

Current Physiotherapy Management of Parkinson's Disease: Is Aquatic Physiotherapy Utilised as a Treatment Modality?

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ABSTRACT

Little is known about the use of aquatic physiotherapy for people with Parkinson's disease (PD). Recent systematic reviews indicate that aquatic physiotherapy has a positive impact on mobility, balance, and quality of life. This study aims to explore current practice in aquatic physiotherapy and identify barriers and enablers to using aquatic physiotherapy from a physiotherapist's perspective. Physiotherapists currently treating people with PD were invited to complete an online survey. Potential differences in levels of confidence treating people with PD, or using aquatic physiotherapy, with years practising were explored. Free-text responses were thematically categorised. One hundred and thirteen physiotherapists completed the survey. The majority were aged 30–39 years (37%), practising in Australia (86%) and over half (56%) had been practising for > 11 years. One third used aquatic physiotherapy in PD. There was no difference in confidence levels among participants who used aquatic physiotherapy for people with PD, relative to the number of years they had practised ($p = 0.13$). An increased falls risk and medical fragility were reported as challenges in the aquatic environment. Overall, aquatic physiotherapy is not commonly utilised for people with PD, with therapist, environmental, and participant challenges identified. Updating clinical practice guidelines and ensuring therapist education may enhance uptake of aquatic physiotherapy for PD.

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INTRODUCTION

Aquatic physiotherapy has been used frequently in musculoskeletal and other neurological conditions such as osteoarthritis, low back pain, multiple sclerosis, and stroke (Barker et al., 2014; Marinho-Buzelli et al., 2015). There is a growing body of research into the use of aquatic physiotherapy as a treatment option for Parkinson's disease (PD), with several recent systematic reviews showing that it has a positive effect on gait, balance, and quality of life (Carroll et al., 2020; Carroll et al., 2017; Neto et al., 2020; Pinto et al., 2019; Terrens et al., 2018). The systematic review by Pinto et al. (2019) found that aquatic physiotherapy had a moderate level of evidence for improving balance when combined with land-based therapy or used as a stand-alone treatment. However, of the 19 studies included in this systematic review, the findings from only six of eight randomised controlled trials (RCTs) were included in the meta-analyses. A subsequent systematic review by Neto et al. (2020) replicated this result with respect to aquatic physiotherapy being a superior treatment option for improving balance in those with PD, and also indicated that aquatic physiotherapy led to greater improvements in mobility and quality of life compared to land-based exercise. This systematic

review is potentially more robust compared to others as it only included RCTs in its design, although it is worth noting that the quality of included RCTs ranged from 4 to 8 (out of 10) on the PEDro scale. Sample sizes of aquatic interventions in studies throughout all systematic reviews were relatively small; therefore, larger and more adequately powered studies may be required to confirm the results presented in these systematic reviews.

Despite benefits with respect to buoyancy, clients with PD are potentially vulnerable in the aquatic environment, considering the effects of aquatic physiotherapy on the cardiovascular and respiratory body systems (Aquatic Physiotherapy Group, 2015). Immersion in water causes an increase in stroke volume and a decrease in diastolic blood pressure (Aquatic Physiotherapy Group, 2015). Approximately 30% of people with PD suffer from orthostatic hypotension, which means that participation in exercise in the aquatic environment carries a potential risk of an adverse event. Swimming in people with PD is compromised (Neves et al., 2020), potentially due to bradykinesia and impaired coordination resulting in difficulty floating horizontally (Tosserams et al., 2020). Given these benefits and risks, it is not known whether aquatic physiotherapy is being routinely used

as a treatment modality by physiotherapists for people with PD, and why it is or is not being implemented (Carroll et al., 2020; Cugusi et al., 2019; Neto et al., 2020; Radder et al., 2020; Terrens et al., 2018).

