A Biopsychosocial Approach to Aquatic-Based Exercise Interventions for Chronic and Disabling Conditions

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This thesis is submitted in fulfilment of the requirements for the
Degree of Doctor of Philosophy
February 2018

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Abstract

Purpose: The purpose of this research was to explore aquatic-based exercise as an intervention for chronic and disabling conditions. This research explored the implications of aquatic-based exercise interventions and links to participation and adherence from the perspective of key stakeholders.

Method: A pragmatic approach was taken to this research, influenced by the researcher’s occupational therapy background and by the biopsychosocial model; the most practical method for answering each of the research questions was employed. The biopsychosocial model directed the exploration of aquatic-based exercise interventions and provided a structure to organise the aquatic research, to identify gaps that need to be addressed, and to provide a platform for the development of practice principles.

Guided by the biopsychosocial lens, this research involved reviewing the literature to identify and synthesise the current best evidence for the effectiveness of aquatic-based exercise interventions. This was followed by three qualitative studies that involved a series of focus groups with key stakeholders in order to address gaps identified by the literature reviews, identify factors associated with participation and adherence, and to provide input into the development of aquatic-based exercise principles.

In a practical sense, this research sought to address the ‘why’ and ‘how’ of aquatic-based exercise interventions. The ‘why’ was addressed in the first part of this research where the evidence for the effectiveness of aquatic-based exercise was explored. This part of the research involved reviewing the literature, in the form of an evidence map and scoping review, to identify and synthesise the current best evidence for the effectiveness of aquatic-based exercise interventions. This was followed by a series of focus groups to expand on current understanding of the effectiveness of such interventions and to gather input from aquatic users. The ‘how’ was addressed through a series of focus groups, the data from which supported the development of a set of principles to guide the implementation of aquatic-based exercise interventions that promote participation and adherence with these interventions.

Findings: Aquatic-based exercise appears to be an effective intervention for meeting the complex needs of people with chronic and disabling conditions. This research suggests that users of aquatic-based exercise can experience benefits across biological, psychological and social domains, and consideration of several program factors not only impacts these benefits, but also promotes participation and adherence with aquatic-based exercise, an important aspect to consider given the chronicity of these conditions.

The culmination of literature and research studies was the development of theory-driven, evidence-based principles to guide the development and implementation of aquatic-based exercise interventions with a focus on clients with chronic and disabling conditions. These principles can be used to support the successful implementation of aquatic-based exercise interventions, help guide the referral of clients to the aquatic environment and assist with delivery of the aquatic interventions. Furthermore, these principles can serve as a template for future researchers for development of additional symptom-specific or disease-specific guidelines related to aquatic-based exercise interventions.
Statement of Originality

- the thesis is my own account of research undertaken by me; and
- the thesis has been wholly completed during candidature, except where the Committee has approved a transfer of enrolment from another higher degree by research; and
- where work has been done conjointly with other persons, my contribution is clearly stated and the contribution of other persons is clearly acknowledged and recognised; and
- the thesis does not contain as its main content any work or material which is embodied in a thesis or dissertation previously submitted by me or any other person for a University degree or other similar qualification at this or other higher education institution, except where approval has previously been granted by the Committee.

Signature:

Date: February 2018
Acknowledgements

I would like to acknowledge the contributions and support of several people. Thank you to the David Kirk Foundation for your generous support of this research through an aquatic therapy scholarship.

I would also like to acknowledge the participants and health professionals who participated in this research. Thank you for your willingness to share your opinions and experiences with me.

Thank you to my supervisors, Professor Brendan Burkett, Dr. Michele Verdonck, Dr. Mark McKean and Dr. Florin Oprescu, for your patience and support. Thank you for sharing your knowledge and experience and always making me feel like I was capable in the midst of chaos and confusion. A special thank you also to David Duncan who provided support at the most crucial point of this research: the editing and revision stage. Thank you for your amazing editing skills and for making this part of the process feel manageable.

Thank you to my amazing colleagues for helping to lighten the workload at times and reminding me to take breaks for coffee and to eat lunch. To the HDR café crew who sympathised, empathised and commiserated, thank you for making this process less daunting and lonely.

To my amazing friends, thank you for not giving up on me despite my best efforts at social exclusion. Thank you for the coffees, lunches, pep talks and gratitude walks that helped me to stay sane.

To all of my beautiful family cheering from Canada, especially my most fearsome cheerleader, my dad, thank you for the daily emails that reminded me that life existed outside of my PhD world, thank you for the hours of editing and listening to me talk through my latest confusion, but most of all thank you for knowing that on my most frustrating days, all I needed to read was “…dad, cheering for Heather”.

To my gorgeous kids who have kept me grounded through the last four years. My Grace, who is wise beyond her years, thank you for the cleaning, the awesome snacks but mostly the pep talks that reminded me to believe in myself and never give up. I couldn’t have wished for a better ‘super-friend’; My Jack, who is clever and witty, thank you for reminding me to celebrate even the small ‘wins’ and forcing me to keep my sense of humour over the past four years; My Charlie, who is gentle and funny, thank you for reminding me to be a unicorn in a field of horses; My Sam, who is thoughtful and precocious, thank you for reminding me to take breaks for morning snuggles and making sure I always knew if dad was making the ‘right choices’ and last but not least, my amazing partner John, who is so patient and encouraging, thank you for your super IT skills, your pep talks, coffee refills and never ending support.
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Chapter 1: Introduction

1.1 Introduction

Chronic and disabling conditions are becoming more prevalent due to lifestyle factors and the ageing population. Globally, chronic disease is the leading cause of death and disability and by 2020 chronic disease is expected to account for 73% of all deaths and 60% of the global burden of disease (World Health Organisation, 2013). In Australia, chronic diseases are becoming increasingly common with over 50% of Australians reporting having at least one chronic disease in 2015 (Australian Bureau of Statistics (ABS), 2006). With the increased prevalence of chronic disease and the accompanying personal and community impacts, chronic diseases pose a significant burden to healthcare practice.

Physical activity can play a key role in the management of chronic conditions (Australian Bureau of Statistics (ABS), 2011) with exercise recognised as the best non-pharmacological treatment for several chronic and disabling conditions (Booth, Roberts, & Laye, 2012; Durstine, Gordon, Wang, & Luo, 2013; Pedersen & Saltin, 2015). However, those who are diagnosed with these conditions often face significant challenges to engage in land-based physical activity (Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004) such as increased pain, decreased endurance and balance, risk of injury and fear of falling (Bethancourt, Rosenberg, Beatty, & Arterburn, 2014). Alternatives to land-based exercise need to be considered in order to meet the needs of the chronic and disabling population.

The aquatic environment offers a safe alternative for people to be able to engage in physical activity without the pain and discomfort associated with land-based exercise and has shown numerous physiological benefits (Becker, 2009; Carere & Orr, 2016; Heywood et al., 2017, Meyler et al., 2013). Aquatic-based exercise interventions may hold significant implications for people with chronic and disabling conditions and could be considered a key management strategy. Therefore, the purpose of this research is to explore aquatic-based exercise as an intervention for chronic and disabling conditions.

1.1.1 Aquatic-based exercise - defined

Aquatic-based exercise involves using the physical properties of water to add resistance to the body and/or facilitate movement. Often referred to as hydrotherapy, aquatic therapy or aquatic exercise, its broad rehabilitation potential has become increasingly popular as an intervention for management of acute injuries as well as general health maintenance for chronic disease sufferers (Becker, 2009). For the purpose of this thesis, “aquatic-based
exercise” will be used to describe all therapeutic movement or exercise performed in water, including hydrotherapy, aquatic therapy, aquatic physiotherapy and aquatic exercise.

**Definition of aquatic-based exercise:**

Aquatic-based exercise refers to the use of water as a therapeutic medium to facilitate movement and or exercise for the purpose of maintaining or improving functional outcomes of individuals. (Medical Dictionary, © 2009 Farlex and Partners)

1.1.2 Chronic and disabling conditions -- defined

Chronic and disabling conditions refer to a broad range of long-term, persistent and complex health conditions and often lead to the gradual deterioration of health and loss of independence (Australian Institute of Health and Welfare, 2018). Many chronic conditions occur across the life cycle, although they become more prevalent with older age and can create disability and compromise quality of life. “Disability” is an umbrella term used to describe impairments, activity limitations and participation restrictions, referring to the negative aspects of the interaction between health conditions and environments (Leonardi, Bickenbach, Ustun, Kostanjsek, & Chatterji, 2006). For the purpose of this thesis “chronic and disabling conditions” will be used to describe long-term health conditions that restrict participation in physical activity and include musculoskeletal, cardiopulmonary, metabolic and neurological conditions.

**Definition of chronic disabling conditions**


1.2 Theoretical Perspective

Theories can provide a means for organising and guiding the research process and often reflect the ideas, beliefs and experiences of the researcher and need to be disclosed in order to communicate the lens from which the research is presented (Creswell, 2013). The theoretical perspective of this research is based on the biopsychosocial model. The biopsychosocial model was chosen because of its recognition within the literature in relation to understanding chronic disabling conditions and their management and for its connections to the background of the researcher (discussed in section 1.3 of this chapter).

The biopsychosocial model was introduced by George Engel in the 1970s and encourages consideration of the biological, psychological and social constructs of illness and disability.
The biopsychosocial model suggests that each construct impacts the others, and the overlapping of the biological, psychological and social concepts impacts the overall quality of life of individuals (Engel, 1977, 1980). The biopsychosocial model is recognised within the health literature and has been used to guide the treatment of various health conditions including chronic and disabling conditions (Kamper et al., 2015; Saragiotto, de Almeida, Yamato, & Maher, 2016; Spector & Orrell, 2010), making it an appropriate model to apply to the research topic.

The biopsychosocial model is recognised as both a philosophy of practice and practical conceptual guide and has been highly regarded in a variety of healthcare fields (Borrell-Carrió, Suchman, & Epstein, 2004; Penney, 2013; Wade, 2015a, 2015b). The biopsychosocial perspective recognises the interrelated biological and psychosocial impacts of disease and disability and serves as a model from which interventions can be based in an attempt to meet the complex needs of clients with chronic and disabling conditions. It forms the basis of the World Health Organisation International classification of functioning and disability (WHO ICF-D) and is widely used in research into complex healthcare interventions such as chronic back pain (Cabak, Rudnicka, Kulej, & Tomaszewski, 2017).

Based on its holistic representation of the chronic and disabling conditions, along with its proven track record within the health literature in relation to the management of these conditions, the biopsychosocial model was deemed an appropriate and ideal framework for the exploration of aquatic-based exercise interventions as a strategy for the management of chronic and disabling conditions. Within this research, the biopsychosocial model has served as a framework to define the focus and goal of the research, inform the search strategies and literature reviews, present the research findings and allow for the application of theory that may be useful to the design and implementation of aquatic-based exercise interventions.

1.3 Researcher’s background

The researcher’s knowledge and experience of a particular topic can influence the research process in that it creates a ‘lens’ from which the phenomenon being studied is viewed (Creswell, 2013; Linda, 2002a). As such, it is important that the assumptions based on the researcher’s background be disclosed in an attempt to maintain the credibility of data presented. Reflexivity acknowledges the personal experiences of the researcher as a key driver of the research process and is particularly important within qualitative research (Creswell, 2013; Linda, 2002b). This research adopted a qualitative approach and as such is influenced by the researcher’s knowledge and experience.
In qualitative research, patterns, themes and categories emerge based on what the researcher wants to know, and how the data is interpreted based on their own subjective perspectives, understanding of the phenomenon being studied and ontological and epistemological positions (Creswell, 2013). It is therefore important to enable the reader to understand the phenomenon (in this case, aquatic-based exercise in the management of chronic and disabling conditions) through the lens of the researcher. It is this lens that influenced the choices and interpretations made in this research. For this reason, the researcher’s background and ensuing assumptions are disclosed in the following section. A brief discussion of the research paradigms that framed the research is presented in chapter four of this thesis, and where deemed appropriate, reflexivity will be used within this thesis to indicate where the researcher’s personal perspective may have influenced the research process.

Occupational therapy is a client-centred health profession concerned with promoting health and wellbeing through engagement in activity. Occupational therapists work with clients and communities to enable participation in valued daily activities and enhance overall quality of life (Honaker, 2007). As an occupational therapist, the researcher is trained to consider each client or group of clients from a holistic perspective and consider all aspects of a person when designing an appropriate intervention. Occupational therapy models promote consideration of the client in relation to the personal, environmental, and occupational experiences and in turn how these concepts impact engagement in occupational performance. However, the use of a discipline-specific model may limit the understanding and generalisability of information related to this research. Therefore, this research was approached with a more generic lens, the biopsychosocial model, discussed in the previous section of this chapter, in an attempt to resonate with a larger portion of the population. The biopsychosocial approach allows for a holistic representation of the research while avoiding exclusively occupational therapy-specific concepts, and by doing so may create more opportunity for a range of health professionals, program planners and users to benefit from the findings of this research.

This holistic approach, coupled with knowledge of the best available evidence related to the intervention, assists with the decision-making process. Furthermore, the client-centred philosophy of the profession encourages collaboration with clients in relation to the intervention, and client input play key roles in the successful implementation of the chosen intervention. This impacted the decision to use a predominantly qualitative approach to the research in that the perspective of the users and intervention providers was considered an important perspective to add to the research on the topic, in order to fill a gap in the current
The researcher is not a practitioner of aquatic-based exercise therapy but has worked extensively with clients diagnosed with chronic or disabling conditions.

Initial assumptions based on personal opinions and professional experiences include:

1. Pain and discomfort in clients with chronic disabling conditions made physical activity interventions challenging for the occupational therapist to implement and for the client to adhere to.
2. When designing or planning new interventions for a particular client or group there is often limited or conflicting evidence related to the efficacy of interventions. The lack of clarity relating to a specific intervention was time consuming for a practitioner to sift through the data related to the topic to identify relevant information, creating challenges for identifying the best evidence for clinical decision-making.
3. Emphasis on the medical model resulted in limited consideration of a more holistic approach to interventions that facilitate the psychological, emotional and social wellness of individuals.

Limited consideration of the user’s experience related to the perceived benefits and reasons for participation in exercise interventions, which is needed to promote successful implementation of an intervention while providing key links to adherence.

1.4 Thesis Overview

This thesis presents the results from two literature reviews and three investigative studies that were undertaken to explore aquatic-based exercise as a strategy for managing chronic and disabling conditions (Figure 1).
Chapter 1 Introduction

Exploration of aquatic-based exercise for managing chronic & disabling conditions

LITERATURE REVIEW 1
Evidence map of the effect of aquatic-based exercise on health-related outcomes

LITERATURE REVIEW 2
Aquatic-based Exercise: A Scoping Review of Psychosocial Outcomes

STUDY 1
The Psychosocial Outcomes of Aquatic-based Exercise: An Exploratory Study

STUDY 2
An Exploratory Study of Factors Related to Participation and Adherence with Aquatic-based Exercise Interventions

STUDY 3
The Development of Guiding Principles to Support Participation and Adherence with Aquatic-based Exercise Interventions

Figure 1. Overview of publications in this thesis
This first chapter provided an introduction of the topic including a definition of aquatic-based exercise. The theoretical perspective and researcher’s background and initial assumptions related to this research were also disclosed.

Chapters 2 and 3 present a review and synthesis of the current literature related to aquatic-based exercise, creating the foundation from which the three studies presented in this thesis were developed.

Chapter 4 describes methods used in this research. This chapter also introduces the methodological approach taken and the research strategies applied. Methods related to each phase will be described and will include an explanation and rationale for choosing different methods. Strategies to ensure quality and trustworthiness of the data as well as potential limitations of each strategy will also be presented.

Chapters 5-7 present the details related to the three studies as papers which have been submitted and are all currently under review for publication.

Chapter 8 presents the discussion and conclusion section of the thesis and will bring together the results of the two literature reviews and three studies described in chapters 4-8. The main contributions of each phase will be highlighted along with the overall contribution of this research. Limitations will be discussed briefly in this chapter along with concluding statements by the author.
Chapter 2: Literature Review 1 – Evidence Map

2.1 Chapter Overview

This chapter discusses the relevant literature on the topic and presents the findings from an evidence map based on a review of systematic reviews of the effectiveness of aquatic-based exercise on health outcomes. The first section of this chapter provides a rationale for and overview of the evidence map method (described in more detail in section 2.4 followed by a section highlighting the purpose of the evidence map method). Section 2.4.1 presents a publication which cites important findings from the literature relating to aquatic-based exercise and health-related outcomes, and identifies areas that need further investigation. The concluding section provides a summary of the chapter and highlights the results of the evidence map used to inform the next step in the research, thereby providing links to the subsequent chapter.

2.2 Evidence Map Rationale and Method

An evidence map is a systematic process used to identify gaps in the literature and provide a user-friendly, visual depiction of the broad scope of literature related to a topic (Hetrick, Parker, Callahan, & Purcell, 2010; Miake-Lye, Hempel, Shanman, & Shekelle, 2016). Evidence maps are an evidence synthesis method that provide an inclusive summary of the extent and distribution of the evidence in a broad clinical area, allowing a snapshot of what evidence exists and where it may be lacking. Although the classic systematic review and meta-analysis are more commonly used to synthesise the evidence on a topic, they can be resource intense and time consuming, potentially limiting the scope of what can be covered (Bastian, Glasziou, & Chalmers, 2010; Miake-Lye et al., 2016). The evidence map was chosen as an alternative to this classic evidence synthesis method as it addressed the time and resource issues of the researcher while still meeting the needs associated with the research agenda.

Additionally, the evidence map was chosen to synthesise the evidence related to aquatic-based exercise, after a preliminary review of the literature revealed several systematic reviews on the topic (Bartels et al., 2016; Grande et al., 2014; Heywood et al., 2017; Lima et al., 2013; McNamara, McKeough, McKenzie, & Alison, 2013; Waller, Lambeck, & Daly, 2009). The expansion in the aquatic research base over the last decade, while much needed, presents a potential challenge for clinicians and other key stakeholders in navigating the literature to identify the best evidence on the topic. Research by Smith et al. (2011) suggested that often multiple reviews of the same topic produce discordant results or conclusions, creating challenges for decision makers, and thus highlighting the need for synthesis of the evidence in
a single document (Smith, Devane, Begley, & Clarke, 2011). These syntheses can be considered the basic foundation of knowledge or evidence-base for use in evidence-based interventions or to inform the development of clinical practice guidelines and policy development (Sutton, Cooper, & Jones, 2009). Therefore, a clear synthesis of systematic reviews on the topic of aquatic-based exercise could result in definitive summaries of the large body of research that could be used to inform future research and/or clinical practice in the area.

Essential to all evidence syntheses is the use of explicit and transparent methodology in the formation of the questions they address (Sutton et al., 2009). While the evidence map is still considered an emerging method with a clear standardised method yet to be identified, a study by Miake-Lye et al. (2016) reviewed the literature on evidence maps methods and identified some common elements to consider when conducting this type of review. These included providing a clear definition of an evidence map, using a systematic literature search of a broad research field, and presenting the results, including gaps in knowledge, using a visual figure or graph for a clear, easily-accessible depiction of the results (Miake-Lye et al., 2016). These elements were incorporated into the current evidence map to ensure that the process used the most current literature related to the evidence map methodology.

For the purpose of this research, an evidence map was also used to synthesise the current best evidence related to the health outcomes associated with participation in aquatic-based exercise interventions. This method was used in an attempt to reduce complexity of the research field and provide a clear, visual depiction of the synthesis of information from current systematic reviews on the topic. The evidence map included a systematic review of systematic reviews and provided a visual representation of the best evidence in relation to health outcomes and the presence or absence of research on various populations and topic areas. This evidence also highlighted gaps in the current literature on aquatic-based exercise which informed the next method and topic for the research: a scoping review of the psychosocial outcomes related to aquatic-based exercise, described in chapter 3 of this thesis.

2.3 Purpose

The purpose of the evidence map was to review and describe the research on the effectiveness of aquatic-based exercise for health-related outcomes and to describe the gaps that exist in the current literature. The review addressed the following research questions:

1. What patient populations and conditions have been studied in the aquatic literature to date?
2. What primary health outcomes have been studied within the aquatic-based exercise literature to date?
3. What gaps currently exist in the literature in relation to health outcomes and aquatic-based exercise?

The findings from this review were presented in a paper entitled “An evidence map of the effect of aquatic-based exercise on health-related outcomes”, which has been submitted to *Archives of Physical Medicine and Rehabilitation* and is currently under review for publication.

### 2.4 Evidence Map Publication Submission

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<thead>
<tr>
<th>Title</th>
<th>Journal</th>
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<th>Contribution</th>
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<tr>
<td>An evidence map of the effect of aquatic-based exercise on health-related outcomes</td>
<td><em>Archives of Physical Medicine and Rehabilitation</em></td>
<td>Ms. Heather Scott *</td>
<td>research design, data collection, data analysis, writing of journal article, submission.</td>
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<td>Prof. Brendan Burkett</td>
<td>Writing/revision and editing support</td>
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<td>Dr. Florin Oprescu</td>
<td>Search strategy, Data analysis and writing support</td>
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<td>Dr. Michele Verdonck</td>
<td>Data analysis and writing/revision support</td>
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<td>Dr. Mark McKean</td>
<td>Editing and writing/revision support</td>
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* Denotes primary author

**2.4.1 An evidence map of the effect of aquatic-based exercise on health-related outcomes**

**Abstract**

Objective: The aim of this evidence map is to collate the current best evidence related to aquatic-based exercise, including research on various populations and health outcomes.

Type: Comprehensive analytical review – evidence map of systematic reviews

Literature Survey: Scopus, CINAHL, Web of Science and Cochrane were searched

Methodology: The evidence map is based on a systematic review of systematic reviews. Systematic reviews focusing on aquatic-based exercise of any duration and follow-up and summarising primary research studies for all clinical indications with adult participants in any healthcare or community-based setting were eligible for inclusion. Data extraction was completed and bubble plots were used to provide a visual representation of the aquatic research field base and included literature size and a broad estimate of effectiveness based on clinical populations.
Synthesis: Twenty-eight systematic reviews met the inclusion criteria for the review. Five reviews were Cochrane publications and eleven of the reviews included a meta-analysis. Populations with highest research base within the aquatic literature were musculoskeletal (n=14), followed by neurological (n=5), cardiopulmonary (N=4) and elderly (N=3). The evidence map identifies a number of potentially promising effects across all clinical populations and also highlights areas where the evidence remains unclear. Methodological limitations of studies and heterogeneity of results identified by the included reviews creates challenges for interpreting results and forming firm conclusions regarding the efficacy of aquatic-based exercise.

Conclusion: Aquatic-based exercise has been applied across varying clinical populations and for a number of health-related outcomes. Systematic reviews in the area have indicated several promising results. The evidence map provides a visual overview of the aquatic-based exercise research field so clinicians and stakeholders can easily identify current evidence to inform clinical and research practices.

Introduction
Aquatic-based exercise, also known as hydrotherapy or therapeutic aquatic exercise, offers an opportunity for individuals to participate in physical activity without the impact and stress on the body caused by exercise through land-based means. As an exercise medium, water can be beneficial for rehabilitation, treatment of acute injuries and health maintenance in the face of chronic and disabling conditions, yet it remains an underused modality (Becker, 2009; Mooventhan & Nivethitha, 2014). The density, hydrostatic pressure, buoyancy, viscosity and thermodynamics facilitate relaxation and decrease movement restrictions, joint loading and pressure, thus creating a margin of therapeutic safety wider than that of almost any other treatment setting (Becker, 2009).

As the population ages and chronic and disabling conditions become more prevalent, individuals find it increasingly difficult to engage in land-based physical activity despite its known benefits (Emery, Yang, Frierson, Peterson, & Suh, 2009; Rimmer et al., 2004; Rizzuto, Melis, Angleman, Qiu, & Marengoni, 2017; Schutzer & Graves, 2004). This creates challenges for health professionals who use land-based exercise as an intervention strategy to promote recovery and restore function to various populations of individuals diagnosed with chronic and disabling conditions (Chao, Foy, & Farmer, 2000). As the literature grows to support aquatic-based exercise as an alternative to land-based exercise it is important that health professionals
are armed with the knowledge of the best evidence related to the efficacy and adverse events of aquatic-based exercise (Faraone, 2008; Hurley et al., 2016).

As the aquatic literature has continued to expand over the last decade, several primary research studies and systematic reviews have covered a wide range of health outcomes and populations which can be challenging and time consuming for clinicians and other stakeholders to navigate. Therefore, a systematic review of systematic reviews as an evidence map was carried out in order to provide an overview of the current evidence to support aquatic-based exercise for various populations. Evidence maps are an emerging evidence synthesis tool that provide a broad overview and visual display of both the content and volume of an identified research topic (Miake-Lye et al., 2016; Solloway et al., 2016).

This evidence map contributes to the aquatic research field by presenting a summary of current research on aquatic-based exercise related to clinical populations and health outcomes in a format that is easily accessible to stakeholders, such as healthcare practitioners and policy makers. To date, there has been no overview of systematic reviews with an evidence map examining the range of populations and outcomes related to aquatic-based exercise. The aim of this evidence map is to illustrate the current best evidence related to aquatic-based exercise including the presence and absence of research on various populations and for various topic areas; the evidence map may inform future research agendas and provide the evidence-base for aquatic-based exercise programs.

Methods

An evidence map providing a visual representation of health outcomes related to aquatic-based exercises was developed based on the results of a systematic review of systematic reviews. Systematic reviews provide comprehensive summaries of the research related to clearly defined clinical topics using thorough and comprehensive search strategies and transparent synthesis of the existing evidence. Systematic reviews often use meta-analyses to identify treatment effects by combining the results of small and underpowered studies (Moher et al., 2015; Solloway et al., 2016). Systematic reviews on the topic were identified following a systematic search of four electronic databases (Scopus, CINAHL, Web of Science and Cochrane). Search terms appropriate to the topic were developed with assistance from a health sciences librarian to assist with the effectiveness and efficiency of the search. The initial search terms included: (aquatic-based or “aquatic therapy” OR water-based or hydrotherapy*) AND exercise AND “systematic review” OR meta analysis OR meta-analysis. The initial search was conducted in June 2017 and there were no date or language restrictions in the initial search and
additional studies were identified based on references of identified studies (Adsett, Mudge, Morris, Kuys, & Paratz, 2015; Al-Qubaeissy, Fatoye, Goodwin, & Yohannes, 2013; Bartels et al., 2016; Batterham, Heywood, & Keating, 2011; Bergamin, Zanuso, Alvar, Ermolao, & Zaccaria, 2012; Bidonde et al., 2014; Carere & Orr, 2016; Geytenbeek, 2002; Graetz, Sullivan, Robertson, & Reeve, 2015; Grande et al., 2014; Hall, Swinkels, Briddon, & McCabe, 2008; Heywood et al., 2017; King & Eitivipart, 2016; Li, Khoo, & Adnan, 2017; Lima et al., 2013; Lu et al., 2015; Marinho-Buzelli, Bonnyman, & Verrier, 2015; McNamara et al., 2013; Mehrholz, Kugler, & Pohl, 2011; Methajarunon, Eitivipart, Diver, & Foongchomcheay, 2016; Olson, Kolber, Patel, Pabian, & Hanney, 2013; Perez & Cancela, 2014; Simas, Hing, Pope, & Climstein, 2017; Villalta & Peiris, 2013; Waller et al., 2009; Waller et al., 2014; Waller et al., 2016; White, 2012).

The methodology and results of the evidence map are reported according to the PRISMA guidelines for systematic reviews to the extent possible (the PRISMA checklist is documented in Appendix A).

Inclusion criteria

**Design**

Systematic reviews focusing on aquatic-based exercise and summarising primary research studies for all clinical indications were eligible for inclusion. Reviews that either self-identified as a “systematic review” or reviews that clearly identified a review methodology were included in this review. Systematic reviews published in English were eligible for inclusion.

**Participants**

Systematic reviews including only adult participants regardless of their health status were eligible for inclusion in the review; excluded from this review were systematic reviews that focused primarily on children and adolescents (<18 years of age).

**Intervention**

Systematic reviews of the effects of aquatic-based exercise for any clinical condition or diagnosis were included in the review. Systematic reviews considering aquatic-based exercise in comparison with other interventions were included if aquatic terms were incorporated into the search strategy and reported outcomes related to aquatic-based exercise. General reviews related to exercise interventions without particular focus on aquatic-based exercise were excluded. Also excluded from this review were systematic reviews considering colonic irrigation, water birth, Kneipp therapy, spa therapy, whirlpool therapy, contrast baths and balneology as interventions.
**Outcome**

Systematic reviews were eligible for inclusion if they reported on patient health outcomes. Provider outcomes, feasibility, prevalence, costs, study design features, or intervention features that omitted patient health outcomes were excluded.

**Timing and setting**

Reviews reporting aquatic-based exercise interventions of any duration and follow-up in any healthcare or community-based setting were eligible for inclusion.

**Procedure**

Once duplicates were removed, an initial scan of the article title and abstract was completed by the author and a second researcher. Full texts of citations labelled unclear were obtained and screened against the specified inclusion criteria in order to establish relevance to the topic. Exclusions were discussed and recorded (Figure 2). The full texts of the remaining reviews were screened against the inclusion and exclusion criteria. When both the original and updated versions of a systematic review were available by the same author group, only the more recent version was considered. From each included systematic review, we extracted the primary author, title and year of publication, country, review characteristics (e.g. aims of the review, inclusion and exclusion criteria), number of trials included in the review, the number of participants, comparators, clinical diagnosis, patient outcomes (e.g. pain, QOL), intervention details (e.g. timing, duration), exercises type, adverse events and adherence. Data extraction was similarly completed by two researchers to ensure completeness of data tables.
Figure 2. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) literature flow diagram

Data Synthesis

Bubble plots were used to provide a visual representation of the aquatic-based exercise research field base and included health-related outcomes based on clinical populations.

Colour

Clinical outcomes that have been addressed in Cochrane reviews (i.e. specialising in unbiased evidence synthesis) have been presented in dark blue while all other outcomes that have not been identified in a Cochrane review are presented in light blue.
Literature size estimate (y-axis)
The bubble plot provides an overview of the research volume for aquatic-based exercise outcomes. The research size represents the number of systematic reviews that were identified for each clinical outcome identified in the literature.

Effect estimate (x-axis)
The effect estimates were categorised and presented as either potentially promising effects or unclear or no effect. Outcomes were put in the potentially promising effect category based on the number of reviews that reported a statistically significant effect. Cochrane reviews were weighted higher than other potentially biased reviews and statistically significant outcomes reported in Cochrane reviews were automatically placed in the potentially promising effect category unless the results were based on only one RCT. In this case, outcomes with only one reported RCT were placed in the unclear category due to the paucity of research and a lack of replication effect. However, if a Cochrane review reported a statistically significant result and other reviews reported similar findings then they were included in the potentially promising effects category. Outcomes supported by two or more reviews were considered to have a potentially positive effect and reviews that reported conflicting results related to outcomes were categorised as unclear.

