Perceived and Real Water Competency and Drowning Risk Among Adults in Open Water: A Wicked Problem

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Education, The University of Auckland, 2021.

Abstract

Any competency base required to survive a drowning situation is dynamic, complex, and multi-faceted. Traditional understanding of survivability has been based on swimming competency, determined simplistically by how far a person can swim. However, swimming ability alone is unlikely to offer much protection from drowning. Rather, a more complex understanding of water competencies involved is needed, especially in respect to the high incidence of adult drowning in high-income countries. This research addresses this need through a series of studies aimed at examining the gap between perception and reality.

In the first study (Stanley & Moran, 2017), over one-half (58%) of parents and caregivers estimated they were good swimmers, yet more than half (55%) could swim less than 25 m. Most (87%) estimated their child was a good swimmer, although most (74%) could swim less than 25 m. Most parents (59%) and children (81%) had not swum their estimated distance in open water, yet one-half (51%) believed their child safe in open water. In Study Two (Stanley & Moran, 2018) among adult minority groups, most (70%) perceived themselves as good swimmers despite most (73%) estimating they could not swim more than 25 m, and most (73%) relying on that level of competence to keep themselves safe. In Study Three (Stanley & Moran, in-press), although older adults were less likely than two younger age groups to estimate themselves as proficient swimmers (46%, vs. 66% and 73%), there was little change in safer risk perceptions and attitudes. In Study Four, adults' perceived water competence was measured against their actual water competence in closed and open water environments. Despite most adults (98%) unable to swim more than 100 m in open water, more than half (59%) perceived themselves as good swimmers, and more than quarter (27%) thought they could swim more than 200 m.

In conclusion, reality gaps were found in water competence among adult groups, especially in open water settings. Differences between perceived and actual competence have underestimated the risk and overestimated their competency. This provides a plausible explanation of why many adults drown. Relationships with water safety attitudes, opinions, and risk perceptions are discussed to provide recommendations for prevention of adult drowning.

Acknowledgments

I wish to thank various people for their contribution in the completion of this project. Dr Kevin Moran has been instrumental in me commencing, and completing, this body of work. I have been fortunate to have been the recipient of his expert subject guidance and sense of humour. Kevin who began as my supervisor, and, once retired, became my Advisor, has my utmost respect and appreciation.

My supervisors Associate Professor Alan Ovens and Associate Professor Dawn Garbett have provided me with their dedicated support and knowledge. Dr Ovens has shared my entire journey, and Dr Garbett joined more recently. Thank you, Alan, for your measured, calm, and professional responses on my journey, and Dawn, for your enthusiasm, encouragement, and well-thought-out suggestions. I also acknowledge the assistance of Pam Oliver for her expert proofreading skills.

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Contents

List of Tables

List of Figures

Co-Authorship Forms

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Please indicate the chapter/section/pages of this thesis that are extracted from a co-authored work and give the title and publication details or details of submission of the co-authored work. Chapter 4.2 Study 1 – Parental Perceptions of water competence and drowning risk for themselves and their children in an open water environment Stanley, T., & Moran, K. (2017). Parental perceptions of water competence and drowning risk for themselves and their children in an open water environment. International Journal of Aquatic Research and Education 10(1), 4. http://scholarworks.bgsu.edu/ijare/vol10/iss1/4

Nature of contribution by PhD candidate	Drafted research objectives, study design and research tool. Completed research, data input, data cleaning, and data analysis. Drafted publication.
Extent of contribution by PhD candidate (%)	70%

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Name	Nature of Contribution
Kevin Moran	Study 1 - Guidance with research objectives, study design and survey tool. Edited publication. Guidance with publishing.

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and
- that the candidate wrote all or the majority of the text.

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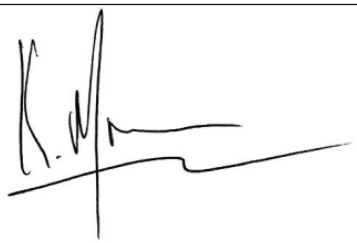
Kevin Moran		8/10/2020

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Please indicate the chapter/section/pages of this thesis that are extracted from a co-authored work and give the title and publication details or details of submission of the co-authored work. Chapter 5.2 Study 2 – Self-Estimates of Swimming and Rescue Competence, and the Perceptions of the Risk of Drowning among Minority Groups in New Zealand – Life Saving or Life Threatening? Stanley, T. & Moran, K. (2018). Self-estimates of swimming and rescue competence, and the perceptions of the risk of drowning among minority groups in New Zealand – lifesaving or life threatening? Journal of Education and Human Development, 7(1), 82-91. http://jehdnet.com/journals/jehd/Vol_7_No_1_March_2018/10.pdf

Nature of contribution by PhD candidate	Drafted and wrote research goals and methodology, and survey tool. Completed research, data input, data cleaning, and data analysis. Wrote publication.
Extent of contribution by PhD candidate (%)	80%

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Please indicate the chapter/section/pages of this thesis that are extracted from a co-authored work and give the title and publication details or details of submission of the co-authored work. Chapter 6.2 Study 3 - Perceptions of water competencies, drowning risk and aquatic participation among older adults Stanley, T., & Moran, K. (in press). Perceptions of water competencies, drowning risk and aquatic participation among older adults. International Journal of Aquatic Research and Education.

Nature of contribution by PhD candidate	Sourced funding. Developed research goals. Drafted methodology and survey. Undertook research, data cleaning, and data analysis. Wrote publication.
Extent of contribution by PhD candidate (%)	85%

CO-AUTHORS

Name	Nature of Contribution
Kevin Moran	Study 3 - Guidance with study design and research tool. Edited publication.

Certification by Co-Authors

The undersigned hereby certify that:

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Kevin Moran		8/10/2020

Last updated: 28 November 2017

Chapter 1 Introduction

1.1 Personal Background

Not a lot is known about how adults construct their understanding of their competence to survive in open water. Traditionally, water competency has been defined in terms of how far a person can swim. Other survival proficiencies such as floating, orientation, entry into and exit from water, and risk perception or water safety knowledge have not been included. In addition, the conditions of the ability to swim a particular distance have tended to be calculated in benign closed water environments such as heated swimming pools.

Any competency base required to survive a drowning situation is dynamic, complex, and multi-faceted. Environmental influences such as colder temperature, deeper or murky water, or water movement may not be considered when defining proficiency, and the competence shown in one environment may not necessarily be appropriate to another environment. Furthermore, the type of activity taking place in or around the water may also influence the likelihood of drowning. What is required to diminish the potential of drowning is contingent on the ever-changing relationships of the three factors of the individual and what the individual brings (fitness, experience, skills, knowledge and capability), the environment, and the activity.

As for many with a passion for water activity, aquatic sports and recreation have been an enormous component in all facets of my life - professional, personal, and health and well-being. My love for swimming was passed on to me by both my parents, one a life member of our national swimming association and the other current patron of our local club and regional association. Around the age of six I followed my older siblings to swim training and club nights. Decades after representing New Zealand at swimming, I still swim two or three times per week, albeit at a more relaxed pace.

At age 14 years, old enough to qualify and volunteer as a surf lifeguard in New Zealand, I followed my brother into the surf lifesaving movement and have remained associated with that organisation ever since. In that first summer as a lifeguard I achieved my first solo rescue. I swam out towing a neoprene rescue tube, wearing fins, and completed the rescue by providing the rescue tube for flotation, fastening the rescue tube around the chest of the victim and

swimming him back to shore. I am very grateful to my patrol captain who swam out with me, guided me through the rescue and enabled me to ‘save a life’. The victim was a much older (to my 14 years) and much larger male. Full of adrenaline myself, I didn’t stop to ask the questions then about why he needed to be rescued - why couldn’t he stay afloat, why was he out of his depth if he couldn’t float, why couldn’t he swim back to shore, why did he think it was safe for him to be swimming where he was, why was he swimming alone, and did he think he was a good enough swimmer to be swimming where he was?

Summer holidays throughout my school and university undergraduate degree years were spent at swimming and surf lifesaving training camps or competitions, or in volunteer or professional lifeguarding, in between family boating and scuba diving activities. I was fortunate to travel both within New Zealand and internationally, competing in both swimming and surf lifesaving.

Once qualified I joined the education system teaching secondary students health and physical education. The difference in students’ water competencies between the two schools I taught at, one a low decile co-educational South Auckland school, the other an inner-Auckland city high-decile girls’ school, was marked. It did not escape me that the aquatic opportunities I had always had, and expected, were available for some but not everyone.

I started to specialise professionally in aquatics when I began a role with the Auckland Surf Life Saving Association (now Surf Life Saving Northern Region) co-ordinating the secondary school Surf Survival Scheme, teaching teachers, and extending to 17 outposts throughout New Zealand. We also developed surf safety resources for primary schools and intermediate schools. When the position was taken over by Surf Life Saving New Zealand, I also played a role developing the first resources for nipper (7-13 years) parents and coaches. When Water Safety New Zealand (WSNZ) closed its regional Auckland office, we established WaterSafe Auckland (now called Drowning Prevention Auckland) to lead and co-ordinate water safety in the Auckland region, where I became an inaugural board member. I have undertaken numerous roles at Drowning Prevention Auckland which has given me extensive theoretical and practical expertise in drowning prevention. Roles include instigating and delivering programmes including new settlers, home pool safety and council Geographic Information System (GIS)

mapping of water safety hazards for Waitakere and Manukau City Councils, as part of an early childhood programme, as well as Business Manager and current Research Manager.

Aquatic sports and recreation have provided me with many opportunities to live, learn and enjoy. While I acknowledge that most people may not want to be involved at quite the same level as me, aquatic activity in open water is a popular pastime. This dissertation intends to answer some of the questions that I asked myself after my first rescue so many years ago.

In high-income countries it is adults, rather than children, who have higher numbers of drowning. This research has focussed on adults as the key drowning population in New Zealand. Minority ethnic groups and older adults are two key adult risk groups overrepresented in drowning statistics in New Zealand. Parents and caregivers, responsible for children in their care, are another significant group when addressing drowning prevention because they have the dual responsibility of avoiding drowning for themselves and those in their care. Information on perceived and actual water competence and risk of drowning in open water was sought from adults in these three population groups to provide knowledge to assist in the prevention of drowning.

Reporting of drowning and promotion of drowning prevention are often viewed through the lens of pragmatism but are often not well informed by theory. The traditional solution for preventing drowning has been to teach swimming, an approach which has been widely endorsed even though it solves only part of the problem. The difference between people's perceived and actual water competence may cause people to be unaware or underprepared. Addressing this gap in the current knowledge can assist in guiding education toward a more holistic solution to reducing drowning. The present research, by way of portfolio, adds to the understanding of the aquatic competence needed to be safe in open water environments. It provides answers to the questions about why my drowning victim, and many other adults, fail to comprehend the issues around safety in open water. It discusses the gaps in water competence identified between what people can do, and what they think they can do, in open water, and how that gap may lead to an underestimation of risks in open water environments.

1.2 Aims of Research

This doctoral research informs the field of drowning prevention by adding to the understanding of the perceptions and reality of open water competence required to prevent drowning, including what people perceive as the level of water competence needed to be safe in open aquatic environments.

Research Questions

The focus of this research is the disparity between what competencies people perceive they need to be safe in open water, and their competence in coping in open water environments. The results show an underestimation of the risk, together with an overestimation of competence. This research hypothesised that the wider the gap between perception and reality, the greater the likelihood of drowning, and conversely, the closer reality is to perception, the greater the likelihood of preventing a drowning situation in an open water environment.

The overarching research question was to examine the perception and realities of water competence, utilising the wicked problem framework (see p. 11) that underpins open water drownings in New Zealand. The research has been developed in four distinct studies. The specific research focus of Study One (Stanley & Moran, 2017) is to explore the beliefs of adults and their children as to their current perceived water competency and estimation of drowning risk associated with open water activity. Study Two (Stanley & Moran, 2018) extends that exploration into people's beliefs and perceptions of competence in open water among those in high-risk groups (Māori and Pasifika). Study Three (Stanley & Moran, in-press) investigates similar beliefs and perceptions with an emerging high-risk group (older adults). Finally, Study Four examines real and perceived adult water competencies both in pool and open water environments.

The following research questions were developed:

i. What factors lead to the gaps between people's perception of how safe they think they are in open water and how safe they are in reality?
ii. What causes the mismatch between perceived and actual water competence and risk estimation in open water?

iii. If any gaps are shown, are they different for groups at high risk of drowning?

iv. Does increased competence change the perception of risk relative to the actual risk?