Physiotherapists use clinical practice guidelines to assist with determining what interventions are most effective in certain patient populations, particularly those with more complex conditions, such as PD (Moseley et al., 2020). The current European Guidelines for Physiotherapy in Parkinson's Disease GRADE-based (Grading of Recommendations, Assessment, Development, and Evaluations) recommendations unfortunately do not contain recommendations or synthesised evidence regarding aquatic physiotherapy (Keus et al., 2014). PD guidelines such as those published by the National Institute of Clinical Excellence (NICE) (2017) and the earlier Royal Dutch Society for Physical Therapy document (Keus et al., 2004) similarly made no mention of aquatic physiotherapy. These guidelines were developed prior to systematic reviews being published supporting the use of aquatic physiotherapy in this population and it is not known when these guidelines are due to be updated. As there are no aquatic clinical guidelines to direct physiotherapists regarding its use and efficacy, the extent to which aquatic physiotherapy is being prescribed for people with PD is unknown. Therefore, the primary aim of this study was to investigate physiotherapists' current clinical practices around the use of aquatic physiotherapy in people with PD.

METHODS

Study design and participants

Physiotherapists who work with people with PD were invited to participate in this cross-sectional study using an online survey. To be eligible, individuals needed to be currently qualified to practise as a physiotherapist in their country, be currently working as a physiotherapist, and have treated at least one client with PD in the last 12 months. There were no restrictions on the types of workplace or expertise level of physiotherapists, although participants had to be able to understand written English. This study was approved by the Monash University Human Research Ethics Committee (project ID 17812).

Recruitment strategy

Physiotherapists were recruited using a snowballing approach to maximise participation across different countries and work locations. The survey was advertised via national and international professional associations (e.g., Australian Physiotherapy Association, Chartered Society of Physiotherapy in the UK) and emails were sent to the research team's clinical and research contacts in Australia and internationally inviting physiotherapists to participate. Contacts were also encouraged to forward the email to their clinical partners. Flyers were also disseminated at relevant international conferences including the 2019 World Parkinson's Congress in Japan and the 2019 World Confederation of Physical Therapy Congress in Switzerland. There was no remuneration for completing the survey. Based on a previous study examining the practices of physiotherapists for osteoarthritis using a similar recruitment strategy (Nicolson et al., 2018), we anticipated that between 100–150 physiotherapists would participate and that a sample of this size would be sufficient to be able to generalise findings.

Survey development and design

The online survey was developed in Qualtrics (Qualtrics, Provo, UT) by the research team, who have extensive clinical experience in PD and survey design. The questions were designed to address the aims of the project, which was to examine physiotherapists' current clinical practices regarding the use of aquatic physiotherapy in PD, and choices of treatments more broadly. Questions recording demographic information such as age, gender, country, qualification, workplace, and years practising as a physiotherapist comprised the first third of the survey. The survey covered current practices in managing people with PD including previous training or professional development for treating people with PD and training in aquatic physiotherapy. If participants indicated that they use aquatic physiotherapy, they were directed to additional questions regarding why they use it, and any challenges faced. Their self-perceived confidence in providing aquatic therapy was also assessed using a purpose-designed scale ranging from 0 (not at all confident) to 10 (extremely confident). Likewise, if participants indicated that they do not use aquatic physiotherapy, they were invited to provide a reason why not. Piloting of the survey was undertaken by all researchers to ensure all possible question combinations were logical and that data were captured for every scenario. A copy of the survey is available from the authors upon request.

Data collection

Data were collected on the secure Monash-licensed Qualtrics survey platform between March and August 2019. Physiotherapists who responded to the study advertisement could proceed directly to the online survey and were presented with an overview of the study. If participants chose to continue, they were asked to complete the three eligibility questions outlined above (i.e., registered physiotherapist, currently working, and has a PD caseload). If participants responded negatively to any one of these questions, they were not considered eligible to participate in the study and thanked for their interest. If participants were eligible, they were immediately directed to the first question of the survey. Consent was implied if the participant commenced the survey.

Statistical analysis

Descriptive statistics were used to summarise demographic data and data regarding intervention types and challenges. Confidence in treating people with PD and using aquatic physiotherapy as a treatment modality were evaluated according to years practising as a physiotherapist using the Kruskal-Wallis test. This non-parametric test was applied to take a conservative approach to avoid over-estimation of results. In the thematic analysis, free text responses were coded for themes by AT using inductive coding, and included in the descriptive analysis.

