barriers to acquiring the knowledge required to achieve roles of high status in health (Kelly, 1985; Pavco-Giaccia et al., 2019). These narratives in society extend well beyond medicine and conditioning begins early. Indeed, toys that build scientific knowledge and expertise, dominance, and excitement are preferentially marketed to and purchased for boys, while toys encouraging caring, socialising, and being pretty are directed to girls (Fine & Rush, 2018). While parents may find it acceptable for girls to play with toys associated with the opposite gender, surveys show this belief is significantly reduced when it is reversed (Boe & Woods, 2018).

With a wider focus on identity, Judith Butler (1988) theorised that gender is socially constructed rather than inherent, and that these notions serve to continue the domination of women by men, as well as queer communities. A biological explanation for women's roles ignores the differences between gender and sex, and different cultural learnings about gender. Being a man or a woman means learning what it is to be masculine or feminine in your culture, and this differs in different regions, highlighting the weakness of this argument (Storkey, 2000). Evidence that a social construct of gender disadvantages women can be seen in studies that identify learned bias women face in the workplace, including ideas such as that women are less competent than men, and are lacking in leadership potential (Diekman & Eagly, 2000; Heilman, 2012). Further, studies have also shown that when women see successful ambitious female role models, they report greater aspiration and motivation to achieve high-status positions themselves (Laguía et al., 2022). If women simply biologically longed for social connectedness and prioritised this over career goals, one wouldn't expect this to change when presented with different role models than the current status quo.

Butler's theories also serve to explain research showing that women don't argue for pay rises or promotion as often as men, and a phenomenon I have witnessed in my own career: that female physiotherapists are criticised by their female colleagues for bringing up the issue of low pay, with a narrative that you shouldn't be doing this job unless you're doing it because you care (Babcock & Laschever, 2007). This is an example of internalising a socially constructed belief that nice women should be focusing on caregiving and community, not economics and self-interest.

Hartmann (1981) proposed that the gendered division of labour is the main structure in society that perpetuates men's dominance over women, keeping women generally in lower paid positions, which in turn increases their dependence on men. Occupational division of labour has been used to keep the best paid jobs for men, who then expect their wives to carry out domestic duties for them, and in turn men now benefit from both higher paid/status positions and reduced domestic work. Hartmann argues that these two forms of oppression then reinforce each other, as the women's disadvantaged position in paid work means they are vulnerable when making arrangements within marriage regarding the division of unpaid labour, then their position in the family goes on to further disadvantage their potential for paid work.

This theory incorporates both how society is structured along with social norms that allow the cycle to be perpetuated. Research supports Hartmann's theory, with studies showing that when women marry, their unpaid domestic labour increases while men's reduces, and that women do more household work even when employed for the same hours as men (Ferreant & Thim, 2019). Currently, across every demographic, women still do more housework than men (Hess et al., 2020). Indeed, the oppression of women currently plays an important economic role. The contribution that unpaid work makes towards a country's gross domestic product (GDP) has been calculated, revealing that women's unpaid labour in New Zealand contributes to a significant share of the GDP at 23% (Ferreant & Thim, 2019). The Covid-19 pandemic response further exacerbated gender inequality, and the unequal division of childcare during lockdowns (irrespective of work hours and fathers being home) was associated with women transitioning out of paid employment, described as the 'pink-collar pandemic' (Zamarro & Prados, 2021).

These theories may go some way to exposing dynamics behind gender inequality. To create a bridge between scholarly literature and the clinical setting, however, it becomes important to understand the influence of gender within physiotherapy currently, and to consider concrete steps to reduce existing gender disadvantage within this sector.

REALITY BITES: GENDER AND PHYSIOTHERAPY TODAY

Gender and the clinician

The impact of gender in physiotherapy and the prevalence of gender bias has become more widely acknowledged and explored, and the means to address these challenges considered (Dahl-Michelsen & Solbrække, 2014; Enberg et al., 2007; Hammond, 2013; Linker, 2005; Nicholls, 2022; Parry, 1995; Sudmann, 2009).