I draw on the paradigm of pragmatism to answer these questions. The traditional assumption in the prevention of drowning has been to rely on the development of swimming distance competence. Swimming competence may not be a full solution, and may even be part of the problem, if increasing confidence leads to underestimation of risk (Baker et al., 1992; Brenner et al., 2003). As a paradigm, pragmatism is based on the pragmatic approach of what works best when undertaking research, while also being cognizant of the research goals and methods (Kaushik & Walsh, 2019; Morgan, 2014). Pragmatism allows for the development of "real life" solutions to investigate "real life" situations, such as most drownings occurring in open water, and when exploring diverse assumptions around prevention of drowning including the gaps between how competent people think they are, and how competent they really are, and the gaps between real and perceived risk.

The knowledge derived from each of the present studies develops in an emergent and scaffolding manner, each coming from different perspectives. The first three studies were precipitative, asking people what they think they need to survive a possible drowning event before any event has occurred. Study One (Stanley & Moran, 2017) considered beliefs of water competence and drowning risk with parents and their children. Study Two (Stanley & Moran, 2018) built on this knowledge by studying the ethnic groups identified as high-risk drowning groups in New Zealand (Māori and Pasifika). In Study Three (Stanley & Moran, in-press) my target group was older adults aged over 65 years, an emerging high-risk group. In Study Four, I examined the reality versus perception for adults, in both a pool and open water, and the differences between their real and perceived water competencies.

Each study questioned the hypothesis, how much of a given drowning occurrence is due to the reality gap between competence and perception. Wicked problems are tricky, often social problems, that are not solved by a linear solution (Australian Government, 2007; Bore & Wright, 2009; Rittel & Webber, 1973; Whyte & Thompson, 2012). The wicked problems lens provided a theoretical framework for the development of knowledge in these four studies.

1.3 Drowning Prevention Model

I developed a drowning prevention model to test each of the three factors (individual – task – environment) that may contribute to a drowning, along with their respective relationships to risk and competencies, and to perceptions and realities.

Figure 1.1 shows the model developed to explore the interactions across various factors – perceived and real risk, and perceived and real competency - and how they variously play a part in drowning prevention. This model has been adapted from Langendorfer's (2011) adaptation of Karl Newell's (1986) constraints model, which includes individual characteristics, task factor and environmental conditions for drowning. In Langendorfer's (2011) model, and the subsequent model I developed, individual factors include demographics such as age, gender, ethnicity, socio-economic status and culture, as well as other individual characteristics such as personal physique, experience, frequency of participation and water competence. Environmental factors include water and air temperature, water depth, water clarity, water movement including waves, rips and currents, and slippery or dangerous ground surface both under and around the water; and could vary in any environment such as a pool, lake, river, beach, harbour or open sea. Activity differentiates the type of aquatic activity that was taking place in or around the water. This research is focused on swimming in open water, although the model could be useful to develop understanding for other activities and environments.

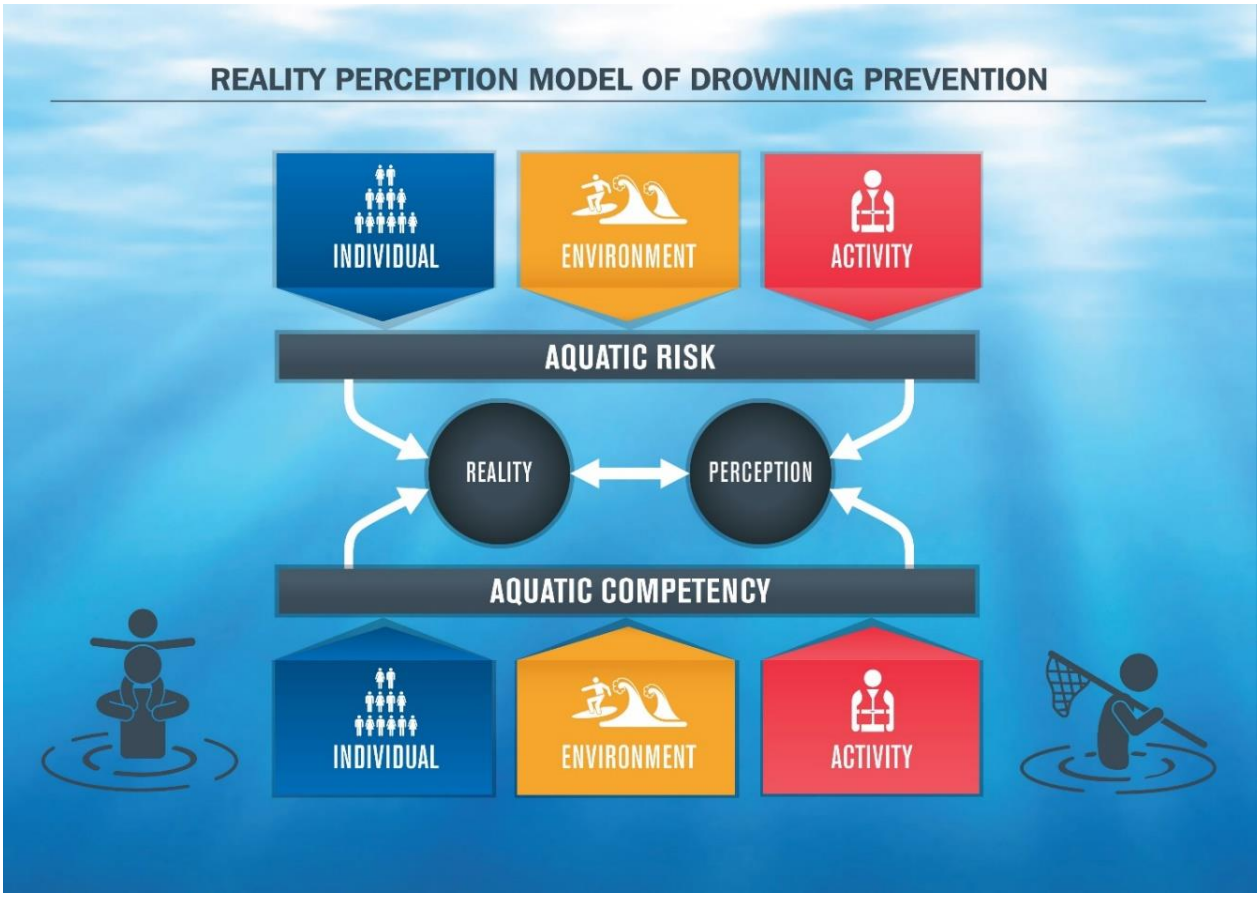

Figure 1.1 Drowning Prevention Model

The present research tests the model I developed. It explores the relationships between the perception of aquatic competency and the individual (gender, ethnicity and age), the environment and the activity. It also investigates the relationships between perception of risk and how people are influenced by the individual factors, environments and activities. The focus for the individual factors is where drowning statistics have shown high-risk groups to be male, minority ethnic groups and age specific (Water Safety New Zealand, 2020a). The research concentrates on the activity of swimming in the open water environment which accounts for almost one-fifth (19%) of all fatal drowning in the five years from 2015-2019 (Water Safety New Zealand, 2020a). It was expected that each of the studies would show that there is a gap in the perceptions of parents and high-risk groups, of their competence and risk, when compared to the actual competencies and risk.

Figure 1.2 shows the complexity of the interactions within the components. The model shows how the individual, environment and activity factors affect both risk and competency, and the reality and perceptions of both competencies and risk are shown to influence drowning prevention. The intricacies of these relationships suggest the prevention of drowning is a wicked problem.

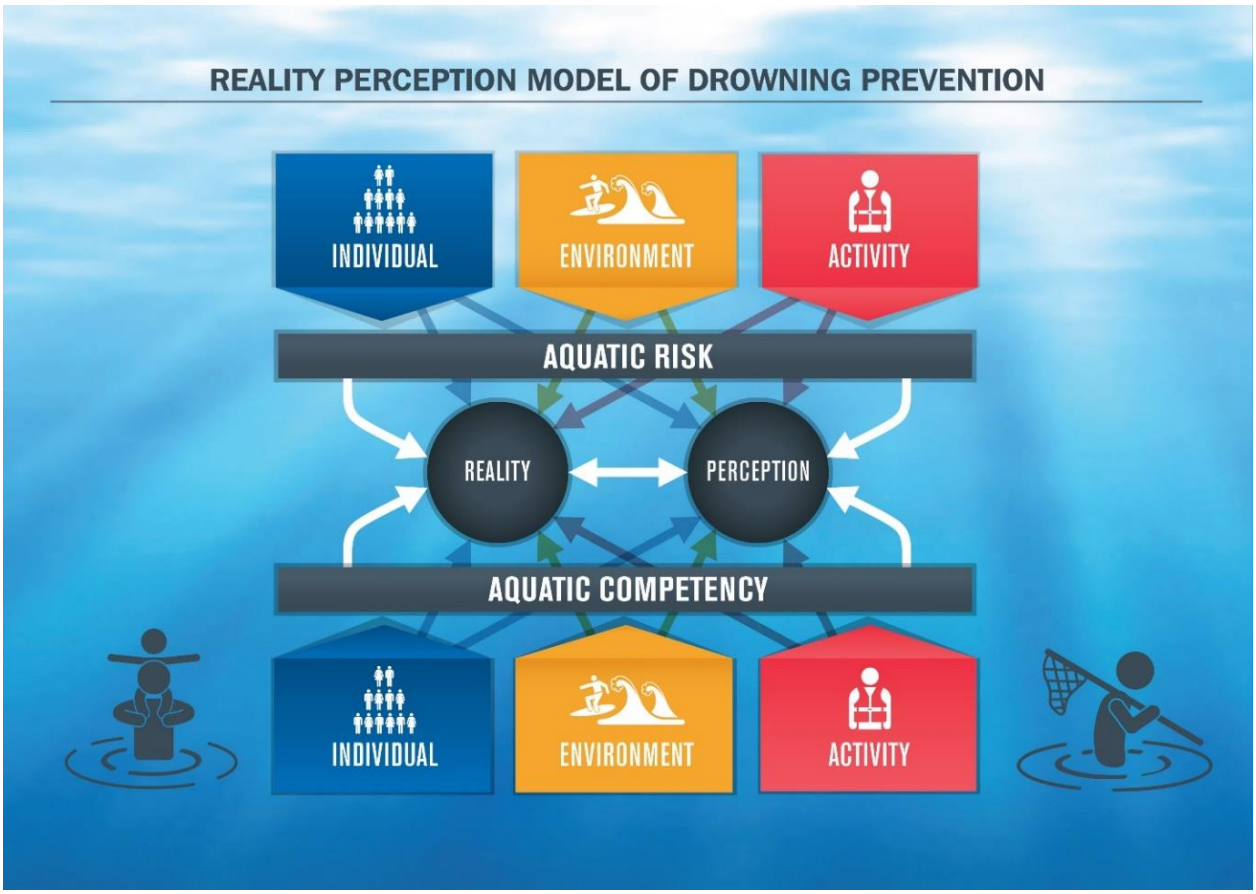

Figure 1.2 Drowning Prevention Model with Interactions

It is hypothesised that there is a reality gap in the perceptions of what people think is good enough to be safe, and what experts think is good, and that the closer perception matches reality (as in Figure 1.3), the higher likelihood of the prevention of drowning.