RESULTS

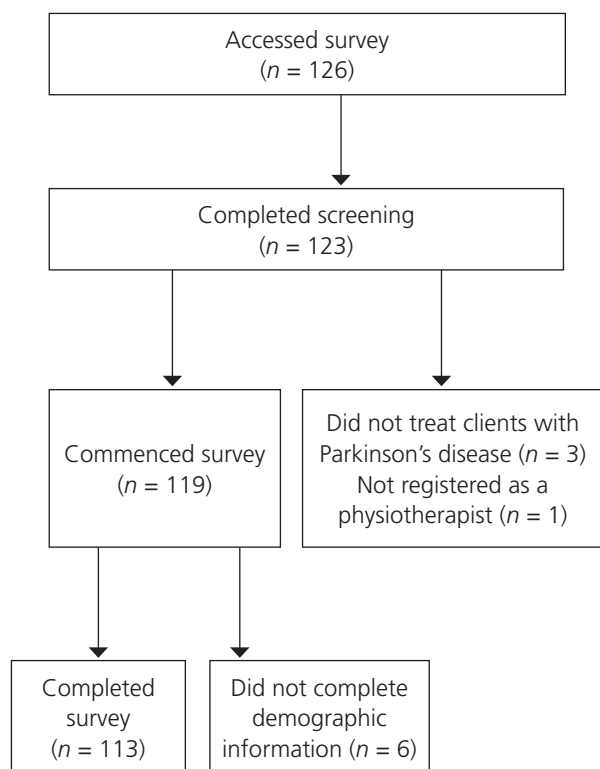
Survey responses

The survey was accessed by 126 physiotherapists, with a participation rate of 98% (123/126) and a completion rate of 90% (113/126) (Figure 1). Six participants did not progress past answering information regarding their demographic characteristics, and were found to not be different from other participants in terms of age ($\chi^2 = 3.11$, $p = 0.79$), years practising

as a physiotherapist ($\chi^2 = 4.23, p = 0.25$), and confidence treating people with PD ($\chi^2 = 7.76, p = 0.44$). Therefore, these participants were excluded from further analyses.

Figure 1

Flowchart of Participants Through the Study



Participant characteristics

Table 1 displays the demographic data from all participants. The majority of participants were female (101/113, 89%) and aged 30–39 years (42/113, 37%). Most respondents (97/113, 86%) were from Australia, with 16 (14%) physiotherapists from other countries, such as the United Kingdom (5/113, 4%) and New Zealand (4/113, 3%). The majority (103/113, 90%) of participants identified that they practised in a metropolitan setting, 71% (82/113) worked full time and 70% (80/113) worked in a hospital environment. Education levels varied from a bachelor degree (57/113, 50%) to clinical doctorate (3/113, 3%), and 56% (64/113) had been practising for more than 11 years.

Current practice of physiotherapists regarding aquatic physiotherapy

About one-third (39/113, 35%) of participants reported that they used aquatic physiotherapy when treating people with PD. For those who used aquatic physiotherapy, the most common reason for selecting this as a treatment modality was because it is known to be an effective intervention (22/39, 56%), with the second most common reason being that existing comorbidities (i.e., osteoarthritis) made land-based exercise difficult (5/39, 13%). Some physiotherapists felt that people

move easier in the aquatic environment (4/39, 10%) and that it is a safe environment in which to treat clients (2/39, 5%). Two (5%) participants offered aquatic intervention as it was 'expected' of them, and one participant (3%) felt that the clients enjoyed the pool and that the pool is relaxing. Physiotherapists who did not use aquatic physiotherapy as a treatment modality (74/113, 65%) reported that this was because they did not have access to a pool (22/74, 30%) or did not know that it was a suitable treatment

Table 1

Demographic Data

Participant characteristic	<i>n</i>	%
Age (years)		
20–29	27	24
30–39	41	36
40–49	23	21
50–59	14	12
60–69	8	7
Sex		
Male	12	11
Female	101	89
Country		
Australia	97	86
International ^a	16	14
Work location		
Metropolitan	101	89
Rural or remote	12	11
Employment		
Full-time	80	71
Part-time	32	28
Casual/locum	1	1
Work setting (could choose multiple)		
Hospital	78	69
Community	60	53
Other	6	5
Education level		
Bachelor degree	59	52
Postgraduate certificate or diploma	16	14
Entry-level diploma or master's ^b	11	10
Postgraduate master's	22	20
PhD or Clinical doctorate	5	4
Number of years practising		
0–5	30	26
6–10	21	19
> 11	62	55
Working in a specialised Parkinson's disease programme		
Yes	32	28

Note. *N* = 113. All data are response counts unless otherwise specified.