Results
Twenty-eight systematic reviews met the inclusion criteria for the review (Adsett et al., 2015; Al-Qubaeissy et al., 2013; Bartels et al., 2016; Batterham et al., 2011; Bergamin et al., 2012; Bidonde et al., 2014; Carere & Orr, 2016; Geytenbeek, 2002; Graetz et al., 2015; Grande et al., 2014; Hall et al., 2008; Heywood et al., 2017; King & Eitivipart, 2016; Li et al., 2017; Lima et al., 2013; Lu et al., 2015; Marinho-Buzelli et al., 2015; McNamara et al., 2013; Mehrholz et al., 2011; Methajarunon et al., 2016; Olson et al., 2013; Perez & Cancela, 2014; Simas et al., 2017; Villalta & Peiris, 2013; Waller et al., 2009; Waller et al., 2014; Waller et al., 2016; White, 2012) and publications years ranged from 2002 – 2017 with 76% of reviews published in the last 5 years (Adsett et al., 2015; Al-Qubaeissy et al., 2013; Bartels et al., 2016; Bidonde et al., 2014; Carere & Orr, 2016; Graetz et al., 2015; Grande et al., 2014; Heywood et al., 2017; King & Eitivipart, 2016; Li et al., 2017; Lu et al., 2015; Marinho-Buzelli et al., 2015; McNamara et al., 2013; Methajarunon et al., 2016; Olson et al., 2013; Perez & Cancela, 2014; Simas et al., 2017; Villalta & Peiris, 2013; Waller et al., 2014; Waller et al., 2016). Of the 28 included systematic reviews, eleven included a meta-analysis and 5 reviews were Cochrane publications suggesting an unbiased evidence synthesis (Bartels et al., 2016; Bidonde et al., 2014; Grande et al., 2014; McNamara et al., 2013; Mehrholz et al., 2011). Program components and outcome
measures varied across and within reviews and the aquatic exercise interventions, duration and frequency of the programs, also varied. Some reviews could not report the program details due to lack of information from included studies. Figures 3, 4, 5 and 6 provide a visual representation of the aquatic-based exercise evidence based on an identified clinical population.
Figure 3. Evidence map of aquatic-based exercise for musculoskeletal population
Figure 4. Evidence map of aquatic-based exercise for the neurological population.
Chapter 2 Evidence Map

Figure 5. Evidence map of aquatic-based exercise for cardiopulmonary population
Effect Estimate

Unclear effect/no effect

Potentially positive effects

Figure 6. Evidence map of aquatic-based exercise for elderly population.
Populations

Populations with highest research base within the aquatic literature were musculoskeletal conditions with 14 reviews reporting the evidence related to 151 trials (Al-Qubaeissy et al., 2013; Bartels et al., 2016; Batterham et al., 2011; Bidonde et al., 2014; Carere & Orr, 2016; Heywood et al., 2017; Lima et al., 2013; Lu et al., 2015; Olson et al., 2013; Simas et al., 2017; Villalta & Peiris, 2013; Waller et al., 2009; Waller et al., 2014; White, 2012). Musculoskeletal conditions included rheumatoid arthritis (RA) and osteoarthritis (OA), orthopaedic surgery, fibromyalgia (FMS), bone health and general musculoskeletal conditions. Neurological conditions (Li et al., 2017; Marinho-Buzelli et al., 2015; Mehrholz et al., 2011; Methajarunon et al., 2016; Perez & Cancela, 2014) had five reviews with a total of 52 trials and cardiopulmonary conditions (Adsett et al., 2015; Graetz et al., 2015; Grande et al., 2014; McNamara et al., 2013) had four reviews with a total of 22 trials. Neurological reviews included those related to spinal cord injury (SCI), multiple sclerosis (MS), Parkinson’s disease (PD) and stroke, while cardiopulmonary reviews included the impact of aquatic exercise on heart failure (HF), chronic obstructive pulmonary disease (COPD) and asthma.

Three reviews focused on the elderly population (Bergamin et al., 2012; King & Eitivipart, 2016; Waller et al., 2016) with a total of 50 trials reviewed for evidence to support aquatic exercise with the healthy elderly, including physical functioning and physical fitness in the elderly. Two of the included reviews considered both neurological and musculoskeletal conditions with 53 trials considering the impact of aquatic exercise on a range of neurological and musculoskeletal conditions. The results of these reviews will be included in the musculoskeletal conditions results as the majority of the trials included in both these reviews were related to musculoskeletal conditions with authors of both reviews citing a lack of research focusing on neurological conditions (Geytenbeek, 2002; Hall et al., 2008).

Musculoskeletal Conditions

Musculoskeletal (MSK) conditions were the most commonly studied with 14 reviews considering a range of MSK conditions and outcomes. Also included in this section are two reviews that focused on a combination of musculoskeletal and neurological conditions as the majority of outcomes were related to MSK conditions (Geytenbeek, 2002; Hall et al., 2008) Nine of the included reviews provided a meta-analysis (Bartels et al., 2016; Batterham et al., 2011; Bidonde et al., 2014; Heywood et al., 2017; Lima et al., 2013; Lu et al., 2015; Simas et al., 2017; Villalta & Peiris, 2013), were Cochrane reviews (Bartels et al., 2016; Bidonde et al., 2014; Heywood et al., 2017; Lima et al., 2013; Lu et al., 2015; Simas et al., 2017; Villalta & Peiris, 2013).
Six of the included reviews focused on arthritis including osteoarthritis and rheumatoid arthritis (Al-Qubaeissy et al., 2013; Bartels et al., 2016; Batterham et al., 2011; Lu et al., 2015; Waller et al., 2014; White, 2012), four of which considered the effectiveness of aquatic-based exercise for management of symptoms related to OA (Bartels et al., 2016; Lu et al., 2015; Waller et al., 2014; White, 2012), One review focused on RA (Al-Qubaeissy et al., 2013) and another was a mixture of OA and RA (Batterham et al., 2011). A Cochrane review by Bartels et al. (2016) included 13 trials evaluating the effectiveness of aquatic-based exercise for people with mild to moderate hip or knee OA (Bartels et al., 2016). A meta-analysis reported positive pooled results for pain (absolute change: 5% [95% CI 3% to 8%], relative change: 9.0% [95% CI 4.3% to 13.6%]), number needed to treat (NNT): 9 (95% CI 6 to 16); disability (absolute change: 5% [95% CI 3% to 8%], relative change: 12.4% [95% CI 6.6% to 18.2%]), NNT: 11 (95% CI 8 to 19) and quality of life (absolute change: 7% [0 to 13%], relative change 13.2% [95% CI 0.5% to 25.9%]), NNT: 13 (95% CI 8 to 288) (Bartels et al., 2016). Similarly, a review and meta-analysis by Waller et al. (2014) indicated that aquatic-based exercise is an effective treatment option for the management of symptoms related to OA based on standard mean difference (SMD) including pain (SMD=0.26 [95% CI = 0.11, 0.41]), QOL (SMD=0.24 [95% CI=0.04, 0.45]), physical function, indicated by activity level (SMD=0.22 [95% CI=0.01, 0.42]) and ROM (SMD=0.56 [95% CI=0.14, 0.99]), perceived physical function (SMD=0.30 [95% CI=0.18, 0.43]) and stiffness (SMD=0.20 [95% CI=0.03, 0.36]). Aquatic-based exercise did not appear to have a significant effect on muscle strength (Waller et al., 2014). Furthermore a review by White (2012) indicated positive links to reduction in pain and increase in function in patients with hip OA who participate in aquatic-based exercise based on nine trials, but did not indicate a treatment effect and suggested that more high quality studies are necessary to indicate effectiveness (White, 2012). A review and meta-analysis by Lu et al. (2015), included six RCTs and found that aquatic-based exercise had a moderate effect on physical function of patients with knee OA when compared to a non-exercise control group (SMD =−0.55; 95% CI −0.94 to −0.16) however, no significant effect was found for pain or quality of life when compared with a land-based exercise group or a non-exercise control group which differed from the results of the review by Bartels et al. (2016). Lu et al. highlighted the small number of included studies and the substantial heterogeneity between included studies as challenges which may have influenced the results of the review (Lu et al., 2015). One review, with 10 trials of participants diagnosed with either OA or RA of the hip and knee, compared the effectiveness of aquatic-based
exercise to land-based exercise on outcomes related to function and mobility. Meta-analysis revealed non-significant differences between aquatic-based exercise and land-based exercise for walking ability, dynamic balance, and function (Batterham et al., 2011). One review looking exclusively at the effectiveness of aquatic-based exercise for the management of rheumatoid arthritis and based on six trials concluded that aquatic-based exercise is effective in reducing pain in patients with RA; however, the authors did not include a treatment effect (Al-Qubaeissy et al., 2013).

Two reviews focused on fibromyalgia syndrome (Bidonde et al., 2014; Lima et al., 2013), with the largest review including 27 trials (Lima et al., 2013) and a Cochrane review considering 16 trials (Bidonde et al., 2014). The results of the largest review indicated a statistically significant difference for the outcomes of quality of life (SMD = −1.35 [−2.04; 0.67], P = .0001), stiffness (SMD = −1.58 [−2.58; −0.58], P = .002), physical function based on the 6-minute walk test with (SMD = 43.5 (metres) [3.8; 83.2], P = .03), favouring the aquatic based exercise, but only after 20 + weeks of the treatment. For the other outcomes, including pain, depression and tender point count, no significant effects were found (Lima et al., 2013). The Cochrane review by Bidonde et al. (2014) also reported statistically significant improvements in function (SMD = 5.97, 95% CI -9.06 to -2.88; NNT 5, 95% CI 3 to 9) and stiffness (SMD = 18.34, 95% CI -35.75 to -0.93; NNT 3, 95% CI 2 to 24), but also found significant improvements in self-reported physical function (SMD = 4.35, 95% CI -7.77 to -0.94; NNT 6, 95% CI 3 to 22), pain (SMD = 6.59, 95% CI -10.71 to -2.48; NNT 5, 95% CI 3 to 8), muscle strength (SMD = 0.63, 95% CI 0.20 to 1.05; NNT 4, 95% CI 3 to 12) and cardiovascular function (improved by 37 metres on 6-minute walk test [95% CI 4.14 to 69.92]), depression (SMD = 0.45, 95% CI -0.82 to -0.08), anxiety (SMD = -0.57, 95% CI -0.95 to -0.19) and sleep (SMD = -0.63, 95% CI -1.12 to -0.14) when comparing aquatic-based exercise to a non-exercise control. However, when compared to land-based exercise, no statistically significant results were found between groups except for muscle strength where very low quality of evidence was found in favour of land-based exercise (Bidonde et al., 2014). The authors concluded that although the effectiveness of aquatic-based exercise appears promising for several outcomes, further research related to overall wellbeing and function, pain, stiffness, muscle strength, and cardiovascular fitness is likely to have an important impact on confidence in the results and may change the results (Bidonde et al., 2014).

Two reviews considered low back pain (Olson et al., 2013; Waller et al., 2009), with the largest review including seven trials (Waller et al., 2009). Both reviews concluded that aquatic-based exercise was effective for managing chronic low back pain; however, neither of the reviews
were able to undertake a meta-analysis due to a limited number of high quality trials and lack of homogeneity among included studies (Olson et al., 2013; Waller et al., 2009).

The single review on orthopaedic surgery included eight trials, and results suggested after orthopaedic surgery, when compared with land-based physical therapy, early aquatic physical therapy does not increase the risk of wound-related adverse events (risk difference=.01, 95% CI=.05 to .07) and improves performance of activities of daily living (SMD=.33, 95% CI=.07-.58, I²=0%). No statistically significant difference was found for oedema, pain and muscle strength and the reviewer was unable to include ROM and QOL in the meta-analysis due to the heterogeneity of included studies (Villalta & Peiris, 2013).

A review considering the effectiveness of aquatic-based exercise on bone health of older adults, the majority of which had osteoporosis or osteopenia, included 11 trials (Simas et al., 2017). Meta-analysis revealed significant improvements in bone mineral density (BMD) at the lumbar spine (SMD 0.03 g/cm²; 95% CI: 0.01 to 0.05) and femoral neck (SMD 0.04 g/cm²; 95% CI: 0.02 to 0.07) for the aquatic-based exercise group compared to a non-exercise control group. However, when compared to land-based exercise, significant differences were found in favour of land-based exercise for changes in bone mineral density of the lumbar spine and femoral neck (Simas et al., 2017). Changes in strength and balance were also reported in the aquatic-based exercise group compared to the control group but these results were not statistically significant. Flexibility was also considered in the review but the authors stated that no results were reported for the aquatic-based exercise group (Simas et al., 2017).

Two reviews considered a range of musculoskeletal conditions (Carere & Orr, 2016; Heywood et al., 2017). The largest review included 15 studies and reported a very low to low quality evidence for the effectiveness of aquatic exercise in improving hip strength, knee strength and muscular endurance in people with MSK. However, the authors cited the lack of effectiveness is likely due to insufficient resistance levels to elicit significant changes and suggest that appropriate resistance training principles related to the aquatic environment need to be identified (Heywood et al., 2017). Another review considered the effectiveness of aquatic-based exercise for reducing pain and disability associated with a range of MSK conditions. The authors concluded, based on the results of nine studies, that aquatic-based exercise had a positive impact on pain, QOL, disability and functional exercise capacity; however, study results varied within and across studies and no summary estimate for aquatic-based exercise effects was provided (Carere & Orr, 2016).
Two reviews included both MSK and neurological conditions; the largest review by Geytenbeek (2002) included 31 trials with a mixture of both musculoskeletal conditions and neurological disorders. Geytenbeek’s review included 17 RCTs, 12 cohort studies and two case reports, the majority of which focused on musculoskeletal conditions. The review by Geytenbeek did not provide details of pooled treatment effects but concluded there is a moderate quality of evidence that suggests hydrotherapy offers benefit toward improving strength, flexibility, function, self-efficacy and affect, balance and fitness, and reducing pain, in patients with generally chronic conditions, such as rheumatic diseases, hip osteoarthritis and chronic low back pain, and the elderly (Geytenbeek, 2002). Another review considering both neuro and MSK conditions by Hall et al. (2008) considered 19 RCTs, five of which were included in a meta-analysis that suggested a small posttreatment effect in favour of aquatic-based exercise in relieving pain in patients with neurological and musculoskeletal conditions compared with no treatment (P=.04; SMD= -.17; 95% CI, -.33 to -.01), as well as comparable pain-relieving effects between aquatic and land-based exercise (P=.56; SMD=.11; 95% CI, -.27 to .50) (Hall et al., 2008).

Adherence and Adverse Events

Four of the included reviews provided a summary of adherence rates which were often comparable to a treatment control group and ranged from 60 to 100% (Bidonde et al., 2014; Simas et al., 2017; Waller et al., 2009; Waller et al., 2014). Seven of the included reviews reported adverse events, the majority of which were considered minor and included mild joint discomfort, lumbar pain and cramps, muscle pain, tinea pedis, shoulder impingement, chlorine hypersensitivity and exacerbation of symptoms (Bartels et al., 2016; Bidonde et al., 2014; Lima et al., 2013; Simas et al., 2017; Villalta & Peiris, 2013; Waller et al., 2009; Waller et al., 2014).

Summary of MSK results

Overall, the effectiveness of aquatic-based exercise has been demonstrated by statistically significant pooled treatment effects and a high number of research studies included findings for pain, physical function (in relation to stiffness, ROM, disability and ADLs) and quality of life (QOL) in clients with musculoskeletal conditions. Unclear effect or lack of research has been identified for muscle strength, balance, oedema, flexibility, perceived wellbeing, self-efficacy and affect. These results were comparable to land-based exercise across the majority of outcomes.
**Neurological Conditions**

Neurological conditions had the second largest number of reviews (N=5). The majority of these reviews reported on results of individual studies and did not provide a pooled treatment effect related to aquatic-based exercise and the neurological condition considered. One review, a Cochrane review by Merholz et al. (2011), investigating the effects of water-based exercises for reducing disability after stroke, presented a meta-analysis and reported improvements in activities of daily living (ADLs) (MD 13.20; 95% CI, 8.36, 18.04; \( P < .00001 \)) and muscle strength (MD 1.01Nm/kg; 95% CI, 0.19 to 1.83; \( P = .02 \)) but no improvements for walking ability, postural balance or fitness after aquatic-based exercise treatment compared to control (Mehrholz et al., 2011). The reviewers caution interpretation of the results based on the small number of trials (n=3) and heterogeneity between the trial designs and interventions and participant characteristics (Mehrholz et al., 2011).

One review considered the impact of aquatic-based exercise on physical function and physical fitness and found weak evidence in favour of aquatic-based exercise for improving these outcomes among people with spinal cord injury (SCI) and insufficient evidence to support aquatic-based exercise related to body composition, leg strength and balance. Meta-analysis was not conducted in this review due to the heterogeneous study characteristics, intervention programs, outcome measures and lack of comparison group for most trials (Li et al., 2017).

One review considered the effectiveness of aquatic-based exercise for people diagnosed with Parkinson’s disease (PD) and included 12 trials. Results of individual studies in the review indicate potential benefits of WBE for PD patients in motor function, functional mobility, fitness level, flexibility and cardiorespiratory endurance. However, there was insufficient evidence related to PD progression, cognitive impairment, activities of daily living, or perceived quality of life within the included studies. The authors were unable to perform a meta-analysis due to methodological flaws and heterogeneity among included studies (Perez & Cancela, 2014).

Two reviews considered a range of neurological conditions, including multiple sclerosis, Parkinson’s disease and stroke (Marinho-Buzelli et al., 2015; Methajarunon et al., 2016). The larger of these two reviews included 20 trials with a range of study designs. A narrative synthesis of the studies provided by the authors indicated aquatic-based exercise improves dynamic balance and gait performance in individuals with neurological disorders when compared to a control. However, when compared with land-based exercise there is insufficient evidence to indicate aquatic therapy is superior for improving mobility in individuals with a
neurological condition. The diversity in study design and outcome measures of the included studies made it difficult to identify significant conclusions for a specific group of neurological disorders (Marinho-Buzelli et al., 2015). The smaller review included eight trials and focused on the effect of aquatic-based exercise on balance in patients with neurological conditions. The findings from the review indicate a small statistically significant improvement in static and dynamic balance in MS, stroke and PD patients and statistically significant improvements in gait ability for MS patients only. Of the eight included studies, only four were randomised control trials and the authors cited methodological flaws and heterogeneity among included studies (Methajarunon et al., 2016).

Adherence and Adverse Events

Two of the included reviews provided a summary of adherence rates which was comparable to a treatment control group and ranged from 80-100% (Mehrholz et al., 2011; Perez & Cancela, 2014). Three reviews included information on adverse events which were few and included mild fatigue, anxiety and chlorine sensitivity (Li et al., 2017; Mehrholz et al., 2011; Perez & Cancela, 2014). No major adverse events were reported for people with neurological conditions.

Summary of neurological results

The effectiveness of aquatic-based exercise has been demonstrated by results of a number of research studies which included findings for physical function, physical fitness and mobility in clients with neurological conditions. However there is no clear effect in relation to body composition, flexibility, balance, PQOL and mental health outcomes in clients with neurological conditions. Authors cited a lack of research relating to aquatic-based exercise and neurological conditions, methodological flaws in included studies and a lack of homogeneity among studies, making it challenging to conclude with any certainty the overall effectiveness of aquatic-based exercise with the neurological population.

Cardiopulmonary Conditions

Cardiopulmonary conditions had the least number of reviews (N=4). Two of the included reviews focused on patients diagnosed with heart failure, and two reviews were Cochrane reviews, reporting on the effectiveness of aquatic-based exercise for patients with asthma (Grande et al., 2014) and chronic obstructive pulmonary disease (COPD) (McNamara et al., 2013). The largest review reported on the effectiveness of aquatic-based exercise for individuals with stable heart failure compared to land-based exercise or usual activity. The
review included eight studies and reported results of a meta-analysis for primary VO$_{2\text{peak}}$, peak power and six-minute walk test (6MWT) (Adsett et al., 2015). Overall the analysis favoured the aquatic-based exercise for the 6MWT and peak power, but showed no significant difference for VO$_{2\text{peak}}$ between the aquatic-based exercise and comparator groups. Muscle strength, cardiac dimensions, haemodynamic parameters and brain natriuretic peptide were measured and had mixed results based on individual studies in the review. Heterogeneity between trials did not allow for pooled treatment effects and low methodological quality of included studies suggests further research is needed to determine an effect for these outcomes (Adsett et al., 2015). The smaller review had six trials and provided a narrative synthesis evaluating the effectiveness of aquatic-based exercise for improving exercise tolerance and quality of life in patients with chronic heart failure (CHF) (Graetz et al., 2015). The majority of individual studies within this review favoured the aquatic-based exercise group for exercise tolerance measured by 6MWT and VO$_{2\text{peak}}$. Two studies demonstrated aquatic-based exercise intervention groups significantly improved 6MWT from baseline ($p<.05$), while two studies found significant improvements when compared to non-exercising ($p=.01$) and land-based exercise ($p=.001$) controls. Four studies reported significant improvements ($p<0.05$) in VO$_{2\text{peak}}$ from baseline following hydrotherapy interventions. Mixed results were reported for HRQOL related to aquatic-based exercise with two of the included studies reporting significant within group improvements compared to baseline or control (Graetz et al., 2015). The authors of both reviews related to heart failure cautioned interpretation of the results due to small sample sizes and heterogeneity of study characteristics (Adsett et al., 2015; Graetz et al., 2015).

A Cochrane review by McNamara et al. (2013), considered the effectiveness of aquatic-based exercise for improving exercise capacity and quality of life in patients with COPD. The review included five trials and reported significant mean improvements in functional exercise capacity, peak exercise capacity and endurance exercise capacity following aquatic-based exercise compared with no exercise. Endurance exercise capacity also improved following aquatic-based exercise compared with land-based exercise and exceeded the minimum clinically important differences (MCIDs) that have been reported in the literature. Health-related quality of life was measured in all five studies; however, the authors cited insufficient data within all studies, preventing pooling of results in a meta-analysis (McNamara et al., 2013). Improvements were reported in QOL scores for individual studies for the aquatic-based exercise group compared to a non-exercise control group; however, the authors reported none of the studies in the review were adequately powered to determine a significant change in QOL outcomes. When comparing aquatic-based exercise to a non-exercise control group for
pulmonary function, a mean difference change of 6.3% (95% CI 3.4 to 9.2) for FEV1 % was found, favouring aquatic-based exercise when the results of two studies were combined and a weighted mean difference change of 3.8% (95% CI 0.3 to 7.4) for FVC % was also found in favour of aquatic-based exercise when the results of three studies were combined. However, when compared to land-based exercise, no statistically significant effects on pulmonary function were found for the aquatic-based exercise group (McNamara et al., 2013). Significant improvements were also found in the aquatic-based exercise group in two studies that measured respiratory pressure compared to a non-exercise control. No statistically significant improvements were reported when comparing the aquatic-based exercise group to a land-based exercise group. Body composition was considered in two studies and although the authors reported a mean weight loss of 1.29 kg (95% CI -2.65 to 0.07) for the aquatic-based exercise group compared with land-based exercise group, the mean weight loss did not reach statistical significance (McNamara et al., 2013). The authors conclude there is limited quality of evidence to suggest aquatic-based exercise improves exercise capacity and QOL in patients with COPD when compared to a non-exercise control. There is also limited quality evidence that aquatic-based exercise is superior to land-based exercise for improving endurance exercise capacity. The authors caution interpretation of results due to the quality of evidence and small sample sizes (McNamara et al., 2013).

A Cochrane review by Grande et al. (2014) was conducted to evaluate the effectiveness of aquatic-based exercise for adults with asthma. The review included three RCTs, and primary outcomes included quality of life and exacerbations in asthma symptoms. No meta-analysis was possible due to methodological and interventional heterogeneity between included studies. Instead, the authors provided a narrative synthesis of the three trials. The authors reported that none of the included trials provided data on quality of life. One study reported two exacerbations in the aquatic-based exercise group when compared to a land-based exercise group. One of the included trials reported a statistically significant difference favouring water-based exercise over land-based exercise; however, analyses of change from baseline found that the difference was no longer significant. No significant change in general asthma symptoms or medication use was reported following aquatic-based exercise (Grande et al., 2014). However, the authors concluded that due to the small number of participants in the three included studies, the clinical and methodological heterogeneity and the high risk of bias, the evidence for effectiveness of aquatic-based exercise for adults with asthma is unclear.
Adherence and Adverse Events

Three of the included reviews provided a summary of adherence rates which was comparable to a treatment control group and ranged from 80-100 (Adsett et al., 2015; Graetz et al., 2015; McNamara et al., 2013). All four of the included reviews provided information regarding adverse events with the cardiopulmonary population which included skin sensitivity, accidental skin tear, two separate episodes of arrhythmia and exacerbation of symptoms (Adsett et al., 2015; Graetz et al., 2015; Grande et al., 2014; McNamara et al., 2013).

Summary of cardiopulmonary results

While the effectiveness of aquatic-based exercise has been demonstrated by results of a number of research studies and included findings for outcomes related to exercise performance, physical function, muscle strength, respiratory muscle strength, body composition and respiratory function, it is unclear if aquatic-based exercise has an effect in relation to QOL, anxiety, cardiac dimension and haemodynamic-related outcomes in clients with cardiopulmonary conditions. The authors cited a lack of research relating to aquatic-based exercise and neurological conditions, methodological flaws in included studies and a lack of homogeneity among studies, making it challenging to conclude with any certainty the effectiveness of aquatic-based exercise with the cardiopulmonary population.

Elderly

The largest review by Waller (2016) investigated the effects of aquatic-based exercise on physical functioning of healthy older adults and included a meta-analysis. Based on the results of 28 studies, the authors concluded that aquatic-based exercise is more effective at improving physical functioning in older adults than control intervention and is equally as effective as land-based exercise. When aquatic-based exercise was compared to control interventions, aquatic-based exercise had a moderate positive effect on physical functioning (SMD = 0.70 [95% CI 0.48 to 0.93]) of older adults based on results from pooled data with statistically significant differences reported for outcomes of maximum strength, muscular endurance, agility, flexibility, walking ability, aerobic power and self-reported physical functioning, but not for muscle power, respiratory muscle function and postural stability. Compared to land-based exercise, aquatic-based exercise had a small positive effect on physical functioning (SMD = 0.39 [0.12 to 0.66]) and statistically significant differences were reported for outcomes of muscular power and self-reported physical functioning. The authors advise that due to the
high risk of bias, high heterogeneity and poor methodological quality of included studies, results need to be interpreted with caution (Waller et al., 2016).

Bergamin et al. (2011) conducted a critical review to determine the effectiveness of aquatic-based exercise for improving physical fitness in healthy elderly subjects. This systematic qualitative review analysed nine studies and considered aerobic, muscular strength, flexibility and body composition outcomes. Four out of five studies using various measures for evaluating aerobic capacity (e.g. Including VO$_2$$_{\text{max}}$, VO$_2$$_{\text{peak}}$, and HR) reported improvements in the aquatic-based exercise group, with three high quality studies reporting statistically significant improvements. Eight of the included studies evaluated strength and seven of these reported statistically significant improvements in muscular strength based on various strength variables. Flexibility was evaluated in six of the included studies; five of these used the sit and reach test. Four out of the six studies reported improvements in flexibility for the aquatic-based exercise group; however, no pooling of the results was reported. Body composition was assessed in five studies, with only two studies reporting significant changes in the aquatic-based exercise group. The authors concluded that there is strong evidence to suggest aquatic-based exercise is effective for improving aerobic capacity and strength, and moderate evidence related to flexibility improvements and inconclusive evidence related to body composition parameters (Bergamin et al., 2012). However, no treatment effects were reported and very little information was provided regarding the methodological quality of included studies.

A review by King and Eitivipart (2016) presented the results of a systematic review on the effectiveness of aquatic-based exercise for balance in the elderly. Thirteen studies were included in the narrative review and the authors concluded there is some evidence to suggest aquatic-based exercise has a positive impact on balance in the elderly when compared to control interventions; however, there is little to no evidence to suggest aquatic-based exercise is more effective than land-based exercise. The authors report substantial variation in outcome measures, dosage and type of intervention along with methodological issues with the included studies (King & Eitivipart, 2016).

*Adherence and Adverse Events*

Of the three included reviews on the elderly population, only one provided a summary of adherence rates which ranged from 55-100% and was comparable to both land-based exercise and other controls (Waller et al., 2016). None of the included reviews provided information relating to adverse events for the elderly population.
Summary of elderly results

A small number of studies reported the effectiveness of aquatic-based exercise in relation to self-reported physical functioning, muscular strength, physical functioning, muscular endurance, aerobic capacity, flexibility and balance in the elderly population. However, an unclear effect or no effect has been identified in relation to muscle power, respiratory muscle function and postural stability. All authors cited a lack of research relating to aquatic-based exercise and the elderly population, and methodological flaws and high heterogeneity between studies suggest that these results should be considered with caution.

Discussion

This evidence map for aquatic-based exercise is based on 28 published systematic reviews and provides a broad overview and visual representation of the available evidence of the effectiveness of aquatic-based exercise on various clinical populations. It included a systematic search and review of a broad field to provide an indication of the research concentration including current research evidence, volume of available research in the area, gaps in knowledge and future research needs. Evidence maps present results in a user-friendly format and highlight outcomes where positive results have been reported in published systematic reviews and identify areas where there is still unclear evidence for the effectiveness of aquatic-based exercise.

Aquatic-based exercise has been evaluated for a variety of clinical populations and has had mixed results in efficacy related to health outcomes. Aquatic-based exercise was most commonly compared to land-based exercise as researchers attempted to determine which method of exercise was more effective across a number of populations and outcomes. The majority of reviews comparing aquatic-based exercise to land-based exercise found small but insignificant differences between the two groups and in most cases both exercise groups were found to be comparable. When compared to other controls aquatic-based exercise was often found to be superior across a number of outcomes and conditions. Some systematic reviews included a large number of primary research studies in the area, but often included a range of study types and were therefore only able to present a narrative synthesis of the results. The majority of the reviews were published over the last 5 years, suggesting a recent interest in the topic area. Although the purpose of the evidence map is not to evaluate the current research in the area, but instead to give a broad overview, it is noteworthy that across populations and
the majority of health outcomes, reviews reported more rigorous research is needed to determine the clinical effectiveness of aquatic-based exercise. Furthermore, the effectiveness of aquatic-based exercise may depend on several factors, including water temperature, type of exercise performed in the water, patient characteristics and length and type of intervention. Due to the high heterogeneity between studies, the authors were unable to determine the optimum type of aquatic intervention (Heywood et al., 2017; McNamara et al., 2013; Perez & Cancela, 2014). However, lucid distillation of the research outcomes suggests that there are potential benefits in relation to health outcomes, making aquatic-based exercise a reasonable therapeutic choice for certain populations.