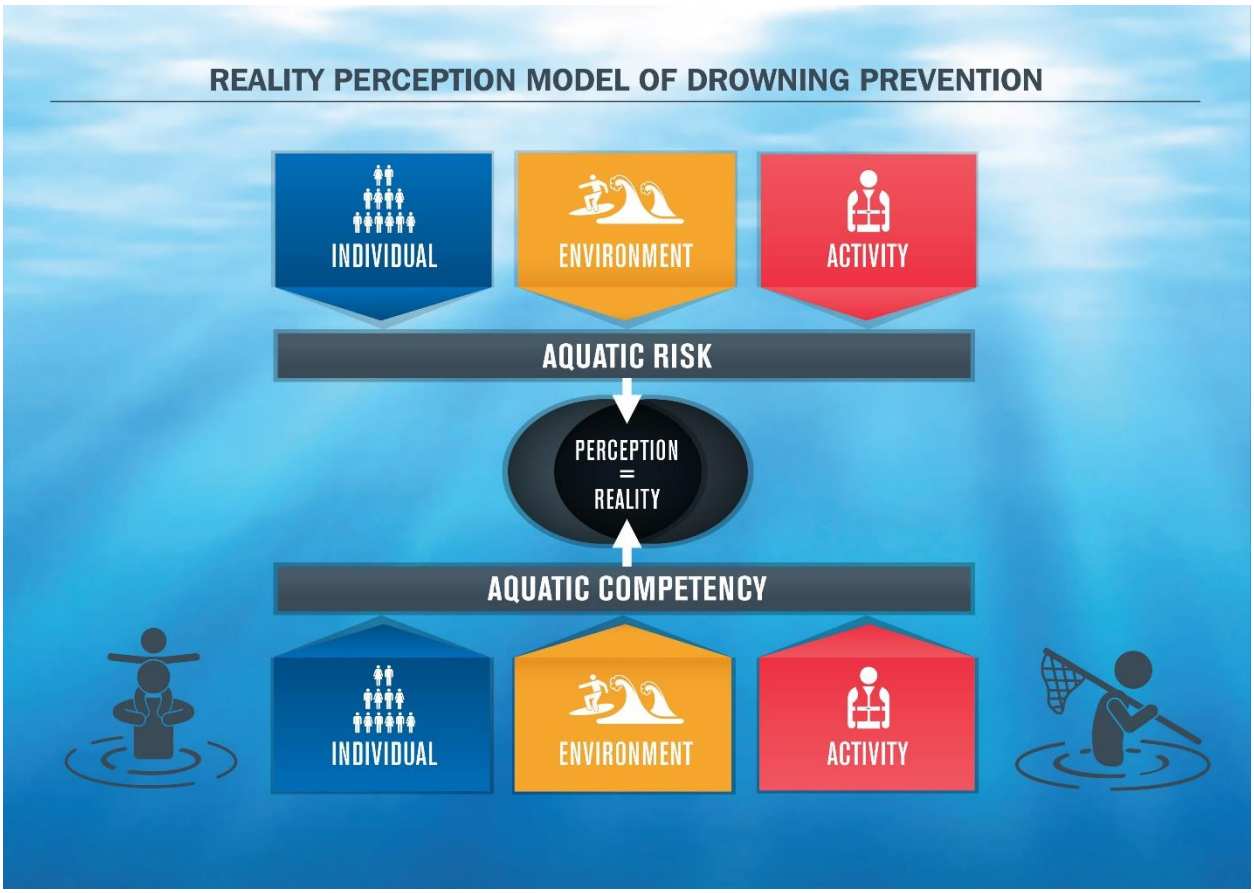

Figure 1.3 Drowning Prevention Model – Closure of Gaps

In high-income countries where circumstances surrounding drowning are well recorded, evidence shows that drowning is influenced by a combination of the three factors - the individual and the attributes the individual brings, the environment, and the activity taking place. In New Zealand, a comprehensive database of drowning fatalities (Drownbase™) provides valuable information on individual, environmental and activity-related influences (Water Safety New Zealand, 2020a). Each of these factors may impact on water competency, and it is suggested that this competency is dynamic and dependent upon the individual and their abilities, the variance of the environment and the nature of the activity. Furthermore, it is possible that ones' ability to cope with the risk of drowning may be overestimated. This overestimation in competence may be one reason people underestimate the risk, while others could be lack of knowledge of the environment or lack of access to protective equipment for various activities; however, it is suggested that it is the gap between the perceived risk and the actual risk that is the main issue in

drowning. This model, conceptualised to test the complexities and theories, intended to add knowledge to the causes of drowning.

1.4 Complex, Wicked or just a Mess?

The reasons people drown have been described as 'complex and multi-faceted' (Moran, 2013a). Age group, gender, ethnicity, socio-economic status, attitudes, activity, environment, weather, supervision, equipment, frequency of participation and experience are all factors that may contribute to the likelihood of a drowning occurring. Furthermore, levels of water competence and risk, both perceived and real, add another dimension for consideration. It follows, therefore, that the solution aimed at preventing drowning, is equally complex and multi-faceted.

Although complex by character, drowning does not necessarily fit into complexity thinking. Complexity thinking originated in the sciences from fields such as physics, biology, chemistry and economics (Mason, 2008), and in the past two decades has made its way into the social sciences fields such as education (Ovens et al., 2013a) and health promotion (McQueen, 2000). For a system to be considered complex it displays nonlinearity, unpredictability, and adaptability, and is interlinked and co-dependent but not stable (Ovens et al., 2013b; Tinning & Rossi, 2013). While complexity thinking shares a dynamic systems theory with drowning (Mason, 2008), complex systems are adaptive and more emergent in solving problems within its own system.

Conklin (2006) suggests social complexity and wickedness are the two most dividing components in many complex issues, adding another layer of difficulty to rectify the issues. Wicked problems are about people and society, and are therefore inherently complex and adaptive (Ritchie, 2013). However, somewhat a misnomer, wicked problems are not solvable or have no clear solutions. Furthermore, whilst fundamentally complex in nature (Trowler, 2012) wicked problems are not simply complex (Whyte & Thompson, 2011).

'Social messes' are sets of interrelated problems and other 'messes' (Horn & Weber, 2007). 'Mess mapping' or 'resolution mapping' could be used within the drowning prevention sector to provide a resolution for the many components of drowning prevention (Horn & Weber, 2007).

The present research has utilised the theory of 'wicked problems' as a framework to discuss the problem of drowning. This framework allowed an opportunity to take a holistic perspective of the drowning issue in search of the many solutions and is recommended for solving complex policy issues (Whyte & Thompson, 2012). Bore and Wright (2009) argue that a wicked problem

is misunderstood if a ‘tame’ or linear solution is implemented to solve it. It will likely fail, or the problem will reappear, or be accelerated by the tame solution.

Originally devised by Rittel and Webber (1973) to describe the complicated issue of planning, a wicked problem is a multi-faceted problem where every problem is distinct, and each problem has an exclusive solution (Bore & Wright, 2009).

For a problem to be accepted as ‘wicked’ it must include the following aspects (Australian Government, 2007; Rittel & Webber, 1973; Whyte & Thompson, 2012). Wicked problems:

- are difficult to define
- have many interdependencies and often multi-causal
- often lead to unforeseen outcomes when attempting to solve them
- have no clear solutions
- are often unstable
- are socially complex
- are never the responsibility of one organisation
- involve changing behaviour
- are characterised by chronic policy failure
- are unique and novel

These aspects can be interpreted within the issue of drowning and water competence in open water settings, as follows:

- Difficult to define the problem as well as the solutions and terminology, such as swimming and water competence
- Have many interdependencies within the issue such as the links between ethnicity and activity, or perception versus real water competence.

- Attempts to address wicked problems often lead to unforeseen consequences, such as when an increase in competence leads to an overreliance on competence as a protection from drowning
- Often not stable, in that drowning numbers are often reflective of the increased exposure to amenable weather systems
- No foreseeable endpoint to the wicked problem; whilst targets can be made to reduce drowning, there may be no likelihood of eliminating drowning entirely, therefore there may be no definitive validity to the 'true' solution
- Innumerable solutions to help reduce drowning, such as environmental design, education, developing water competence or placement of lifeguards
- Socially complex, such as links with various socio-economic groups and developing water competence, or gathering kaimoana (seafood) for pleasure or necessity
- Usually more than one organisation required to solve the problem; most wicked problems involve collaborative and coordinated action from a range of stakeholders at local, regional, national and international levels, as is the case for the multi-sectorial issue of drowning
- Involve changing behaviour to reduce the problem, such as the documented behaviour change for rock fishers in wearing lifejackets and the subsequent reduction in rock fisher drownings
- May be characterised by chronic policy failure; one example in New Zealand is the lack of consistent national policy around the wearing of lifejackets on vessels and the numerous and varied regional by-laws in existence
- Every unique problem is different, therefore cannot use previous solutions. Resolutions that help to address other problems in society may not be appropriate in the prevention of drowning

*"*Drowning is a significant, complex, and multifaceted phenomenon, which has at its heart, the way in which humans interact with their aquatic environment" (Moran, 2013a p.7). Although drowning is dynamic and complex, the 'wicked' problem context may provide a better framework to understand the drowning problem. The studies in this research test the theory of adapting wicked problems to the drowning problem.

1.5 Structure of Portfolio

Limited information is available about the water competencies required by adults to provide protection from drowning, especially in open water environments where most drowning incidents occur.

The broad aim of the present research was to enhance knowledge of the complexity of drowning events and their prevention by exploring the relationship between competence in open water environments and the factors that influence how people perceive water competence, safety and risk in open water settings.

The conceptual framework presented in Figures 1.1, 1.2 and 1.3 was developed to provide a means of conceptualising initial thoughts about the relationship between people's perceptions of their aquatic competency, their actual competency, their perception of risk, and the actual risk in open water environments.

The present research is a portfolio of published studies, and each study has its own review of the literature germane to that particular study. A comprehensive review of the literature (Chapter 2) contextualises the whole research, highlighting significant gaps in current knowledge. It also includes material about the development of a theoretical framework that ties together the four studies. This review informed the following areas of research focus and research objectives.

Study One - Chapter 4 Perceptions of Water Competency among Parents and their Children

Chapter 4 explored the perceptions of risk and competency among parents and their children, to assess the level of competence that parents perceive that they and their children need in order to be safe in open water environments. The level of competence at which people feel that they, or others in their care, are safe to swim in an open water environment is currently unknown. Parents are a group who have responsibility for both themselves and their children. While some evidence is available on parental perceptions of safety and risk at the beach (Moran, 2009a, 2010), little information is available on what constitutes 'safe' levels of swimming competence for self or others in open water.

Objectives:

i. To determine the perceived swimming competence of parents/caregivers and their children

ii. To determine what parents/caregivers perceive as being a competent swimmer in terms of drowning prevention for themselves and their children

iii. To determine if swimming competency in open water affects the perceived level of safety

iv. To determine what level of swimming competency the public consider is required to be safe in open water

Study Two - Chapter 5 Water Competency among Māori and Pasifika

Chapter 5 builds on the initial supposition that certain ethnic groups were more at risk than other groups. Māori and Pasifika ethnicities are at high risk of drowning in New Zealand and are overrepresented in drowning statistics (Water Safety New Zealand, 2020a). Study Two (Stanley & Moran, 2018) sought information on the perceived water competencies among Māori and Pasifika adults to explore their estimated perceived safe levels of competence and risk in open water environments.

This study aimed to investigate the perception of competency and risk of drowning in open water in an adult population at high risk of drowning (Māori and Pasifika).

Objectives:

i. To determine perceived swimming competence in closed water environments

ii. To determine perceived self-competency in open water environments

iii. To determine perceived competence to rescue people in open water

iv. To determine attitudes towards risk for various open water scenarios

v. To determine ability to assess risks in open water environments

Study Three - Chapter 6 Water Competency among Older Adults

Chapter 6 investigates aquatic participation, attitudes and perceived risk and water competence for older adults over 65 years of age. Older adults are becoming more susceptible to drowning (Water Safety New Zealand, 2020a). Although older adults are an increasing proportion of the whole population in many high-income countries such as New Zealand, their proportion of the drowning toll is growing at even greater rates (Ministry of Health, 2019; Wilson, 2018; Water Safety New Zealand, 2020a). The aims of Study Three (Stanley & Moran, in-press) are to determine the nature and extent of aquatic recreation among older New Zealanders, and explore their perceptions of their practical water competency and their understanding and practice of water safety when engaged in aquatic recreation.

Objectives:

i. To determine if older adult aquatic participation differs from that of other population groups

ii. To determine the drowning risks for older adults relating to their drowning incidents and participation

iii. To determine if older adults differ from other population groups in their perceptions of water safety and risk of drowning

iv. To determine the water safety attitudes and behaviours of older adults and if those differ from other age groups

v. To determine the perceptions of water competencies among older adults and how those relate to risk perception and aquatic participation

Study Four - Chapter 7 Perceived and Actual Water Competency

Chapter 7 explores actual adult water competencies in a pool and open water, in particular the relationship between perceived and real water competencies and risk perception for adults.

Objectives:

i. To determine the perceived levels of a range of water competencies for adults

ii. To determine actual adult water competencies in a closed pool environment

iii. To determine actual adult water competencies in an open water environment

iv. To determine the drowning risk perceptions of adults

v. To determine any gaps or relationships between perceptions of drowning risk and perceived and actual water competencies

In the concluding chapter, Chapter 8, I draw together my findings from all the studies. I discuss the limitations of the studies and future areas that need to be investigated more thoroughly.