^a United Kingdom (*n* = 5); New Zealand (*n* = 4); United States of America (*n* = 3); China (*n* = 1); Egypt (*n* = 1); Ireland (*n* = 1); Thailand (*n* = 1).

^b A postgraduate certificate or diploma is a postgraduate qualification in a specialist area of physiotherapy. An entry-level diploma or master's degree is defined as a postgraduate qualification that allows the clinician to practise as an entry-level physiotherapist upon completion.

technique (19/74, 26%). Other noteworthy reasons included client preference for land-based therapy (10/74, 14%) and time constraints (10/74, 14%).

Eighty-two out of 113 (73%) participants reported receiving specific training in treating clients with PD, with the majority stating that they had accessed online resources (65/113, 58%). The majority (77/113, 68%) of participants felt confident treating people PD, with a median self-reported confidence rating of 8 out of 10 (interquartile range [IQR] = 1). Around half of all respondents (59/113, 52%) reported having had training in aquatic physiotherapy, with the most common form of training being in-house education (41/59, 69%). Of those who used aquatic physiotherapy, self-reported confidence using aquatic physiotherapy was also high, with a median confidence rating of 8 out of 10 (IQR = 3).

A Kruskal-Wallis test showed that participants who had been practising as a physiotherapist for longer had higher confidence treating clients with PD ($\chi^2(3) = 24.9, p = 0.01$). There was no difference in confidence levels among those who used aquatic physiotherapy for people with PD in terms of years practising ($\chi^2(3) = 5.7, p = 0.13$).

Challenges when treating in an aquatic environment

Physiotherapists who used aquatic physiotherapy reported several challenges to treating people with PD in the aquatic environment. Responses have been classified into three main categories, namely patient, therapist, and environmental factors, as shown in Table 2. In terms of patient factors, physiotherapists reported that they were concerned with the increased risk of falls in the aquatic environment (35/39, 90%). The majority of the physiotherapists also felt that the medical fragility of the PD population was a challenge (32/39, 82%). A small proportion of physiotherapists reported that "fatigue" (1/39, 3%), "dysphagia" (1/39, 3%), and "poor cognition" (1/39, 3%) posed a problem when treating people with PD in the aquatic setting.

Minimal environmental factors were reported, with "safety getting dressed and undressed" (3/39, 8%), "hypophonia" (2/39, 5%), and having an adequate "amplitude of movement in the water" (1/39, 3%) identified. From a therapist perspective, physiotherapists found that having to manage the multiple

health issues of this population (29/39, 74%) and not knowing what exercises to use in the pool (16/39, 41%) were factors that prevented them from treating people with PD in the aquatic environment.

DISCUSSION

This study investigated physiotherapists' current practice in using aquatic physiotherapy for people with PD. Only one third of our surveyed physiotherapists reported using aquatic physiotherapy in their treatment of people with PD, which suggests that this is not a well-utilised treatment modality despite recent evidence demonstrating that it might be (Neto et al., 2020; Terrens et al., 2020, 2021; Terrens et al., 2018). This study highlights several barriers to implementing aquatic physiotherapy in practice.

Confidence treating people with PD was high in this cohort, and among those who used aquatic physiotherapy, confidence using this treatment modality was equally high. The majority of physiotherapists indicated that they accessed online materials to help guide them when treating people with PD, which shows that the development and updating of such resources is important to help assist physiotherapists in following best practice guidelines and therefore selecting their treatment choices.

Only half of the respondents reported that they had training in aquatic physiotherapy. In addition, fewer than half of participants also reported that they did not know what exercises to use in the pool, which demonstrates the need for further education and guidelines to be available for physiotherapists regarding the use of aquatic physiotherapy in PD. This finding also highlights that aquatic physiotherapy remains an area that requires further development, particularly in teaching undergraduate students. As this study is the first to report physiotherapists' management of PD in relation to aquatic physiotherapy, it is not possible to compare findings to prior studies, and suggests a need for larger scaled studies in this area to confirm the results and enhance generalisability.

This cohort of physiotherapists reported patient, therapist, and environmental challenges within the aquatic environment. The majority of participants reported that the increased falls risk and the medical fragility of people with PD were the main barriers to using aquatic physiotherapy with this population.