The evidence map provides a unique visual representation of the volume and focus of a research area through bubble colour and location based on the results of a systematic review of reviews (Solloway et al., 2016). The evidence map employs a systematic review method which allows for replication of the review, identification of gaps and areas for future research and presents a practical representation of a substantial body of literature (Miake-Lye et al., 2016; Moher et al., 2015; Solloway et al., 2016). To date there are no established reporting guidelines for evidence mapping; however, Miake-Lye et al. (2016) suggested that some key components should be present within the evidence map, including a user-friendly visual representation of the data, as was presented in this review (Miake-Lye et al., 2016).

There are several limitations to the evidence map. Firstly, there are no effect size estimates from meta-analyses, no risk of bias assessment or quality of evidence evaluations conducted as part of the evidence mapping method. Therefore, the evidence map provides an overview of an intervention based on the literature without making any definitive claims about the effectiveness. Although initially there was no restriction on language of included trials, lack of time precluded translation of articles in languages other than English. Therefore, we evaluated only English-language systematic reviews, thus possibly missing pertinent information written in other languages. Secondly, we relied on information provided by included systematic reviews and any errors within the reviews may have gone undetected and could potentially skew results. Furthermore, no attempts were made to avoid overlap between included studies across reviews, potentially skewing results. Lastly, the inclusion of reviews that consisted of a variety of study types enabled a narrative synthesis of the included studies, but potentially undermined the quality of the results. Nonetheless, this evidence map has also included several high quality unbiased reviews, including Cochrane reviews, demonstrating that high-quality evidence does exist and gaps in the research evidence were identified.
The broad overview of evidence illustrated in this review suggests several promising effects related to aquatic-based exercise interventions. Further rigorous exploration and meta-analyses across primary research studies could establish more information on the effectiveness of aquatic-based exercise across different clinical populations and health outcomes. Future research should also consider the large number of topic areas that were classified as having unclear or no effect in order to determine the effectiveness of aquatic-based exercise for these outcomes.

Conclusion

Aquatic-based exercise has been considered with a variety of populations with varying efficacy across a range of outcomes. The evidence map provides a broad overview of the aquatic research. Evidence maps provide an easy and engaging summary of the size, scope and breadth of a specific domain of research and the visual representation enables clinicians and stakeholders to easily identify current evidence to inform clinical practice. In this instance the evidence map showed a range of potentially positive effects of aquatic-based exercise in relation to various populations highlighted within this review.

Funding

No funding source affiliated with this study.

2.5 Chapter Conclusion

An evidence map based on the results of a review of systematic reviews of the aquatic literature allowed for identification of the current best evidence related to the biological, psychological and social benefits related to aquatic-based exercise. The results of this literature review were used to provide a clear summary of the best evidence to inform health professionals considering aquatic-based exercise interventions for their clients. The results of the evidence map highlighted potentially positive impacts of aquatic–based exercise as well as areas that had limited information that resulted in unclear effects. Limited or conflicting information was found in relation to the psychosocial outcomes studied within the aquatic literature and therefore considered, by the current researcher, to be a gap within the aquatic literature. The results from the evidence map were used to inform the subsequent scoping review presented in chapter 3 of this thesis, where psychosocial outcomes were explored in more detail.
Chapter 3: Literature Review 2 – Scoping Review

3.1 Chapter Overview

This chapter presents the findings of a scoping review of the psychosocial benefits of aquatic-based exercise. A scoping review is another form of evidence synthesis, and, with similarities to the evidence map, this chapter will not revisit the literature on either the evidence synthesis or the comparison with systematic literature reviews presented in chapter 2. Instead, this chapter will introduce the key aspects of the scoping review methodology and discuss the rationale for its use and difference between the scoping review and the evidence map used in chapter 2.

3.2 Scoping Review Rationale and Method

A scoping review, in a broad sense, refers to the rapid gathering of literature in a given policy or clinical area where the aims are to accumulate as much evidence as possible and map the results. Scoping reviews are often conducted on a broad research topic and do not typically review the quality of included studies (Rumrill, Fitzgerald, & Merchant, 2010). Furthermore, a scoping review considers several study designs and sources in an attempt to provide a general overview of a topic. This approach allows for consideration of a broader research question focusing on breadth of evidence as opposed to depth (Arksey & O’Malley, 2005; Brien, Lorenzetti, Lewis, Kennedy, & Ghali, 2010; Levac, Colquhoun, & O’Brien, 2010; Rumrill et al., 2010). Arksey and O’Malley (2005, p. 21) highlight “four common reasons why a scoping review might be undertaken”, of which the first one is "to examine the extent, range and nature of research activity; this type of rapid review might not describe research findings in any detail but is a useful way of mapping fields of study where it is difficult to visualize the range of material that might be available".

The second common reason is “to determine the value of undertaking a full systematic review” through preliminary mapping of the literature (Arksey & O’Malley, 2005, p. 21). The third and fourth reasons for conducting a scoping review are to summarise and disseminate research findings and identify gaps respectively (Arksey & O’Malley, 2005). A scoping review was chosen as an evidence synthesis method as it addressed the need for a broad sweep of the literature and allowed for consideration of a range of data sources. Furthermore, similar to the evidence map, this form of synthesis is resource intense and therefore appeared to be a practical approach to supporting the research agenda.
The scoping review method is similar to the evidence map presented in the previous chapter in that both studies involved a systematic search of the literature, a synthesis of evidence and a description of the results. Furthermore, neither method provides an evaluation of the quality of the evidence, which is a key feature of a systematic review (Arksey & O'Malley, 2005; Miake-Lye et al., 2016). Although these types of evidence synthesis have similar methods, there are some differences. According to the literature, the main point of difference between the evidence map and scoping review appears to be related to the depiction of results (Miake-Lye et al., 2016; Schmucker, Motschall, Antes, & Meerpohl, 2013) with the evidence map providing a visual representation of the data and the scoping review providing a narrative summary (Schmucker et al., 2013). For the purpose of this research, the scoping review was undertaken to fill the gaps identified by the evidence map, i.e. the lack of data on psychosocial outcomes, and therefore a distinction was also made between the evidence map and scoping review based on the methods related to the inclusion of studies. The evidence map utilised more specific inclusion criteria that narrowed the type of included studies to systematic reviews. Alternatively, the scoping review was based on a broad sweep of the literature and included a variety of research studies – in order to capture research that was not considered within the systematic reviews, specifically in relation to the psychosocial content.

The scoping review method, based on the work of Arksey and O'Malley (2005) and expanded on by Levac et al. (2010), has been used to guide several scoping review studies (Pham et al., 2014). The method involves six key stages: (a) Identifying the research question, (b) searching the relevant studies, (c) selecting studies, (d) charting the data, (e) collating, and (f) summarising and reporting the results (Arksey & O'Malley, 2005; Levac et al., 2010). This method was used in the current scoping review and discussed in more detail in the methods section of the publication submission in section 3.4 of this chapter.

3.3 Purpose

The purpose of the scoping review was to review the literature on psychosocial outcomes related to aquatic therapy interventions as this was a gap identified in the previous literature review. The scoping review answered the following questions:

1. What psychosocial outcomes have been studied in the aquatic literature to date?
2. What does the literature say regarding psychosocial outcomes related to aquatic-based exercise?
3. What gaps currently exist in the aquatic literature with regard to psychosocial outcomes?
The findings from this review were presented in a paper entitled “Aquatic-based exercise: a scoping review of psychosocial outcomes”, which has been submitted to *Quality of Life Research* for review for publication.

### 3.4 Scoping Review Publication Submission

<table>
<thead>
<tr>
<th>Title</th>
<th>Journal</th>
<th>Author</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic-based exercise: a scoping review of psychosocial outcomes</td>
<td><em>Quality of Life Research</em></td>
<td>Ms. Heather Scott *</td>
<td>Research design, data collection, data analysis, writing of journal article, submission.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. Brendan Burkett</td>
<td>Writing/revision and editing support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Florin Oprescu</td>
<td>Search strategy, Data analysis and writing support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Michele Verdonck</td>
<td>Data analysis and writing/revision support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Mark McKean</td>
<td>Editing and writing/revision support</td>
</tr>
</tbody>
</table>

* Denotes primary author

### 3.4.1 Aquatic-based exercise: a scoping review of psychosocial outcomes

**Abstract**

**Background**: Aquatic-based exercise is a treatment modality which involves using the physical properties of water to add resistance to body movements during activity and at the same time to provide support for a greater range of motion and decreased loading. This makes A-BE particularly useful for injured patients, individuals with chronic disabling conditions and those individuals who would otherwise be unsuitable for physical activity in traditional land-based settings. Most of the research to date has focussed on the physical benefits of aquatic exercise. Exploration of other aspects, such as psychosocial outcomes of aquatic-based exercise, is currently needed.

**Objective**: To synthesise the literature reporting psychosocial outcomes related to aquatic-based exercise.

**Methods**: A six stages method based on the methodological framework of Arksey and O’Malley was employed: (a) identifying the research question, (b) searching the relevant studies, (c) selecting studies, (d) charting the data, (e) collating, and (f) summarising and reporting the results.
Results: A number of articles (n=61) were included in this review. Control trials were the most commonly used study design (n=32), while other designs were quasi-experimental (n=24) or pilot studies (n=5). Measurement tools varied and ranged from broad in scope to disease specific, and from psychometrically robust instruments to researcher-designed tools. Most studies focused and reported primarily on physiological outcomes with psychosocial outcomes presented as secondary outcomes. The three major areas of psychosocial outcomes reported on included quality of life, mood and self-efficacy.

Conclusion: There is a gap in the literature in regard to studies focusing primarily on psychosocial outcomes related to aquatic-based exercise. Measures specifically designed to measure psychosocial functioning need to be developed in order to evaluate such outcomes consistently. Qualitative inquiry may be well suited as a complement to quantitative measures and as a way to generate new data regarding the psychosocial outcomes of aquatic-based exercise in future studies.

Keywords: quality of life, health promotion, rehabilitation, mood, self-efficacy, aquatic-based exercise
Aquatic-based exercise: a scoping review of psychosocial outcomes

Aquatic-based exercise is a treatment modality which involves using the physical properties of water to add resistance to the body during activity while also encouraging a greater range of motion and decreased loading (Meyler, Moss, & Skinner, 2013). Aquatic-based exercise has become increasingly popular as an intervention for management of acute injuries as well as general health maintenance for chronic disease sufferers (Becker, 2009). Research in the area of aquatic rehabilitation has explored and documented benefits in the areas of posture, strength, balance, lung capacity and pain management (Meyler et al., 2013), and the effectiveness of aquatic rehabilitation has been demonstrated in musculoskeletal, neuromuscular, rheumatic and cardiopulmonary treatments (Becker, 2009; Geytenbeek, 2002).

The benefits and versatility of aquatic-based exercise are related to the fundamental principles of hydrodynamics (density, hydrostatic pressure, buoyancy, viscosity and thermodynamics). These water-based properties stimulate different physiological and biomechanical responses to exercise, when compared to dry land exercise. This makes A-BEE particularly useful for injured patients, individuals with chronic disabling conditions and those individuals who would otherwise be unsuitable for physical activity in traditional land-based settings (Cuesta-Vargas et al., 2012; Meyler et al., 2013).

Most of the research to date has focused on the physical outcomes of aquatic exercise. Exploration of other aspects, such as psychosocial outcomes, is currently needed. Psychosocial health encompasses the mental, emotional, social and spiritual aspects of health, and studies in aquatic-based exercise report benefits in both psychological and social functioning (Mosey, 1986). Outcomes related to quality of life (QOL) are often considered representative of psychosocial outcomes and will therefore be considered as such (Da Silva Cardoso & Chronister, 2009; Warburton, Nicol, & Bredin, 2006).

Understanding the effect of aquatic-based exercise on psychosocial outcomes is important from multiple perspectives, including health promotion, public health and disease management. For example, psychosocial well-being is particularly important for the prevention and management of chronic disease, such as cardiovascular disease, diabetes, osteoporosis, hypertension, obesity, cancer and depression (Low, Thurston, & Matthews, 2010; Roest, Martens, de Jonge, & Denollet, 2010; Rutledge, Reis, Linke, Greenberg, & Mills, 2006; Warburton et al., 2006).
Additionally, psychosocial factors are documented predictors of successful rehabilitation outcomes and inclusion of psychosocial interventions in a rehabilitation program is important in promoting recovery, adherence and long-term well-being (Biddle, 1995; Lyn Nathenson & Nathenson, 2013; Park & Gaffey, 2007). Identification of the psychosocial outcomes of aquatic-based exercise could be useful to a number of stakeholders, such as policy makers, program developers, healthcare providers and users of the aquatic environment.

In order to document the current state of knowledge and the current gaps, a scoping review was conducted to summarise the research on the topic, including: identification of what psychosocial outcomes have been studied in the literature to date, how these psychosocial outcomes are being measured, and to identify gaps in the literature that could inform future research in this area. Scoping reviews are a method of evidence synthesis that can help to determine if there is sufficient evidence for conducting a systematic review by considering the extent, range and nature of research activity in a particular area and often precede a systematic review (Brien et al., 2010). A scoping review allows for a broader research question focusing on breadth of evidence as opposed to depth (Rumrill et al., 2010). To the authors’ knowledge, no scoping review currently exists which focuses on literature related to the psychosocial outcomes of aquatic-based exercise.

**Methods**

The current scoping review used the methodological framework of Arksey and O’Malley (2005). This method has six stages: (a) identifying the research question, (b) searching the relevant studies, (c) selecting studies, (d) charting the data, (e) collating, and (f) summarising and reporting the results (Arksey & O’Malley, 2005).

**Search Strategy**

For the purpose of this review psychosocial health included mental, emotional, social and spiritual elements. Thus, both psychological and social functioning were considered. The term aquatic-based exercises was used to refer to interventions in which participants performed physical movements in water and included single or group interventions (Mehrholz et al., 2011). A search of the literature from the year 2000 to January 2017 was conducted to identify the most current research relevant to aquatic-based exercise and psychosocial outcomes.

Electronic databases searched included Scopus, CINAHL, PsycINFO, Web of Science and the Cochrane Database of systematic reviews. Pubmed was covered via Scopus. The initial search terms included: (aqua* or pool or water or hydrotherapy* or immers*) AND (psych* or soc*) AND therapy. However, these terms yielded few relevant psychosocial results and search
terms were further expanded to include quality of life as suggested by a member of the research team (FO). Exact search string criteria included: (aqua* OR pool OR “water-based” OR hydrotherapy* OR immers*) AND (psych* OR soc* OR "quality of life" OR QOL OR HQOL) AND therapy.

Quality of life (QOL) was selected as an appropriate expansion to the search terms as it encompasses both psychological and social aspects, both of which comprise psychosocial functioning. According to Oort, Visser, and Sprangers (2005), QOL is affected by physical and psychological state, personal beliefs, social relationships and their relationship to salient features of their environment (Oort et al., 2005). The addition of “quality of life (QOL)” provided additional articles relevant to this review and identified a promising area of aquatic-based exercise research.

Study Selection

An initial search of the literature was conducted by the first author (HS). After the initial search was completed and duplicates were removed abstracts of the remaining articles were reviewed by two members of the research team (HS & MV) for relevance to the topic. Where abstracts appeared relevant, full texts of the articles were considered and screened against the inclusion criteria. Articles were included in the scoping review if the study focused on the adult population, if they used psychosocial or QOL measures and included subjects immersed in or exercising in water.

Excluded from the review were: colonic irrigation, water birth, Kneipp therapy, spa therapy, whirlpool therapy, contrast baths and balneotherapy, as these activities did not fit within the physical activity domain. However, articles with these terms in their titles were not excluded until they were reviewed to ensure the terms were not being used synonymously with aquatic-based exercise. Articles were excluded if they were outside the scope of the review (i.e., focused solely on physiological outcomes, did not report results relating to psychosocial outcomes, or simply implied an effect on psychosocial outcomes without a clear indication that data had been systematically measured or recorded). In cases where investigators disagreed on whether or not to include a study (n=3), another member of the research team (BB) reviewed the articles independently and consensus was reached based on the original inclusion/exclusion criteria.

Other exclusions were studies considering a combination of treatments or co-interventions, as these created challenges for determining if the outcome was related to the aquatic intervention itself or due to other intervention factors. For example, a study by Cuesta-Vargas,
Buchan, and Arroyo-Morales (2014) considered cognitive behavioural strategies, in conjunction with aquatic exercise, for improving quality of life in breast cancer patients. The inclusion of cognitive behavioural education created potential co-intervention bias and thus was excluded from the sample (Cuesta-Vargas et al., 2014). Attempts were made to identify English versions of articles that were not originally published in English. However, if an English version was not found, the article was excluded from the review. Unpublished results and grey literature were excluded because of the sheer wealth of published literature on the topic. Pain was also omitted from the studies as the high global prevalence of pain and the complexity of both the aetiology and sequelae suggest studies should focus exclusively on pain for a more comprehensive understanding (Goldberg & McGee, 2011) and be the topic of another scoping review.

Reference lists of included papers were reviewed to identify any additional articles. Relevant information from included articles was extracted, summarised and tabulated using the following headings: Primary author(s), Year of publication, Intervention type and comparator; Duration of the intervention, Study populations, Aims of the study, Methodology, Outcome measures and Results (Arksey & O’Malley, 2005).

**Results**

The initial search using the specified keywords yielded 2,228 articles across the five databases. After duplicates were removed and titles were screened for eligibility, 290 articles remained. Abstracts and/or full texts of the remaining results were scanned for inclusion and 61 articles that met the inclusion criteria were included in this review (Figure 7).
The full results of the scoping review were tabulated according to Arksey and O'Malley’s (2005) suggestion for charting the data, then distributed into smaller tables in order to provide a quick view of the findings relating to psychosocial variable, study population, measurement tool and results/effect. Control trials were the most commonly used study design (n=32), while other designs were quasi-experimental (n=24) or pilot studies (n=5). The aim of this review was not to assess or comment on the quality of the evidence, but simply to compile and organise data from relevant studies to identify future research priorities (Arksey & O'Malley, 2005).

The studies included in the review were published between 2001 and 2014, with over 90% (56/61) published after 2006. The majority of studies indicated that the overall effect of aquatic-based exercise on psychosocial functioning was positive (Table 1). A result was
considered positive if there was an improvement in outcome measure scores from baseline; however, this change did not necessarily reflect a clinically or statistically significant change from baseline.

The most common populations studied were populations with chronic musculoskeletal diseases. Less studied populations included chronic obstructive pulmonary disease, neurological disorders, obesity and haemophilia (Table 2).

<table>
<thead>
<tr>
<th>Psychosocial Variables</th>
<th>Number of times Studied</th>
<th>Number of Positive Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Life</td>
<td>55</td>
<td>52</td>
</tr>
<tr>
<td>Depression</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Anxiety</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Anxiety and Depression</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Happiness</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>81</td>
<td>73</td>
</tr>
</tbody>
</table>

*Table 1. Psychosocial outcomes studied*
<table>
<thead>
<tr>
<th>Population</th>
<th>Number of Trials</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibromyalgia</td>
<td>15</td>
<td>789</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>10</td>
<td>1157</td>
</tr>
<tr>
<td>COPD</td>
<td>5</td>
<td>200</td>
</tr>
<tr>
<td>Low Back Pain</td>
<td>4</td>
<td>228</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
<td>4</td>
<td>176</td>
</tr>
<tr>
<td>Arthritis</td>
<td>3</td>
<td>118</td>
</tr>
<tr>
<td>Haemophilia</td>
<td>2</td>
<td>66</td>
</tr>
<tr>
<td>Parkinson's Disease</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>Hip/Knee Replacement</td>
<td>2</td>
<td>98</td>
</tr>
<tr>
<td>Obesity</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Rheumatoid Arthritis</td>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>Chronic Heart Failure</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Elderly</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Women</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Ankylosing Spondylitis</td>
<td>1</td>
<td>69</td>
</tr>
<tr>
<td>Disability</td>
<td>1</td>
<td>60</td>
</tr>
<tr>
<td>Healthy Women</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Rheumatic Disease</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>2</td>
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</tr>
<tr>
<td>Stroke</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>1</td>
<td>68</td>
</tr>
<tr>
<td><strong>Total Number of Trials</strong></td>
<td><strong>61</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Number of Subjects</strong></td>
<td><strong>3493</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Study population
The number of participants in each study ranged from 3 (Kelley & Loy, 2008) to 312 (Cochrane, Davey, & Matthes Edwards, 2005). Study variables fell under three main categories: QOL, mood (e.g. anxiety and depression) and self-efficacy. Several studies considered more than one psychosocial variable, and in most cases QOL was measured in combination with a mood-related outcome measure. Measurement tools varied and ranged from broad in scope to disease specific, and from psychometrically robust instruments to researcher-designed tools.

The three major areas of psychosocial outcomes identified in the literature reviewed and agreed upon by all members of the research team included: quality of life, mood and self-efficacy. They are detailed next.

**Quality of Life (QOL)**

Fifty-five studies considered the impact of aquatic-based exercise on QOL. In general, authors of the included studies identified they were measuring the ‘quality of life’ of study participants; other authors used terms such as ‘psychological variables’ (Latorre et al., 2013), ‘psychosocial factors’ (Baenato et al., 2014), and ‘psychological well-being’ (Fransen, Nairn, Winstanley, Lam, & Edmonds, 2007; Taghi Zamani, Zarei, & Amirtash, 2014). Eleven studies used more than one outcome measure to assess QOL in their study, often pairing a more generic QOL measure with a disease-specific measure (Alexander, Butcher, & MacDonald, 2001; Assis et al., 2006; Cuesta-Vargas & Adams, 2011; Hinman, Heywood, & Day, 2007; Ide, Laurindo, Rodrigues-Júnior, & Tanaka, 2008; Latorre et al., 2013; Lin, Davey, & Cochrane, 2004; Mannerkorpi, Nordeman, Ericsson, & Arndorw, 2009; Roehrs & Karst, 2004; Von Mackensen et al., 2012; Wadell, Sundelin, Henriksson-Larsén, & Lundgren, 2004) in an attempt to capture a more comprehensive understanding of the factors impacting QOL, including those psychosocial factors that may not be specific to the disease, but still impact QOL (Parkerson et al., 1993).

Several studies (n=27) used the SF-36 to measure QOL. All of these studies reported a positive result in relation to overall QOL. Some studies reported a change specific to the mental and social components of the SF-36; however, the authors had a tendency to present an overall QOL score which encompassed the physical changes as well, restricting insight as to the impact related to the psychosocial benefits. (Baenato, Arroyo-Morales, Delgado-Fernández, Gatto-Cardia, & Artero, 2013; Baenato, et al., 2014; Baenato, Delgado-Fernández, et al., 2014; Devereux, Robertson, & Briffa, 2005; Dundar, Solak, Yigit, Evcik, & Kavuncu, 2009; Von Mackensen et al., 2012; Wadell et al., 2004). Improvements in QOL were also found using disease specific measures such as the Fibromyalgia Impact Questionnaire (FIQ) (Assis et al.,
All other studies reported mixed results in outcome measures related to QOL. The Parkinson’s Disease Questionnaire 39 (PDQ-39) was used in two studies with conflicting results (Ayan & Cancela, 2012; Villegas & Israel, 2014). The Short Form 12 (SF-12) was used in three studies with mixed results. A pilot study considering the impact of aquatic-based exercise on the QOL of individuals with fibromyalgia syndrome (FMS) (n=44) reported an overall increase in QOL based on scores of the SF-12 (Cuesta-Vargas & Adams, 2011), while two randomised control trials (RCTs) comparing the effects of aquatic-based exercise on the QOL of individuals diagnosed with osteoarthritis (n=105; n=152) reported no change in mental component scores from baseline data (Foley, Halbert, Hewitt, & Crotty, 2003; Fransen et al., 2007). St. George’s Respiratory Questionnaire (SGRQ) was used in two studies. An RCT by De Souto Araujo et al. (2012) (n=42) reported an increase in all domains of the SGRQ for the aquatic group compared to the floor exercise group and non-exercise control group (De Souto Araujo et al., 2012). A control trial by Wadell et al. (2004) (n=43) also found improvements related to overall QOL based on SGRQ scores, but when paired with results of the SF-36, reported the changes were likely related to physical component scores, as there was no change found for the psychosocial domains of the SF-36 (Wadell et al., 2004).

The Chronic Respiratory Disease Questionnaire (CRDQ) was used in two studies. An RCT by McNamara, McKeough, McKenzie, and Alison (2013) compared water-based exercise and land-based exercise (n=45) and found both the land-based group and aquatic-based group improved in overall QOL; however, no between group differences were found in relation to psychosocial components of QOL. Özdemir et al. (2010) reported improvements in QOL scores on the CRDQ, based on a randomised comparison between an aquatic rehabilitation group and a non-exercise control group (n =50); however, these results were not statistically significant (Özdemir et al., 2010). Two studies used the Euroqol and found improvements in QOL scores of patients with both fibromyalgia and rheumatoid arthritis (Cuesta-Vargas & Adams, 2011; Eversden, Maggs, Nightingale, & Jobanputra, 2007). A pilot study (n=44) by Cuesta-Vargas et al. (2014), using the Euroqol in combination with the SF-12 and FIQ, reported statistically significant improvements in QOL scores for participants in the aquatic group (deep water running) over the multimodal physiotherapy program group (Cuesta-Vargas et al., 2014). Similarly, an RCT by Eversden et al. (2007) reported improvements in QOL scores for both the
aquatic group and the land-based group. Although there was no significant difference between groups based on QOL scores, through the addition of a self-reported measure of overall treatment effect, participants reported “feeling much better” than the participants in the land-based comparison (Eversden et al., 2007).

The Western Ontario McMaster Universities Arthritis Index (WOMAC) was used to measure QOL in three studies (Hinman et al., 2007; Lin et al., 2004; Mazloum, Khayambashi, & Rahnama, 2014). In a study by Mazloum et al. (2014) patients with haemophilia (n=38) showed a significant improvement in QOL in the aquatic exercise group compared to the land-based exercise control. However, while the WOMAC may provide an overall QOL, this measure does not contain a score for changes related specifically to psychosocial outcomes, so provided little insight related to the aim of this review (Ackerman, 2009). The two other studies paired the WOMAC with other measures and could therefore report on the psychosocial domains related to QOL of individuals. Lin et al. (2004) used the WOMAC to capture the QOL of individuals with osteoarthritis and, in addition to the WOMAC, used subscales of ‘social activity’, ‘support from family and friends’, ‘level of tension’ and ‘mood’ from the Arthritis Impact Measurement Scale 2 (AIMS 2) in an attempt to capture the psychosocial status of participants (n=106) (Lin et al., 2004). Improvements were found in overall QOL in relation to both physical and psychosocial components for both the aquatic exercise group and the control group; however, there were no between group differences related to the psychosocial outcomes (Lin et al., 2004).

A pilot study (n=20) by Lau et al. (2014) had similar results to Lin et al. (2004); however, the study did not include a control group (Lau et al., 2014). An RCT (n=71) by Hinman et al. (2007) reported improvements in overall scores for the aquatic group compared to a non-exercise control group using the WOMAC and the Assessment of Quality of Life (AQoL) in patients with osteoarthritis; however, they did not provide details related to the psychosocial outcomes (Hinman et al., 2007).

Less used measures included the World Health Organisation Quality of Life Questionnaire (WHOQOL) which was used in two of the included studies. Schuch et al. (2014) found an improvement in both physical and psychosocial domains of QOL for the aquatic-exercise group in a population of obese elderly women (n=28) (Schuch et al., 2014). Rica et al. (2013) reported a similar result for a group of healthy women (n=47) (Rica et al., 2013). The Haem-A-QOL (Von Mackensen et al., 2012) and Stroke Specific Quality of Life Scale (SS-QoL) (Montagna, Santos, Battistuzzo, & Loureiro, 2014) also indicated an improvement in QOL. A mixed methods study by King, Yang, and Malkin (2006) paired the Leisure Satisfaction Measure (LSM) with a
qualitative researcher-generated questionnaire with a group of arthritis patients (n=14) and found positive results in QOL were consistent between both quantitative and qualitative data (King et al., 2006).

**Mood**

Nineteen studies considered the impact of aquatic-based exercise on mood, with 58% (11/19) considering the effect of aquatic-based exercise on depression in particular. Three studies considered the effect of aquatic-based exercise on anxiety (Ide et al., 2008; Munguia-Izquierdo & Legaz-Arrese, 2008; Tomas-Carus et al., 2008). Four studies measured both anxiety and depression (Fransen et al., 2007; Mannerkorpi et al., 2009; McNamara et al., 2013; Özdemir et al., 2010) and one study measured happiness (Hejazi, Soltani, Javan, Aminian, & Hashemi, 2012).

All 11 studies considering the effect of aquatic-based exercise on depression reported a positive change (Assis et al., 2006; Belza, Topolski, Kinne, Patrick, & Ramsey, 2002; Cadmus et al., 2010; Castro-Sánchez et al., 2012; Evcik et al., 2008; Funderburk & Callis, 2010; Hejazi et al., 2012; Kim, Chung, Park, & Kang, 2012; Letieri et al., 2013; Schuch et al., 2014; Solak et al., 2008). Of these studies, eight used the Beck Depression Inventory (BDI) and found a reduction in depressive symptoms for individuals with both musculoskeletal and neurological conditions (Assis et al., 2006; Castro-Sánchez et al., 2012; da Silva et al., 2013; de Andrade et al., 2008; Evcik et al., 2008; Funderburk & Callis, 2010; Hejazi et al., 2012; Schuch et al., 2014; Solak et al., 2008). Two studies used the Centre for Epidemiological Studies Depression Scale (CESD-R) in an RCT with a group of patients with osteoarthritis (n=249) (Belza et al., 2002; Cadmus et al., 2010).

Similarly, a quasi-experimental study by Kim et al. (2012) found an improvement in depression scores in using the Zung self-rating depression scale with a group of patients with osteoarthritis (n=70) (Kim et al., 2012). Overall, studies comparing aquatic-based exercise and a non-exercise control group found a significant difference in depression scores between groups, while studies comparing aquatic-based and land-based exercise indicated a similar effect between the interventions, but no significant between-group effect was reported (Assis et al., 2006; McNamara, et al. 2013).