Chapter 2 Review of Literature

> Drowning is a significant, complex, and multifaceted phenomenon, which has at its heart, the way in which humans interact with their aquatic environment. (Moran, 2013a, p. 7)

Drowning has been described in the World Health Organisation (WHO) 'Global Report on Drowning' (2014) as a "serious and neglected public health threat claiming the lives of 372 000 people a year worldwide" (p. vii). Furthermore, this number is likely to be underestimated, as many countries do not include all drowning deaths, excluding those caused by intentional means, flood disasters, and water transport or boating incidents (WHO, 2014). Globally, at least 91% of drownings occur in low- to middle-income countries, males are twice as likely to drown worldwide compared to females, and more than half of those who drown are under 25 years of age (World Health Organisation, 2014).

The *Global Burden of Disease Study* (Lozano et al., 2012) estimated a global mortality rate of 5.1 deaths per 100,000 population, with a total of 439,100 unintentional international drowning deaths in 2010, a drop in the rate from 7.5 in 1990. Recent data shows this trend continuing with the 2017 global mortality rate estimated lowered to 4.0 per 100,000 (Franklin et al., 2020). A disparity is evident between high- and lower-income countries. High-income countries have a much lower drowning rate than lower-income countries, estimated at 2.3 per 100,000 (World Health Organisation, 2014). In high-income countries drowning usually occurs as a result of exposure to water through recreation, whereas in low- and middle-income countries drowning is often through everyday activities such as bathing or washing (International Life Saving Federation [ILSF], 2007).

Drowning rates currently seen in low- and middle-income countries are less than what many high-income countries used to experience historically. One example is New Zealand, where in the late 19th century drowning was referred to as the New Zealand Death (Moran, 2010a; Pascoe, 1971). Not only has the rate of drowning in New Zealand been reported as being high, in 1863 with a drowning rate of 86 per 100,000 population being much higher than most low-income countries in modern times, it was more than four times the rate in England and Wales, at 14 per 100,000 at that time (Madle, 1996; Maynard, 2013).

The reduction in drowning rates amongst high-income countries over the last 10–20 years has been attributed to the implementation of numerous initiatives through the combined efforts of many organisations. For many years high-income countries have implemented initiatives to minimise risks, such as introducing barriers, signage, lifeguards, policy (lifejackets, pool fencing) and education (water competencies and supervision) to combat drowning.

Global Drowning Solutions

In 2017, the World Health Organisation released an implementation plan, 'Preventing drowning: an implementation guide – 2017', based on the following six evidence-based interventions and four strategies to assist drowning prevention organisations and practitioners, researchers, government officials and policymakers to approach drowning prevention from a collaborative, strategic and evidence-based perspective (WHO, 2017).

Interventions

- Install barriers controlling access to water
- Provide safe places (for example a day-care centre) away from water for preschool children, with capable childcare
- Teach school-age children swimming and water safety skills
- Train bystanders in safe rescue and resuscitation
- Set and enforce safe boating, shipping and ferry regulations
- Build resilience and manage flood risks and other hazards locally and nationally

Strategies

- Strengthen public awareness of drowning through strategic communications
- Promote multisectoral collaboration
- Develop a national water safety plan
- Advance drowning prevention through data collection and well-designed studies

Recently some of these strategies have been introduced successfully to reduce drowning in low- and middle-income countries such as Bangladesh, Sri Lanka and Vietnam (Life Saving Association of Sri Lanka, 2014; Nguyen et al., 2020; Rahman et al., 2010, 2014).

Drowning in New Zealand

Despite the high total drowning numbers worldwide, New Zealand drowning death rates have been slowly reducing since the introduction of drowning data collection in 1980 (Water Safety New Zealand, 2020a). New Zealand ranked around the middle (32nd) in a study of the drowning rates of 60 countries from 2007–2009 (Lin et al., 2014). More recent data show New Zealand with a lower rate sitting alongside the United States at 1.42 (per 100,000), but this is still a higher rate of drowning than Australia (0.80 per 100,000) and the United Kingdom (0.42 per 100000) (World Life Expectancy, 2020). Of the 183 countries listed, New Zealand has the 44th lowest drowning rate.

New Zealand has similar high-risk drowning factors in terms of gender, age and minority groups as other high-income countries such as Australia, Canada and the United Kingdom (Drowning Prevention Research Centre Canada, 2018; National Water Safety Forum, 2018; Royal Life Saving Society Australia, 2020).

For the five-year period to 2019, New Zealand had an average of 82 preventable drowning fatalities per annum (Water Safety New Zealand, 2020b) for recreational (where people had intended to be in the water) and non-recreational (when people had no intention of being in the water) incidents. Individual traits such as gender, ethnicity and age highlight the groups at risk of drowning. As in other countries, drowning is predominantly a male risk. Males are four times more likely to drown than females in New Zealand, comprising 80% of the national drowning toll (Water Safety New Zealand, 2020b).

Both New Zealand Māori, the indigenous people of New Zealand, and Pasifika are marginally overrepresented in national drowning fatalities. Although NZ European comprised almost half (46%) of the drowning toll for the five years to 2019 (Water Safety New Zealand, 2020b), two-thirds (64%) of the New Zealand population identify as NZ European (Statistics NZ, 2020). Similarly, Asian ethnicities make up 13 percent of the drowning fatalities, where 15 percent of the population identify as Asian. In contrast, one-fifth (19%) of all drowning fatalities in New Zealand were Māori and one tenth (10%) Pacific peoples, more than the percentages that identify with those ethnicities in the general population (Māori 17% and Pacific peoples 8%) (Statistics NZ, 2020; Water Safety New Zealand, 2020b). The issue with overrepresentation

among ethnicities becomes more apparent at a regional level. Pasifika ethnicities comprised one-third (31%) of the Auckland drowning toll for the five years to 2019 (Water Safety New Zealand, 2020b), while accounting for 13% of the Auckland population (Statistics NZ, 2020).

In the early years of the 21st century, children aged under five years were drowning in similar numbers as youth aged 15-24 years, a rate generally accepted to be high risk (Child and Youth Mortality Review Committee, Te Rōpū Arotake Auau Mate o te Hunga Tamariki, Taiohi, 2009) and similar to current child drowning rates in low- and middle-income countries (Rahman et al., 2009; World Health Organisation, 2014). More recently, childhood drowning has dropped dramatically in New Zealand, and adults of all ages are an emerging drowning risk. For the five years 2015-2019, children 14 years and under comprised less than one tenth (8.5%) of total drowning, with all other age groups (in 10-year brackets) ranging from 13-18 percent (15-24 years 17.6%, 25-34 years 15.4%, 35-44 years 13.7%, 45-54 years 14.2%, 55-64 years 13.7%, over 65 years 16.7%) (Water Safety New Zealand, 2020b). Of concern is the gradual increase in both drowning percentages and numbers among adults aged over 65 years.

The majority of the deaths in New Zealand occur in open water, either when the victim was purposefully in the water (39%) or after falling in (42%) (Lin et al., 2014), highlighting the open water environment as high risk. Almost all (90%) drownings in the five years 2015-2019 have occurred in open water settings, with the highest three risk environments accounting for almost two-thirds (63%) - beaches 26%, rivers 22%, and offshore (classified as within 1km or more offshore) 15% (Water Safety New Zealand, 2020b).

Unintentional immersion, when people have fallen into or not intended to enter the water, accounted for almost one-third (31%) of drowning deaths in the past five years (Water Safety New Zealand, 2020b). High risk activities include swimming and boating, accounting for one-fifth each (22% and 20% respectively) of drownings in the five years to 2019 (Water Safety New Zealand, 2020b). Aquatic recreational activities are popular in New Zealand. Almost one-third (30%) of New Zealand adults reported having swum in the previous 12 months (Water Safety New Zealand, 2018a), with swimming being the second most popular of all recreational activities and the most popular aquatic activity (Sport New Zealand, 2015, 2018). An additional fifth of the population (20%) participated in fishing and almost a tenth (8%) in

canoeing/kayaking. Furthermore, almost one-half (42%) of adult New Zealanders either own or spend time on a recreational boat (Griffiths et al., 2018).

High levels of recreation in water and frequent exposure to water have been suggested as reasons for New Zealand's high drowning toll (Langley et al., 2001). However, this present research is posited on the notion that underestimation of risk and overestimation of water competency offers a more comprehensive explanation of why people drown.

Development of 'Water Competence'

Traditional drowning prevention initiatives have included the development of swimming skills. The inference of 'swim and survive' is that if one can swim, one can survive - that is 'swim' equals 'safe' - which may not necessarily be the case. Unfortunately, no clear definition of what constitutes swimming ability has evolved. The lack of an international measure to define swimming competency is suggested as one reason that people may have an exaggerated confidence in their swimming competence (Dixon & Bixler, 2007). A shared understanding of terminology is recommended by frameworks such as Collective Impact that measure the outcomes of the efforts of groups of organisations aiming to achieve common goals, as in the prevention of drowning (Collective Impact Forum, 2020; Friedman; 2005).

A transition to include water safety education has come about in recent years. Moran et al. (2011) used the Delphi process to develop internationally applicable public water safety messaging for swimming in open water. Eighteen experts from 12 countries agreed on 16 open water safety messages in two categories: keeping yourself safe; and keeping others safe. The first message in each category is "Learn swimming and water safety skills" (p. 3), noting, however, doing so may assist but not guarantee safety. Supporting this message, the WHO 'Global Report on Drowning' (2014) also stresses the importance of teaching water safety in its third point of Actions to Prevent Drowning - "Teach school age children basic swimming, water safety and safe rescue skills" (p. 18) - and the WHO 'Preventing drowning: an implementation guide' (2017) intervention - "Teach school-age children swimming and water safety skills" (p. 30), although neither addresses the aquatic competency of adults to ensure their own safety, or that of their children.

Recent evidence about swimming competency has highlighted concerns not only around what swimming competency actually means, but also around the differences between real and perceived swimming ability (Moran et al., 2012; Petrass et al., 2012; Stallman et al., 2010). Anecdotal evidence suggests that many open water drowning fatalities involve victims who are described post-incident as being good swimmers. Furthermore, rescue victims on current reality television series (such as *Piha Rescue* in New Zealand, *Bondi Rescue* in Australia) often describe themselves as good swimmers. Given that the thrust of many drowning prevention programmes is to improve the practical swimming competency of participants (often children in the first instance), the critical issue in open water drowning prevention is how good is good enough, especially in an environment that may be considerably more challenging than the one in which swimming competencies were learned and practised.

More recently it has become accepted that developing personal water competence is one of the initiatives successful in the prevention of drowning in open water environments. The ILSF (2007) position statement recommends everyone should have access to training in water safety, personal survival, and water rescue, as well as knowledge and understanding of water environments and hazards. What isn't as clear is the understanding of the term 'water competence' and what competencies should be included. Langendorfer and Bruya (1995) introduced the term 'water competence' to include not only a swimming distance competency, but also other competencies and knowledge associated with aquatic participation. Brenner et al., (2006) in *The Handbook on Drowning* (Bierens, 2006) supported the holistic terminology of 'water competence'. They recommended that while swimming ability is an important factor in the prevention of drowning, that it be replaced by the more inclusive concept of water competency. Subsequently Moran (2013b) defined water competence as "the sum of all personal aquatic movements that help prevent drowning, as well as the associated water safety knowledge, attitudes and behaviours that facilitate safety in, on and around water" (p. 4). This definition encompasses not only swimming competence, but also water survival skills such as floating, orientation, submersion, entering and exiting the water safely, and rescue skills, as well as the knowledge and critical thinking to enable safety in aquatic environments. A recent review of 14 international organisations (Quan et al., 2015) recommended the inclusion of five physical competencies, including propulsion through the water, safe entries and exits, submersion, recovery, and changing body position. However, this definition excludes the component of

specific knowledge and risk awareness that is acknowledged as an important factor in the prevention of drowning. The present research accepts the holistic understanding of water competence and includes swimming and water safety competencies as well as the knowledge and critical thinking required to enable safety in and around water environments.