Table 2

Challenges Encountered When Treating People with Parkinson's Disease in the Aquatic Environment

Patient	Therapist	Environmental
Falls	Managing multiple health issues	Safety getting dressed ^a
Medical fragility	Knowing what exercises to use in the pool	Hypophonia ^{a, b}
Fatigue ^a		Amplitude of movement ^a
Dysphagia ^a		
Poor cognition ^a		

^a Direct quotes from participants. ^b Hypophonia was classified as an environmental factor as it is difficult to hear people with soft voices over the ventilation required in the aquatic environment.

This is consistent with previous research in patients with spinal cord injuries where therapists identified medical comorbidities as a barrier to aquatic physiotherapy (Marinho-Buzelli et al., 2019). Although a moderate number of physiotherapists from this survey reported having access to a pool, it is known that access to pools may vary between different countries, as costs for maintaining or hiring a pool can be prohibitive to healthcare centres or private physiotherapists.

Treatment choice by the patient on whether they wish to participate in exercises in an aquatic environment also has to be taken into account when considering physiotherapy management of this clientele. Several barriers to participating in aquatic physiotherapy from a patient's perspective have been identified previously, such as fatigue, and safety getting dressed and undressed (Terrens et al., 2021). The study by Terrens et al. (2021) was nested within a larger study, and examined health-related quality of life and patient perceptions and experiences regarding aquatic physiotherapy. Although the qualitative section of this study only had a small number of participants ($n = 13$), several barriers were identified using the COM-B system, a framework that illustrates how capability, opportunity, and motivation factors result in behaviour change (Michie et al., 2011), that can help guide future aquatic physiotherapy practice. These barriers from the perspectives of both the patient (as outlined in our previous publication) and the physiotherapist (as reported in this study) need to be considered when implementing an aquatic physiotherapy programme in people with PD.

While approximately a third of participants reported that they used aquatic physiotherapy, around a quarter of those who did not were unaware that it was a suitable treatment option when treating people with PD. Although aquatic physiotherapy has been shown to be beneficial in people with PD (Neto et al., 2020; Pinto et al., 2019; Radder et al., 2020), it is not being routinely prescribed as a treatment modality. Previous studies have shown that there is typically a 17-year knowledge translation time lag (Balas & Boren, 2000; Morris et al., 2011) from the development of evidence regarding an intervention to the time of implementation in practice, and potentially more frequent reviews of clinical practice guidelines would reduce such a lag. There has been a large body of evidence supporting aquatic physiotherapy in the PD population, which has been published since physiotherapy practice guidelines (Keus et al., 2004; NICE, 2017) were released. This includes two systematic reviews examining RCTs that agree aquatic physiotherapy is better than land-based therapy for improving balance and quality of life (Cugusi et al., 2019; Neto et al., 2020). Considering this evidence, it would be beneficial for all physiotherapy clinical practice guidelines for PD, including future editions of the European Guidelines for Physiotherapy in PD, to include aquatic physiotherapy to offer clinicians another intervention choice when treating clients with PD.

Limitations

Although this study included a relatively small cohort of physiotherapists, the survey completion rate was high and there was a diverse range of participants from different age groups, work settings, and with variable years of experience. Nevertheless, this was a cross-sectional study with participants

predominantly from Australia and care must be taken when generalising results internationally. This study did not collect data on years of experience working in neurorehabilitation, only total years working as a physiotherapist, and this information may have provided further insight into the participant pool. As recruitment was via the snowballing method and advertisements at conferences that the researchers attended, selection bias may have occurred. Due to differences between countries in terms of access to pool, hire costs, and maintenance, it may not be possible for all physiotherapists to use aquatic physiotherapy when treating clients with PD. Augmenting these results with in-depth qualitative studies may confirm and aid in understanding why clinicians do or do not use aquatic physiotherapy in this population. The majority of the evidence supporting the use of aquatic physiotherapy in the PD cohort has been published after the last edition of the European Guidelines for Physiotherapy in PD; therefore, it is not unexpected that these guidelines do not contain recommendations regarding its use.