Two out of the three studies measuring symptoms of anxiety reported positive results related to the aquatic intervention (Ide et al., 2008; Tomas-Carus et al., 2008). Of the three studies considering the effect of aquatic-based exercise on anxiety, two studies used the State Trait
Anxiety Inventory (STAI) (Munguia-Izquierdo & Legaz-Arrese, 2008; Tomas-Carus et al., 2008) with a fibromyalgia population with mixed results (Munguia-Izquierdo & Legaz-Arrese, 2008; Tomas-Carus et al., 2008). Results of an RCT by Tomas-Carus et al. (2008) (n=30) suggest that aquatic-based exercise has a positive impact on anxiety, whereas the RCT by Munguia-Izquierdo and Legaz-Arrese (2008) found no change in anxiety (Munguia-Izquierdo & Legaz-Arrese, 2008; Tomas-Carus et al., 2008). Munguia-Izquierdo and Legaz-Arrese (2008) went on to suggest that the lack of change in result could be due to the length of the aquatic-exercise program used in the study (16 weeks) and suggest developing aquatic-exercise interventions greater than 20 weeks. The study by Tomas-Carus et al. (2008) was 32 weeks which suggests that the duration of the aquatic-exercise intervention may play a role in its efficacy. The third study used the Hamilton Anxiety Rating Scale (HAS) to measure changes in anxiety (Ide et al., 2008). This 4-week RCT found improvements in anxiety with a group of 40 fibromyalgia patients (Ide et al., 2008).

Of the four studies that measured both anxiety and depression, three used the Hospital Anxiety and Depression Scale (HADS) (Mannerkorpi et al., 2009; McNamara et al., 2013; Özdemir et al., 2010) and one used the depression, anxiety and stress scale (DASS21) (Fransen et al., 2007). All three studies that used the HADS reported improvements in both anxiety and depression scores with the study by Özdemir et al. (2010) reporting statistically significant improvements in anxiety scores from baseline for a chronic obstructive pulmonary disease (COPD) (n=50) population compared to a non-significant difference in the medical therapy only control (Özdemir et al., 2010). An RCT by McNamara et al. (2013) also reported improvements in anxiety and depression scores with the COPD population (n=45) using the HADS; however, no between group differences were found when comparing aquatic and land-based exercise (McNamara et al., 2013). Improvements in anxiety and depression scores were also reported in a study by Mannerkorpi et al. (2009) based on the results of an RCT (n=134) with a fibromyalgia population (Mannerkorpi et al., 2009). Fransen et al. (2007) also reported improvements in anxiety and depression scores using the DASS21 following a 12 week aquatic-based exercise intervention for a group of people with osteoarthritis (n=152), but these improvements were not statistically significant (Fransen et al., 2007).

Positive changes in overall mood were found in an RCT by Cantarero-Villanueva et al. (2013) using the Profile of Mood States questionnaire in a population of breast cancer survivors (n=68) (Cantarero-Villanueva et al., 2013), and an increase in happiness was found in a quasi-experimental study by Hejazi et al. (2012) following an 8 week aquatic-exercise program, measured using the Oxford Happiness Questionnaire with a multiple sclerosis population.
Self-efficacy

Seven studies addressed self-efficacy related to aquatic-based exercise. Five studies used the Arthritis Self-Efficacy Scale (ASES) with the appropriate population (Cadmus et al., 2010; Foley et al., 2003; Jentoft, Kvalvik, & Mengshoel, 2001; Kim et al., 2012; Wong & Scudds, 2009), one study used a researcher-generated questionnaire with the arthritis population (Kang, Ferrans, Kim, Kim, & Lee, 2007), and one study used the Modified Falls Efficacy Scale (MFES) with a group of individuals with osteoporosis (Devereux et al., 2005). However, these studies had mixed results in relation to self-efficacy. Three studies indicated a positive result. Kim et al. (2012) found that subjects with osteoarthritis (n=70) who participated in the aquatic-based exercise group reported increased levels of self-efficacy, whereas those in the control group worsened, which is consistent with prior studies of exercise programs in arthritic patients (Kim et al., 2012; Mannerkorpi, Nyberg, Ahlmen, & Ekdahl, 2000).

Wong and Scudds (2009) also reported positive results in self-efficacy in a group of subjects with rheumatic disease (n=30) after aquatic-based intervention; however, only selected scales of ASES were used instead of the whole scale, questioning the validity of this measure, a limitation of the study recognised by the authors (Wong & Scudds, 2009). Kang, Ferrans, Kim, Kim, et al. (2007) reported positive results measuring self-efficacy using an aquatic exercise self-efficacy scale. This validated scale was developed specifically for the aquatic environment based on previous self-efficacy instruments (Kang, Ferrans, Kim, Kim, et al., 2007).

Devereux et al. (2005) reported no change in falls efficacy following an aquatic intervention with a group of osteoporosis patients, and results of an RCT by Foley et al. (2003) comparing self-efficacy outcomes between land-based and aquatic-based exercise in a group of osteoarthritis patients (n=105) indicated a change in self-efficacy for the land-based group and a slight negative effective for the aquatic-based group (Foley et al., 2003). Jentoft et al. (2001) also reported no change in self-efficacy following a 20 week aquatics program with a group of fibromyalgia patients (n=34). Cadmus et al. (2010) considered self-efficacy and its relationship to perceived quality of life (PQOL) in an RCT with 249 osteoarthritis patients. No change in self-efficacy was reported, and, although there appeared to be an overall increase in PQOL after aquatic-based exercise intervention, results indicated that self-efficacy was not a mediator of PQOL in the osteoarthritis (OA) population studied (Cadmus et al., 2010).

The number of studies considering psychosocial outcomes are presented in Figure 8.
Discussion

The results of this scoping review indicate that aquatic-based exercise may be linked to positive results related to psychosocial outcomes, specifically in the areas of quality of life, self-efficacy and mood. However, it is important to note that the majority of studies reviewed reported primarily on outcomes related to physical and/or biomechanical changes associated with aquatic-based exercise, thus psychosocial outcomes are an under-researched and under-reported area. Psychosocial outcomes were often presented as secondary outcomes and often were not clearly identified or reported on in study results. For example, the psychosocial domains of the SF-36 were often not reported by authors, which created challenges in identifying and extracting the relevant data for the current review.

Measurement tools varied between studies and populations making it difficult to compare results. The majority of psychosocial outcomes related to aquatic-based exercise were measured using either generic measures, such as QOL questionnaires, or disease specific questionnaires that had a psychosocial component. Furthermore, some QOL questionnaires lack an evaluation of social functioning, and this suggests that an overall QOL score is not an
accurate reflection of psychosocial functioning. Further exploration specific to social functioning is needed to identify potential mediators of the changes on overall QOL scores.

Other studies used a more general measure for QOL. For example, of the 61 studies included in the review, QOL was measured by the SF-36 in 27 studies. The SF-36 is a self-reported questionnaire with strong psychometric properties and eight domains, including physical, mental and social functioning (McHorney, Ware Jr, & Raczek, 1993). However, caution should be used while interpreting these results in relation to psychosocial outcomes, as the SF-36 measures changes in physical, psychological and social domains. The authors often reported an overall score on the SF-36 or identified domain scores relating to the aims of their study, which, as mentioned previously, did not always relate directly to psychosocial outcomes. Therefore, the overall score could reflect changes that were purely physical and could easily be misinterpreted. Although there is no clear guideline for reporting the SF-36, investigators should report the findings for each of the eight domains and give implications for the participants (Ware & Sherbourne, 1992).

Due to the high prevalence of mood-related disorders within the general population and in relation to chronic disease and illness, an understanding of the benefits and effect of aquatic-based exercise on mood is important as it is likely to be a factor in the clinical environment regardless of the population being treated (Cornwell & Waite, 2009; Dickens, Richards, Greaves, & Campbell, 2011). The majority of studies reported a positive effect on mood, and studies comparing aquatic-based exercise to land-based exercise showed a positive result in both groups, but no significant difference was found between groups. This suggests that aquatic exercise is as effective as land-based exercise in alleviating negative symptoms related to mood.

However, considerably more work is needed to determine the effectiveness of aquatic-based exercise on psychological aspects of disability, specifically, anxiety and depression (Al-Qubaeissy et al., 2013). Furthermore, inconsistency in measuring tools across studies and clinical populations can create barriers to understanding the overall efficacy of aquatic-based exercise on mood (Al-Qubaeissy et al., 2013). Caution should be exercised when interpreting changes in mood scores in the aquatic-based exercise group as improvements may not be based exclusively on the aquatic exercise and could be due to a combination of factors, including social interaction/group therapy effect and interaction with the therapist (Belza et al., 2002). Further exploration is needed to identify potential mediators of mood changes.
Self-efficacy is an important factor related to psychosocial outcomes as it is the belief in one’s own ability to successfully execute a given task and these beliefs can influence the amount of time and effort the individual exerts on the task (Bandura, 1977). Overall positive results were reported with regard to self-efficacy and aquatic-based exercise. The majority of studies presented in the review used disease specific questionnaires across different populations, limiting the generalisability of the results.

Future studies need to consider additional populations, larger sample sizes, and behavioural strategies related to increased self-efficacy, and which components of the aquatic-based interventions lead to these increases in order to accurately reflect changes (Ahern, Nicholls, Simionato, Clark, & Bond, 1995). Furthermore, exploration of self-efficacy through qualitative means, in an attempt to capture the user’s experience, may also yield important insights into the potential mediators of self-efficacy. As self-efficacy has been linked to QOL, adherence and motivation, understanding the impact aquatic-based exercise has on the self-efficacy of individuals is an important aspect of program design and implementation (Cadmus et al., 2010; Foley et al., 2003; Kang, Ferrans, Kim, Kim, et al., 2007).

The main psychosocial outcomes noted from the literature included QOL, mood and self-efficacy, leaving several key psychosocial concepts yet to be measured. Studies focusing on concepts such as social support, social connectedness, social roles, self-esteem and self-concept related to aquatic-based exercise need to be considered. Expanding future studies to reflect a larger number of psychosocial variables and using qualitative methods, such as interviews or focus groups, could yield a more comprehensive understanding of psychosocial outcomes related to aquatic-based exercise.

Aquatic-based exercise has been researched in several clinical populations and the populations that were studied most likely reflect the effects of the illness or disability on the body and the accommodating properties of water. This appears to be a continuing trend in aquatic-based research and is likely due to the nature of the disease as the aquatic environment offers decreased loading, increased support and gentle resistance without the physical impact related to land-based exercise, which could prove challenging for the chronically disabled population (Al-Qubaeissy et al., 2013). However, there are still several populations that remain under-investigated with regard to psychosocial outcomes related to aquatic-based exercise, and even among the most frequently investigated populations, several gaps still exist.
Limitations

Due to the scope of this review, no major assertions can be made about the efficacy of aquatic-based exercise on psychosocial outcomes. However, a scoping review can often be used for determining the feasibility of performing a systematic review related to the topic (Arksey & O'Malley, 2005). Secondly, although every attempt was made to identify all aquatic literature related to psychosocial outcomes with keyword searches related to both psychosocial terminology and assessment tools, this was challenging as inconsistencies in terminology and the broadness of the psychosocial concept may have left some literature unaccounted for. However, the number of studies included in this review provides a comprehensive summary of the existing literature from which suggestions for both researchers and clinicians have been made in relationship to psychosocial outcomes of aquatic-based exercise.

Conclusion

This scoping review provided an overview of the psychosocial outcomes that have been considered in relation to aquatic-based exercise. The majority of studies have considered psychosocial outcomes as secondary to physiological outcomes. Thus, several gaps still exist within the literature which need to be addressed. Studies need to be conducted with a primary focus on psychosocial outcomes related to aquatic-based exercise, and measures specifically targeted to psychosocial functioning need to be identified or created and incorporated into studies in order to evaluate these outcomes consistently. The subjective nature of psychosocial components creates challenges for collecting and comparing data from a strictly quantitative perspective, and qualitative inquiry may be well suited to enrich the data and appropriately capture the psychosocial outcomes of aquatic-based exercise. Qualitative inquiry offers a suitable method to inform, expand and enrich the data related to psychosocial outcomes, and could reveal a number of new psychosocial concepts that have yet to be considered within the aquatic-based literature. Qualitative data can also be used to inform the creation of a tool that accurately reflects the impact of aquatic-based exercise on psychosocial functioning. Furthermore, using a qualitative approach to measure psychosocial outcomes would provide clinicians and researchers with a more in-depth understanding of reported outcomes. Expanding on the information collected through the measuring tools would yield further insight into psychosocial outcomes and provide connections to program components. Determining links between these concepts holds implications for program design and
implementation and may be instrumental in the promotion of wellness, motivation and adherence with aquatic-based exercise.

**Compliance with ethical standards**

**Conflict of interest**

All authors declare there are no conflicts of interest to report.

**Ethics approval**

This scoping review does not contain any studies with human participants or animals performed by any of the authors.

### 3.5 Chapter Conclusion

The results of the scoping review confirmed the lack of evidence regarding psychosocial outcomes highlighted in the evidence map. However, despite the variation in study design and interventions and outcome measures, synthesis of the literature suggested there is some quantitative data to support that aquatic-based exercise has a positive impact on psychosocial outcomes. Although this review has addressed some gaps highlighted in the evidence map in relation to psychosocial outcomes, several gaps remain that need to be addressed: more specifically, gaps related to the number of outcomes studied and the limited research in relation to the user experience of psychosocial outcomes within the literature. These areas needed to be explored further, and qualitative enquiry in the form of focus groups appeared to be the next practical step in the research in order to gain an understanding of the biological, psychological and social implications of aquatic-based exercise, key factors influencing participation, and key principles to guide aquatic-based exercise interventions.
Chapter 4 Methodology

4.1 Chapter Overview
This chapter presents the methods used in this research and will provide an explanation of the belief system or research paradigm that guided this research project. The research questions will be presented along with the overarching methodology and rationale, followed by a summary of the key methods used in this research in relation to the three studies. Finally, an overview of the methodological quality used throughout the research to ensure trustworthiness of the research will be provided. The final section concludes the chapter and provides a brief summary of the above information.

4.2 Research Paradigm
A research paradigm or world view carries with it a set of beliefs and assumptions that guide the research process. Declaring one’s theoretical orientation has historically been important to understand the lens through which research has occurred. Different world views can create controversy about a researcher’s methods, theories and epistemological claims, so firmly aligning oneself with a set paradigm may be potentially limiting (Creswell, 2013; Tashakkori, 1998). Therefore, the research presented in this thesis has not aligned itself with a particular world view and instead has been approached from a principally practical point of view. Creswell (2013) explores the idea that more than one inquiry paradigm be used in an attempt to provide a greater appreciation and understanding of what is being studied and the practicalities experienced. This approach allows researchers more flexibility in choosing research methods with less of a focus on choosing methods that remain consistent with a particular theoretical orientation and more about choosing the method that can best address the research questions or problem being addressed (Creswell, 2013). This research has been approached from this practical standpoint and is therefore most appropriately aligned with a pragmatic perspective.

Pragmatism is a set of ideas articulated by historical figures such as John Dewey, William James and Charles Sanders Pierce, to contemporaries, such as Cherryholmes (1992) and Murphy (1990). A pragmatic approach allows areas to be studied that are of interest to the researcher, embraces methods that are appropriate for addressing the research questions and uses findings in a positive manner that supports a particular value system (Creswell, 2009). Within the pragmatic perspective, instead of the method being dominant, the research problem is viewed as the most important concern (Creswell, 2009), and the research questions provide
the rationale for the choice of approach. For this thesis, the researcher decided on the most effective approach to address the research questions.

The pragmatic perspective does not require the research to be classified as purely quantitative or qualitative in nature with either a positivist or interpretive philosophy, and instead, allows for the use of both qualitative and quantitative research approaches to collect information and make inquiry into various complex phenomena (Creswell, 2009; Morgan, 2014). In other words, the pragmatic perspective allows for a balanced point between the deductive and inductive perspectives of thinking, which offers practical answers for merging different paradigms (Creswell, 2009). Therefore, where the use of either quantitative or qualitative approaches does not completely address the research problem, the pragmatic approach provides the justification and rationale for combining methods, allowing for a combination or mixing of methods, or mixed methodology, which may be the more appropriate for answering the research questions (Creswell 2009; Creswell & Plano Clark, 2011; Johnson et al., 2007; Tashakkori, 2003). Within the mixed methodology, the mixing of more than one research method (described as multiple methods, rather than mixed methods) allows for the adoption of data collection and analysis methods that may provide greater insight into the research problem (Creswell, 2003; Mackenzie & Knipe, 2006; Morse, 2009; Tashakkori, 2003).

The pragmatic perspective aligns well with the background of the researcher, previously divulged in chapter 1 of this thesis, as one of the key drivers of the research. From a clinical perspective, I am interested in both the empirical evidence related to a specific intervention – especially in relation to its effectiveness, precautions and contraindications- and the experience of the users or clients involved in the intervention. Furthermore, I am interested in how this information may interact to form a holistic understanding of the intervention experience. These interests influenced the decision to use a mixing of methods, which aligns well with a pragmatic perspective in which the data collection and analysis of the research was guided by the overall research aim and corresponding research questions.

The information sought by the researcher required the application of different research methods in order to accurately understand both the empirical evidence and the client experience. The adoption of the pragmatic perspective and mixed methodology approach appeared best suited to support the research process necessary for understanding the “what”, “why”, and “how” of this particular phenomenon (Saunders et al., 2009). In other words, the mixing of methods was chosen in an attempt to allow for the use of the most practical methods to address the research problem. Therefore, with the research questions in mind, the
most practical approach to gaining the information needed to answer the questions was considered, and ultimately influenced the recruitment, data collection, analysis and interpretation of results.

4.3 Research Questions

This thesis presents the results of two literature reviews and three investigative studies to answer the following research questions:

1. What are the potential biological, psychological and social outcomes of aquatic-based exercise interventions?
2. What are the key factors influencing participation and adherence with aquatic-based exercise interventions, experienced by program users and instructors?
3. What key principles should guide aquatic-based exercise interventions in order to maximise the benefits and support participation and adherence with these interventions?

The next section provides the methodology used to address the research questions.

4.4 Overview of Methodology

The purpose of this dissertation is to address three main research questions (presented in section 4.3), the results of which are designed to provide clinicians and other key stakeholders with evidence to inform aquatic-based exercise interventions for clients with chronic and disabling conditions. The three research questions were addressed through two comprehensive literature reviews and three qualitative research studies: an evidence map based on a systematic review of reviews (chapter 2), scoping review (chapter 3), and exploratory focus groups and interviews (chapters 5, 6, and 7). The temporal sequence of this research along with the methods used is presented in Figure 4.1. Each of the studies informed the next, with study results collectively contributing to the overall purpose of this research. The two previous chapters highlighted the rationale and method in relation to the evidence map and scoping review and will not be addressed in this chapter. However, a brief description and justification of the methods used in this research will be provided in relation to the three qualitative research studies. This will also include a brief description of how these methods link back to the theoretical perspective (chapter 2) and research paradigm previously identified in this chapter.
4.4.1 Overview of Studies

The first research question was addressed using the results from the evidence map and scoping review (previously discussed in chapters 2 and 3 respectively) along with focus groups for further exploration on the topic. The evidence map was based on a review of systematic reviews of health outcomes related to aquatic-based exercise. The scoping review focused on the psychosocial outcomes of aquatic-based exercise. The focus groups were with current aquatic-based exercise program users regarding their perspective of the biopsychosocial outcomes of aquatic-based exercise.

The evidence map revealed a gap in the literature in relation to the psychological and social outcomes related to aquatic-based exercise. The scoping review was then performed to identify the psychosocial outcomes of aquatic-based exercise within the literature. Results from the scoping review revealed a lack of user experience within the literature in relation to the psychosocial outcomes, and therefore focus groups and interviews were used to gain a deeper understanding of the psychosocial outcomes from the users' perspective.
As previously discussed in chapter 1, this research was guided by the biopsychosocial model in that the literature and focus group questioning route were approached with a biopsychosocial lens and results were organised and presented to reflect biopsychosocial concepts. Results from the two literature reviews and the focus groups answered the first research question: What are the biological, psychological and social implications of aquatic-based exercise interventions? Results also allowed for the development of a biopsychosocial representation of the health outcomes related to aquatic-based exercise.

Study 2 answered the second research question: What are the key factors of aquatic-based exercise interventions influencing participation and adherence experienced by aquatic-based exercise users and instructors? This study involved a series of focus groups with current aquatic users and instructors in an attempt to explore links between health outcomes and components of aquatic-based exercise interventions from the perspective of both the users and instructors of these interventions. The themes that emerged from this study along with previous results from Study 1 and the two literature reviews (a biopsychosocial representation of the benefits of aquatic-based exercise) were synthesised into six practice principles that could potentially support the participation and adherence with aquatic-based exercise for people with chronic and disabling conditions. This list of principles was considered an original draft and was used in the final study (study 3) of this research in order to answer the final research question: What key principles should guide aquatic-based exercise interventions in order to maximise the benefits and support participation and adherence with these interventions? This final question was addressed using focus groups with physiotherapists with aquatic-based exercise experience. The original draft of the principles was used as a trigger for the focus groups in order to explore the perceptions of aquatic physiotherapists in relation to the proposed principles for the purposes of principle refinement. The studies that make up this research are described in more detail in chapters 5-7; however a description of the main methods used consistently across the research are presented along with justification for each method.

4.4.2 Focus Groups

Focus groups were used to collect data in the three qualitative research studies of this research. Focus groups are a widely used method in qualitative health research, and are often used when the research aim is to gather information on an under-researched topic area (Liamputtong, 2011). The advantages of using a focus groups methodology are multifaceted: firstly, focus groups can elicit a range of experiences, opinions and feelings about a topic
(Krueger, 2000), and the interaction in focus groups can result in enhanced disclosure and better understanding of participants’ experience, as participants support or challenge each other’s perceptions and opinions (Liamputtong, 2011). Furthermore, focus groups allow for in-depth coverage on a topic in a short amount of time (Krueger, 2000), minimising time constraints on the researcher and the participants. While there are several advantages to using focus groups to collect data, in order to avoid a principal limitation of the method, it is important for the focus group facilitator to be well skilled in the running of focus groups to ensure quality of the discussion and participation by all subjects (Krueger 2000). The advantages associated with the focus group methodology were considered along with the results of the literature reviews -highlighting the limited qualitative research in the area of aquatic-based exercise interventions for management of chronic and disabling conditions.

From a pragmatic stance, focus groups appeared to be the most practical approach to answering the research questions. Furthermore, the client-centred philosophy of the researcher’s profession (previous disclosed in chapter 1) encourages collaboration with clients in relation to their experience of intervention, and it is the belief of the researcher that client input plays a key role in the successful implementation of intervention strategies.

Study 1 of this research involved qualitative enquiry through the use of focus groups with aquatic users. The focus groups provided the perspective of the aquatic user with a focus on the perceived psychosocial benefits related to aquatic-based exercise. The focus group structure allowed for open discussion about the topic along with specific examples of how the intervention had impacted the lives of the users. Results from the study 1 focus groups not only corroborated and supplemented results from the literature reviews, but also expanded on the information. Further detail and results of study 1 are presented in chapter 5 of this thesis.

Study 2 of this research used the focus group methodology to expand on the results of the two literature reviews and study 1 by exploring connections between the implications of aquatic-based exercise identified through the literature reviews and study 1 along with potential links to components of the aquatic-based interventions. These focus groups explored the perceptions of aquatic users and instructors in an attempt to understand the ‘why’ of the research topic. In other words, the focus groups allowed for an exploration of why people chose to participate in these interventions and what made them continue to participate in the aquatic-based exercise intervention. Study 2 is discussed in further detail in chapter 6 of this thesis.

The final study in this research, study 3, used focus groups to elicit feedback from aquatic physiotherapists regarding a set of principles developed by the researcher. These principles
were developed based on results of the previous studies in this research. Focus groups were
guided by the principles and prompted discussion between the physiotherapists regarding the
strengths, limitations and possible refinements of the principles. This study served as a sort of
triangulation process which will be discussed in more detail in study 3 in chapter 7 of this
thesis.

4.4.2.1 Purposive Sampling

Purposeful sampling is a non-probabilistic technique widely used in qualitative research and
involves identifying and selecting individuals or groups of individuals that are especially
knowledgeable about or experienced with the phenomenon of interest (Creswell & Plano Clark,
2011). In addition to knowledge and experience, Bernard (2002) notes the importance of
identifying individuals who are available and willing to participate and able to communicate
experiences and opinions. For this research, purposive sampling was used in all three studies in
an attempt to recruit individuals who were best suited to provide information relating to
aquatic-based exercise interventions, more specifically, to recruit individuals currently involved
in aquatic-based exercise interventions in either a user or instructor capacity depending on the
study. Unlike a sample of convenience, as characterised by Etikan et. al. (2016), where subjects
are selected based on their proximity to the researcher; subjects were instead selected who
were knowledgeable and experienced with the topic being studied. This allows for
“information-rich” cases and the most practical use of available resources (Patton 2012).
Furthermore, unlike random sampling, which deliberately includes a diverse cross-section of
ages, backgrounds and cultures, purposive sampling attempts to recruit participants with
particular characteristics who are better able to assist with the research topic.

While proponents of probabilistic or random sampling would argue that this sampling method
could potentially restrict the generalisability of findings (Palinkas, Horwitz, Green, Wisdom,
Duan & Hoagwood, 2015; Suen, Huang & Lee 2014), based on the pragmatic stance of the
researcher and the information being sought, purposive sampling appeared to be the most
practical approach to acquiring a sample of individuals who could provide insight into the topic.
Within each of the three studies, purposive sampling resulted in focus groups that were
homogenous in terms of the participants’ shared experience with aquatic-based exercise
either as users or as instructors. This allowed for meaningful discussion of shared experiences
within the focus groups, providing rich, in-depth data on the topic. Furthermore, in order to
acquire a comprehensive understanding of the topic, sampling continued until saturation was
reached, a key aim of purposive sampling (Palinkas et al., 2015). Saturation was determined
with the aid of the data analysis process, template analysis, described in more detail in the following section.

**4.4.2.2 Template Analysis**

Thematic analysis in the form of template analysis was used to analyse the focus group data for all three studies. Introduced by Crabtree and Miller (1999) and further developed by King (2002), template analysis refers to a set of structured procedures for analysing qualitative data. Central to the template analysis technique is the development of a coding template, usually based on a subset of the data, which is then applied to further data, and revised, refined and reapplied (Crabtree & Miller, 1999). The process of template analysis is similar to interpretive phenomenological analysis (IPA) (Creswell 2013) commonly used in qualitative research analysis; however, unlike IPA, template analysis is often influenced by *a priori* data including: results from a literature review, existing theory, research objectives, issues or questions, or developed from raw data, or a combination of both (King, 2012). Furthermore, while IPA is more focused on within case analysis, template analysis is more concerned with between case analysis, which is a more practical approach to the analysis of a larger amount of data, such as focus groups data.

Template analysis is considered a set of data analysis procedures that is not necessarily aligned to a specific epistemological position (King, 2012) and therefore sits well within the pragmatic perspective of this research. Template analysis has been used as a data analysis process in qualitative research studies in business, education and health care research (Waring, 2008) and is advocated for use with large qualitative data sets like those often collected from focus groups (King, 2012), which can be overwhelming for a novice researcher. The template provided a structure for the data from which constant comparisons could be made with new data, resulting in a more organised approach to the development of codes. The template structure and implications will be described in more detail in the following section (section 4.5) as it relates to the trustworthiness of the research.

The data analysis process used within this research was based on the six stages of template analysis described by King (2012): familiarisation with the data, preliminary coding, clustering, producing an initial template, applying and developing the template, and final interpretation. Although variations existed across the three studies in relation to the codes, themes and number of template revisions, a brief overview of the process used will be described with details of how it was applied to specific studies to be addressed in chapters 5-7 of this thesis.
Transcripts from the focus groups were uploaded to NVIVO 10 qualitative analysis software where they were reviewed, and initial coding was started. Meaningful and relevant comments that appeared to fit the aim of the study were highlighted and categorised, creating initial codes relevant to the research. After analysis of three or four focus groups, the emerging codes and themes were discussed with a second researcher. Next, codes were grouped or clustered depending on their similarity, and the hierarchical organisation of codes was produced. An initial *a priori* template was constructed based on a combination of the preliminary coding, existing literature on the topic, and the research objectives. Another set of focus group transcripts was then coded to the initial template. Any new codes were noted and the template was revised to reflect the new information. The template was organised in a hierarchal structure representing relationships between themes. The template underwent several revisions, resulting in the development of the final template. Template changes were documented and discussed with a second researcher. The final template consisted of a number of primary codes that were most relevant to the research, along with several sub-codes. This final template was then used to recode all focus group transcripts.

4.5 Methodological quality

To develop trustworthiness in qualitative research, Lincoln and Guba (1994) suggest five criteria: credibility, dependability, confirmability, transferability and authenticity. However, Morse (2015) advocates for use of more mainstream social science terminology, such as ‘reliability’, ‘validity’ and ‘generalisability’. Despite the difference of opinion concerning terminology, the main purpose of the development of these criteria was to establish the quality of qualitative research, and there are several strategies discussed within the literature that support research quality (Merriam, 1995). For practical purposes, the information in this section will focus on the specific strategies used within this research to ensure its quality, rather than on the criteria outlined above. Several strategies were used in an attempt to establish the quality of this research, including the use of open disclosure of the researcher’s background (previously discussed in chapter 1 of this thesis), audit trails, triangulation and data saturation. A brief description of the strategies used in the research will be provided next.

4.5.1 Audit trail

The development of an audit trail during the data analysis process allowed for a clear description of the process of theme development used in this research. The process of template analysis used in this research (discussed previously) lends itself well to the development of an audit trail, as the iterative process of refining the codes in relation to new
data provided a detailed description of the process, including an explanation of how the themes were developed, resulting in the final thematic structure. This process can be useful for establishing the quality of the final analysis by providing a means of recounting and explaining the decisions made throughout the coding process (King, 2012). Furthermore, the inclusion of *a priori* codes based on relevant literature on the topic allowed for the comparison of the focus group data with themes or concepts from the literature, thereby applying another strategy for ensuring trustworthiness, triangulation, which will be discussed next.

4.5.2 Triangulation

Both data triangulation and investigator triangulation were applied in this research to strengthen the trustworthiness of the data obtained. Data triangulation involved the use of a variety of data sources of evidence across all three studies (Merriam, 1995). As previously mentioned, themes emerging from the data were compared with the literature both before and after the analysis process. Other data sources included audio transcripts, field notes and literature. Information from the focus groups was audio recorded, and field notes were used for observations and reflections during the data collection experience. The field notes helped to capture the context of the research studies and ensured that information was not lost in the data analysis process, providing a richer understanding of the data collected in the audio transcripts (Phillippi & Lauderdale, 2018). Investigator triangulation involves more than one researcher engaging in the research process (Patton, 1999). Throughout this research, supervisors were used as a means for reflecting on the research process. Two investigators were used at various stages throughout the research, including the data collection and analysis process. Across all three studies, supervisors reviewed themes developed during data analysis. Furthermore, the exploration of the perceptions of both aquatic users and instructors in study 2 (described in more detail in chapter 6), allowed for multiple sources for the same topic (Cope, 2014), further impacting the quality of the data.