Traditionally, water safety programmes have focussed on learning to swim. 'Learn to swim' programmes with swimming distance as a measure of competency have conventionally been implemented as a preventative measure of drowning; however, the distances used to assess competencies have varied. In 2015 in New Zealand, a distance of 200 m (Water Safety New Zealand, 2015a) had been set as a benchmark for all school children to achieve by the time they have completed primary school (approximately 11 years old). Similar distances have been set as guidelines in other countries. In the United Kingdom (UK), the highest level of the Amateur Swimming Association (ASA) *Learn to Swim* Pathway contains a continuous swim of 100 m, comprising 25 m of each of the four competitive strokes, and a separate routine of other water competencies (Amateur Swimming Association, 2015). More recently other aquatic skills have been included in competency measures. The Canadian Lifesaving Society *Swim to Survive* programme standard is set at 50 m, but also includes a roll into deep water as well as treading water for one minute (Lifesaving Society Canada, 2015). Australia's Royal Life Saving Society's *Swim and Survive* programme requires a swim of 150 m various strokes together with other competencies at Level 4 (Royal Life Saving Society Australia, 2015) - a target set for all children to achieve by the end of primary school (Australian Water Safety Council, 2012). An international position statement recommended a minimum distance of 25 m in addition to a range of other water competencies including entry/exit, floating and rescue skills (ILSF, 2012).

All these measures, however, are tested separately rather than in a simulated emergency scenario. One suggestion as a solution for this anomaly is the model developed to test water competencies in a progressive circuit as advocated by Stallman et al. (2008) involving a swim combined with other water competencies. Testing the multiple water competencies of children reported a low predictor for the completion of a 200 m combined circuit test even for those children who could swim 1000 m (Junge et al., 2010), or relative to a normal 200 m timed swim (Laakso & Stallman, 2011).

Another concern is that the assessment of competencies is generally completed in a closed pool environment, which may not necessarily protect a person in an emergency that could be in the rough, deep, cold or murky conditions of open water. Testing competencies in outdoor aquatic environments may not be practical or a safe option; however, there are activities and simulated environments that can be replicated to assist in transferring the development of competencies to the open water.

Furthermore, it is becoming more widely accepted that the protective nature of water competence for drowning prevention is relative to the aquatic environment (Kjendlie et al., 2013; Lagendorfer, 2011; Moran, 2013b; Quan et al., 2015). Langendorfer (2011) used Newell's constraints model (1986) to show the interaction between the person (individual)-task (activity)-environment factors and how water competence is affected by the three factors in a dynamic system (Figure 2.1).

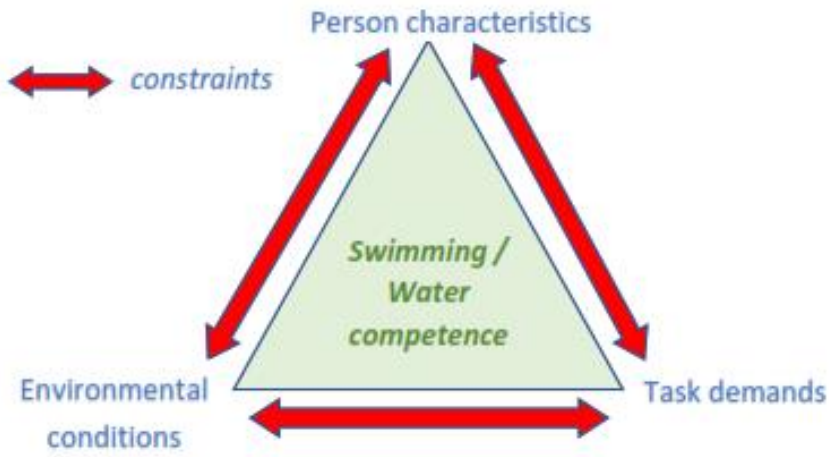

Figure 2.1 Newell's Dynamic Constraints Model (1986)

Individual qualities such as physical size, strength, capabilities, knowledge, and attitudes are at one corner of the competency triangle. The task or activity being undertaken, including any personal equipment such as wetsuits, lifejackets or clothing are at another corner. The third corner comprises the environmental conditions, which include factors such as air and water temperature, water depth, clarity, and movement. Using Newell's model (1986), Langendorfer argues that from the relationships between the three factors, there emerges a level of water competence or drowning risk. Connolly (2014b) supports this theory, reporting that 'pool only

swimmers' are at greater risk of drowning than those who swim frequently in open water environments due to 'First Time Problem' factors such as cold water, the wearing of clothing, or swimming without goggles that swimmers may experience in open water.

Current research shows the evidence to include 15 water competencies for the prevention of drowning (Langendorfer et al., 2018; Stallman et al., 2017). The 15 competencies are adaptable to the activity or environment and each merits its inclusion based on the evidence provided. Competencies 1–10 are in the practical or psychomotor domain, competencies 11-14 are cognitive, and 15 is in the affective domain, collectively covering the individual factors of Newell's constraints model (1986).

The 15 water competencies (in no particular order or skill importance) are:

Psychomotor domain

1. Safe entry
2. Breath control
3. Stationary surface / floating
4. Water orientation
5. Propulsion / swimming
6. Underwater
7. Safe exit
8. Use of Personal flotation devices (PFDs) / lifejackets
9. Wearing clothes
10. Open water

Cognitive domain

11. Knowledge of local hazards
12. Coping with risk
13. Assess personal competency
14. Recognise / assist a drowning person

Affective domain

15. Water safety attitudes, values and behaviours

The ‘no particular order’ is important. Just as it is recognised that all 15 competencies are recommended to be learned for preventing drowning, rather than learning in a linear fashion, each competency is linked to all the others and should be taught in conjunction with them. For example, Water competency 3. *Stationary surface*, floating or treading water, should be taught in conjunction with Water competency 4. *Water orientation*, looking around on the surface for assistance or a safe exit point, and linking in with Water Competency 7. *Safe exit*, to ensure those entering the water, either intentionally or unintentionally, can return to land safely. As another example, teaching beach safety would be to link Water Competencies 2. *Breath control* and 6. *Underwater* with Water Competencies 10. *Open water* and 11. *Knowledge of local hazards* when learning about negotiating how to go under waves.

If swimming distance was the only competence mastered, even if it were to a reasonably proficient level of 200 m, there is likely to be little protection from drowning when in deep or choppy open water, especially if learning to swim had been undertaken in a warm swimming pool. Even the additional skill of floating, or treading water for one minute, is unlikely to prevent a drowning unless there was also the inclusion of other competencies such as experience in open water and how to cope with the risks.

Drowning Prevention Auckland (DPA) has developed a diagram that illustrates each of the water competencies and how they may integrate with one another (Figure 2.2). While each competence merits its inclusion based on the evidence provided (Langendorfer et al., 2018; Stallman et al., 2017), there is also comprehensive research around levels of proficiency for many of the practical competencies.

Evidence has been provided for why each of the 15 competencies must be developed to prevent drowning (Stallman et al., 2017). Further studies have expanded on this evidence or provided suggested levels for some competencies for various sectors of the population, together with the interaction among the competencies.

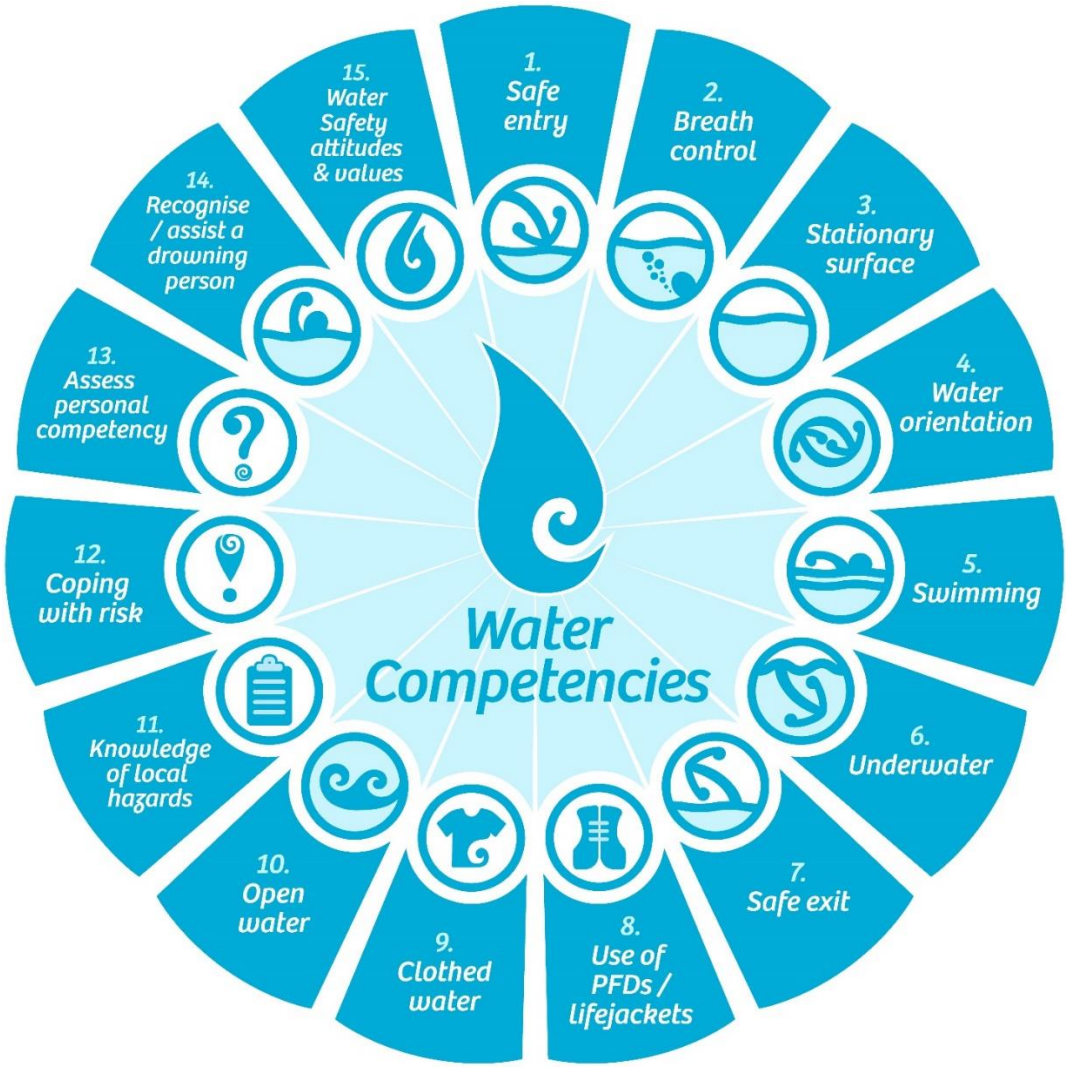

Figure 2.2 Water Competencies for Drowning Prevention (Drowning Prevention Auckland, 2019)

Water Competencies in The Present Research

The present research has focussed on the following competencies: open water (10), assessing and coping with risk (12), assessing personal competency (13), and water safety attitudes, values and behaviours (15). In addition, evidence was sought regarding perceived and real practical competence for safe entries (1) and exits (7), stationary surface floating (3), and swimming (5), and information regarding knowledge of local hazards (11) and recognising and assisting a drowning person (14) was requested.

Open Water

The majority of drownings throughout the world occur in open water (Tyler et al., 2017; World Health Organisation, 2014), and in New Zealand this relates to nine out of ten fatalities (Water Safety New Zealand, 2020b). Open water settings are diverse and include beaches, rivers, waterholes, drains, estuaries, harbours, ponds, lakes, and offshore. Each environmental setting is unique, adding to the complexity of drowning in the dynamic system (Langendorfer, 2011). Water will vary in depth, temperature, clarity, salinity, and movement, each factor requiring specific competence to negotiate.

Most *learn to swim* lessons occur in pool environments, although in recent years extensive child aquatic lessons have been established in open water settings in low- and middle-income countries such as Bangladesh (Rahman et al., 2010; Rahman et al., 2014). The traditional teaching of swimming may not offer protection from drowning in open water settings (Guignard et al., 2020; Sutcliffe et al., 2016). In addition, most research studies have taken place in closed water pool settings. Two studies in simulating open water reported reduced water competency in simulated waves (Kjendlie et al., 2013) and in cold water (Schnitzler et al., 2018). Button et al. (2020) found that many water competencies in children improved after an open water educational programme, although the testing was completed in a pool setting.

One study in an open water setting (Tipton et al., 2008) that compared lifeguard swimming competence variously in a pool, flat open water and surf, found a small decrease in flat open water compared with a pool, but up to 50% decrease in surf. As with swimming in clothes (Moran, 2014a), the less competent swimmers had the greatest reduction in performance.