CONCLUSION

Aquatic physiotherapy is not a well-utilised treatment technique for people with PD, despite evidence of its efficacy. Several therapist, environmental, and participant challenges were identified, with a large number of therapists not knowing what type of aquatic exercises to use. To improve utilisation of aquatic physiotherapy, further education for physiotherapists and an update in clinical practice guidelines for PD needs to occur.

KEY POINTS

1. Recent systematic reviews indicate that aquatic physiotherapy has a positive effect on mobility, balance, and quality of life in people with Parkinson's disease (PD).
2. Aquatic physiotherapy is not a well-utilised modality among physiotherapists.
3. Several barriers from a physiotherapist perspective have been identified, such as knowing what exercises to use in the pool for this population, the falls risk and medical fragility of the clients, and safety when getting dressed in the change rooms.
4. Physiotherapy clinical practice guidelines for PD require updating to include aquatic physiotherapy and further education needs to be provided to physiotherapists highlighting the benefits of this treatment modality.

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

This study was approved by the Monash University Human Research Ethics Committee (project ID 17812). Informed consent was obtained from all participants.

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REFERENCES

- Aquatic Physiotherapy Group. (2015). *Australian guidelines for aquatic physiotherapists working in and/or managing hydrotherapy pools* (2nd ed). Australian Physiotherapy Association. https://australian.physio/sites/default/files/tools/Aquatic_Physiotherapy_Guidelines.pdf
- Balas, E. A., & Boren, S. A. (2000). Managing clinical knowledge for health care improvement. *Yearbook of Medical Informatics*, 1, 65–70. <https://hdl.handle.net/10675.2/617990>
- Barker, A. L., Talevski, J., Morello, R. T., Brand, C. A., Rahmann, A. E., & Urquhart, D. M. (2014). Effectiveness of aquatic exercise for musculoskeletal conditions: A meta-analysis. *Archives of Physical Medicine and Rehabilitation*, 95(9), 1776–1786. <https://doi.org/10.1016/j.apmr.2014.04.005>
- Carroll, L. M., Morris, M. E., O'Connor, W. T., & Clifford, A. M. (2020). Is aquatic therapy optimally prescribed for Parkinson's disease? A systematic review and meta-analysis. *Journal of Parkinson's Disease*, 10(1), 59–76. <https://doi.org/10.3233/JPD-191784>
- Carroll, L. M., Volpe, D., Morris, M. E., Saunders, J., & Clifford, A. M. (2017). Aquatic exercise therapy for people with Parkinson disease: A randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, 98(4), 631–638. <https://doi.org/10.1016/j.apmr.2016.12.006>
- Cugusi, L., Manca, A., Bergamin, M., Di Blasio, A., Monticone, M., Deriu, F., & Mercurio, G. (2019). Aquatic exercise improves motor impairments in people with Parkinson's disease, with similar or greater benefits than land-based exercise: A systematic review. *Journal of Physiotherapy*, 65(2), 65–74. <https://doi.org/10.1016/j.jphys.2019.02.003>
- Keus, S. H. J., Hendriks, H. J. M., Bloem, B. R., Bredero-Cohen, A. B., de Goede, C. J. T., van Haaren, M., Jaspers, M., Kamsma, Y. P. T., Westra, J., de Wolff, B. Y., & Munneke, M. (2004). KNGF guidelines for physical therapy in patients with Parkinson's disease. *Dutch Journal of Physical Therapy*, 114(Supplement 3). <http://www.ergod.org/download/Guideline%20Parkinsons%20disease.pdf>
- Keus, S. H., Munneke, M., Graziano, M., Paltamaa, J., Pelosin, E., Domingos, J., Brühlmann, J., Ramaswamy, B., Prins, J., Struiksma, C., Rochester, L., Nieuwboer, A., & Bloem, B. R., on behalf of the Guideline Development Group. (2014). *European physiotherapy guideline for Parkinson's disease*. KNGF/ParkinsonNet. https://www.unify-cr.cz/obrazky-soubory/eu_guideline_parkinson_201412-development-c2d2a.pdf?redir