4.5.3 Theoretical Saturation

Through the moderation of focus groups and recording of field notes by the researcher and conversations with the moderator assistant, an assumption was made regarding data saturation. It appeared by the final focus groups that data saturation had been reached, as no new information was shared by the participants at this stage. However, the decision to cease data collection was not made until all data had been transcribed and analysed using template analysis (discussed in the previous section). The final template was an indication that data saturation had been reached, as it should, in theory, represent all data relevant to the topic.
4.6 Chapter Conclusion

This chapter provided an overview of the research paradigm that guided the research and included an overview of the methodology and a brief description of the main methods used throughout the research. This research was undertaken based on a pragmatic perspective and therefore the qualitative methods used reflect the approach best suited to answer the research question rather than a theoretical orientation. The chapter presents a summary of the findings of the evidence map – lack of psychosocial outcomes- and scoping review – lack of user perspective- and suggest using a biopsychosocial approach in an attempt to address these gaps and gain a deeper understanding of aquatic-based exercise through the experience of the users. The chapter concluded with a brief discussion on the strategies used throughout the research to establish quality. The next three chapters of this thesis describe the three studies undertaken in this research.
Chapter 5: Study 1 - Psychosocial Outcomes of Aquatic-based Exercise

5.1 Chapter Overview
Chapter four presented a description of the methodology underpinning this research and provided a brief overview of the methods and quality measures. This chapter presents the first study undertaken in this research – a study predicated on the results from the evidence map and scoping review, the theoretical perspective of the researcher and a pragmatic approach to the research questions. Firstly, the rationale and purpose for this study are presented. This is followed by the details of the study which are presented as a manuscript. Concluding statements will highlight the outcomes of this study and provide links with study 2 which will be presented in the subsequent chapter.

5.2 Study 1 Rationale
The topic of study 1 and the methods used were based on the results of the two reviews previously presented in chapters 2 and 3. The evidence map (chapter 2) highlighted the limited research in the area of psychosocial content within the aquatic literature. This was further supported by a scoping review which also emphasised the limited qualitative research on the psychosocial implications of aquatic-based exercise. With regard to addressing the first research question, ‘What are the biological, psychological and social implications of aquatic-based exercise?’, the gap in psychosocial content needed to be addressed. From a pragmatic standpoint, the best method to answer the research question was a qualitative study to capture the perspectives of aquatic-based exercise users in relation to the psychosocial implications of the intervention. A focus group methodology (previously discussed in chapter 4) was used to capture in-depth coverage on the topic whilst minimising constraints on both the researcher and the participants. However, interviews were offered as an alternative to focus groups for those participants who were unable to attend the focus group or felt uncomfortable disclosing information in the group setting. Details of the study are presented in section 5.4 of this chapter as a manuscript entitled ‘The psychosocial outcomes of aquatic-based exercise: An exploratory study’, which has been submitted to Qualitative Health Research for review for publication. The purpose for the study along with the research questions guiding the study is presented in the next section.
5.3 Purpose

The purpose of the focus groups and interviews was to explore the psychosocial outcomes of aquatic-based exercise interventions from the perspective of current users of aquatic programs. The focus groups explored the outcomes of aquatic-based exercise from the perspectives of individuals currently involved in aquatics interventions and answered the following questions:

1. What are the implications of aquatic-based exercise interventions for individuals who are currently accessing aquatic programs?
2. How are the outcomes, identified by the participants, reflected in their everyday lives?

Results from this study expanded on the current literature surrounding psychosocial outcomes related to aquatic-based exercise interventions. The focus groups provided valuable insight into the perceptions of participants as to the psychosocial outcomes of aquatic-based exercise by qualitative means, a perspective which is currently lacking in the literature. The qualitative approach used in this study provided a deeper understanding of psychosocial outcomes and also provided insight into outcomes related to intervention components and/or design. This holds implications for existing aquatic interventions and for the creation of new aquatic-based exercise programs.

5.4 Study 1 Publication Submission

<table>
<thead>
<tr>
<th>Title</th>
<th>Journal</th>
<th>Author</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Psychosocial Outcomes of Aquatic-based Exercise: An Exploratory Study</td>
<td>Qualitative Health Research</td>
<td>Ms. Heather Scott *</td>
<td>Research design, data collection, data analysis, writing of journal article, submission.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. Brendan Burkett</td>
<td>Writing/revision and editing support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Florin Oprescu</td>
<td>Writing/revision and editing support</td>
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<tr>
<td></td>
<td></td>
<td>Dr. Michele Verdonck</td>
<td>Research design, Data analysis and writing/revision support</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Mark McKeen</td>
<td>Editing and writing/revision support</td>
</tr>
</tbody>
</table>

* Denotes primary author
5.4.1 The Psychosocial Outcomes of Aquatic-based Exercise: An Exploratory Study

Abstract:

Purpose: The purpose of this study was to explore the psychosocial outcomes of aquatic-based exercise from the perspective of aquatic users.

Method: A purposive sample (n=38) of persons over 18 years of age and currently participating in aquatic-based exercise took part in focus groups discussing the psychosocial outcomes of aquatic-based exercise. Template analysis was used to analyse the data. NVivo (version 10) was used to support the data analysis process.

Results: Aquatic-based exercise appears to have an impact on psychosocial outcomes, including improved mood, improved social interaction and improved self-efficacy. Participants described the positive impacts such benefits had on their ability to undertake activities of daily living and their motivation to continue the aquatic-based exercise intervention.

Conclusion: Self-efficacy, mood and social participation were perceived by participants as beneficial outcomes of aquatic-based exercise. Instructors and developers may highlight these outcomes to their clients in order to increase adherence with aquatic-based exercise interventions for individuals with chronic disabling conditions.

Keywords: mood, social interaction, self-efficacy, adherence, aquatic exercise

Introduction

The aquatic environment, specifically the properties of water, can therapeutically increase a client’s ability to perform physical activities, by minimising participation barriers and reducing fear of injury for those with a variety of chronic disabling conditions (Becker, 2009). The aquatic environment presents an opportunity to encourage physical activity for individuals experiencing age-related changes, chronic, disabling conditions and for those who struggle with typical land-based exercise.

Systematic reviews synthesising the evidence for the effectiveness of aquatic-based exercise for various clinical populations have focused primarily on physiological responses and have described numerous benefits in relation to posture, strength, balance, lung capacity and pain management (Becker, 2009; Geytenbeek, 2002). The effectiveness of aquatic rehabilitation has been demonstrated with musculoskeletal, neuromuscular, rheumatic and cardiopulmonary
pathologies (Batterhan, Heywood, & Keating, 2013; Hall et al., 2008; Martin-Valero, Cuesta-Vargas, & Labajos-Manzanares, 2012; McNamara et al., 2013; Naumann & Sadaghiani, 2014; Plecash & Leavitt, 2014; Waller et al., 2014).

In addition to the physical health benefits of aquatic-based exercise, some preliminary research suggests that aquatic-based exercise may also have a positive impact on psychosocial health (Funderburk & Callis, 2010; Kang, Ferrans, Kim, Kim, et al., 2007; King et al., 2006; Latorre et al., 2013). Psychosocial health encompasses the mental, emotional, social and spiritual aspects of health, and studies in aquatic-based exercise report outcomes in both psychological and social functioning (Mosey, 1986). The literature on aquatic-based exercise and psychosocial outcomes is limited and focuses primarily on quantitative measurements (Adsett et al., 2015; Bartels et al., 2007; Lu et al., 2015; McNamara et al., 2013; Naumann & Sadaghiani, 2014; Plecash & Leavitt, 2014; Waller et al., 2014). Studies considering self-efficacy, depression and anxiety in relation to the effectiveness of aquatic-based exercise for various populations have reported mixed results (Al-Qubaeissy et al., 2013; Geytenbeek, 2002; Naumann & Sadaghiani, 2014; Plecash & Leavitt, 2014) and researchers have highlighted the need for additional research conducted with a primary focus on psychosocial outcomes related to aquatic-based exercise (Belza et al., 2002; Cadmus et al., 2010). However, the subjective nature of psychosocial components creates challenges for collecting and comparing quantitative data while qualitative inquiry may be well-suited to explore the psychosocial outcomes of aquatic-based exercise (Davidson, Ridgway, Kidd, Topor, & Borg, 2008). Understanding the psychosocial benefits will inform clinical practice and holds implications for expanding clinical populations utilising aquatic-based exercise and can provide insights into enhancing motivation and adherence (Belza et al., 2002; Cadmus et al., 2010; Gyurcsik, Estabrooks, & Frahm-Templar, 2003). Therefore, the aim of this study is to identify the psychosocial impacts of aquatic-based exercise interventions by exploring the experience of the users of these interventions.

**Methods**

A qualitative approach was used to collect and analyse data related to the psychosocial experience and perceived outcomes of aquatic-based exercise interventions from the perspective of participants. Focus groups with people who participate in aquatic-based exercise were conducted to explore the psychosocial experience of aquatic-based exercise users. Focus groups were chosen as a data collection method, as they allow for collection of rich information from multiple participants at the same time (Krueger, 2000). Focus groups
also allow for free flowing conversation between participants that may illicit discussions and comment that may not be included in individual interviews (Morgan, 1997). Purposive sampling was used to recruit available participants from three major aquatic centres in the region in order to capture the perspective of individuals currently accessing aquatic-based exercise programs. According to Creswell and Plano Clark (2011) purposive sampling involves recruiting subjects who are knowledgeable about or experienced with the phenomenon of interest while, Bernard (2002) notes the importance of identifying individuals who are available and willing to participate and able to communicate experiences and opinions. Once ethical approval (# S15724) was obtained, participants were recruited to participate in the study through flyers distributed to local pools in the region. Inclusion criteria involved adults (over the age of 18) currently participating in aquatic-based exercise interventions and who were English speaking and free from impairments that would impact their understanding of the study and ability to provide consent. No exclusions were made based on physical impairment, chronic disease or illness, as a goal of this research was to gain feedback from a broad range of people who are currently involved in aquatic-based exercise and not a specific clinical population.

Data collection

Demographic data identifying characteristics of people accessing the program to provide possible links to outcomes and allow for comparison with the current literature was collected. Focus groups were used to collect a range of experiences, opinions and feelings about the topic. The interaction in focus groups can result in enhanced disclosure and better understanding of participants’ experience, and allow for in-depth coverage on a topic in a short amount of time (Krueger, 2000), minimising time constraints on the researcher and the participants (Liamputtong, 2011). Focus groups took place at an aquatic centre before or after the participants had completed their scheduled aquatic-based exercise class. Twelve such focus groups took place and ranged from 30-60 minutes in duration and ranged in size from 3-5 people. The total number of participants was 38. In order to assist with the management of the focus groups and recording of field notes, a moderator assisted with the data collection phase. The focus groups were audio recorded and transcribed verbatim, and identifying information was removed. No interviews were requested by participants and therefore not conducted.

Data analysis
Thematic analysis was conducted in the form of template analysis, as described by King (2012) and aided through the use of NVIVO 10 qualitative analysis software. Template analysis emphasises the use of hierarchical coding, and central to the technique is the development of a coding template, usually on the basis of a subset of the data, which is then applied to further data, and revised, refined and reapplied (King, 2012).

In the current study, template analysis was conducted over six stages: familiarisation with the data; preliminary coding; clustering; producing an initial template; applying and developing the template, and final interpretation (King, 2012). Once the transcripts were reviewed, they were coded and categorised using meaningful and relevant comments related to the psychosocial outcomes of aquatic-based exercise. After analysis of four focus groups, the emerging codes and themes were discussed, verified and adjusted with the assistance of a second researcher. Next, codes were grouped or clustered depending on their similarity, and the hierarchical organisation of codes was produced. An initial *a priori* template was constructed based on a combination of the preliminary coding, existing literature on the topic and the research objectives. The next set of focus group transcripts was then coded using the initial template. Any new codes were noted and the template was revised to reflect the new information. The second template was organised in a hierarchal structure representing relationships between themes. The template underwent four revisions during subsequent analysis of remaining focus groups which resulted in the development of the final template. Template changes were documented, discussed and verified by a second researcher. The final template consisted of three primary codes, each comprised of several sub-codes that were most relevant to understanding the psychosocial outcomes from the perspective of the participants. The three main codes identified were mood, social connection and self-efficacy. This final template was used to recode all twelve focus group transcripts.

**Trustworthiness**

Several strategies were used for addressing the quality or trustworthiness of the study findings, including field notes during the data collection phase, the use of an audit trail during the data analysis phase, and theoretical saturation. Field notes were used to record detailed information related to the study along with observations and reflections of the researcher related to the topic and the method. The use of field notes helped to capture the context of the study, adding to the richness of the data collected in the audio transcripts (Phillippi & Lauderdale, 2018).
The process of developing and refining the template, inherent in template analysis, provided an audit trail which allowed for the clear demonstration and explanation of theme development and application of the final thematic structure (Waring, 2008). This helped to establish the quality of the final analysis by providing a means of recounting and explaining the decisions made throughout the coding process. Furthermore, the development of a template was an iterative process where template refinement was continued throughout the analysis phase until no new refinements were necessary, indicating that theoretical saturation had been reached (Patton, 1999).

Results

Demographic data

Thirty-eight participants-- twenty-eight females and ten males-- participated in the focus groups. Four participants did not complete the demographic information and therefor the demographic results are based on the 34 participants who completed the profile. Participants ranged in age from 35 to 87 years of age with most participants in the 75+ age range. The majority of participants commenced aquatic-based exercise after being referred by a health professional (Supplementary Table 3 – Referral Source) and included physiotherapists and general medical practitioners. Others were introduced to aquatic-based exercise by friends or family. The majority of participants were retired (Supplementary Table 4 – Employment History), while others were self-employed, or unable to work due to various disabling symptoms related to their condition.

<table>
<thead>
<tr>
<th>Family/Friends</th>
<th>N = 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthcare referral</td>
<td>N = 21</td>
</tr>
<tr>
<td>Pool Advertisement</td>
<td>N = 4</td>
</tr>
<tr>
<td>Other</td>
<td>N = 1</td>
</tr>
</tbody>
</table>

Table 3. Referral Sources (N = 34)

<table>
<thead>
<tr>
<th>Employed</th>
<th>N = 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homemaker</td>
<td>N = 5</td>
</tr>
<tr>
<td>Retired</td>
<td>N = 21</td>
</tr>
<tr>
<td>Employment Status</td>
<td>N</td>
</tr>
<tr>
<td>-------------------</td>
<td>---</td>
</tr>
<tr>
<td>Self-employed</td>
<td>4</td>
</tr>
<tr>
<td>Unable to work</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4. Employment status (N = 37)

Thirty-three of the thirty-four participants reported having an injury or disability and most reported more than one medical diagnosis. Twenty-two participants reported a musculoskeletal disease, including osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, osteoporosis, low back pain, fractures and joint replacement. Mood disorders were reported by fifteen participants and included a previous diagnosis of anxiety/depression. Three participants reported previous pulmonary disorders, including coronary artery disease or heart disease/failure as a previous diagnosis. Neurological disorders were reported by three participants and included stroke, Guillain Barre Syndrome, and a C7 neck injury resulting in peripheral nerve damage. Metabolic disorders were reported by 20 participants with nine participants reporting a diagnosis of obesity, six reporting diabetes and five reporting thyroid disorders. Five participants reported a previous cancer diagnosis, Parkinson’s disease was reported by one participant, and progressive muscular atrophy was reported by one participant.

**Aquatic-based exercise description**

Aquatic-based exercise classes were reported to last 45-60 minutes and were conducted in a group environment by a certified instructor. Some participants reported having individual programs that they completed independently or with one-on-one instruction from the physiotherapist. The majority of aquatic activities consisted of head-out water immersion exercises, and, although these varied depending on the functional ability of the clients, programs typically included components of warm-up, resistance training, cardiovascular training and stretching.

Participants reported that activities were tailored to the functional needs of each client despite the utilisation of a group-based approach. Programs were modified according to each participant’s symptoms and functional ability. Participant attendance ranged from 1 to 5 sessions per week with the majority of participants attending 2-3 sessions/week. Attendance depended on several factors, including cost, transportation, severity of symptoms, work/family commitments and weather.
Data analysis revealed three major themes: mood, social interaction and self-efficacy, which are detailed next.

**Mood**

Improvement in mood was a psychosocial benefit for the majority of participants. Participants reported significant mood improvements after starting aquatic-based exercise. Participants reported “feeling happier” and “feeling better” or “more positive” after attending their aquatic-based exercise session. One participant described aquatic-based exercise as “a great mood lifter”, while others described feeling more “relaxed”, and “calm”. One participant spoke about improvements to symptoms related to her mood disorder after attending aquatic-based exercise sessions:

> I struggle with depression and anxiety. I'm under the care of a psychologist and a psychiatrist. Even on the days when I'm not feeling great, I know I can come to hydro [aquatic-based exercise] ... and go home feeling better ...

Some participants commented how their improved mood continued even after leaving the aquatic environment: “… you feel much happier when you've been and you've done some exercise and have company. You go home and you feel much happier”. Other participants discussed how their improved mood impacted their daily activities and interactions with family and friends: “I feel happier [after attending aquatic-based exercise], so that's also nice. The impact on my family ... with me being happier is great.” Participants discussed how the increased mood carried over into their daily lives and had a positive impact on their ability to cope with stress and the positive impact it had on their family and friends. “Feeling better” was associated with increased motivation to participate in daily activities. Overall, participants’ responses indicate that participating in aquatic-based exercise has a positive impact on mood and thus a psychosocial benefit of aquatic-based exercise.

**Social Interaction**

The second major theme was social interaction. Participants indicated that social interaction was a benefit of aquatic-based exercise, and this emerged as a significant theme from the focus groups. The aquatic environment offered an opportunity for social interaction in which users described the benefits of support, understanding, motivation, connection and provision of information.

For some, the aquatic-based exercise intervention provided the only connection to people for the week, as several participants lived alone and reported little social contact outside of
aquatic-based exercise classes. Isolation was discussed by participants in relation to the impact of physical disability and how this influenced their social participation. Aquatic-based exercise offered an opportunity for social interaction, potentially reducing the negative impact of social isolation and creating feelings of belonging. As one participant mentioned: “I live by myself and sometimes I get very lonely, I look for somebody to talk to and I come here three times a week and they’re always welcoming”. Another participant discussed how the social interaction helped prevent a decline in mood “…to be able to talk to somebody else who has also got their challenges, it can really help lift you to have that contact with other people. Because we can be very isolated.” Others discussed that interacting in the aquatic environment with participants in the program has resulted in the formation of friendships: “We’ve made friendships that we probably wouldn’t have outside your normal groups”. Some participants discussed how interacting with people who have similar issues and experiences helped to normalise their situation and they felt less alone and more connected to others: “…contact with other people [with similar issues] that makes you feel normal. Feel as though everyone has got something”.

A feeling of belonging was described by the majority of participants in relation to the “sense of community” that had developed and some participants considered the group as a family: “We’re actually becoming a pool family”. The comments from participants suggested that the aquatic environment supported social interaction, which facilitated a sense of connection, belonging, and acceptance within the aquatic setting.

**Self-efficacy**

Self-efficacy, the belief in one’s own ability to perform a task or activity, was a dominant theme that emerged from the analysis of transcripts. Self-efficacy was reported to increase in relation to the participant’s belief in his or her ability to perform aquatic-based exercise, the overall ability to engage in physical activity, and ability to engage in everyday life. Participants discussed challenges that they faced related to their diagnosis or condition and how this impacted their self-efficacy in several areas. Participants discussed symptoms associated with their condition, specifically how pain, fear and discomfort resulted in abandonment of previous physical activity. In contrast, the aquatic environment allowed participants to feel they could once again participate in physical activity, whether from a rehabilitation perspective with intention to transition to land-based exercise, or as a sole means of physical activity.

One participant discussed the impact of aquatic-based activities on her ability to transition to land-based activities:
The difference has been massive because it [aquatic-based exercise] is just so gentle. I couldn't kneel to begin with either, but doing the sit-ups, squats and pull gave me the strength, the courage to be able to attempt other [land-based] activities.

Other participants consider aquatic-based exercise the only option for engagement in physical activity due to symptoms related to their condition: “This is like a gym for people with scars and wobbly legs.” and “This is the gym that I can't do in other places.” One participant experiencing severe symptoms of arthritis felt that aquatic-based exercise was his only possibility for exercise: “Water is the only thing to answer the weight off your joints; when every part in your body has no cartilage, it's impossible to do any other exercise.”

Another participant discussed how aquatic-based exercise not only allowed her to replace previous physical activity, but also made her feel that it was better for her: “I can't do the physical exercise that I used to be able to do. At least in hydro I'm getting some exercise. The right type of exercise.” Some discussed how the “buoyance” or “weightlessness” of the water allowed them to feel more “supported” and “confident”, which, in turn, made them feel more capable of performing the exercises in the water. One participant discussed the impact of weightlessness on her ability to perform the exercises: “The weightlessness I suppose and that feeling that you can really do anything.” Some participants reported feeling able to do more in terms of both exercise type and effort compared to land-based exercise: “I find that I do more exercises and not just more exercises, but I tend to ... push myself a lot harder in the pool than I do on the land”.

Furthermore, as they engaged in the aquatics program they experienced the benefits of physical activity, and several participants discussed physical improvements that they had experienced, further increasing their self-efficacy related to physical activity. One participant discussed how he experienced the typical benefits of exercise, including: “The feeling of being fitter and the feeling of being more steady and the feeling of being more able.” These feelings of being “more able” further impacted the belief in their ability to participate in life-related activities. One participant discussed how improvements from aquatic-based exercise resulted in more enjoyable time with her grandchildren: “I think I seem to be able to enjoy doing things with my grandchildren a little bit more because you're not always worried that you're going to hurt something.” Another discussed how she felt more able to engage in activities with her children: “I think it just builds your endurance up a lot. I was just saying today that I'm going to teach the kids to read when they come over today. I was just running through sight words. I don't think I would've done that without hydrotherapy.”
Improved self-efficacy was reported to be a significant theme related to aquatic-based exercise and a key benefit expressed by the participants.

**Discussion**

The results of this study suggest that the majority of people accessing aquatic-based exercise programs are those with chronic disabling conditions and that those participating in aquatic-based exercise interventions experience improvements in mood, social interaction and self-efficacy. While the studies in the aquatic literature that have considered psychosocial outcomes related to aquatic-based exercise have identified mixed results based on quantitative measures (Cadmus et al., 2010; Foley et al., 2003; Geytenbeek, 2002; Hejazi et al., 2012; Kang, Ferrans, Kim, Lim, & Lee, 2007; Kim et al., 2012; King et al., 2006; McNamara et al., 2013; Özdemir et al., 2010; Schuch et al., 2014), this study provides qualitative evidence suggesting that aquatic-based exercise has a positive impact on the psychosocial functioning of individuals. The results also indicated a relationship between the themes, a relationship which suggests implications for adherence with physical activity through aquatic-based means. The qualitative nature of this study also allowed for deeper exploration of the psychosocial outcomes, which produced results that described how the benefits of aquatic-based exercise extended beyond the sessions impacting activities of daily living.

The demographic data indicated that the majority of the people participating in the aquatic-based exercise interventions are older adults who have some kind of chronic disabling condition. This is consistent with the aquatic literature, where the majority of studies have focused on populations with chronic and disabling conditions (Bidonde et al., 2014; Heywood et al., 2017; Plecash & Leavitt, 2014; White, 2012). This is likely due to the nature of the aquatic environment in that the properties of water aid in the ease of movement, often decreasing the factors that would otherwise restrict participation in physical activity through traditional land-based means (Becker, 2009).

Results related to mood and self-efficacy are supported by previous literature in aquatic-based exercise, where studies reported improvements in mood and self-efficacy based on changes from baseline data (Kim et al., 2012; Mannerkorpi et al., 2000). However, while social interaction emerged as a key theme of this study, there is very limited research to support this concept in the existing aquatic-based exercise literature. Furthermore, unlike previous studies, the qualitative nature of this study allowed for further development of these concepts in the context of aquatic-based exercise, revealing potential links between concepts and the implications of this.
Links between concepts were expressed through participants’ stories and examples of the impact the aquatic-based exercise had on their lives. Mood appeared to be influenced by social interaction and self-efficacy, as participants discussed how being in contact with and connecting with other aquatic-based exercise participants helped improve their mood. This is consistent with the literature which suggests that social interactions can often evoke a positive affective response and provide the support needed for increasing a person’s overall mental well-being (Tovar et al., 2016). Self-efficacy also seemed to influence mood, as people discussed feeling more able to participate in the aquatic-based exercise as well as activities outside of the pool; they discussed how their mood lifted and they felt happier. Furthermore, as mood improved, participants discussed feeling more capable of managing everyday activities and felt more like spending time with family and friends. This is consistent with the literature demonstrating a strong correlation between self-efficacy and mood (Craig, Wijesuriya, & Tran, 2013; Kavanagh & Bower, 1985). Self-efficacy also appeared to be influenced by social interaction, as people often described feeling more confident in their ability to perform aquatic-based exercise after seeing others in the group perform the activities and make functional gains. This is consistent with Bandura’s concept of vicarious learning or vicarious experience whereby individuals can gain confidence in their ability to perform a task by watching others perform it successfully (Bandura, 1977). Although these links have not been considered extensively in the aquatic-based exercise literature to date, literature clearly supports the inextricable connection between mood, social interaction and self-efficacy (Tovar et al., 2016). The literature expands on these connections and suggests that not only are these concepts connected, but they appear to be key variables in promoting adherence with participation in physical activity where self-efficacy may be the key mediator for mood changes and social participation (Ashford, Edmunds, & French, 2010; Tovar et al., 2016). This holds implications for developing aquatic-based exercise interventions that could support the psychosocial health of individuals and ultimately impact adherence with these interventions.

**Adherence**

The results suggest that the psychosocial concepts of mood, social interaction and self-efficacy not only influence one another, but also appear to be mediators, both independently and collectively, of adherence to interventions. Participants discussed how the benefits they experienced through aquatic-based exercise were key contributors to their adherence or continuation with the intervention. Some discussed how knowing their mood would improve or they would “feel better” after attending encouraged them to go even when they were
experiencing low mood and lack of motivation. Supporting these results is a review by Picorelli, Pereira, Pereira, Felício, and Sherrington (2014) who found decreased mood was associated with poorer adherence to physical activity in older adults in a number of included studies, even more so than decreased physical function.

Participants also reported that social interaction played a key role in their continuation with the intervention. They discussed how spending time with others made them feel more connected and supported. Similar findings have been reported in the aquatic literature, suggesting that social interaction is a strong facilitator for physical activity engagement and adherence in older adults, both with and without a disability (Moody Hale & Waters 2012). Kang et al. (2007) identified that social aspects of the aquatic intervention played a significant role in adherence and went on to suggest that exercise adherence was influenced more by social aspects of group cohesion— in particular, social bonding and friendship— than the interest in the exercise itself (Kang et al., 2007). These results suggest that a group-based approach to aquatic-based exercise interventions could promote adherence by way of increasing social connectedness.

Self-efficacy also appeared to be linked with adherence to the aquatic-based exercise interventions as participants discussed feeling more capable and able to perform the exercises and this feeling encouraged them to keep attending. The feeling of being more able to participate in the aquatic-based exercise, as well as in everyday activities, appeared to be a key motivator for continuation with the intervention. A causal link between self-efficacy and behaviour related to physical activity has been suggested, and self-efficacy is a key predictor of whether individuals will adopt and maintain physical activity (Netz & Raviv, 2004). Similarly, Gyurcsik et al. (2003) found self-efficacy was a predictor of aquatic exercise attendance, and, as individuals became more confident in their abilities to exercise, they attend more aquatic classes, suggesting that enhancing self-efficacy may be a reasonable approach for improving adherence with participation in aquatic-based exercise.

These three concepts, mood, self-efficacy and social interaction, all appear to influence adherence with aquatic-based exercise, both individually and collectively (Belza et al., 2002; King et al., 2006). It follows that encouraging the fostering of self-efficacy and social group cohesion during participation in aquatic-based exercise is a strategy to increase long-term exercise adherence (Kang et al., 2007). Furthermore, the benefits of adhering to an aquatic-based exercise intervention are substantial, as those participants with the best adherence often experience the most significant changes, both physiologically and psychosocially (Belza
et al., 2002). Therefore, strategies that encourage adherence with aquatic-based exercise interventions need to be considered.

Limitations

Purposive sampling was used to recruit participants for the study, which may have resulted in sampling bias favouring participants who have had a positive experience with aquatic-based exercise. However, this type of sampling was useful for targeting relevant aquatic-based exercise users who are currently participating in an aquatic-based exercise intervention. The use of focus groups can sometimes prevent people from sharing information; however, participants were given the option of an interview if they felt uncomfortable sharing information in front of others. No interviews were conducted during this study. Another limitation of this research was that it included only the perspective of the aquatic-based exercise user or client and future research could include the perspective of other key stakeholders, including instructors or prescribers of aquatic-based exercise interventions. Furthermore, the data did not allow us to identify what components of aquatic-based exercise interventions have generated benefits highlighted in this study. Future research may explore links between the benefits of aquatic-based exercise interventions and components of these interventions in an attempt to encourage participation and adherence with aquatic-based exercise interventions.

Conclusion

The results of this current study suggest that participation in aquatic-based exercise has a positive impact on mood, social interaction and self-efficacy. This study yielded rich descriptions of participant experiences related to mood, social interaction and self-efficacy, revealing connections between concepts as well as links to adherence. This study provides qualitative evidence suggesting that aquatic-based exercise has a positive impact on the psychosocial functioning of individuals. More specifically, persons currently utilising aquatic-based exercise experience psychosocial benefits, including improved mood, increased social interaction and self-efficacy. The results of this study added to the limited research on psychosocial outcomes related to aquatic-based exercise, particularly in relation to qualitative data. Furthermore, the results of this study allowed for expansion of these concepts in terms of their relationship to each other, as well as suggested connections to aspects of these interventions that could potentially impact participation or adherence with aquatic-based exercise. This holds implications for program instructors and developers in designing and implementing successful aquatic-based exercise interventions that maximise the psychosocial
benefits for the client. Furthermore, as these psychosocial concepts appear to be mediators of adherence, identifying strategies to maximise improvements both individually and collectively will not only improve the psychosocial functioning of the client, but also offer implications for adherence to physical activity through aquatic-based means, an ongoing issue for public health and health promotion initiatives for decades.

**Declaration of interest**

The authors have no declarations of interest to report.