Assessing and Coping with Risk

The understanding of risk terminology is made more difficult in that there is no commonly accepted definition of risk; it can be a hazard, a consequence, a probability, or a threat (Slovic, 2002). Haddock (1993) refers to Priest and Bailie's definition of risk as the concept of potentially losing something of value. What is considered to be of value will differ greatly across individuals, and may include ‘valuables’ that are physical, financial, social, spiritual, and/or psychological. Rosa (2003) adds to the concept of loss of value as an uncertainty of outcome. The ultimate risk of drowning is loss of life, and while life is considered priceless, in New Zealand the value of statistical life (VOSL) is currently set at NZ$4.53 million (Ministry of

Transport, 2019). Despite the lack of clarity in the definition of risk, the distinction between the reality of risk and the possibility of risk is one that all risk concepts have in common (Renn, 1998). The greater the underestimation of risk, the more likely a preventable event will occur.

Scientists, mathematicians, psychologists, and economists each support various risk perception theories, or a mixture of theories, and there seems to be no consensus in understanding the perception of risks. Slovic (2000) discussed three main theories around risk perception - psychological (experiential and cognitive), sociological (cultural) and interdisciplinary approaches. Wildavsky and Dake (1990) tested an individual's endorsement of risk-taking versus risk aversion in terms of technology for five rival theories of risk perception - knowledge, personality, economic, political and cultural - and found the cultural theory to be the best predictor of risk perceptions and risk-taking preferences, better than knowledge and personality.

It is commonly accepted that the personal evaluation of probability and severity are the two key variables in how people think about risk (Weber, 2003; Weinstein, 2003: Windschitl, 2003). Both threat factors can be measured or processed by hard data in an analytical way. The more knowledge or experience one has in relation to a risk, the more likely a person is to use this analytical method and to perceive a risk through this method (Weber, 2003). Further to this judgement of risk is the concept of *feeling* vulnerable to risk, and Weinstein (2003) argues this factor should also be included in the understanding of risk perception. He argues that the feeling or worry, based on personal experiences, is the best predictor of intentions and behaviour. This view was developed further by Windschitl (2003) who recommends that the perceived probability or likelihood of an event occurring should be measured in two components - beliefs about the objective likelihood of an event occurring, and the intuitive or gut-level feeling a person has about whether an event will occur. An example in an open water environment is that some people may be anxious about shark attacks even though they know there has never been an attack in that vicinity.

The introduction of the worry or anxiety factor aligns with the two types of systems we have to process information that run parallel but are located in different areas of the brain (Weber, 2003; Windschitl, 2003). The analytical system (slower and methodical) makes judgements on the objective components while the associative or affective system (intuitive) uses

feelings and associations to serve as a warning system. It is suggested that the lay public relies more heavily on the associative /affective processing system and that affective responses carry more weight in terms of behaviour (Weber, 2003) and use of stereotypes, images or emotions may cloud behavioural decisions (Kahneman, 2011). A person with little knowledge or experience in aquatic environments may be more likely to rely on their intuitive system for how they behave. Further, although personal experiences in rescues or non-fatal drowning are not the ideal method to drive behavioural change, the feeling associated with a near miss or a non-fatal drowning is more likely to create personal behavioural change than the less vivid analysis of the likelihood of an incident occurring.

Cameron (2003) has further introduced complication into the understanding of risk perception by using the five key features of the common sense model, a self-regulation theoretical model of health threat knowledge and behaviour, which have particular relevance to risk perception and ongoing protective behaviour. The first three of the domains - identity (belief of an individual to be at risk), cause (personal or environmental factors), and timeline (how imminent the risk is) - serve as the basis to inform probability or likelihood judgements. The other two domains - consequences (outcomes of the risk) and controllability (ability to cure or control the outcome) - inform severity estimates. Although introduced for a health promotion situation, this model could be useful to the understanding of perceived risk in a drowning prevention scenario, as the self-regulation component of the model sees an emotional response (anxiety or fear) motivated as a result of the analytical judgment of the risk.

It is also acknowledged that manipulation from advertising and marketing can create experiential knowledge by learning from others' experience (Slovic et al., 2004). In a study on the perceived risk of participation in the outdoor environment, parents and schools showed a shift away from water-related activities such as kayaking in a river, with the perception that the risk for these activities was regarded as unacceptable. The risk for kayaking in a pool or sheltered environment was perceived as acceptable by parents (New Zealand Tourism Research Institute, 2010).

Rogers (1983) developed a 'protection motivation' theory of risk protection which has been adapted and used as a conceptual framework by Moran (2008b, 2011) with rock fishers, McCool and colleagues (2009) with beachgoers, and Moran et al. (2018) with parents, to

improve understanding of the perception of risks in terms of drowning prevention. The model is based on two cognitive dimensions, with five risk cognition factors affecting the appraisals: the threat appraisal process (severity, vulnerability and concern/worry); and the coping appraisal process (response efficacy [preventative action] and perceived self-efficacy). In a similar concept to the 'common sense' model, there is a self-regulation component in the coping appraisal process.

Unrealistic expectations of competence can lead to underestimation of risks, especially in open water environments. Perceived effectiveness in self-rescue has been evidenced in rock fishers. In a five-year study of Auckland's west coast predominantly male rock fishers (Moran, 2011), although two-thirds believed that drowning was a constant threat to life when fishing from rocks, more than one-third thought that their swimming ability and their local knowledge would keep them out of trouble. The difference between the perceptions of risk and the actual risk is critical in open water environments. Knowledge and competencies have been shown to affect perception of risk in aquatic environments (Moran, 2006; 2008a; McCool et al., 2008; Morrongiello, Sandomierski, Schwebel et al., 2013; Morrongiello, Sandomierski & Spence, 2013) and an underestimation of the risk may lead to incidents, injuries, or fatalities. In beach environments, a higher level of confidence among male parents in, variously, their own swimming fitness, estimated swimming competence and the perception that they were safer than others in open water led to them being more likely to underestimate the risk (Moran, 2009a, 2010). Moran (2009a) reported that significantly more male parents estimated higher swimming competence for their 5-9-year-old children, and twice as many males as females were likely to estimate no risk of drowning for their 5-9-year olds.

Studies have identified risky behaviours as plausible risk factors in drowning. In New Zealand almost two-thirds of youth (Moran, 2006) and over half of 21-year-old males (Gulliver & Begg, 2005) self-reported swimming at non-patrolled beaches. This behaviour was replicated by almost half of youth in a United States study (Smith & Brenner, 1995). One-third of rock fishers have self-reported never wearing a lifejacket (Moran, 2008b). Other risky behaviours reported by youth were swimming alone (47%), jumping or diving into water without knowing its depth (33%), ignoring directions or advice (39%) and swimming after taking alcohol or drugs (24%) (Moran, 2006). Drinking alcohol is a key risk factor with Australian studies detecting

alcohol in the blood of 30%-70% of those who had drowned (Driscoll et al., 2004), 37% in river drowning fatalities (Peden, Franklin, & Leggat, 2017), and 30%-50% of adult and youth drowning in the United States (Bell et al., 2001; Howland et al., 1995; Quan & Cummings,2003; Smith & Brenner, 1995).

McCool et al. (2009) found that male beachgoers aged 16-49 years were more likely to perceive lower levels of the threat appraisal (severity, vulnerability and concern) to a risky beach swimming situation than did females, those aged over 50 years of both sexes, and those of Asian ethnicity. Males and younger participants (under 50 years) also reported a lower response efficacy (likelihood to undertake protective action), but, as with non-Asian ethnicities, reported higher self-efficacy (ability to cope with the risks). This low perception of the risk of water-related injury or drowning has been shown in other studies to be associated with higher self-reported swimming skill and at-risk swimming behaviours, especially for males (Moran, 2008a; Moran & Willcox, 2010). These findings reinforce the theory that the perceived risk acts as a signal to take protective action (Weber, 2003) and influence or change behaviour (Cameron, 2003). If people perceived themselves as being competent swimmers, they were more likely to display riskier behaviours in aquatic environments, such as drinking alcohol before water activities (Gulliver & Begg, 2005).

Among Auckland parents and caregivers, females, people of Asian ethnicities and people with lower self-estimated swimming and rescue competency perceived greater severity of drowning risk and greater vulnerability to that risk when swimming in open water more often than did others (Moran et al., 2018); males, non-Asian peoples and those with self-perceived proficient swimming and rescue competencies were more likely to report confidence in the self-efficacy of their preventive actions to cope with the risk. Dickson et al. (2000) contended that some activities are insubstantially perceived as having higher risk than others, one reason perhaps for the proliferation of land-based rock fishers in New Zealand.

Water Safety New Zealand (WSNZ) Drownbase™ records both fatal and non-fatal New Zealand drowning incidents, but most of our knowledge is focussed on the fatalities where there is more evidence available around the circumstances causing the fatality. It is recognised that fatalities are the tip of the near miss iceberg, and whilst we are focusing most on knowledge based on fatalities, little information is available from rescues or life-threatening submersion

experiences (LTSE) (Moran, 2010c). Moran (2010c) found that over a third (37%) of over 2,000 youth in New Zealand had experienced a life-threatening submersion experience, but the majority (66%) claimed no change in their aquatic activity. Furthermore, little is known about the relationship between experiencing a life-threatening submersion experience and people's risk perception. The above studies have added to the knowledge around perception of risk, and how appraisals of threat and coping are likely to influence behaviour, especially for different cohorts of our society. They report perception of risk in relation to self-reported perception of competence and behaviours. There is little information available regarding real risk and it is recommended that further research be undertaken to develop an understanding of the relationship between perceived risk and competence in an actual risk situation of a rescue or fatal or non-fatal drowning.

Assessing Personal Competency

There is a developing understanding of the differences between real and perceived swimming competencies (Laakso & Stallman, 2011; Moran et al., 2012; Petrass et al., 2012; Stallman et al., 2011). The reasons are unclear for differences between what people think they can do, and what they can actually do. Confusion in the terminology of what actually constitutes being able to swim may be one reason. Anomalies are created if one person believes they can swim because they can achieve a distance of 200 m, whereas another believes they are competent by achieving a distance of 25 m. Another reason could be the 'recency' or time elapsed since competencies were last achieved. Most people participate in aquatic lessons during their school years achieving swimming distances and other water competencies at that time of their lives; however, they may not be able to achieve those same competencies later on in their lives without regular practice, but still perceive they have the ability to perform their earlier competencies. The more often and recently one swims and completes other aquatic activities, the more likely their perceived competence is likely to match their actual competencies. The 'Can you swim' international study (Kjendlie et al., 2013; Moran et al., 2012; Petrass & Blitvich, 2014; Petrass et al., 2012; Queiroga et al., 2013) provides an understanding of what people think they can do in controlled water environments, but there is a need to develop this knowledge into open water environments and for high-risk populations such as adult males and some minority populations.

More importantly, there is an emerging acceptance that there are differences between what people think they can do, and what they can actually do in the water. The 'Can You Swim?' research (Moran et al., 2012; Petrass et al., 2012; Stallman et al., 2010) has shown that gaps exist between perceived and real swimming competence. The first study completed across New Zealand, Australia, Japan and Norway (Moran et al., 2012) reported that collegiate physical education students, a cohort likely to have a reasonable assessment of their competence, overestimated their competencies for floating and swimming on their backs compared with how well they were able to perform in a pool environment. Two Portuguese studies of children reported that perceived aquatic competence differed significantly from what children were actually able to do in the water (Costa et al., 2020; Queiroga et al., 2013) with the younger age group of children more likely to overestimate their actual aquatic competence (Costa et al., 2020).

The assessment of tasks in a closed pool environment may also affect people's perception to replicate activities in open water. Further studies have tested competencies in simulated conditions that are more likely to occur in the open water environment where most drownings happen. A study of children aged 11 years (Kjendlie et al., 2013) reported an 8% to 24% decrement in performance of aquatic competencies when performed in rough water. Significant differences between estimations and actual competencies have been shown with other survival competencies such as swimming in clothes (Moran, 2014b, 2015) and exiting the water safely (Moran, 2014a). Simulated risk scenarios wearing clothing and no goggles have also been used in adolescents to determine perceived and actual swimming skills (Rejman et al., 2020). That study recommended self-reflection as an important component of the education process for more accurate assessment of competence, especially for boys.