- Marinho-Buzelli, A. R., Bonnyman, A. M., & Verrier, M. C. (2015). The effects of aquatic therapy on mobility of individuals with neurological diseases: A systematic review. *Clinical Rehabilitation*, 29(8), 741–751. <https://doi.org/10.1177/0269215514556297>
- Marinho-Buzelli, A. R., Zaluski, A. J., Mansfield, A., Bonnyman, A. M., & Musselman, K. E. (2019). The use of aquatic therapy among rehabilitation professionals for individuals with spinal cord injury or disorder. *The Journal of Spinal Cord Medicine*, 42(Supplement 1), 158–165. <https://doi.org/10.1080/10790268.2019.1647935>
- Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6, 42. <https://doi.org/10.1186/1748-5908-6-42>
- Morris, Z. S., Wooding, S., & Grant, J. (2011). The answer is 17 years, what is the question: Understanding time lags in translational research. *Journal of the Royal Society of Medicine*, 104(12), 510–520. <https://doi.org/10.1258/jrsm.2011.110180>
- Moseley, A. M., Elkins, M. R., Van der Wees, P. J., & Pinheiro, M. B. (2020). Using research to guide practice: The Physiotherapy Evidence Database (PEDro). *Brazilian Journal of Physical Therapy*, 24(5), 384–391. <https://doi.org/10.1016/j.bjpt.2019.11.002>
- National Institute for Health and Care Excellence. (2017). *Parkinson's disease in adults* [clinical guideline]. <https://www.nice.org.uk/guidance/ng71>
- Neto, M. G., Pontes, S. S., Almeida, L. O., da Silva, C. M., da Conceição Sena, C., & Saquetto, M. B. (2020). Effects of water-based exercise on functioning and quality of life in people with Parkinson's disease: A systematic review and meta-analysis. *Clinical Rehabilitation*, 34(12), 1425–1435. <https://doi.org/10.1177/0269215520943660>
- Neves, M., Bouça-Machado, R., Guerreiro, D., Caniça, V., Pona-Ferreira, F., & Ferreira, J. (2020). Swimming is compromised in Parkinson's disease patients. *Movement Disorders*, 35(2), 365–369. <https://doi.org/10.1002/mds.27918>
- Nicolson, P. J. A., Hinman, R. S., French, S. D., Lonsdale, C., & Bennell, K. L. (2018). Improving adherence to exercise: Do people with knee osteoarthritis and physical therapists agree on the behavioral approaches likely to succeed? *Arthritis Care & Research*, 70(3), 388–397. <https://doi.org/10.1002/acr.23297>
- Pinto, C., Salazar, A. P., Marchese, R. R., Stein, C., & Pagnussat, A. S. (2019). The effects of hydrotherapy on balance, functional mobility, motor status, and quality of life in patients with Parkinson disease: A systematic review and meta-analysis. *Physical Medicine & Rehabilitation*, 11(3), 278–291. <https://doi.org/10.1016/j.pmrj.2018.09.031>
- Radder, D. L. M., Lígia Silva de Lima, A., Domingos, J., Keus, S. H. J., van Nimwegen, M., Bloem, B. R., & de Vries, N. M. (2020). Physiotherapy in Parkinson's disease: A meta-analysis of present treatment modalities. *Neurorehabilitation and Neural Repair*, 34(10), 871–880. <https://doi.org/10.1177/1545968320952799>
- Terrens, A. F., Soh, S.-E., & Morgan, P. (2020). The safety and feasibility of a Halliwick style of aquatic physiotherapy for falls and balance dysfunction in people with Parkinson's disease: A single blind pilot trial. *PLoS One*, 15(7), e0236391. <https://doi.org/10.1371/journal.pone.0236391>
- Terrens, A. F., Soh, S.-E., & Morgan, P. (2021). Perceptions of aquatic physiotherapy and health-related quality of life among people with Parkinson's disease. *Health Expectations*, 24(2), 566–577. <https://doi.org/10.1111/hex.13202>
- Terrens, A. F., Soh, S. E., & Morgan, P. E. (2018). The efficacy and feasibility of aquatic physiotherapy for people with Parkinson's disease: A systematic review. *Disability and Rehabilitation*, 40(24), 2847–2856. <https://doi.org/10.1080/09638288.2017.1362710>
- Tosserams, A., Nijkrake, M., Voet, N. B. M., Bloem, B. R., & Nonnekes, J. (2020). Why people with Parkinson's disease experience near-drowning—and how to prevent it. *Movement Disorders Clinical Practice*, 7(5), 573–574. <https://doi.org/10.1002/mdc3.12989>