**5.5 Chapter Conclusion**

Results from this study supported and expanded on the current literature surrounding psychosocial outcomes related to aquatic-based exercise. The focus groups provided valuable insight into the perceptions of participants as to the psychosocial outcomes of aquatic-based exercise by qualitative means, a perspective which is currently lacking in the literature. The qualitative approach used in this study provided a deeper understanding of psychosocial outcomes, including links between these outcomes and aquatic-based exercise intervention adherence. However, further exploration is needed to identify which components of aquatic-based exercise interventions are linked to the perceived benefits, participation and adherence. Furthermore, while this study provided only the perspective of the aquatic user, a gap still exists in relation to the perspective of other stakeholders, specifically aquatic instructors and prescribers. Exploring these perspectives of other key stakeholders could provide a more comprehensive picture of the benefits and links to participation and adherence with aquatic-based exercise intervention. Chapter 6 presents the results of a qualitative study exploring the perspectives of users and instructors of aquatic based exercise interventions in an attempt to understand links between benefits of aquatic-based exercise and intervention components.
Chapter 6: Study 2 - Participation in, and Adherence with, Aquatic-based Exercise

6.1 Chapter Overview

This chapter presents the second study undertaken in this research – a study triggered by the comments of participants in study one, and by the theoretical framework of this research and the research questions. Similar to the layout of the previous chapter, the rationale and purpose for this study will be presented, followed by the details of the study, which are presented as a manuscript which has been submitted for review to Disability and Health. Concluding statements will highlight the outcomes of this study and provide links with study 3, which will be presented in the subsequent chapter.

6.2 Study 2 Rationale

The topic of study two was based on the results of study one (chapter 5), which explored the psychosocial implications of aquatic-based exercise from the perspective of current users. Results of study 1 highlighted the psychosocial benefits of aquatic-based exercise interventions from the perspective of users and provided insights into potential links between perceived psychosocial benefits and adherence with aquatic-based exercise intervention. While an understanding of the psychosocial predictors of adherence with aquatic-based exercise interventions is a useful addition to the aquatic literature, reasons for adherence are often complex and multifaceted. Therefore, further exploration was required to expand on the results of study 1 in an attempt to identify other factors of aquatic-based exercise interventions related to participation and adherence. Study 2 addressed the second research question, ‘What are the key factors influencing participation and adherence with aquatic-based exercise interventions, experienced by users and instructors?’ From a pragmatic standpoint, the best method to answer the research question was a qualitative study to capture the perspectives of aquatic-based exercise users and instructors in relation to the psychosocial implications of the intervention. A focus group methodology (previously discussed in chapter 4) was used to capture in-depth coverage on the topic whilst minimising constraints on both the researcher and the participants. As in the previous study, interviews were offered as an alternative to focus groups. Although this may be considered a limitation of the study, it was considered a practical option for those participants who were unable to attend the focus group or felt uncomfortable disclosing information in the group setting. Unlike the previous study where only the perspective of the aquatic user was considered, this
study explored the perspective of other stakeholders, specifically aquatic instructors, in an attempt to capture a more comprehensive picture of the factors impacting participation and adherence with aquatic-based exercise intervention. The purpose for the study along with the research questions guiding the study are presented in the next section.

6.3 Purpose

The purpose of study 2 was to explore factors of the aquatic interventions related to the participation and adherence with aquatic-based exercise programs. Study 2 explored the perspectives of aquatic instructors and users to identify specific aspects of the aquatic intervention that could inform strategies to promote participation and adherence with aquatic-based exercise interventions. In order to address the purpose of this study, study two answered the following research questions:

1. What are the key factors of aquatic-based exercise interventions identified by the participants and instructors that are beneficial to users?
2. How do the identified intervention factors influence participation in aquatic-based exercise interventions?
3. How do the identified intervention factors influence adherence with aquatic-based exercise interventions?

The focus groups provided valuable insight into the perceptions of participants and instructors as to the factors that influence participation in, and adherence with, aquatic-based exercise by qualitative means, a perspective which is currently lacking in the literature. The qualitative approach used in this study provided a deeper understanding of outcomes and also provided insight into strategies for improving participation in and adherence with aquatic-based exercise interventions for people with chronic and disabling conditions. This holds implications for existing aquatic interventions and for the creation of new aquatic-based exercise programs. The results of this study informed the development of a set of principles that could support participation and adherence with aquatic-based exercise interventions. The findings from this study are presented in section 6.3 of this chapter as a paper entitled “An Exploratory Study of Factors Related to Participation and Adherence with Aquatic-based Exercise Interventions”, which has been submitted to Disability and Health for review for publication.
6.4 Study 2 Publication Submission

<table>
<thead>
<tr>
<th>Title</th>
<th>Journal</th>
<th>Author</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>An Exploratory Study of Factors Related to Participation and Adherence with Aquatic-based Exercise Interventions</td>
<td><em>Disability and Health</em></td>
<td>Ms. Heather Scott *</td>
<td>Research design, recruitment, data collection, data analysis, writing of journal article, submission.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. Brendan Burkett</td>
<td>Writing/revision and editing support</td>
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<td>Dr. Florin Oprescu</td>
<td>Writing/revision and editing support</td>
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<tr>
<td></td>
<td></td>
<td>Dr. Michele Verdonck</td>
<td>Research design, Data analysis and writing/revision support</td>
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<tr>
<td></td>
<td></td>
<td>Dr. Mark McKean</td>
<td>Editing and writing/revision support</td>
</tr>
</tbody>
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* Denotes primary author

6.4.1 An Exploratory Study of Factors Related to Participation and Adherence with Aquatic-based Exercise Interventions

**Abstract:**

**Purpose:** The purpose of this study was to explore factors related to participation and adherence with aquatic-based exercise interventions.

**Method:** A qualitative exploratory study was used and included focus groups with participants and instructors currently involved in an aquatic-based exercise intervention. Five instructors, 34 participants–24 females and ten males– participated in interviews or focus groups. NVIVO (version 10) was used to support the template analysis process.

**Results:** Three primary themes were identified and included: (i) Intervention Specific Factors, such as referral process, cost, and knowledge and experience of aquatic instructors; (ii) Environment, specifically the physical and social environments; and (iii) Intervention Effectiveness, which included the perceived physical, and psychosocial improvements experienced by the participants.

**Conclusion:** The dominant intervention factors were the referral processes and cost. Participation and adherence with aquatic-based exercise interventions appears more likely if delivered by a knowledgeable professional in a group setting where the social interaction and connection are encouraged during the exercise sessions as well as outside of the sessions.
**Introduction**

Physical activity has shown to have numerous benefits related to the prevention and management of chronic and disabling conditions (Durstine, Gordon, Wang, & Luo, 2013; Emery, Yang, Frierson, Peterson, & Suh, 2009; Pedersen & Saltin, 2015; Warburton, Nicol, & Bredin, 2006). However, often the disabling impact of chronic conditions makes people reluctant to engage in physical activity for fear of pain and discomfort associated with land-based exercise (Durstine et al., 2013; Emery et al., 2009; Patel, Schofield, Kolt, & Keogh, 2013). The aquatic environment provides an opportunity for participation in exercise among populations who find it challenging to exercise using traditional land-based means (Adsett, Mudge, Morris, Kuys, & Paratz, 2015; Heywood et al., 2017; McNama, McKeough, McKenzie, & Alison, 2013; Plecash & Leavitt, 2014; Waller et al., 2014; Waller et al., 2016). This includes individuals with chronic and disabling conditions, the aging population, and those who struggle with typical land-based exercise.

The effectiveness of aquatic rehabilitation has been demonstrated with several chronic and disabling conditions, including musculoskeletal, neuromuscular, rheumatic and cardiopulmonary conditions (Batterhan, Heywood, & Keating, 2013; Hall, Swinkels, Briddon, & McCabe, 2008; Martin-Valero, Cuesta-Vargas, & Labajos-Manzanares, 2012; McNamara et al., 2013; Naumann & Sadaghiani, 2014; Plecash & Leavitt, 2014; Waller et al., 2014), and numerous benefits related to posture, strength, balance, lung capacity and pain management have been cited (Becker, 2009; Geytenbeek, 2002). In addition to the physical health benefits, research suggests that aquatic-based exercise may also have a positive impact on psychosocial health (Funderburk & Callis, 2010; Kang, Ferrans, Kim, Lim, & Lee, 2007; King, Yang, & Malkin, 2006; Latorre et al., 2013). While the benefits of aquatic-based exercise have been well documented, little is known about the factors that drive participation and adherence with these interventions.

Participants who attend and adhere to aquatic-based exercise experience the most significant benefits both physically and psychosocially (Belza, Topolski, Kinne, Patrick, & Ramsey, 2002). Research is needed to identify what factors of aquatic-based exercise interventions contribute to the participation and adherence of aquatic users. Studies aimed at understanding these factors will provide valuable information for health professionals in identifying strategies to maximise improvements, both individually and collectively. Furthermore, designing and implementing successful aquatic-based exercise interventions to maximise the benefits for the
client will not only improve the functioning of the client, but also has implications for adherence to physical activity through aquatic-based means.

The aim of this study is to identify factors that may impact the participation and adherence with aquatic-based exercise interventions by exploring the experience of users and instructors of aquatic-based exercise interventions.

**Methods**

A qualitative approach was used to collect and analyse data related to aquatic-based exercise intervention factors that impact participation and adherence, from the perspective of current service users and instructors. To capture the experience of aquatic-based exercise users, focus groups with people who participate in aquatic-based exercise interventions were conducted. Focus groups can often serve as a trigger for others to share their information and stories, expanding on the comments of others to provide a collection of rich information from multiple participants at the same time (Krueger, 2000; Mansell, Bennett, Northway, Mead, & Moseley, 2004). If participants were unable to attend a focus group they were given the option of attending a semi-structured interview. The questions remained the same as the focus group.

**Recruitment**

Once ethical approval was obtained (# S15724) a purposive sampling approach (Creswell, 2013; Liamputtong, 2009) was used to recruit available participants from major aquatic centres in the region - people with knowledge and experience of aquatic-based exercise who were willing to participate in the research. Participants were adults (over the age of 18) currently participating in aquatic-based exercise. Participants were English speaking and free from impairments that would impact their understanding of the study and ability to provide consent. Only participants who met the criteria outlined and were willing to participate were selected to take part in the study. No exclusions were made based on physical impairment, chronic disease or illness, as the study aimed to provide information from a variety of people who are currently involved in an aquatic-based exercise and not a specific clinical population. Aquatic centres were chosen if they provided an aquatic-based exercise program involving a variety of age groups and populations, in order to maximise the number of participants recruited for the focus groups.

**Data collection**

Aquatic participants and instructors from two centres received a brief introduction describing the purpose of the focus group, and willing participants signed a consent form and filled out a
short biographic /demographic profile (see Appendix 1). Demographic data was collected identifying characteristics of instructors and people accessing the program, to provide possible links to outcomes and allow for comparison with the current literature. The eleven participant focus groups and one instructor focus group ranged from 30-60 minutes in duration and ranged in size from 3-4 people. Two interviews with aquatic instructors also took place as work schedules made it challenging for them to attend a focus group. Focus groups and interviews took place at the aquatic centre before or after a scheduled aquatic-based exercise session, or at a convenient location for participants. The focus groups and interviews were transcribed verbatim and deidentified.

Data Analysis
Template analysis was used to identify themes, as described by King (2012) and aided through the use of NVIVO 10 qualitative analysis software. Hierarchical coding is central to the template analysis technique and involves the development of a coding template, based on familiarisation with the topic being studied and a subset of the data, which the researcher then applies to further data. Revisions and refinements continue as new data is coded until the final template has been developed (King, 2012)

In the current study, template analysis was conducted using the six stages suggested by King (2012): (i) familiarisation with the data; (ii) preliminary coding; (iii) clustering; (iv) producing an initial template; (v) applying and developing the template, and (vi) final interpretation (King, 2012). Transcripts were reviewed, coded and categorised using meaningful and relevant comments that related to the benefits of aquatic-based exercise.

After analysis of the data from three focus groups the emerging codes and themes were discussed with a second researcher for verification, and adjustments were made based on agreement. Codes were then clustered based on similarity, and the hierarchical organisation of codes was produced. The initial a priori template was constructed based on the preliminary coding, existing literature on the topic and the research objectives. Another set of focus group transcripts was coded using the initial template and new codes were recorded. Revisions were made to the template to reflect the new information. The second template was organised in a hierarchal structure representing relationships between themes. The template underwent four revisions during subsequent analysis of remaining focus groups and interviews resulting in the development of the final template. Once the final template was discussed and verified by a second researcher, all focus groups and interviews were recoded using the final template. The final template consisted of three primary themes that captured the influential factors of an
aquatic-based exercise intervention from the perspective of the participants. All identified themes were comprised of several sub-themes. The three primary themes identified were intervention specific factors, environment and intervention effectiveness.

**Trustworthiness**

Field notes, audit trail and theoretical saturation were used to address the trustworthiness of the findings. This was consistent with recommendations by Creswell and Creswell (2013) who suggest researchers using qualitative inquiry engage in a minimum of two procedures to address the trustworthiness of qualitative findings (Creswell & Creswell, 2013).

The use of field notes by the researcher helped to record important thoughts and observations that took place during the focus groups. These recordings captured the context of the participants’ experiences and provided connections important to the results of the study. Recording comprehensive and detailed information of the subjects’ experiences ensured that important information was not lost in the data analysis process (Creswell & Creswell, 2013; McReynolds, Koch, & Rumrill, 2001).

The process of template refinement in the Template Analysis method resulted in the development of an audit trail which provided a means of recounting and explaining the decisions made throughout the coding process. Furthermore, the iterative nature of template development, where the template is continually refined throughout the analysis phase until no new refinements are required, supports theoretical saturation (King, 2012; Patton, 1999).

**Results**

**Demographic data**

Thirty-nine participants—34 aquatic users and 5 aquatic instructors—participated in focus groups and interviews. Aquatic participants ranged in age from 35 to 87 years (74% females and 26% males). All participants reported having been diagnosed with an injury or disability and the majority of participants indicated more than one condition. The most prominent condition reported was musculoskeletal disease, which included osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, osteoporosis, low back pain, fractures and joint replacement. Metabolic disorders were the second most common condition reported and included a diagnosis of obesity, diabetes and thyroid disorders. Mood disorders were also reported by participants and included a previous diagnosis of anxiety and/or depression. Pulmonary disorders appeared less common in the participant sample and included coronary artery disease and heart disease/failure as a previous diagnosis. Other reported conditions were
neurological disorders including stroke, Guillain Barre Syndrome and a C7 neck injury resulting in peripheral nerve damage, a previous cancer diagnosis, Parkinson’s disease and progressive muscular atrophy (Table 5). The majority of participants were retired, while others were self-employed, or unable to work due to various symptoms related to their condition.

<table>
<thead>
<tr>
<th>Reported disability or injury</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than one condition</td>
<td>88%</td>
</tr>
<tr>
<td>Musculoskeletal Disease</td>
<td>65%</td>
</tr>
<tr>
<td>Metabolic Disorders</td>
<td>59%</td>
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<td>Mood Disorders</td>
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<td>Neurological Conditions</td>
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<tr>
<td>Parkinson’s Disease</td>
<td>&lt;1%</td>
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<tr>
<td>Progressive Muscular Atrophy</td>
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</tr>
</tbody>
</table>

Table 5. Aquatic participant condition data

Five aquatic instructors from two different facilities took part in the study in the form of one focus group and two interviews. Ages ranged from 30-50 and qualifications included a Certificate 4 in personal training (n=1), Exercise Physiology degree (n=2), Physical Therapy degree with extra aquatic training (n=2). The experience of the instructors ranged from 3 years to 25 years (Table 6).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Female – 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Range (yrs)</td>
<td>30-50</td>
</tr>
<tr>
<td>Aquatic Qualifications</td>
<td>80%</td>
</tr>
<tr>
<td>Number of years’ experience</td>
<td>3-25</td>
</tr>
</tbody>
</table>

Table 6. Aquatic instructor demographics table

Themes based on template analysis

Data analysis revealed three major themes: (i) Intervention specific factors, (ii) Environment and (iii) Intervention effectiveness. All themes had subsequent sub-themes which are detailed next.

Intervention Specific Factors

Intervention specific factors appeared to have an impact on participation with aquatic-based exercise and included comments related to the delivery of the intervention and the quality of the instructors. While the timing and accessibility of the sessions contributed to participants’
feeling of being able to participate in the intervention, the key factors impacting the participants’ experience were the referral source/process, cost and the knowledge and experience of the instructors.

Participants reported they commenced aquatic-based exercise after being referred by a health professional, which included physiotherapists or general practitioners (GPs). Participants discussed how a referral from a GP would likely get more people participating in aquatic-based exercise, because of their status in the medical community; as one participant said, “...if the doctor says you need to do hydrotherapy or you need to go to the pool to help with your strength, or help you lose weight, or something like they're more likely to do it if their doctor ... says”. Using referrals to increase participation in aquatic-based exercise was supported by comments from the instructors as well. When asked to identify ways to increase the number of individuals participating in aquatic-based exercise, 3 of 5 instructors mentioned referral. As one instructor said, “…I think GPs who have deconditioned or arthritic older people, ... whose patients keep coming back and there's not a lot the GPs can do, but if they could possibly refer [to aquatic-based exercise] that would be brilliant...”. She went on to discuss challenges related to the actual referral process and suggested that one barrier might be that the GP does not necessarily know where to refer to for aquatic-based exercise and are left “…invariably referring to an unknown source...”. The physiotherapists then become the key referring source for aquatic-based exercise after receiving a general referral from the GP. “…We don't really get that many GPs that request hydrotherapy as a treatment plan... It's more or less a discussion with the patient and they either bring it up or we make a recommendation and that's the direction they take...”. Comments from both the participants and instructors highlighted the need for consideration of both the source of the referral and a clearer referral process as factors impacting participation and adherence with aquatic-based exercise interventions.

Cost was also included in intervention specific factors. Participants expressed the need for aquatic-based exercise interventions to be cost-effective for people to be able to participate. Some participants highlighted “cost” as the key barrier to participation in aquatic-based exercise. One participant mentioned it is challenging for some people with medical issues to add on the extra expense of aquatic-based exercise: “The cost would be a barrier I guess to a lot of people. When you get to my age, you can have a lot of medical expenses, you don't need any extras”. Another participant discussed how she would attend more often if the cost wasn’t so high “…I would come more than the once a week if it weren't for the cost...”. While decreasing the cost of aquatic-based exercise interventions exercise might increase participation, it could potentially impact the income of the instructors, although one instructor
commented that she would prefer to see the number of participants increase over the amount of money made: “…I would rather have 15 people in the class paying less money than have 3 people in the class paying a lot of money so I would like to see financial freedom of access...”. Several participants suggested that a government funded aquatic-based exercise intervention would decrease costs for users and increase participation and adherence: “To improve things [participation] I would say that this [aquatic-based exercise] needs to be funded by a health fund...” The lack of funding and high cost of the sessions impacted those participants with long term issues, and participants discussed the chronicity of their condition and the need for ongoing aquatic-based exercise. As one participant said, “...it [aquatic-based exercise] should be government funded, because, people with chronic illness, it’s chronic, we’re always going to have it...”.

Intervention specific factors also included the knowledge and experience of the instructors. These factors appeared to be key factors for participation and adherence with aquatic-based exercise interventions. The knowledge and experience of the instructor appeared to be important to the majority of the participants in order for them to feel safe and supported. Instructors also reported the importance of knowledge regarding various medical conditions for safety purposes: “…you have to have a good understanding of why they’re there and what they need to be working on and have a deep understanding of the background of the conditions that they’re presenting with and what is safe and what might necessarily be unsafe for them...”. The instructors also reported they could offer information about the condition and provide suggestions and recommendations for exercise modifications which they felt fostered a sense of trust, which impacted participation: “…having trust and faith in the instructor so I think qualifications probably help...”. The way the instructors structured the class was important to some participants: “He targets exercise that is suitable for people in our situation”, while others commented on the instructor’s provision of individual attention: “Even though I was in a group it was very personal”. Modifications to the exercises made by the instructors were also important to some participants: “He puts together a program of exercises that are good for us and that he knows what we are able to do”, as well as encouragement to participate to their own ability: “They only encourage you to do as much as you can, not to push yourself” thus making participants feel more willing and able to participate in the aquatic-based exercise intervention. It was also important that the instructors were kind and created a supportive and inclusive atmosphere. One participant commented that she would prefer a “friendly” instructor over a “qualified” instructor in order for her to want to continue with the intervention: “But quite frankly, if you had your choice of two instructors, and one
was really qualified but not friendly, I’d take the other one”. The importance of feeling comfortable with the instructor was also acknowledged by comments from the instructors who suggested that it was an important factor impacting participation with aquatic-based exercise. As one instructor commented: “If they feel comfortable being led by the instructor, and feel comfortable within the pool and with what’s required of them, then they’re more likely to come back”.

Environment
Both the physical and social environments were reported to contribute to participation and adherence with an aquatic-based exercise intervention. The physical environment theme reflected comments that highlight the benefits related to the properties of water and how these benefits impacted participation and adherence with aquatic-based exercise. The social environment theme highlighted the benefits of the group setting in which the majority of the aquatic interventions took place.

Participants discussed how the physical environment elicited feelings of safety and comfort during exercise. It allowed for ease of movement and load reduction, resulting in participation in movement and exercise that they would not be able to do outside the aquatic environment.

Several comments were made relating to the importance of the aquatic environment itself, more specifically the properties of water. One instructor discussed the noticeable impact of the aquatic environment on her clients:

People do find that with the water... they feel like it's a safe environment, they can challenge themselves, and they can try things that they don't normally try on land because it's a safer environment. It's less loading on the body, they can do so much more, they can move much more freely, and I think the warmth of the water as well is almost like a soothing and calming effect as well.

This was supported by several comments from the aquatic participants, who highlighted “buoyancy” as being “marvellous” and offering a sense of “safety” while exercising, a key reason for participation and continuation with aquatic-based exercise:

It would just really take the weight off, and that's why I'm coming to the pool. Just because of the relief, the pressure that it takes off... I mean if offers a level of safety as well, if you fall in the water, it's falling in the water.

Overall the aquatic environment meant that movement and exercises were easier on the body while still providing a safe and effective form of physical activity for the participants; as one
participant commented: “You get the exercise without the stress on your joints”. Other participants’ comments suggested that the properties of water meant that they were able to engage in physical activity and even move their bodies in certain ways not possible on land, which increased their motivation to participate in the intervention: “What I find is I can do a lot of exercises in the water that I can’t do, as I said, doing the cardio and all that. I can do leg movements in the water that I can’t do out of the water.” They experienced movement in the water that they were incapable of doing on land: “I enjoy coming here too, it’s just the gentle exercises in the water which I wouldn’t have been able to do outside of the water so I enjoy it”. When participants were asked what keeps them coming back to aquatic-based exercise, several comments, such as “Actual exercise”, “I think it’s the exercise”, “Exercising in the water” were made, highlighting the importance of the impact of the environment on their ability to participate in exercise.

The physical environment also included the temperature of the water. Participants discussed the importance of the temperature of the water: --the temperature is very important--, and the impact this had on participation and adherence with aquatic-based exercise: “The temperature of the water...that’s what keeps us coming.” Some participants discussed how the colder water temperatures impacted their ability to participate, because they were physically unable to get out of bed: “I've found if the water is not warm enough, I'll end up in bed the next day, or a couple of days”. The importance of temperature was further highlighted in some focus groups where participants discussed the consequences of one of the pool heaters malfunctioning. Several participants commented that the temperature was too cold for their “arthritic bits” and it made them feel more stiff and sore so they would prefer not to attend: “... that’s another important thing to include, temperature. We've had people unable to attend because of their arthritis, and if the water’s too cold, they freeze up and they can't ... they’re not mobile then, but they put in a new heater, and it's made a huge difference”. Some participants discussed how the temperature of the pool impacted adherence with the aquatic intervention, as it often became too cold for some participants during the cooler months of the season: “For ... anybody that has impaired circulation, the pool is often not warm enough for them and a lot of them drop out in winter”.

The social environment was reported to be key in contributing to both the participation and adherence of participants. Exposure to diverse groups challenged participants’ views of their condition and associated limitations, sometimes motivating them to participate in the aquatic-based exercise intervention. Seeing people with similar or more challenging health issues than they had participating in the aquatic-based exercise resulted in feelings of being more able to
participate themselves: “...when you look at other people you think what am I complaining about. It gives you a bit of a lift, that sounds terrible to say. It does, you think ‘I’m not so bad’ and do your [aquatic] exercises, you’re feeling good and it’s positive.”

The social environment was reported to provide opportunity to connect with others while they participated in the aquatic-based exercise. The connections that developed from the social environment impacted participation in the aquatic-based exercise intervention and participants described feeling more likely to attend. Connection was particularly important for those participants who were older or felt isolated due to their condition: “Socially there’s people, especially the older ladies or the widowed ladies, they don’t get out much, for some of them and it’s ... They feel lighter and there’s a lot of laughing so there’s a big social part... They wouldn’t keep coming back I don’t think if that wasn’t a big part.” One participant referred to participating in the aquatic-based exercise intervention as a “social occasion” where she looked forward to attending to “chat with others” and “meet new people”. Others described the fun atmosphere as being key to their participation and adherence: “I think definitely having a fun environment as well makes them more inclined to come back”. As one aquatic instructor stated: “They love the physical effect, but they wouldn’t continue if they weren’t enjoying themselves, like anything. They would maybe seek something else. You’ve got to have both. If it was just fun and no physical benefits, they probably wouldn’t continue either.”

The social environment also appeared to facilitate friendships, which further impacted participation in aquatic-based exercise. Many participants discussed the friendships they had made with others attending the aquatic-based exercise intervention; as one participant stated: “Well, it’s the emotional support, the friendliness ... I don’t have many friends or most of them are in the cemetery unfortunately, so I look for friendship here...”. Instructors also found friendships to be an important factor in participation and adherence with aquatic-based exercise: “Especially if they start to build on some friendships within the group too. They’re more inclined to come back because they want to catch up with Betty after or Poppy and some raisin toast.”

When asked what keeps them coming back, participants made comments such as: “the social side of it”, “the company”, “… just that social aspect”, “Building friendships and keeping those friendships as well over the years”. One instructor summed up the participation relating to the social environment: “People come because it’s group based. Because their friends come. Because they can often talk and exercise at the same time so they can catch up on a conversation. They may have a cup of coffee after with their friends, so there is a big social aspect there.”
Chapter 6 - Study 2

Intervention Effectiveness

The effectiveness of the aquatic-based exercise intervention appeared to be a key factor in participation and adherence with the aquatic-based intervention. Comments made by the participants and instructors highlighted specific physical and psychosocial improvements as well as more general comments related to overall wellbeing and quality of life.

Participants’ perceptions of the effectiveness of the intervention impacted their participation and adherence with aquatic-based exercise. Participants perceived the intervention to be effective if they could see or feel noticeable improvements. The majority of comments were related to physical improvements, however; some participants discussed the effectiveness of the intervention using, comments such as “relief”, “feeling better” and “.... I know what I’m doing [aquatic-based exercise] is going to help my legs”. This was mirrored by comments from the instructors with one suggesting that: “A lot of the ones who are coming long-term come because they feel better”. Some participants made comments that reflected more of the social and psychological benefits and the impact on participation and adherence: “Since getting into the exercises I found I’m much enjoying life a lot more” and “...it certainly lifts your spirits physically, mentally, emotionally, it gives you the drive to keep going [attending]”.

Physical improvements, such as decreased pain, improved balance and increased strength and endurance from attending the intervention, all appeared to impact participation and adherence with aquatic-based exercise. Some participants commented on the impact the aquatic-based exercise had on their pain: “I mainly came in because I have rheumatoid arthritis and coming into the pool, my joints feel a lot freer and looser. I mean, pain reduction basically.” Others said that the consequences of not attending were reason enough to continue participation in the intervention: “I know I’ll be in pain if I don’t keep coming”. Strength, balance, and endurance were also benefits linked to participation and adherence; as one participant commented: “I was coming for mobility and balance, and I’ve got ancient-itis, so it helps that”. Comments from the instructors echoed the comments from the participants; one instructor discussed the benefits of aquatic-based exercise and its impact on participation and adherence: “strength, balance, endurance, flexibility is a big thing and they begin to notice it. That’s the reason I think why they keep coming back”.

As people experienced improvements related to the intervention, they reported feeling more confident in their ability to perform exercises within the pool as well as to participate more in everyday life. These benefits appeared to play a key role in promoting adherence with the intervention. One participant commented: “I don’t trip over and I don’t fall down. That’s
mostly why I come. I’ve got a knee replacement and plates in my foot, in my big toe and my foot”. Others felt that, overall, the intervention made them healthier: “It’s the fact that I’m much, much healthier like this, doing this makes me a lot healthier. This is the gym that I can’t do in other places.”

When asked why participants continue to attend aquatic-based exercise, the majority of participants reported it was due to the benefits: “pain and mobility”, “progress”, “the health benefits”, “just being able to move more freely”. One participant commented: “once you start knowing it helps… you’ve got to go”. Comments from one instructor summed up the efficacy of the intervention and the impact on participation and adherence: “I feel that the biggest thing is the program works. People love the class, they’re happy, and the clients come back”.

**Discussion**

The aim of this study was to identify the essential factors that contribute to the participation and adherence with aquatic-based exercise interventions by exploring the experience of users and instructors of aquatic interventions. Results suggest that factors impacting participation and adherence with aquatic-based exercise include intervention structure, the physical and social environment and perceived effectiveness of the intervention.

Intervention structure appeared to influence participation and adherence with aquatic-based exercise, particularly in relation to the referral source/process, cost of the intervention and the knowledge and experience of the instructors. The majority of participants were referred to aquatic-based exercise by either a GP or a physiotherapist. Both clients and instructors reported that the role of the doctor in the referral process could influence participation in aquatic-based exercise and felt that if the doctor suggested aquatic-based exercise as an option, they would be more likely to attend. This is similar to studies by Chard (2016) who found that GPs played an important role in the initiation of aquatic exercise for people with multiple sclerosis. Previous studies have also highlighted the importance of a supported referral pathway, suggesting that this process inspires confidence that the intervention is appropriate for the client, facilitating participation and adherence with the intervention (Adsett, Hickey, Nagle, & Mudge, 2013; Desveaux et al., 2017). Chard (2017) went on to discuss the importance of the GP in not only the referring process, but also in a supportive role once participants have commenced the intervention (Chard, 2017). This continued support from the GP provided encouragement for continuation with the intervention; a fundamental factor in the success of the program was the recommendation from the health professional to refer (or not) to the aquatic exercise program.
The cost of the program/sessions also appeared to impact the participation and adherence of participants, who reported that the high costs associated with managing their chronic and disabling condition prevented them from being able to attend the aquatic-based exercise program more often. This is supported in a review by Farrance (2016) who found evidence that the practical aspects of community program design, such as cost, can impact participation and adherence with community based exercise interventions (Farrance, Tsofliou, & Clark, 2016). Participants identified government funding as an option for supporting the cost of attending the sessions, but previous studies have found that this solution lacks sustainability (Dorgo, King, Bader, & Limon, 2011). Some studies suggest that the use of peer mentoring, or student mentors, to reduce costs associated with the intervention may be effective, as long as they are supervised by a certified therapist (Moody, Hale, & Waters, 2012; Picorelli, Pereira, Pereira, Felicio, & Sherrington, 2014). Dorgo and colleagues (2011) showed that the peer-mentoring model has the potential to be a cost-effective method of engaging older adults in physical exercise interventions for extended periods and improving their health and wellness (Dorgo et al., 2011). However, Moody (2012) found participants preferred having an instructor who was knowledgeable and supportive over having a peer-mentor system (Moody et al., 2012).