Unrealistic understanding of the competence of others in their care is also a concern for people's perception of risk. Parents have shown that when they perceive that their child's swimming competence has improved, their own vigilance to ensure the safety of their children is reduced. A study of toddlers found that more than one-third of parents (35%) believed their children required less supervision around water after having had swimming lessons (Moran & Stanley, 2006). A study of parental perception of child supervision requirements (Morrongiello, Sandomierski, & Spence, 2013) showed that parents were likely to reduce their level of

supervision as they perceived their child's competency improved and the risk diminished. This finding is even more of a concern if the level of competency is overestimated as indicated in earlier studies.

Attitudes, Values and Behaviours

Increased knowledge is more likely to result in a more accurate perception of risk (Weber, 2003) and it is believed that teaching water safety knowledge as part of water competence development will instill positive water safety attitudes and behaviour in aquatic environments (Blitvich, 2014b; Moran, 2008a: Petrass & Blitvich, 2014).

Many water safety intervention studies have shown an increase in knowledge because of participating in the intervention, although few have analysed the associations between attitudinal and behavioural change. A study of young adults in Australia after a water safety intervention reported a very low level of water safety knowledge, but prior swimming lessons had no impact on knowledge, skills or attitudes toward water safety (Petrass & Blitvich, 2014). Furthermore, although significant improvements in knowledge and swimming ability were reported following the education, no changes were observed in water safety attitudes.

A New Zealand study reported international tourists as more likely than residents to recount unsafe attitudes and behaviours about open water swimming and boating activity despite no significant difference reported in their knowledge (Moran & Ferner, 2017). Furthermore, the unsafe attitudes and high-risk behaviours among Auckland's west coast rock fishers have been reported as resistant to change (Moran, 2020).

Behavioural change through signage information uptake can be conveyed as shown below (Figure 2.3) in the communications and information processing model (C-HIP; Laughery & Wogalter, 2014, p. 4). This diagram shows the possible progressions needed before behavioural change is achieved. Matthews et al. (2014) reported that signage may not be the best source of knowledge as fewer than half of participants in their study even noticed signage; however, of those who did, the hazard signage gained the most attention, and familiarity and clarity of the signage affected comprehension levels (Meis & Kashima, 2017).

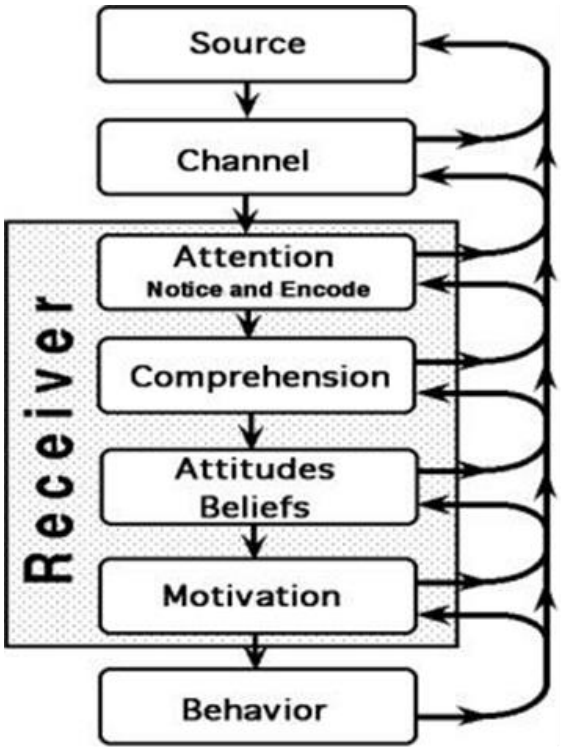

Figure 2.3 The Communications and Information Processing Model (C-HIP; Laughery & Wogalter, 2014)

Adult supervision of others in their care is a key water safety behaviour in the prevention of drowning of young people. Lack of supervision has been shown as a key contributor to drowning among young children (Petrass et al., 2011; Water Safety New Zealand, 2020a) and improved supervision is often cited as a drowning prevention measure (Morrongiello, Sandomierski, Schwebel et al., 2013; Rahman, 2009; World Health Organisation, 2017).

Supervisory behaviours may be related to supervision knowledge, that is the requirement of proximity, constancy and lack of distractions, or other attitudes may have a bearing in how caregivers behave. A study of toddlers' parents found an overly optimistic view among parents of the role of swimming ability and pre-school swimming lessons with one-third of parents preferring to develop the child's swimming ability rather than rely on adult supervision (Moran & Stanley, 2006).

Safe Entries

The lack of water entry proficiency can have dire results. One-third of all drownings in New Zealand occurs following unintentional falls into the water (Water Safety New Zealand, 2020b).

In addition, spinal cord injury (SCI) after entering water comprises a significant component of all spinal cord injuries (Blitvich, 2014a). Knowledge and ability to enter water safely in various settings is essential. Extensive variation has been shown in safe entry competency studies with almost one-half (45%) of Australian and New Zealand tertiary students either unable to perform, or unable to perform with ease, either a stride entry into deep water or a standing dive into deep water (47%), and two-thirds (67%) not able to perform a standing dive from more than 400 mm in height into deep water (Moran & Blitvich, in press). Furthermore, almost one-fifth (18%) in that study had injured themselves getting into the water. There were expected gender differences in self-reported behaviours with males more likely to report greater risk taking (Moran & Blitvich, in press). That finding supported earlier studies of youth perceptions (Moran, 2008c) and risk behaviours identified on YouTube videos of jumping from height into water (Moran, 2013b), where almost all jumpers were male, and between one-fifth (in New Zealand) and one-third (in Australia) were from heights estimated as higher than 12 m.

Safe Exits

Exiting the water is a competency not often discussed in the literature, as drowning is more often assumed to be due to failure to stay afloat or failure to swim to a safe exit point. In a further study of tertiary students, one-half (50%) of females were unable to exit deep water (Moran, 2014b). Attempting to exit after swimming for five minutes wearing clothing, or a lifejacket made this task even more difficult for participants of both genders, and success in exiting was not related to levels of other water competencies.

Stationary Surface / Floating

Keeping airways out of the water by floating may ensure survival in a drowning situation until assistance is provided or accessing a safe exit point can be achieved. Floating becomes more critical in cold water environments, with the recommendation to remain still to conserve warmth (Barwood et al., 2011, 2016), especially when a safe exit point is not in reach (Bowes et al., 2016). Varying levels of competence were also found in a study on stationary surface competencies (Moran, 2019a). Although most (82%) tertiary students could tread water for two minutes, less than half (49%) could tread water for two minutes using only their legs and less than one-third (31%) could float motionless for two minutes. This level of competency, tested in a swimming pool environment, may not be conducive to preventing drowning in an emergency where someone may have to support themselves or another person in deep water. A further study

of adults in simulated moving water reported that while the ‘eggbeater kick’ was the most effective action, the lateral sculling leg kick is easier to achieve and more usual in the adult population (Button et al., 2019).

Swimming

The teaching of swimming has traditionally been promoted as a method of drowning prevention and usually involves teaching the four competitive swimming strokes. While these strokes (at least overarm freestyle or backstroke) may be faster, especially in a pool, in an open water drowning situation they may not be the best strokes to use. Survival strokes, where limbs recover underwater with head lifted to orientate or search for assistance or a safe exit, may be more energy-efficient in open water, especially if wearing clothing.

Evidence is available to show an association between swimming lessons and reduced drowning (Brenner et al., 2009; Stallman et al., 2014; Tyler et al., 2017). However, the ability to swim does not necessarily result in proficiency in other competencies. In a study of children who could swim 25 m, a quarter could not enter deep water, one-half could not roll onto and swim on the back, and most could not float to rest (Junge et al., 2010). Levels of competence in young New Zealand children has been found to be low (Button et al., 2020) and variations in competence may be due to age, gender, frequency of participation, type of education, and recency of participation (Franklin et al., 2015). The international *Can you swim?* study (Moran et al., 2012) reported three-quarters of tertiary physical education students could swim more than 300 m, although only one-third could swim 100 m proficiently on their back.

No research evidence is available on the level of competence required to be safe in open water environments.

Knowledge of Hazards

As mentioned earlier, increased knowledge is believed to result in more accurate perception of risk (Weber, 2003) and more positive water safety attitudes and behaviour in aquatic environments (Blitvich, 2014b; Moran, 2008a: Petrass & Blitvich, 2014). Knowledge can be gained through many channels such as aquatic lessons, school lessons, friends and family, media, social media, websites, brochures, and signage.

Knowledge requirement is included in boating skipper certification which may be recommended, as in New Zealand, or compulsory, as in parts of Australia (Blitvich, 2014b), to skipper recreational craft. However, there is no comparative qualification for open water recreation. The advent of freely available eLearning programmes, such as at Drowning Prevention Auckland (DPA, 2020), may improve knowledge uptake within the general population with internet accessibility. Virtual reality is a new platform that has also been used to improve knowledge in children (Strugnell et al., 2019).

Interviews with Year 4 students (approximately 8 years of age) from across New Zealand were undertaken as part of the National Monitoring Study of Student Achievement (NMSSA) and reported relatively high level of beach safety knowledge and behaviours to keep themselves safe (Moran & Gilmore, 2018). Most (80%) children could identify two things they did to keep themselves safe at the beach, and almost one-half (48%) could identify two beach hazards and explain why each was dangerous.

A national study of New Zealand youth found a lack of water safety knowledge among males, youth from low socio-economic status schools, Pasifika, and Asian students (Moran, 2008a). One-fifth of students could not identify any surf hazards (such as rip currents) or recall any essential boating safety preparation.

A recent study of Auckland west coast beachgoers shows a similar lack of rip current awareness (Pitman et al., 2020). Over three-quarters of beachgoers (78%) were unable to identify a rip in front of them. It would be expected that residents would have more knowledge of local hazards, but that may not necessarily be the case. In an online study among New Zealand residents and international tourists both groups had a poor understanding of rip currents at surf beaches, with no significant difference between the two groups (Moran & Ferner, 2017).

Recognising / Assisting a Drowning Person

One emerging issue in the drowning statistics is that of another recommended competency, bystander rescue (Franklin & Pearn, 2011; Pearn & Franklin, 2012) where similar themes have been associated with such rescues. From 1980 to 2019, 103 people drowned in New Zealand while attempting to rescue others, including 26 in the 10 years to 2019. Of these, most (80%) were male, and all drownings occurred in open water environments (Water Safety New Zealand,

2013, 2020b). Moran and Stanley (2013) reported that almost half (47%) of festivalgoers (*N* = 415) attending a cultural event in Auckland, New Zealand indicated they would jump in and rescue a victim (47%), despite the majority (62%) estimating their swimming competence to be less than 100 m. Furthermore, the majority (85%) had only swum that distance in a swimming pool rather than in open water. Although no gender differences in self-reported swimming and first aid competency were reported, males indicated they were more likely to jump in to save the victim, whereas females were more likely than males to seek help from lifeguards or call the emergency services. The WHO 'Global Report on Drowning' (2014) highlights the importance of 'training bystanders in safe rescue and resuscitation' in its fourth point of Action to Prevent Drowning. Further research is required to determine the relationships between perceived and real competency and risk in bystander rescue.

Other Water Competencies

Breath Control

Breath control is critical in the ability to maintain propulsion for any extended period or distance. Another important element of breath control for preventing drowning is in regard to the gasping and hyperventilation cold shock response (CSR) during the first one to two minutes upon entry into cold water (Bird et al., 2015; Bowes et al., 2016; Brändström, & Giesbrecht, 2014). Lungs may fill with water if airways are underwater during the initial gasp reflex, resulting in drowning. Studies have shown that habituation of cold-water immersions, if coupled with techniques to lower anxiety, could be a protective drowning factor (Bowes et al., 2016; Button et al., 2015; Croft et al., 2013).

Wearing PFDs / Lifejackets

PFDs, lifejackets, and buoyancy aids are designed primarily to provide flotation, some keeping airways clear of the water. Most also provide warmth and visibility. While floating is undoubtedly easier wearing a lifejacket, other competencies may be much more difficult. Concerning results emerged when the water competencies of tertiary students were tested wearing a lifejacket, with two-thirds (63%) not able to swim underwater for 15 m or exit a pool from deep water (Moran, 2019b) - tasks that may need to be undertaken wearing a lifejacket in an emergency situation getting out from under an upturned boat, or trying to climb out of the water onto an upturned boat.