Impacts of gender are multiple, complex, and can intersect with other biases, permeating through career lifespans from training to retirement. The influence of gender in physiotherapy training has been explored, from effects on presentation of sexuality when classmates use each other's bodies as models, to career and specialisation choice (Dahl-Michelsen & Solbrække, 2014; Enberg et al., 2007; Stenberg et al., 2021). Gender has previously been noted as a factor in academic achievement in physiotherapy school, with female students outperforming male students, and male students more likely to fail the course (Hammond, 2013; Hammond, 2009).

In the workplace, male physiotherapists more frequently work in sports and private business, while women are disproportionately represented in the public sector, illustrating how gender constructs influence physiotherapy professional norms (Enberg et al., 2007; Stenberg et al., 2021). These expectations can be formed before training is even initiated, and may in part be a reflection of media focus on physiotherapists in sport, where men are the most common providers of therapy on the sideline (Hammond, 2013).

From training to the workplace, female physiotherapists have been noted to 'de-sensualise' their bodies, both during interactions with intimate modelling for training purposes, and during therapy sessions (Dahl-Michelsen & Solbrække, 2014; Sudmann, 2009). This is particularly so for younger female therapists working with elderly male clients. Strategic approaches in physiotherapy also highlight the objective and unsensual nature of the profession, such as viewing the body as a machine, and being able to demonstrate this biomechanical approach to both medical professionals and the public (Nicholls & Holmes, 2012). These approaches may have originated from a need to establish a clear separation of physiotherapy from masseuses (a term previously used by sex workers to evade prosecution), and to demonstrate professionalism in order to secure the position of physiotherapy in the medical marketplace (Linker, 2005; Nicholls & Holmes, 2012). However, such strategies may additionally aim to serve a protective role, particularly to younger female therapists.

Inappropriate sexual behaviour or harassment towards physiotherapists is high. Studies report that 70% to more than 80% of therapists (mean 77%) experience inappropriate sexual behaviour in the workplace, more widely experienced by younger, less experienced female physiotherapy students or clinicians (Amanulla et al., 2021; Boissonnault et al., 2017). As witnessed in my own public health career, harassment of young female medical staff comes not only from patients, but from other medical staff. Following male patients, the second most common source of sexual harassment of nurses has been reported to occur from physicians (Williams, 1996). Among other risk factors, hierarchical workplace structures, where there are gendered power and status differences between employees (i.e., men are in more valued or higher positions overall than women), are known risk factors for sexual harassment (Bond, 2014; Feldblum & Lipnic, 2016; McDonald & Charlesworth, 2019). The public sector, predominantly filled with female physiotherapists, is traditionally a hierarchical organisation (Brennan & Davidson, 2019; Fernandopulle, 2021; Robinson & Compton, 1996). While demographics are changing, women are still under-represented in senior medical specialties and senior executive positions in public hospitals (Medical Council of New Zealand, 2019; Mose, 2021).

Despite such high levels of workplace violence and the health consequences that can result, therapists note a lack of training on how to respond to or make a complaint about inappropriate sexual behaviour (Cooper & Jenkins, 2008). Education seems essential both during training and in the workplace, including increasing awareness of inappropriate sexual behaviour alongside responses and strategies to reduce risk or resulting harm, how to report incidents, and where to get support (Amanulla et al., 2021). Alongside training, wider workplace dynamics may need addressing to respond to internal sexual violence (Enberg et al., 2007; Sebrant, 1999). Dismantling hierarchical structures, replacing these with more flexible solutions such as team organisation, and greater focus on utilising female skills in leadership positions are among proposed solutions (Sebrant, 1999). Shifting expectations of career pathways and removing barriers to women obtaining senior positions may also reduce gendered status/power differences and gender disadvantage (Evans & Maley, 2021). Assessment of workplace harassment risk by employers and creating a culture where harassment is not tolerated are key. Developing workplace training and a system where employees are held accountable (including complaints and disciplinary procedures) are steps that can be taken to achieve this culture, alongside the promotion of an overall diversity and inclusion strategy (Feldblum & Lipnic, 2016). Workplaces that tolerate harassment have higher levels of harassment than workplaces that do not (Bergman et al., 2002; Feldblum & Lipnic, 2016).