Identifying methods to reduce the costs for participants could result in a greater number of new program users participating in aquatic-based exercise as well as encourage others to attend more often. Reinforcing of the benefits from this form of exercise is one way to balance out the cost to participate.

While high cost appeared to be a barrier to participation, the knowledgeable, supportive staff was reported to positively influence participation and adherence with aquatic-based exercise. Instructors were considered knowledgeable about and understanding of both the condition of the client and the appropriateness of the aquatic exercises, promoting feelings of confidence and trust in participants. This is consistent with the literature, which highlights the importance of the exercise instructor for creating an intervention and context that support the needs, interests and motivations of the program users, and appears to play a key role in the client’s decision to attend the program (Farrance et al., 2016; Moody et al., 2012; Pentecost & Taket, 2011). The knowledge and support of the instructors was important, but so was their approach to the program users. A study by Desveaux (2017) emphasised the importance of empathy and effective communication skills. The presence of an instructor created a sense of safety, confidence and comfort, while qualities including empathy, friendliness and enthusiasm, and the ability to make exercise fun and enjoyable, had a positive impact on participation and adherence (Chiang, Seman, Belza, & Hsin-Chun Tsai, 2008; Desveaux et al., 2017; Moody et al.,
Chapter 6 - Study 2

From the current study, the professionalism of the staff was a key factor for the participation and adherence to the intervention.

In conjunction with the staff who delivered the intervention, the physical environment was also an important factor impacting participation and adherence with aquatic-based exercise. In particular, the physical properties of water allowed for freedom of movement and participation in exercise that the participants would not be able to experience on land. The aquatic environment allowed participants to feel they could once again participate in physical activity, whether from a rehabilitation perspective with intention to transition to other land-based exercise, or as a sole means of physical activity. The feeling of being more able to participate in the aquatic-based exercise, as well as in everyday activities, appeared to be a key motivator for continuation with the intervention. This is consistent with the literature that suggests a causal link between self-efficacy and behaviour related to physical activity and that self-efficacy is a key predictor of whether individuals will adopt and maintain physical activity (Netz & Raviv, 2004). Findings from a study by Gyurcsik et al. (2003) found self-efficacy was a predictor of aquatic exercise attendance and that as individuals became more confident in their abilities to exercise, they attend more aquatic classes, suggesting that enhancing self-efficacy may be a reasonable approach for improving adherence with participation in aquatic-based exercise (Gyurcsik, Estabrooks, & Frahm-Templar, 2003). Highlighting the unique benefits associated from exercising in water can encourage participation and adherence with aquatic-based exercise.

As with many group-based activities the social environment contributed to the intervention and appeared to play a key role in the participation and adherence with aquatic-based exercise, and participants described a sense of connection with both the staff and other participants in the intervention. This social connection is a strong facilitator for physical activity engagement and adherence in older adults, both with and without a disability (Moody et al., 2012). Another study in the aquatic literature by Kang and colleagues (2007) identified that social aspects played a significant role in adherence to aquatic exercise. In fact, results indicated that exercise adherence was influenced more by social aspects of group cohesion, in particular, social bonding and friendship, than the interest in the exercise itself (Kang et al., 2007), suggesting that implementing strategies that encourage the social aspects of the intervention may influence participation and adherence with aquatic-based exercise interventions.

The group based intervention not only enabled participants to experience the benefits of socialising with others while they participate in the exercise, but also allowed for comparison
with others which often motivated them to continue with the intervention. This comparison with others in the group can be used as a source of information regarding their own level of function and often results in feelings of increased confidence to participate and adhere to the exercises (Pentecost & Taket, 2011). To maximise the benefits of the social environment, instructors could encourage social interaction between participants, both during exercise and outside of the aquatic environment (Moody et al., 2012; Picorelli et al., 2014). Using a group-based approach allows clients to experience the benefits of the social environment that contribute to participation and adherence to aquatic exercise.

Participants commented that the improvements they experienced due to their participation in the aquatic-based exercise intervention were the main reason they continued with the intervention. Perceived benefits were reported in both physical and psychosocial domains. This is consistent with a review by Farrance et al. (2016) who found that the perceived health benefits of participating in community based exercise groups included physiological changes as well as mental, cognitive and social improvements. These perceived benefits were key factors impacting adherence (Farrance et al., 2016).

Other perceived benefits of aquatic-based exercise reported by participants included improvements in their ability to perform everyday activities that were relevant to them. These improvements in daily functioning also encouraged them to continue with their aquatic-based exercise intervention. Research has found that highlighting the effectiveness of the intervention, including benefits to physical, mental and social aspects of the person, along with how the physiological benefits can impact day to day functioning, independence, and quality of life could contribute to participation and adherence (Chiang et al., 2008; Forman et al., 2017; Smith, Wallace, O'Dowd, & Fortin, 2016). Highlighting the potential benefits of the aquatic-based exercise interventions to users may have an impact on participation and adherence by increasing their awareness of the benefits and ultimately the effectiveness of the intervention.

Research related to land-based interventions has identified several successful strategies to emphasise the benefits of the intervention to users; these strategies need further exploration within the aquatic literature. These strategies include the use of patient-centred goal setting, and the use of outcome measures in order to monitor progress and highlight health improvements and functional progress (Chiang et al., 2008; Farrance et al., 2016; Forman et al., 2017; Smith et al., 2016). Integrating such strategies into aquatic-based exercise interventions to provide clients with feedback on their progress may encourage participation and adherence with these interventions. From the findings in this current study it appears that in order to
influence participation and adherence with aquatic-based exercise interventions, a number of factors should be considered, including how the intervention is structured, the impact of the physical and social environment and perceived effectiveness of the intervention. Strategies for addressing the factors associated with participation and adherence with aquatic-based exercises have been proposed; however, future research needs to explore the practicality of implementing these different strategies within the context of aquatic-based exercise interventions.

**Conclusion**

The participation and adherence with aquatic-based exercise interventions was found to be influenced by intervention specific factors, the physical and social environment, and the overall perceived effectiveness of the aquatic intervention. The dominant intervention factors were the referral processes and cost. Participation and adherence with aquatic-based exercise interventions appears likely if delivered by a knowledgeable professional in a group setting where the social interaction and connection are encouraged during the exercise sessions as well as outside of the sessions.

**Limitations**

Purposive sampling was used to recruit participants for the study, which may have resulted in sampling bias favouring participants who have had a positive experience with aquatic-based exercise. However, this type of sampling was useful for targeting relevant aquatic-based exercise users and instructors who are currently involved in aquatic-based exercise interventions. The use of focus groups can sometimes prevent people from sharing information; however, participants were given the option of an interview if they felt uncomfortable sharing information in front of other. Furthermore, while the results of this research have offered suggestions for potential strategies for improving participation and adherence with aquatic-based exercise interventions, it did not consider the practicality of incorporating these strategies into an aquatic-based exercise intervention, which may influence whether these strategies are employed or not. This area will need to be explored further.

The authors declare that there is no conflict of interest.

**6.5 Chapter Conclusion**

From the findings in this current study it appears that in order to influence participation and adherence with aquatic-based exercise interventions, a number of factors should be considered, including how the intervention is structured, the impact of the physical and social
environment, and perceived effectiveness of the intervention. Strategies for addressing the factors associated with participation and adherence with aquatic-based exercises have been proposed; however, future research needs to explore the practicality of implementing these different strategies within the context of aquatic-based exercise interventions. The strategies that resulted from this study were organised into a set of proposed principles to support participation and adherence with aquatic-based exercise. The development of these proposed principles was influenced by the study results in conjunction with existing literature related to adherence with health interventions, and guided by the biopsychosocial model. These proposed principles were then considered within the context of aquatic-based exercise and the results presented in chapter 7.
Chapter 7: Study 3 - Principle Development

7.1 Chapter Overview
This chapter presents the third and final study in this research, the development of a set of six principles to support participation and adherence with aquatic-based exercise interventions—principles which may have value for curriculum planning/courses for aquatic-based therapists, current practicing aquatic-based therapists, general practitioners, and pool managers. With a similar layout to the two previous chapters (5 and 6), the rationale and purpose for this study will be presented followed by the details of the study in manuscript format. The overall conclusion will highlight key outcomes of this study and introduce the final chapter in this thesis, the discussion chapter.

7.2 Study 3 Rationale
The results of the two literature reviews (chapters 1 and 2) and of study 1 and study 2 (chapters 5 and 6 respectively) have indicated several benefits across biological, psychological and social domains. However, there remains no clear strategy for the implementation of long term aquatic-based exercise interventions. Guiding principles may offer a much needed strategy, as they serve as parameters and guideposts that can provide a structure from which interventions may be developed—interventions that encourage participation and adherence. There have been no studies to date that have developed practice principles to support aquatic-based exercise interventions with a focus on chronic and disabling conditions.

The development of principles was based on the results of study 2 in conjunction with existing literature related to adherence with health interventions, and guided by research question three of this research: What key principles should guide aquatic-based exercise interventions in order to maximise the benefits and support participation and adherence with these interventions?

Study two (presented in the previous chapter) explored the perspective of aquatic users and aquatic instructors in order to link the benefits of aquatic-based exercise with what parts of the aquatic-based exercise interventions were relevant to participation and adherence with these interventions. Several factors were discussed within the focus groups and included intervention specific factors, such as cost, referral source/process, and the knowledge, experience and approach used by the instructors. Aspects of the physical and social environment were highlighted along with the importance of perceived benefits of participating in the aquatic intervention.
The development of principles was an iterative process that drew from the results of study two in conjunction with biopsychosocial theory and existing literature related to adherence with health-related interventions. A preliminary draft of the principles was developed and then revised based on results of consultations with key stakeholders, i.e. aquatic physiotherapists. Details of the study are presented in the following section of this chapter as a manuscript. The purpose for the study and the research questions guiding the study, are presented in the next section.

7.3 Purpose

The purpose of study 3 was to explore the perceptions of health professionals in the field in relation to the proposed aquatic-based exercise principles. The draft of initial principles was presented to physiotherapists and focus groups were used to elicit feedback on the principles for the purpose of refinement. The aim of study three was to refine the principles developed from the previous studies in this research by gaining feedback from aquatic physiotherapists by answering the following questions:

1. What are the strengths of the proposed principles?
2. What are some challenges of the proposed principles?
3. What changes (if any) need to be made to the principles to better support aquatic-based exercise interventions?

The results of this phase informed the refinement of principles to support participation and adherence with aquatic-based exercise with a focus on clients with chronic and disabling conditions. The findings from the focus groups are presented in a paper entitled “The Development of Guiding Principles to Support Participation and Adherence with Aquatic-based Exercise”, which will be submitted to *Clinical Rehabilitation* for review for publication.
7.4 Study 3 Publication Submission

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<th>Title</th>
<th>Journal</th>
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<tr>
<td>The Development of Guiding Principles to Support Participation and Adherence with Aquatic-based Exercise</td>
<td><em>Clinical Rehabilitation</em></td>
<td>Ms. Heather Scott ː*</td>
<td>Research design, recruitment, data collection, data analysis, writing of journal article, submission.</td>
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<td>Prof. Brendan Burkett</td>
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<td>Dr. Michele Verdonck</td>
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<td>Dr. Mark McKean</td>
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* Denotes primary author

7.4.1 The Development of Guiding Principles to Support Participation and Adherence with Aquatic-based Exercise

Abstract

Purpose: The purpose of this study was to refine a set of principles previously developed to increase participation and adherence with aquatic-based exercise interventions.

Method: A qualitative exploratory study was used and included focus groups with physiotherapists with experience in aquatic-based exercise interventions. Eleven aquatic physiotherapists participated in two focus groups. NVIVO (version 10) was used to support the template analysis process.

Results: Three themes were identified; they highlighted the (i) strengths, (ii) limitations, and (iii) revisions as recommended by the physiotherapists.

Conclusion: Physiotherapists found the principles useful for the aquatic environment, and the biopsychosocial approach to the principles made them more applicable to clients with chronic and disabling conditions. No major changes to the principles were suggested, and minor changes included reorganising the principles to highlight the need for evidence in the area.

Introduction

Chronic and disabling conditions are becoming more prevalent worldwide. With evidence indicating the importance of physical activity in the management of these conditions, it is important to identify evidence-based interventions to encourage participation in physical activity. The challenges that people with chronic and disabling conditions face in relation to
physical activity through land-based means are well documented. Aquatic-based exercise offers a safe alternative to land-based exercise and has shown numerous benefits for people with chronic and disabling conditions (Batterhan, Heywood, & Keating, 2013; Hall, Swinkels, Briddon, & McCabe, 2008; Martin-Valero, Cuesta-Vargas, & Labajos-Manzanares, 2012; McNamara, McKeough, McKenzie, & Alison, 2013; Naumann & Sadaghiani, 2014; Plecash & Leavitt, 2014; Waller et al., 2014).

Over the past decade the research base for aquatic exercise has expanded significantly, including several systematic reviews on the topic (Adsett, Mudge, Morris, Kuys, & Paratz, 2015; Al-Qubaeissy, Fatoye, Goodwin, & Yohannes, 2013; Bergamin, Zanuso, Alvar, Ermolao, & Zaccaria, 2012; Heywood et al., 2017; Mehrholz, Kugler, & Pohl, 2011; Waller, Lambeck, & Daly, 2009; Waller et al., 2016). However, if aquatic-based exercise is going to meet the needs of the chronic disease population, the research needs to move beyond the identification of short-term benefits of aquatic-based exercise interventions and begin to identify strategies to maximise the benefits and encourage long term participation with aquatic-based exercise. As popularity for aquatic-based exercise grows, theory driven, evidence-based principles need to be developed to support the participation and adherence with aquatic-based exercise interventions.

In response to this need a set of six guiding principles is proposed that may support the use of aquatic-based exercise interventions for clients with chronic and disabling conditions. These principles could serve as parameters or guideposts for clinicians and researchers to develop and structure aquatic-based exercise interventions that maximise the benefits of the intervention and promote participation with the intervention in the long-term.

The development of principles was an iterative process that drew from both quantitative and qualitative research in aquatic-based exercise in conjunction with biopsychosocial theory and existing literature related to adherence with health-related interventions. This method has been used in previous research as both a method of data triangulation, and, a method for developing consensus guidelines in clinical practice (Fardy, H. J., & Jeffs, D. 1994; Korngut, L., MacKean, G., Casselman, L., Johnston, M., Day, L., Lam, D., Lorenzetti, D., Warner, J., Jetté, N., Pringsheim, T. 2013). A preliminary draft of six principles was developed and then revised based on results of focus group consultations with key stakeholders, i.e. aquatic physiotherapists.

This paper presents the results of a qualitative study used to elicit feedback from aquatic physiotherapists for the purpose of refining the proposed principles. The purpose of the
principle refinement is to explore the perceptions of health professionals in the field in relation to the proposed principles. These refinements will assist in the development of theory-driven, stakeholder-informed principles that could be considered in guiding the development and implementation of aquatic-based exercise interventions.

This preliminary draft of principles is summarised in Table 7, followed by a description of the study involved in the refinement process.
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<tr>
<th>Principle</th>
<th>Brief description</th>
<th>Strategy</th>
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<tr>
<td><strong>1. Client Centred</strong></td>
<td>Employ strategies to ensure client’s individual needs are considered</td>
<td>• Base aquatic exercises on the client’s identified needs and priorities</td>
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<td></td>
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<td>• Provide meaningful and practical activity options while supporting the user’s choice and control</td>
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<td>• Use a supportive, empathetic approach when interacting with the clients</td>
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<td><strong>2. Contextually Considered</strong></td>
<td>Employ strategies to minimise barriers and maximise utility</td>
<td>• Water depth and temperature need to match the specific needs of the clients</td>
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<td></td>
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<td>• Cost reduction strategies such as peer mentoring or student-led classes need to be considered</td>
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<td>• Benefits of the social and physical context should be highlighted to the clients both in and out of the aquatic environment</td>
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<td><strong>3. Biopsychosocially Focused</strong></td>
<td><strong>Biological:</strong> Employ strategies to increase function and decrease symptoms related to the condition</td>
<td>• Match the properties of water and the impact they have on the condition with related symptoms (e.g. buoyancy to take the weight off joints)</td>
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<td>• Utilise various techniques in the water to promote exercise while minimising injury</td>
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<td>• Consider functional implications related to participating in aquatic-based exercise in terms of the user’s everyday activities</td>
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<td><strong>Psychological:</strong> Employ strategies that target self-efficacy</td>
<td>• Communicate knowledge and understanding of both the condition and impact of the properties of water related to their condition</td>
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<td>• Highlight noticed improvements related to biopsychosocial outcomes with links to function in everyday activities</td>
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<td>• Use evaluation methods or outcome measures to provide feedback to clients</td>
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<td><strong>Social:</strong> Employ strategies to increase social interaction and connection</td>
<td>• Encourage activities that require group or partner interaction in the pool</td>
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<td>• Encourage a buddy system to put new members with long-standing members</td>
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<td>• Promote social activities outside of the pool</td>
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<td>• Provide opportunities for comparison with other group members</td>
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<td><strong>4. Communicated Effectively</strong></td>
<td>Be able to communicate</td>
<td>• Communicate knowledge and understanding of client condition and</td>
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effectively with various stakeholders regarding aquatic-based exercise | impact of the aquatic environment on biopsychosocial outcomes in a way that clients understand
- Communicate with referring health professionals (GPs) regarding the benefits of aquatic-based exercise to encourage referrals from GPs
- Communicate with stakeholders regarding the benefits of aquatic-based exercise for various populations in order to inform users, referring bodies and program developers

| 5. Evidence-based | Be knowledgeable about aquatic-based exercise in relation to client condition and related symptoms | • Be knowledgeable about the properties of water and the impact they have on the condition and related biopsychosocial symptoms
• Be knowledgeable regarding implications and contraindications related to exercising in the aquatic environment in order to promote the benefits while minimising injury

| 6. Qualified instruction | Be able to apply intervention principles and best evidence to the aquatic setting | • Be able to find, interpret, implement and communicate evidence related to aquatic-based exercise interventions
• Advocate for availability of, and access to, appropriate aquatic facilities
• Provide individual attention and management of clients within the group environment based on best evidence and client needs

Table 7. Proposed Principles

Method
Based on a qualitative design, this article uses a methodology of focus group triangulation, by which the views of key stakeholders are explored and compared to previous literature on the topic. Once ethical approval was obtained (# S15724) participants were recruited through purposive sampling where organisations that offer aquatic exercise as a treatment option were contacted to identify physiotherapists interested in participating in the focus groups. A recruitment flyer was provided and emailed to physiotherapists with aquatic experience. Those physiotherapists interested in taking part in the focus groups emailed the primary investigator to express interest. A time and a venue suitable to the participants were arranged for the focus groups to take place. Focus groups with aquatic physiotherapists were conducted to elicit feedback on a set of draft principles developed to support participation and adherence
with aquatic-based exercise interventions. Focus groups can often serve as a trigger for others to share their information and stories, expanding on the comments of others to provide a collection of rich information from multiple participants at the same time (Krueger, 2000; Mansell, Bennett, Northway, Mead, & Moseley, 2004).

Data collection
The two focus groups took approximately 60 minutes in duration and ranged in size from 5-6 people. The total number of participants was 11. Focus groups took place at a convenient location for participants. Once consent was provided, participants filled out a short demographic profile. A trigger was used to start the focus group conversation and included a brief introduction to the focus group where participants received a copy of the proposed principles and a brief explanation of the literature and results of the studies presented in this thesis that supported the development of the proposed principles. Once participants had a chance to review the principles, they were asked to provide feedback regarding the strengths and limitations of the principles as well as any changes they would suggest to inform principle refinement. More specifically, the focus group attempted to answer the following questions:

1. What are the strengths of the proposed principles?
2. What are some challenges of the proposed principles?
3. What changes (if any) need to be made to the principles to better support aquatic-based exercise interventions?

Data analysis
Focus group recordings were transcribed verbatim and identifying information was removed. Thematic analysis was conducted in the form of template analysis, as described by King (2012) and aided through the use of NVIVO 10 qualitative analysis software. Template analysis emphasises the use of hierarchical coding, and central to the technique is the development of a coding template, usually on the basis of a subset of the data, which is then applied to further data, and revised, refined and reapplied (King, 2012).

Template Analysis offers a structured approach to data coding. The process of developing and refining the template lends itself well to providing an audit trail which allows for the clear demonstration and explanation of theme development and application of the final thematic structure (Waring, 2008). This process established the quality of the final analysis by providing a means of recounting and explaining the decisions made throughout the coding process. Furthermore, the development of a template was an iterative process where template
refinement was continued throughout the analysis phase until no new refinements were necessary, indicating that theoretical saturation had been reached.

In the current study, template analysis was conducted over six stages: familiarisation with the data; preliminary coding; clustering; producing an initial template; applying and developing the template, and final interpretation (King, 2012). Once the transcripts were reviewed, they were coded and categorised using meaningful and relevant comments that related to the proposed principles. After analysis of the data from one focus group, the emerging codes and themes were clustered depending on their similarity, and a hierarchical organisation of codes was produced. An initial *a priori* template was constructed by aligning the initial codes with the research objectives. The next set of focus group data was then coded using the initial template and any new codes were noted and the template was revised to reflect any additional information. Template changes were documented, discussed and verified by a second researcher. The second template was organised in a hierarchal structure that represented relationships between themes. The final template consisted of three primary codes most relevant to the information being sought, and included: strengths, limitations/challenges, and refinements, which will be discussed in the following section.

Trustworthiness

Creswell and Miller (2000) recommend that researchers using qualitative inquiry engage in a minimum of two procedures to address the trustworthiness of qualitative findings. This researcher used three procedures in this study: field notes, audit trail and theoretical saturation.

The use of field notes by the researcher captured the context of the participant’s experiences and provided connections important to the results of the study. Recording important thoughts and observations that took place during the focus groups helped to create a comprehensive and detailed account of the subjects’ experience, thereby ensuring that important information was not lost in the data analysis process (Phillippi & Lauderdale, 2018).

An audit trail was developed through the process of template refinement in the Template Analysis method. This audit trail provided a means of recounting and explaining the decisions made during the coding process. Furthermore, the continual refinement of the template during the analysis phase supported the requirement of theoretical saturation (King, 2012; Patton, 1999).
Results

Two 1-hour focus groups were completed with a total of 11 certified physiotherapists; their experience in aquatic-based exercise ranged from one year to twenty years. Focus group data revealed the opinions of the physiotherapists and the data is presented in relation to the strengths, limitations/challenges and refinements of the proposed principles.

Principle Strengths

The strengths highlighted by the physiotherapists included the principles themselves, the biopsychosocial lens of the principles, the comprehensiveness of the principles, and the structure the principles could provide to aquatic-based exercise interventions in terms of evaluating current interventions and developing new interventions that encourage participation and adherence with aquatic-based exercise.

The overall response of the physiotherapists to the principles was positive and prompted reflection on current practice in relation to the principles. One physiotherapist commented, “It’s not just about setting up some generic aquatic program where you get a bunch of people in the pool to move around; it’s about understanding the multiple factors involved and how they fit together”.

Reflection on clinical practice also highlighted the complexity of the conditions the physiotherapists often encounter during clinical practice, and in view of these complexities they considered the biopsychosocial consideration of the client a key strength of the principles. They emphasised the need for all aspects of the condition to be addressed when dealing with clients with chronic and disabling conditions, which is reflected in the biopsychosocial approach of the principles. One physiotherapist commented:

The biopsychosocial focus is great! ... people come in with multiple issues, they're there for a leg but they've got other stuff going on ... this [aquatic-based exercise] is doing so much more than just trying to reduce your knee pain. It's really giving people hope...you can actually give them much more than what they've come for... it’s like steak knives included.

The physiotherapists discussed the importance of the Evidence-based and Qualified instruction principles:

I think the knowledge and the evidence based on having an instructor that can apply, that is probably the most important part. Because if someone doesn’t understand what's going on with the person they can’t tailor the program so that person’s not
going to be happy. Because they’re not getting what they want out of their program, and they don’t feel confident in that person. So they’re not going to come back for a second class.

The importance of client-centred principle was also highlighted by the physiotherapists:

... the client-centred principle, that does give them value .... someone knows them, and knows where they’ve been and where they’re going, or where they want to go and I think it’s always meeting the patient’s goals or empowering the patient to meet their goal.

Overall, the focus groups showed that there was considerable interest in the proposed principles and comments from the physiotherapists highlighted the utility of the comprehensive structured approach to aquatic-based exercise interventions that meet the complex needs of clients with chronic and disabling conditions within the aquatic environment in the long term.

Principle Limitations

While no limitations to the main principles were identified, some limitations were highlighted in relation to the potential challenges in terms of the suggested strategies for implementation, in particular the principle related to context. While participants agreed that this principle was an important consideration for aquatic-based exercise interventions, the physiotherapists highlighted that in some instances they may have little or no control over the environment in which the intervention is taking place e.g. community-based interventions. Aquatic-based exercise interventions that take place at community pools may need to work around other swim programs. These challenges were highlighted in comments from physiotherapists who found it challenging to offer convenient program time for the intervention to take place: “So from seven in the morning, or eight in the morning it’s got kids right up to eleven o’ clock. And then we’ve got a little window in which we can run a class, and then the kids start arriving after school. This really restricts the times we can offer to clients”. Furthermore, community facilities may not provide the ideal environment for the aquatic-based exercise intervention to take place, e.g. poor access and lack of options for different water depths. Another challenge related to the context was the cost of participating in the intervention and the suggested strategies for reducing these costs. Physiotherapists highlighted for aquatic-based exercise interventions that take place at community pools, the participants pay a pool entry fee on top of the cost associated with the intervention itself. While the physiotherapists had no control over the cost of the pool entry, they did consider the value of exploring cost reduction
strategies to help reduce the overall cost to the client. However, proposed cost reduction strategies, such as student-led or peer-led classes, were challenged by several physiotherapists as they saw it in direct conflict with the client-centred, qualified instruction and evidence-based principles.

Several of the physiotherapists had stories or examples where student or assistant led groups had very poor outcomes—where aquatic programs were not based on the specific needs of the clients, but instead just a generic class where they moved around in the water. One physiotherapist felt strongly that “…the student led classes are irrelevant in a private physio practice”, and another physiotherapist expressed her concern regarding peer mentoring: “What my concern would be on the peer mentoring is, unless they’re doing it correctly …it could end up being a bit of a disaster”. Several comments suggested a better approach to cost reduction could be the use of government grants or funding to support aquatic-based exercise interventions for chronic and disabling conditions; however, they noted that the evidence related to aquatic-based exercise interventions and chronic conditions needs to be clear and available to support the application for such funding.

These six principles can be used to support the successful implementation of aquatic-based exercise interventions, help guide the referral of clients to the aquatic environment and assist with aquatic intervention delivery. Furthermore, these principles can serve as a template for future researchers for development of more symptom or disease-specific guidelines related to aquatic-based exercise interventions.

Principle Revisions

Only minor revisions to the principles were suggested by the physiotherapists in the focus groups. None of the principles themselves were recognised as needing revisions; however, revisions focused on some of the suggested strategies which supported the main principles. Revision suggestions included the addition of ‘government funding’ as a potential strategy for cost-reduction related to the principle ‘Contextually-considered’, discussed in more detail in the above section. However, due to potential differences related to the aquatic setting, no consensus was reached as to the best strategies to reduce the cost of the intervention for the client and instead a more generic statement regarding consideration of cost reduction strategies relevant to the setting was used. Another revision was related to the ordering of the principles. While there was no specific order to the principles in the original draft, physiotherapists expressed an interest in seeing the principles placed in order of importance. One physiotherapist suggested that the ‘Evidence-based’ and ‘Qualified-instruction’ principles
be moved to the top of the list, as these were considered to be the two key principles that would have the greatest impact on participation and adherence with the intervention:

I think the knowledge and the evidence based on having an instructor that can apply that is probably the most important part. Because if someone doesn't understand what's going on with the person they can't tailor the program so that person's not going to be happy. Because they're not getting what they want out of their program, and they don't feel confident in that person. So they're not going to come back for a second class.

This revision was supported by the other physiotherapists within the group.

Another revision to the principles was the addition of the words 'assessment', and 'reassessment', as strategies within the principle of 'Qualified Instruction'. Physiotherapists agreed that the assessment and reassessment of clients could support some of the other principles and, overall, participation and adherence with aquatic-based exercise interventions. One physiotherapist highlighted the assessment process for supporting a client-centred approach, “... because it is assessing for the appropriate interventions for that specific client....”. Furthermore, the reassessment of clients could guide how to progress the client’s program based on their changing requirements: “Reassessment and progression are important things ...whether that would be moving from an individual approach to a group setting or moving from a more injury or condition-specific intervention to a more generic rehab or even land-based exercises if that is what the client is interested in”.

Other physiotherapists discussed how an assessment and reassessment process for each client could assist with the principle of “Communicated effectively”, as results of these assessments could provide valuable insight for the client and could be used to provide feedback to other health professionals or referring bodies. One physiotherapist discussed the use of assessment and reassessment as a means of communicating the effectiveness of aquatic-based exercise to encourage participation and adherence with the intervention: “through communicating assessment results, GP [general practitioner] knowledge and understanding of benefits is enhanced...then, if the patient goes, ‘Oh I'm not sure about hydro [aquatic-based exercise’T, then maybe they can be more supportive”.