Gender in clinical settings

Gender bias in physiotherapy extends beyond impacts to the clinician, and unequal treatment of patients based on preconceived stereotypes of gender have been documented. Gender bias is noted to predominantly affect women and marginalised genders, and can intersect with other biases (Fikkan & Rothblum, 2012; Hankivsky, 2012; Kristoffersson et al., 2016; Kristoffersson et al., 2018; Ross & Setchell, 2019; World Health Organization, 2019). Unequal treatment is not a unique phenomenon, and gender bias in physiotherapy reflects a wider trend in healthcare.

Healthcare research, which impacts clinicians' understanding of pathological processes and treatments, involves a majority of male subjects (Johnson et al., 2014; Nowogrodzki, 2017). Specific to sports medicine, available data on treatment results of patellar tendinopathy relating to women were reported as 'astonishingly low', at 2% of all available literature, while only 5% of studies using all or mostly male subjects recognised this as a limitation (Mondini Trissino da Lodi et al., 2022). This lack of representation reduces the ability of clinicians to understand possible treatment differences between male and female patients that may impact on health outcomes (Johnson et al., 2014).

Studies have found that women receive a diagnosis after a longer interval than men for the majority of diseases, and are less likely to be investigated and treated for numerous conditions (Din et al., 2015; Hamberg, 2008; Lee et al., 2019; Westergaard et al., 2019). Recent research indicates that women are more likely to experience adverse outcomes (15%) and to die (32%) following surgery, when operated on by a male surgeon compared to female surgeons (Wallis et al., 2022). Women receive inadequate pain management compared to men and are both less likely to be taken seriously or treated effectively. Despite reporting more frequent, severe, and a longer duration of pain than men, women receive less pain medication and treatment (Chen et al., 2008; Hoffmann & Tarzian, 2001; Zhang et al., 2021). Women are more likely to be prescribed antidepressants and anti-anxiety medication than pain relief, and are less likely to be referred for diagnostic investigation and further treatment of chronic pain than men, including referral to physiotherapy (Stålnacke et al., 2015). These differences have been attributed in part to gender bias originating from historical perceptions of women as being less able to reason, and more prone to hysteria and hypochondria (Hoffmann & Tarzian, 2001; Pavco-Giaccia et al., 2019).

In physiotherapy, research into the influence of gender bias on treatment decisions is limited and results are mixed. When investigating the influence of gender on the treatment of back and neck pain, a study involving 76 physiotherapists in Sweden found that male and female patients were treated with minimal difference (Stenberg & Ahlgren, 2010). However, there were significant differences in techniques used, with female therapists using treatment that favoured mental function and acupuncture, while male therapists used more joint mobility training. Gender differences in advice to patients with back or neck pain were found in a qualitative study involving 12 participants, 10 of whom were seen initially by a physiotherapist, and two initially seen by a doctor (Stenberg et al., 2014). Female patients were more likely to perceive a message to 'be careful', with men recalling messages that 'heavy work leads to pain' (despite many of the women also having heavy physical tasks). Men were also given fewer exercise suggestions due to a perception of their increased strength. Gender bias in accessing rehabilitation for children with cerebral palsy was noted in a study on 303 children, with boys more likely to receive physiotherapy intervention, and to more frequently receive physiotherapy intervention than girls (Degerstedt et al., 2017). Current research provides a weak level of evidence but suggests that physiotherapists are not immune to gender bias and further research is needed. Challenging this bias with gender discussions during training could disrupt the current course and allow the profession to evolve (Dahle, 2001). Physiotherapists themselves recognise a need for gender training (Bisconti et al., 2020).

Gender and the health workforce: The current state of pay

Perhaps the greatest focus of gender disadvantage in the workforce falls to renumeration. The gender pay gap is higher in the health care sector than most other sectors, and the feminisation of this industry has been highlighted as the key factor behind pay disparity (World Health Organization, 2022).

A high proportion of employees in the health sector are women, and a substantial gender-wage gap exists between professional and technical fields (Newman, 2014). An analysis by the World Health Organization (WHO) of 104 countries puts the overall gender imbalance in the general health sector as 67% female, with an overall pay gap of 28% for women compared to men's wages. Once hours worked and similar occupations have been controlled for, a gap remains at 11.2% (Boniol et al., 2019).

Female-dominated professions such as nursing and physiotherapy show an even wider gap, and, specifically for physiotherapists in Aotearoa New Zealand, 76% of the workforce in 2018 were women (Potera, 2015; Reid & Dixon, 2018). In 2018, the average income for male physiotherapists was $82,138 with an hourly rate of $38.50, while the average income for female physiotherapists was $60,649, with an hourly rate of $37.40 (Reid & Dixon, 2018). The wage gap does not just exist across gender, but a racial wage gap also exists, and both this and 'the double disadvantage' of being an ethnic minority and female urgently need to be addressed (Mandel & Semyonov, 2016).

This analysis of the wage gap in physiotherapy faces limitations, as a number of employment factors that could explain the data were not controlled for. Nursing research has previously been criticised for similar limitations, including the use of cross-sectional studies and outdated data (Muench et al., 2015). Pay disparities are thought to occur due to many factors including, among others, unequal work hours, occupational distribution, years in the labour force, work hierarchy, and discrimination (Sin et al., 2017). Women work fewer hours than men, leading to lower earnings, and, like other careers (even those female-dominated), men dominate more senior and higher status positions within the profession (Carter, 1994; Tabassum & Nayak, 2021; World Health Organization, 2022). Indeed, the governing body of Physiotherapy New Zealand (PNZ) is more than half made up of men (Reid & Dixon, 2018). However, in studies that account for these factors, women are still paid less than men, despite contributing the same value to their employer (Boniol et al., 2019; Muench et al., 2015; World Health Organization, 2022).

Looking to how gender norms have been successfully disrupted over history can outline how to break down the barriers for future generations. This has previously occurred through scholarly activity and the sharing of information, and the digital age widens this opportunity. Already feminist bloggers such as 'A Mighty Girl' and 'Everyday Feminism' have a wide audience, and feminist art and creative platforms are visible and gaining attention (Danckaert & Smith, 2022; Kim, 2022). Activism and protests can exist on a large and immediate scale. Yet physiotherapists have been far less active in calling for improved pay and working conditions, when compared with teachers and nurses in Aotearoa New Zealand.

Eliminating the gender pay gap in health is essential not only to achieve equality, but to address the global shortage of health care workers. Further, elimination of the gender pay gap is required to meet international commitments by 2030. All United Nations member countries, including Aotearoa New Zealand, are signatories to the United Nations 2030 Agenda for Sustainable Development, committing to productive, sustainable and inclusive economic development, including the promotion of gender equality and empowerment of women and girls (United Nations, 2015). The World Health Organization (2022) has noted steps that can be taken to achieve this. These include, among others, 1) the collection and analysis of sector-specific wage data, 2) introducing wage transparency and tools to confront pay discrimination, and 3) the provision of training, mentoring, and opportunities for women to ascend to more senior positions, alongside wider societal challenges to gender norms.

CONCLUSION

Despite significant gains to equality made over several generations, gender disadvantage is alive and well, in both the workplace and the home. By understanding components that contribute to gender disadvantage and increasing awareness of these issues, concrete steps can be taken to achieve gender equality and, with it, a resilient health sector. Discussions on the impact of gender during physiotherapy training and professional development will be an important step towards reducing gender disadvantage both for patients and clinicians. Wider workplace dynamics and structures need addressing to achieve gender equality, and gender equality has been successfully promoted in some countries through policy change, including the provision of paternity leave (Rocha, 2021). To create lasting change, social norms, structures, and culture need to be challenged to reduce the disadvantage of being female.

KEY POINTS

1. Gender disadvantage exists for health workers, including physiotherapists.
2. Female physiotherapists get paid less than male physiotherapists in New Zealand after accounting for hours worked, and other contributing factors.
3. Exploring how gender bias has evolved and been disrupted historically can allow understanding of how to move towards equality.
4. Feminist theories are critiqued using scholarly literature to explore how gender discrimination is supported and perpetuated in our society.
5. Pathways for disruption are broad with new technologies and advocacy, and structural policy change may be needed for long-term equity.

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None required.

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