The revised principles are presented in Figure 10.
Chapter 7 - Study 3

Principles of aquatic-based exercise interventions that can increase participation and adherence

1. Evidence-based
   - Be knowledgeable about A-BE in relation to client condition and related symptoms
     a. Be knowledgeable about the properties of water and the impact they have on the condition and related biopsychosocial symptoms (e.g., buoyancy to take the weight off joints allowing for movement that may not be possible on land which increases mood and self-efficacy)
     b. Be knowledgeable regarding implications and contraindications related to exercising in the aquatic environment in order to promote the benefits while minimizing injury

2. Qualified Instruction
   - Be able to apply program principles and best evidence to the A-BE setting
     a. Be able to find, interpret, implement and communicate evidence related to A-BE programs
     b. Advocate for availability of, and access to, appropriate A-BE facilities
     c. Provide individual attention and management of clients within the group environment based on best evidence and client needs
     d. Employ appropriate assessment and re-assessment strategies across all BP/S domains

3. Biopsychosocially focussed
   - Biological:
     - Employ strategies to increase function and decrease symptoms related to the condition
       a. Match the properties of water and the impact they have on the condition with related symptoms (e.g., buoyancy to take the weight off joints)
       b. Utilise various techniques in the water to promote exercise while minimizing injury
   - Psychological:
     - Employ strategies that target self-efficacy
       a. Communicate knowledge and understanding of both the condition and impact of the properties of water related to their condition
       b. Highlight noticed improvements related to biopsychosocial outcomes with links to function in everyday activities
   - Social:
     - Employ strategies to increase social interaction and connection
       a. Encourage activities that require group or partner interaction in the pool
       b. Encourage a buddy system to put new members with long-standing members
       c. Promote social activities outside of the pool
       d. Provide opportunities for comparison with other group members

4. Client-centred
   - Employ strategies to ensure client's individual needs are considered
     a. Base aquatic exercises on the client's identified needs and priorities
     b. Provide meaningful and practical activity options while supporting the user's choice and control
     c. Use a supportive, empathetic approach to when interacting with the clients

5. Communicated effectively
   - Be able to effectively communicate with various stakeholders regarding A-BE
     a. Communicate knowledge and understanding of client condition and impact of the aquatic environment on biopsychosocial outcomes in a way that clients understand
     b. Communicate with referring health professionals (GPs) regarding the benefits of A-BE to encourage referrals from GPs
     c. Communicate with stakeholders regarding the benefits of A-BE for various populations in order to inform users, referring bodies and program developers

6. Contextually considered
   - Employ strategies to minimise barriers and maximise utility
     a. Water depth and temperature need to match the specific needs of the clients
     b. Cost reduction strategies relevant to program structure need to be considered
     c. Benefits of the social and physical context should be highlighted to the clients both in and out of the aquatic environment

Figure 10. Principles of aquatic-based exercise interventions
Discussion

This study used a focus group method for the purpose of gaining input from key stakeholders, in this case, aquatic physiotherapists, for the purpose of developing principles to support participation and adherence with aquatic-based exercise. These principles were developed to provide clinicians a framework from which to structure aquatic-based exercise interventions in order to maximise participation and adherence with these types of interventions. Physiotherapists expressed a keen interest in the principles; and they considered the development of the list of principles with their corresponding strategies, in itself, to be a strength. They shared experiences from clinical practice that supported the utility and acceptability of the principles. The principles served as a means for reflecting on current practice as well as informing future practice. A particular key strength was the biopsychosocial focus of the principles. Physiotherapists highlighted the importance of this approach, as the majority of their clients had chronic conditions with symptoms impacting all areas of their lives. Application of the biopsychosocial theory encourages consideration of the biological, psychological and social constructs of illness and disability (Engel, 1977) when implementing aquatic-based exercise interventions. The biopsychosocial theory has been used to guide interventions for clients with chronic and disabling conditions and has been used to inform clinical practice guidelines for chronic pain management (Kamper et al., 2015; Saragiotto, de Almeida, Yamato, & Maher, 2016; Spector & Orrell, 2010), making it a useful approach for principle development, which was further supported by comments from the physiotherapists. No changes to the main principles were required and any limitations and revisions highlighted by the physiotherapists were related to the strategies for supporting the proposed principles. Cost reduction strategies seemed to be context specific and therefore were made more generic to suit the needs of various contexts or program environments.

The main change to the principles was in relation to the order in which they were listed. Physiotherapists recommended that the evidence-based principle be moved to the top of the list in order to highlight its importance in informing effective aquatic-based exercise interventions and to encourage participation and adherence with aquatic-based exercise interventions. This is supported by research that suggests the implementation of evidence-based practices can result in safe, effective interventions and can improve participation and adherence with the interventions (Doyle, Lennox, & Bell, 2013; Kristine, 2016). Therefore, aquatic-based exercise should be evidence-based in order to increase the successful
implementation of the intervention and provide a safe therapeutic environment that can benefit clients with chronic and disabling conditions in the long term.

Limitations to the research included the small sample size, which may limit the generalisability of the study. Furthermore, this research sought the perspectives of physiotherapists only, excluding other health professionals whose experiences may have impacted the principles differently. Future research should consider larger sample sizes and the inclusion of other health professionals and key stakeholders.

Conclusion
Overall, the principles were considered useful as a tool to guide aquatic-based exercise interventions for people with chronic and disabling conditions. Physiotherapists confirmed the need for a holistic approach to the treatment of chronic and disabling conditions through aquatic-based means in order to meet the complex needs of the client and promote participation and adherence with these interventions.

7.5 Chapter Conclusion
This chapter presented the results of a qualitative study of principles developed to support participation and adherence with aquatic-based exercise interventions: that aquatic interventions be evidence-based, be led by qualified instructors, be biopsychosocially focused, be client-centred, be communicated effectively, and be contextually considered. These principles were developed and refined through this last study; they represent a culmination of the results of two literature reviews and three studies, the impact of which will be considered in the final chapter of this thesis (chapter 8).
Chapter 8: Implications for Aquatic-based Exercise Interventions

8.1 Introduction

The purpose of this research was to explore aquatic-based exercise as an intervention for people with chronic and disabling conditions. In a practical sense, this research sought to address the ‘why’ and ‘how’ of aquatic-based exercise interventions. Guided by the biopsychosocial lens, this research involved systematically reviewing the literature along with a series of qualitative studies with key stakeholders – the key stakeholders being clients with chronic and/or disabling conditions, as well as general practitioners, physiotherapists, funding agencies and program developers. The culmination of literature and research studies was the development of theory driven, evidence-based principles to guide the development and implementation of aquatic-based exercise interventions with a focus on clients with chronic and disabling conditions.

The ‘why’ was addressed in the first part of this research where the evidence for the effectiveness of aquatic-based exercise was explored in the form of an evidence map (chapter 2), scoping review (chapter 3) and focus groups (chapter 5), which supported individually and collectively, the use of aquatic-based exercise interventions with chronic and disabling conditions. The ‘how’ was addressed through a series of focus groups (chapters 6 and 7), the data from which supported the development of a set of principles to guide the implementation of aquatic-based exercise interventions that promote participation and adherence with these interventions.

8.2 Aquatic-based interventions and chronic and disabling conditions: a biopsychosocial approach

The complex nature of chronic conditions requires a multifaceted approach to management (March et al., 2014; Rizzuto, Melis, Angleman, Qiu, & Marengoni, 2017). In an attempt to address these complexities, this current research applied the biopsychosocial model, a model that has been recognised within the literature in relation to understanding chronic disease and its management (Cabak, Rudnicka, Kulej, & Tomaszewski, 2017; Marin et al., 2017; Sotile, 2005). The biopsychosocial model takes into account all relevant determinants of health and disease and essentially supports the integration of biological, psychological and social factors in the management of diseases (Engel, 1980; Penney, 2013; Wade & Halligan, 2017). It does not diminish the significance of biological factors, but extends beyond a rather limited...
biological approach to more holistic practice by understanding the psychosocial factors that influence a patient.

Within this research, the biopsychosocial model has served as a framework to help define the focus and goal of the research and inform the search strategies and literature reviews, resulting in a key aim of this research: to identify the biological, psychological and social implications of aquatic-based exercise. This aim was addressed in the first part of this research through two literature reviews and a series of focus groups with key stakeholders (users, instructors and physiotherapists).

The evidence map presented in chapter 2 synthesised the best evidence of the effectiveness of aquatic-based exercise intervention on various health outcomes. The evidence map supported the original assumption that those people with chronic and disabling conditions could benefit the most from aquatic-based exercise, as they were the most studied populations and had the most significant outcomes, especially in relation to physiological outcomes (Bartels et al., 2016; Heywood et al., 2017; McNamara, McKeough, McKenzie, & Alison, 2013; Mehrholz, Kugler, & Pohl, 2011; Waller, Lambeck, & Daly, 2009). From a biopsychosocial perspective, the results from the evidence map provided insight primarily into the biological outcomes of aquatic-based exercise interventions and also highlighted limited research focused on the psychological and social outcomes within the literature.

The scoping review provided an overview of the literature on aquatic-based exercise in relation to the psychosocial impacts. Results from the scoping review added to the biopsychosocial representation of the aquatic-based exercise benefits; however, several gaps still existed, especially in consideration of the social benefits. As the quantitative research in the area did not appear to identify or report on the social outcomes related to aquatic-based exercise interventions, a qualitative approach was used in an attempt to identify data in the area. Chapter 5 presented results of a focus group that included the user’s perspective and expanded on the current literature in the area in relation to the psychosocial outcomes of aquatic-based exercise.

Based on the results of the two literature reviews (chapters 2 and 3) and study 1 results (chapter 5) there appears to be evidence to support the effectiveness of aquatic-based exercise interventions for chronic and disabling conditions; results indicated several benefits across biological, psychological and social domains. The biopsychosocial representation of the benefits of aquatic-based exercise contributes to theory, research and clinical practice, as it provides a theoretical foundation for understanding the evidence supporting aquatic-based
exercise, offers valuable information necessary to drive future research in the area, support clinical decision making and provides a platform for scientific dialogue with other health professions and stakeholders (Figure 11).

![Biopsychosocial representation of the outcomes related to aquatic-based exercise](image)

**Figure 11. Biopsychosocial representation of the outcomes related to aquatic-based exercise**

8.3 Principles to support aquatic-based interventions

The main contribution of this research was to the field of knowledge and practice that can support the development and implementation of aquatic-based exercise interventions through the development of set of guiding principles. The development of a set of best practice principles was an iterative process that drew on both formal documented evidence from existing aquatic research and the results of a series of qualitative studies with key stakeholders on the topic.

An evidence-based approach to practice involves an understanding of the current literature or research evidence along with clinical consensus that the intervention is both efficacious and safe, and consideration of the client’s needs and the context (Akobeng, 2005; Kristine, 2016).
Chapter 8 – Discussion and conclusion

Lack of consideration of any of these areas when designing an intervention decreases the chances of successful implementation (Kristine, 2016). The principles developed in this current research are based on the research evidence, client involvement and clinical experience of the health professional.

The literature review in chapter 2 used an evidence map methodology, combining the best evidence on the topic of aquatic-based exercise in relation to health outcomes, and providing a visual representation of the research to date for various chronic and disabling conditions. The evidence map provided a synthesis of the best evidence that addresses the effectiveness and safety of aquatic-based exercise interventions and the visual representation of the literature provided a quick snapshot of the evidence of the benefits of aquatic-based exercise interventions in relation to health outcomes for various chronic and disabling conditions. This is considered a key strength of the evidence map methodology highlighted in the literature (Miake-Lye, Hempel, Shanman, & Shekelle, 2016; Solloway et al., 2016) and a practical outcome of this research. The scoping review (chapter 3) provided additional information regarding the psychosocial implications of aquatic-based exercise interventions, further supported by the results of study 1 which looked at the client’s perspective of the psychosocial benefits.

Study 1 (focus groups with aquatic users, chapter 5) and study 2 (focus groups with aquatic users and instructors, chapter 6) added to the evidence base by expanding on the client perspective and by providing the perspective of the instructors; two perspectives considered important for the successful implementation of an intervention (Kristine, 2016). Study 2 provided insight into the context of the intervention and the impact that aquatic-based exercise interventions had on the participants, highlighting key factors related to the intervention that impact their participation and adherence with the intervention. The last study, study 3 (focus groups with physiotherapists, chapter 7), explored the perspective of clinicians; the results provided their clinical and professional expertise on the topic, another aspect of evidence-based practice (Kristine, 2016). Each of the principles will be discussed next in relation to the published literature and the study results.

**Principle 1— Evidence-based**

In order to increase the successful implementation of the intervention and provide a safe therapeutic environment that can benefit clients with chronic and disabling conditions in the long-term, aquatic-based exercise should be evidence-based. While clinical judgement and patient preference are important aspects of clinical decision making, research evidence should
be the overwhelming driver in this process (Akobeng, 2005; Kristine, 2016). This research contributed to the evidence-based application of aquatic-based exercise interventions through several means. While the principles themselves are evidence-based, the aquatic-based interventions are also supported by the evidence synthesised in the evidence map.

The physiotherapists in study 3 indicated that the evidence was key in establishing the credibility of the intervention, and, that once this credibility was established through research, application and communication of the evidence would result in more people attending and adhering to aquatic-based exercise interventions. Furthermore, physiotherapists felt the evidence would help to justify the cost, and, that people made aware of the evidence to support the intervention would be more willing to disregard cost as a barrier. At the very least, the physiotherapists felt the evidence could be used to support funding from government agencies in order to reduce the financial burden on the clients attending the intervention as a long-term management strategy for their condition.

Furthermore, incorporating these factors into aquatic-based exercise interventions can support the successful implementation of safe and effective aquatic-based exercise interventions for clients with chronic and disabling conditions. While this section has focused more on research utilisation, for an intervention to be truly evidence-based it requires the intervention providers to be knowledgeable about the research, but also to understand it in the context of the environment and know how to use the research to support their clinical practice. These are all aspects of qualified instruction, which is the next principle to be discussed.

**Principle 2 – Qualified Instruction**

Aquatic-based exercise should have qualified instruction where instructors are able to navigate the research base in order to understand the evidence and how it relates to the clients in the aquatic environment. Having qualified, knowledgeable instructors builds confidence in clients that they are receiving the appropriate intervention to address their specific health needs, making them more likely to participate and adhere with the intervention (Farrance, Tsofliou, & Clark, 2016; Moody, Hale, & Waters, 2012). This principle was supported by the focus groups in study 2 (chapter 5) where the knowledge and experience of the instructor appeared to be important to the majority of the participants in order for them to feel safe and supported.

Instructors were considered knowledgeable about and understanding of both the condition of the client and the appropriateness of the aquatic exercises, promoting feelings of confidence and trust in participants (Farrance et al., 2016). Instructors also reported the importance of
having knowledge regarding various medical conditions for safety purposes including the potential impact that the aquatic environment might have on the condition. Because of their knowledge of both the aquatic environment and the medical conditions, they could offer valuable information about the condition and provide suggestions and recommendations for exercise modifications, which they felt fostered a sense of trust and respect, which in turn impacted participation and adherence. This is consistent with the literature highlighting the importance of the exercise instructor in creating an intervention and context that supports the needs, interests and motivations of the program users (Farrance et al., 2016; Moody et al., 2012; Pentecost & Taket, 2011). Knowledge and understanding of both the client condition and the properties of water, including the implications and contraindications associated with the environment and how these impact on the client from a biopsychosocial perspective, are important to promote the safety and effectiveness of the treatment.

**Principle 3 – Biopsychosocially focussed**

Aquatic-based exercise interventions should be biopsychosocially focused, particularly if they are going to adequately address the complex needs of clients with chronic and disabling conditions. The application of theory to the principles created a more holistic approach to the implementation of the intervention, an important consideration of interventions targeting clients with chronic and disabling conditions (Wade & Halligan, 2017). Interventions that provide a holistic approach to the management of chronic conditions result in more successful outcomes and more “buy-in” from patients, often resulting in continued utilisation of services— an important consideration given the chronicity of the condition— and interventions intended to support these clients and encourage participation, especially long-term, should be legitimised by theory (Bartholomew, Parcel, Kok, & Gottlieb, 2011; Sales, Smith, Curran, & Kochevar, 2006; Vanderplasschen & De Maeyer, 2014).

A biopsychosocial focus to aquatic-based exercise interventions should include not only using strategies to maximise the biopsychosocial effectiveness of the aquatic environment, but also discerning how these biological, psychological and social aspects interact to impact participation and adherence with aquatic-based exercise. The aquatic-based exercise research has indicated improvements across both physical and psychosocial domains with the majority of research focused on the former (Ahern, Nicholls, Simionato, Clark, & Bond, 1995; Cadmus et al., 2010; Carere & Orr, 2016; Geytenbeek, 2002; Gyurcsik, Estabrooks, & Frahm-Templar, 2003; Waller et al., 2016). Results of the focus groups contributed to the evidence of improvements to the psychosocial domains and substantiated the complexity of these conditions and the associated impact on daily life.
Results of the focus groups confirmed the overlap between the biological, psychosocial, and social benefits experienced by the participants and both the overlap and the importance of the overlap were confirmed by the aquatic instructors. Participants discussed aquatic-based exercise in relation to the biological, psychological and social implications and indicated that perceived improvements in mood, self-efficacy, social interaction, along with symptom-specific improvement, impacted their participation and adherence with aquatic-based exercise. Furthermore, improvements in one area often elicited improvements in other areas.

The biological changes experienced by the participants (i.e. Improvements in balance, flexibility etc.) impacted their psychosocial wellbeing, in particular their self-efficacy or belief in their ability to complete the exercises, as well as in their ability to participate in everyday activities. Examples of this can also be found in the aquatic literature where self-efficacy is often linked to adherence (Bandura, 1977; Gyurcsik et al., 2003). Findings from a study by Gyurcsik et al. (2002) found self-efficacy was a predictor of aquatic exercise attendance and as individuals become more confident in their abilities to exercise they attend more aquatic classes. Furthermore, self-efficacy is impacted by both perceived physical ability and social connection, further highlighting the importance of a biopsychosocial approach to aquatic-based exercise interventions (Gyurcsik et al., 2003; Tovar et al., 2016). This suggests strategies used to enhance positive outcomes in one area may impact other areas and interventions, and therefore focusing on impacting all areas is likely to encourage participation and adherence with aquatic-based exercise.

Principle 4 – Client-centred
Both quantitative and qualitative evidence supported the importance of a client-centred approach to aquatic-based exercise. Client-centred or person-centred practice encompasses a philosophy or approach to clinical practice that reflects the specific needs of individuals or groups of clients (Leplege et al., 2007). It encourages the involvement of the client in all aspects of the intervention, including the planning and implementation of services (Leplege et al., 2007; Whalley Hammell, 2013). While this is well documented as an essential component of healthcare delivery as a strategy to elicit “buy-in” from the clients or users of rehabilitation services (Bamm, Rosenbaum, Wilkins, Stratford, & Mahlberg, 2015; Cott, 2004; Leplege et al., 2007; Whalley Hammell, 2013), it has scarcely been considered in the aquatic literature. Some key aspects of client-centred aquatic-based exercise interventions should include creating the aquatic-based exercise around the client’s identified needs and priorities, allowing the client to feel like his/her personal situation is being considered. This was highlighted by participants in the focus groups as a factor contributing to participation and adherence with aquatic-based
exercise, specifically the instructor’s provision of individual attention; modifications to the exercises made by the instructors that were specific to the individual needs of the participants made them feel supported.

The importance of client-centeredness was further supported by the physiotherapists in study 3 who confirmed the need for each client to be considered as an individual with unique needs to be addressed. They considered being client-centred as a key part of building rapport with the client and fostering a sense of trust which would make the client more likely to continue with the intervention. This is consistent with the literature highlighting the importance of creating an intervention and a context that support the needs, interests and motivations of the program users as a key strategy for participation and adherence (Farrance et al., 2016; Moody et al., 2012; Pentecost & Taket, 2011). It is through this approach that a sense of connection and trust with the practitioner is developed, and these connections have been found to be closely related to adherence and overall satisfaction with intervention or services.

Principle 5 – Communicate effectively
Both the quantitative and qualitative literature supported the need for effective communication in aquatic-based exercise interventions. Effective communication is considered an essential requirement underpinning any successful clinical encounter and is integral to the client-centred approach to practice (Leplege et al., 2007; Roberts & Bucksey, 2007). Effective communication has been linked to increased patient knowledge, improved health outcomes, enhanced satisfaction and adherence to treatment interventions (Butow & Sharpe, 2013; Haskard Zolnierek & Dimatteo, 2009; Roberts & Bucksey, 2007). The focus groups highlighted the importance of the aquatic instructors communicating knowledge and understanding of the client’s condition and its impact on the client’s ability to participate in aquatic-based exercise, and the impact of aquatic-based exercise on the condition as well as the other benefits. This fostered a sense of trust, enhancing the relationship between the physiotherapist and the client, which is a key factor impacting adherence (Butow & Sharpe, 2013).

Physiotherapists felt that communication was an important tool for helping the clients to understand the multitude of benefits the aquatic environment can elicit. Making clients aware of the many benefits of aquatic-based exercise interventions and how these benefits can positively impact functioning outside of the aquatic environment can result in clients feeling more confident in their ability to perform exercises within the pool, as well as to participate
more in everyday life. These benefits appeared to play a key role in promoting adherence with the intervention.

Effective communication should include communication not only with the client, but also with referring health professionals and other stakeholders. Promoting the intervention and its benefits educates potential referring bodies and clients. Creating an awareness of the benefits means that other people may be referred and benefit, very significantly, from the environment. The qualitative data suggested that both clients and instructors believed that the role of the doctor in the referral process could influence participation in aquatic-based exercise and felt as well that if the doctor suggested aquatic-based exercise as an option they would be more likely to attend. This is similar to studies by Chard (2016), who found general health practitioners played an important role in the initiation of aquatic exercise for people with multiple sclerosis.

Previous studies have also highlighted the importance of a supported referral pathway, suggesting that such a process inspires confidence that the intervention is appropriate for the client, facilitating participation and adherence with the intervention (Adsett, Hickey, Nagle, & Mudge, 2013; Desveaux et al., 2017). Chard (2017) went on to discuss the importance of the general health practitioner in not only the referring process, but also in a supportive role once participants have commenced the intervention (Chard, 2017; Clemence & Seamark, 2003). This suggests effective communication between the physiotherapist and the general health practitioner could lead to an increase in aquatic-based exercise referrals and improved support for current aquatic-based exercise users, potentially impacting adherence with these interventions.

**Principle 6 – Contextually Considered**

Research suggests both the physical and social environment need to be considered as playing key roles in participation and adherence with aquatic-based exercise (Chard, 2017; Lindsay Smith, Banting, Eime, O'Sullivan, & van Uffelen, 2017; Moody et al., 2012). The importance of both was highlighted in the focus group results as participants discussed aspects of both the physical and social environment as key factors impacting their participation and adherence with aquatic-based exercise.

The physical environment included the aquatic medium itself, and, more specifically, the properties of water. Several participants discussed how the aquatic environment allowed for movements they would not typically be able to perform on land due to the disabling impact of their condition. Participants discussed how the aquatic environment reduced the physical burden on their bodies and elicited feelings of safety and comfort associated with moving
freely in a supportive, stress free environment. These positive experiences associated with the physical environment played a key role in participation and adherence with the intervention.

Other factors of the physical environment need to be considered, as they appear to impact participation and adherence with aquatic-based exercise interventions. Evidence in the aquatic literature suggests that water temperature and depth of the pool need to be matched to the needs of the client, as the level of immersion impacts the buoyancy of the client and depending on the client’s condition and the purpose of the intervention, the client may require more significant offloading. Furthermore, variation in temperature can impact on pain, stiffness and mood depending on the client’s specific diagnosis (Cooney et al., 2011; Frohman et al., 2015), and such responses may impact the participation and adherence with certain client populations whose needs are not being addressed appropriately. If the context meets the needs of the client, the client is more likely to reap the benefits of the intervention and is likely to be more willing to adhere with the intervention.

Cost also needs to be considered, as the evidence suggests that it is a key facilitator of participation and adherence with physical activity for older adults. Cost was discussed by the participants in the focus groups as an important consideration for participation and adherence with aquatic-based exercise. Participants discussed the lack of funding and high cost of the sessions in relation to the chronicity of their condition and the need for ongoing aquatic-based exercise. This is supported in a review by Farrance (2016) who found evidence that the practical aspects of community program design, such as cost, can impact participation and adherence with these interventions especially for those with long-term or chronic conditions (Farrance et al., 2016).

Some studies suggested that the use of peer mentoring, or student mentoring, to reduce costs associated with the intervention may be effective as long as these mentors are supervised by a certified therapist (Moody et al., 2012; Picorelli, Pereira, Pereira, Felício, & Sherrington, 2014). Dorgo and colleagues (2011) demonstrated that the peer-mentoring model has the potential to be a cost-effective method of engaging older adults in physical exercise programs for extended periods and improving their health and wellness (Dorgo, King, Bader, & Limon, 2011). However, results of study 3 (focus groups with physiotherapists, chapter 7) suggested that while the majority of physiotherapists agreed with the need for cost-reduction strategies, they disagreed with the peer-mentoring approach. Physiotherapists felt that this approach was in direct conflict with other principles such as “qualified instruction” and “client-centred”, suggesting the peer-mentoring approach is not suitable for this environment.
As an element of context, the social environment also needs to be considered, as it offers benefits to the aquatic users and can impact participation and adherence with aquatic-based exercise. Participants from the focus groups discussed how the group-based approach provided an opportunity to connect with others. The connections and friendships that developed as a result of the social environment impacted participation with the aquatic-based exercise intervention: participants described feeling more likely to attend. Connection was particularly important for those participants who were older or felt isolated due to the disabling impact of their condition.

This was supported by the aquatic literature which suggests that social environment plays a significant role in participation and adherence with aquatic-based exercise, and that social aspects, such as social bonding and friendship, may play a more significant role in adherence with the intervention than the exercise itself (Kang, Ferrans, Kim, Lim, & Lee, 2007; Moody et al., 2012). To maximise the benefits of the social environment, instructors could encourage social interaction between participants both during exercise and outside of the aquatic environment (Moody et al., 2012; Picorelli et al., 2014). Using a group-based approach to aquatic-based exercise interventions allows clients to experience the benefits of both the physical and social environments that contribute to participation and adherence with aquatic exercise.

8.4 Limitations

It is not the purpose of the evidence map and scoping review to evaluate the effectiveness of aquatic-based exercise within the literature, nor could it be construed as a limitation. Instead these evidence-synthesis methods provide compendious overview of the potential positive effects of aquatic-based exercise for the various outcomes. While this information is useful for general practitioners, physiotherapists, researchers and aquatic-based instructors, a full systematic review and meta-analysis would significantly complement the current findings. Further investigation is needed within aquatic research to address methodological flaws and heterogeneity between and among studies, followed by well-constructed, non-biased reviews reporting effectiveness.

Another limitation of this research is that the majority of psychological and social outcomes are based on the results of a series of focus groups and therefore may not represent an exhaustive picture for the effectiveness of aquatic-based exercise for these domains. The results presented provide a number of concepts within the psychosocial domains that clearly represent psychosocial outcomes as identified by participants of aquatic-based exercise.
interventions. These concepts will need further exploration and verification through quantitative studies using appropriate measures and methods.

The principles were based on the needs of clients with chronic and disabling conditions, and, as such, may not transfer to a more acute injury management client where the aquatic environment may be used instead as a short-term rehabilitative approach. However, several of the principles could govern general clinical practice, and the specifics of the aquatic intervention may be the only modification necessary to guide the intervention. Future research could focus on the application of these principles with different clinical populations or with clients at various stages of the injury or disease process.

Another limitation of this research is the inclusion of both community–based and private-practice aquatic settings. This research took a broad approach to aquatic-based exercise interventions, and therefore some principles, specifically, some of the strategies suggested to support the principles, may not be relevant for one or the other. Focusing more specifically on one aquatic environment may have allowed for more detailed strategies that could offer more explicit guidance on the implementation of these principles for that specific environment. However, the inclusion of both settings in the research resulted in a broader description of strategies that are potentially more generalisable to other aquatic settings. Future research could focus on a particular setting, resulting in the development of more context specific strategies.

8.5 Conclusion

This research explored aquatic-based exercise interventions for people with chronic and disabling conditions and sought to identify the implications of these interventions as well as links to participation and adherence from the perspective of key stakeholders. A pragmatic approach was taken to this research. The researcher’s background and the biopsychosocial model dictated the most practical method for answering each of the research questions. The use of the biopsychosocial model to drive the exploration of aquatic-based exercise interventions provided a structure to organise the aquatic research, identified gaps that need to be addressed, and provided a platform for the development of practice principles.

Aquatic-based exercise appears to be an effective intervention for meeting the complex needs of people with chronic and disabling conditions. This research suggests that users of aquatic-based exercise can experience benefits across biological, psychological and social domains, and consideration of several intervention factors not only impacts these benefits, but also
promotes participation and adherence with aquatic-based exercise, important aspects to consider given the chronicity of these conditions.

Guided by the biopsychosocial lens, this research involved systematically reviewing the literature to identify and synthesise the current best evidence for the effectiveness of aquatic-based exercise interventions. This comprehensive literature search was followed by three qualitative studies that involved a series of focus groups with key stakeholders in order to address gaps identified by the literature reviews, identify factors associated with participation and adherence, and provide input into the development of aquatic-based exercise principles. These principles can be used to support the successful implementation of aquatic-based exercise interventions, help guide the referral of clients to the aquatic environment and assist with delivery of the aquatic interventions. Furthermore, these principles can serve as a template for future researchers for the development of more symptom-specific or disease-specific guidelines related to aquatic-based exercise interventions.
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doi:10.1177/146879410200200205


## Appendix A: Prisma 2009 Checklist

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
<td>Does not apply, this is an evidence map, a relatively new evidence synthesis product</td>
</tr>
<tr>
<td><strong>ABSTRACT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
<td>1</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
<td>2 &amp; 3</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
<td>3</td>
</tr>
<tr>
<td><strong>METHODS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
<td>No</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
<td>4</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
<td>3 &amp; 4</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
<td>Supplementary material</td>
</tr>
<tr>
<td>Section/topic</td>
<td>#</td>
<td>Checklist item</td>
<td>Reported on page #</td>
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<tr>
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</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
<td>5</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>5</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
<td>6</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td>6</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
<td>N/A</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>14</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.</td>
<td>6</td>
</tr>
<tr>
<td>Risk of bias across studies</td>
<td>15</td>
<td>Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).</td>
<td>N/A</td>
</tr>
<tr>
<td>Additional analyses</td>
<td>16</td>
<td>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**RESULTS**

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study selection</td>
<td>17</td>
<td>Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.</td>
<td>4 &amp; 5</td>
</tr>
<tr>
<td>Study characteristics</td>
<td>18</td>
<td>For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.</td>
<td>n/a (data not presented as a systematic review but as an evidence map)</td>
</tr>
<tr>
<td>Risk of bias within studies</td>
<td>19</td>
<td>Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).</td>
<td>Incorporated in to synthesis</td>
</tr>
</tbody>
</table>
### Results of individual studies

| 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | N/A |

### Synthesis of results

| 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | n/a (narrative synthesis and bubble plot) |

### Risk of bias across studies

| 22 | Present results of any assessment of risk of bias across studies (see Item 15). | Incorporated in to synthesis |

### Additional analysis

| 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | Bubble plot X 4 |

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**DISCUSSION**

| 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 19 |

| 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 21 |

| 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 21 & 22 |

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**FUNDING**

| 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | 22 |

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*For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org)*.