Wearing Clothes

Drowning prevention advice around wearing clothing in the water has changed in recent years. Traditional lifesaving courses taught removal of clothing in deep water to enable more efficient propulsion; however current advice suggests keeping clothing on to provide initial buoyancy and prevent heat loss (Barwood et al., 2011; Tipton, 1989). Wearing clothing has been shown to reduce swimming competence (Bowes et al., 2016) in both speed and distance (Moran, 2014a), although clothing was found to have no significant effect on ability to float (Moran, 2014a). The greatest loss of efficacy was in the less generally competent individuals (Moran, 2014a). This knowledge is important in drowning situations where decisions need to be made on whether to swim to a safe exit point or to save energy and float.

Evidence Gaps in the Literature

Stallman et al. (2014, p.204) identified the following international directions for further research:

> Development of further evidence using outcomes research that swimming and other water survival competencies underpin prevention of drowning
>
> Study of the skills, knowledge, attitudes and behaviours that contribute to water survival competencies especially among high-risk groups such as children and males
>
> The relationship between real and perceived swimming and other water survival competencies, especially among high-risk groups
>
> Perceptions of drowning risk related to underestimation of risk and overestimation of ability to manage that risk, especially among high-risk groups such as males and new migrants
>
> The dynamic interaction between water survival competence and drowning protection using outcomes-based research methods.

There is a growing body of literature regarding water competence, and the need for a wider definition of water competence to include the cognitive and affective domains as well as a number of psychomotor skills, rather than the traditional ‘learn to swim’ teachings of the past (Langendorfer et al., 2018; Moran et al., 2012; Stallman et al., 2017). Much of this literature has a focus on child and youth population groups and in-water testing to measure differences between real and perceived competencies has been undertaken in a pool, some simulating open

water factors of moving or cold water (Button et al., 2015; 2019; Costa et al., 2020; Croft et al., 2013; Kjendlie et al., 2013).

Despite the high likelihood of drowning in open water environments, minimal literature is available on what people can do, or think they can do, in open water. Furthermore, there is a gap in the research available about how the most high-risk drowning population, that is, adults, assess water competency and risk in open water.

Chapter 3 Pilot Study – Real and Perceived Water Competencies and Risk of Drowning of Adults in Open Water – What Gaps?

Introduction

The review of the drowning literature identified a lack of evidence available around actual adult competencies, especially in open water where most people drown (Water Safety New Zealand, 2020a). In addition, little evidence is available on adult perceptions of those competencies and what that means in relation to drowning risk. A pilot study was developed and undertaken to attempt to determine if there were any differences between real and perceived competencies in open water, competencies in a pool and open water, and water competence in relation to perception of risk.

This pilot study aimed to report on actual water competencies, and compare it to the perceived water competencies and risk in an adult population, in particular to explore the relationship variously among:

- perceived swimming and floating competence in closed and open water
- actual swimming and floating competence in closed and open water
- perceived ability to rescue
- perceived risk in various open water scenarios and
- self-competency in pool and open water environments

Research Questions

1. What are the perceptions of a range of water competencies for adults?
2. What are the actual water competencies in a closed pool environment for adults?
3. What are the actual water competencies in an open water environment for adults?
4. What are the risk perceptions of adults?

5. What are the relationships between perceptions of drowning risk and actual water competencies?

Methodology

This study used a cross-sectional design with a self-completion written survey methodology. Adult members of the workforce from five organisations in Auckland who work in or around water, such as the Department of Conservation and Watercare, were invited to take part in the study during the 2016/17 summer. The organisations completed an employer-sponsored two-day water safety programme with research components from this study included in the programme. Research ethics approval was obtained from The University of Auckland Human Participants Ethics Committee (UAHPEC) (Reference number 016725). An Organisation Information Sheet was distributed, and a signed Organisation Consent Form was completed before the course began.

Participants

A total of 38 employees from five workplace organisations completed a pre- and post-self-completion written questionnaire during a two-day water safety course as part of a workplace health and safety initiative. In addition, the participants competed five practical water competencies in a swimming pool, during a pool-based educational session, and completed the same five competencies in open water. A Participant Information Sheet (PIS) was distributed to participants and signed individual Consent Forms were obtained before participation.

Four participants were trained and current lifeguards. It was anticipated lifeguards would display risk perception and water competence different from the typical adult population. Data for these four individuals were removed, leaving 34 participants.

Survey Instrument

The pre- and post-course surveys were designed to be completed in about 10 minutes at the beginning and end of each two-day course. The questionnaire consisted of 14 closed questions based on previously validated studies (Moran, 2003; 2006; 2008b; McCool et. al., 2009; Moran & Stanley, 2013). The first four questions assessed socio-demographic characteristics including gender, age (*15–19 years, 20-29 years, 30–44 years, 45-64 years, 65+ years*), self-identified

ethnicity (*New Zealand European, Māori, Pasifika, Asian* and "*Other*" ethnic groups) and length of residency in New Zealand *(<1 year, 1-4 years, 5-9 years, >10 years*).

Seven questions sought information on swimming competency by asking participants whether they could swim and, if so, (i) how they would rate their swimming competency using four response categories (*poor, fair, good, very good*) and (ii) how far they estimated could swim non-stop (based on Moran, 2003). In addition, information was sought on (iii) when and where they had swum the estimated distance (*last month, last year, last 5 years, last 10 years*), (iv) how easily they thought they could swim the distance estimated in open water (*very easily, easily, with difficulty, with great difficulty*), (v) how often they swum in open water (*daily, weekly, about once a month, less than once a month, never*), (vi) if they thought they could rescue someone in open water, and (vii), if so, how easily (*very easily, easily, with difficulty, with great difficulty*) (Moran & Stanley, 2013).

To determine water safety attitudes, participants were asked a series of six statements using a three-point response scale of *agree*, *disagree* and *unsure* (McCool et al., 2009; Moran 2008b). A series of 10 statements designed to ascertain their estimated competency in open water used a three-point response scale of *confident*, *anxious* and *unsure.* In addition, perception of the risk of drowning was determined using a series of five statements (for example, when being caught in a rip current at a surf beach, or being swept off isolated rocks by a wave while fishing) with a four-point response scale (*extreme risk, high risk, slight risk, no risk*) (Moran, 2008b, Moran et.al., 2012).

Finally, Borg's Rate of Perceived Exertion (RPE) (Borg, 1998) scale was used to determine the exertion expected (pre-) or actual (post-) to complete five practical skills, using estimates from 6-20, with 6 = the easiest and 20 = most difficult.

Practical Testing

Five practical skills were chosen to elicit a level of water competency amongst the adults: deep-water entry, deep-water exit, fast 25 m swim, five-minute float, and a five-minute swim. Each of these was completed in a pool and an open water environment on separate days.

The entry and exit were rated on a scale of 1–4 as follows: *did not complete; completed with poor form; completed with good form;* and *completed with excellent form.* The form was

graded by the researcher with poor being assessed as either incorrect form or completed with great difficulty, good was assessed as able to complete correctly with some difficulty, and excellent form was correctly performed with ease. The 25 m swim was scaled for time swum non-stop to 25 m with no stroke or speed specified (time achieved assessed on a 5-point scale): 1, *more than 1 min*; 2, *between 45-59 sec*; 3, *30-44 sec*; 4, *15-29 sec*; 5, *less than 15 sec*. The stationary float was completed in deep water, with participants instructed to have minimal swimming motion and timed on a 5-point scale: 1, *less than 15 sec*; 2, *15-59 sec*; 3, *1 - 3 min*; 4, *3 - 5 min*; 5, *more than min*. The distance swim was completed non-stop in five minutes with no stroke or speed specified (distance achieved assessed on a 5-point scale): 1, *less than 25 m*; 2, *26- 100 m*; 3, *101-200 m*; 4, *201- 400 m*; 5, *more than 400 m*. To reduce risk of drowning and/or hypothermia it was agreed that wetsuits and lifejackets were worn in the open water settings.

Data Analysis

All data were entered anonymised into SPSS Statistics Version 24 (Armonk, NY, USA) for statistical analysis. Frequencies and percentages were generated to report categorical variables such as demographic data and perceptions of competence and risk. Chi-square tests were used to determine any association between dependent variables (such as perceived swimming competency and risk) and independent variables (such as gender, age and ethnicity). Where multiple responses were included (for example, swimming and rescue competency), results were dichotomised for ease of interpretation with *poor* and *fair* grouped as *poor/fair* and *good* and *very good* grouped as *good/very good*. Paired sample *t*-tests were undertaken to compare pre- and post- results and the pool and open water testing.

Results

Demographics

Five groups with a total of 34 participants completed all four components of the study. Most (65%, n = 22) identified as NZ European, Māori comprised 15% (n = 5), Pasifika 6% (n = 2) and Asian 3% (n = 1). ‘Other’ ethnicities from Australia and the United Kingdom made up 12% (n = 4). The cohort consisted of slightly more females (53%, n = 18) than males (47%, n = 16). Age groups were evenly spread throughout the working age population (20-29 years, 38%, n = 13; 30-44 years, 24% , n = 8; 45-64 years, 35%, n = 12; over 65 years, 3% , n = 1). Most were born

in and had lived in NZ all their lives (65%, n = 22), and a further quarter had lived in New Zealand for more than 10 years (24%, n = 8).

Actual Water Competencies

Five water competencies were tested first in a pool and then in the open water on a separate day. All participants were able to complete all tests. Results for the competencies tested in the pool are shown in Table 3.1 and open water in Table 3.2.

Most participants could complete the deep-water entry with excellent form in the pool (62%, n = 21) and in open water (82% (n = 28). Males were significantly more likely to perform deep-water entry with excellent form in both the pool (males 81%, n = 13, vs. females 44%, n = 8) ($\chi2(2) = 6.596$, $p = 0.037$) and open water (males 100%, n = 16, vs. females 67%, n = 12) ($\chi2(1) = 6.476$, $p = 0.011$).

Participants were less likely to exit deep water with excellent form in both the pool (50%, n = 17) and the open water (44%, n = 15). Males reported similar proficiency in the deep-water exits being more likely to perform deep-water exit with excellent form in both the pool (males 69%, n = 11, vs. females 33%, n = 6) ($\chi2(2) = 9.497$, $p = 0.009$) and open water (males 69%, n = 11, vs. females 22%, n = 4) ($\chi2(2) = 8.428$, $p = 0.015$).

Wide variances were found in floating competencies. One-quarter (24%, n = 8) could float for five minutes stationary in a pool and one-quarter (24%, n = 8) could float for less than 15 seconds in a pool. Most males (81%, n = 13) could float for less than one minute. Females were significantly better floaters than males ($\chi2(3) = 12.024$, $p = 0.007$), as most could float for more than one minute (72%, n = 13), and all participants who could float for more than five minutes were female. In the open water most (79%, n = 27) could float for five minutes, likely to reflect the buoyancy assistance participants were wearing in open water (wetsuits and lifejackets).

Most participants completed the 25 m fast swim in a pool in 25 seconds or less (74%, n = 25) and there was no statistical difference for gender. In the open water, most completed the 25 m swim in over 25 seconds (79%, n = 27). Males were significantly faster in open water ($\chi2(2) = 6.858$, $p = 0.032$). Males were more likely to swim in under 25 seconds (31%, n = 5) compared

with females (11%, *n* = 2), and less likely to swim 25 m over 40 seconds (11%, *n* = 1) compared with females (44%, *n* = 8).

Table 3.1 *Actual Water Competency in Closed Water by Gender*

	Male (n = 16)		**Female (n = 18)**		**Total**	
	n	***%***	***n***	***%***	***n***	***%***
Deep-water Entry*						
Poor form	0	0%	5	27.8%	5	14.7%
Good form	3	18.8%	5	27.8%	8	23.5%
Excellent form	13	81.3%	8	44.4%	21	61.8%
Deep-water Exit*						
Poor form	0	0%	8	44.4%	8	23.5%
Good form	5	31.3%	4	22.2%	9	26.5%
Excellent form	11	68.8%	6	33.3%	17	50.0%
Stationary Float*						
Less than 15 seconds	6	37.5%	2	11.1%	8	23.5%
15 seconds – 5 minutes	10	62.5%	8	44.4%	18	52.9%
More than 5 minutes	0	0%	8	44.4%	8	23.5%
25m Fast Swim*						
Less than 25 seconds	13	81.3%	12	66.6%	25	73.5%
26 – 40 seconds	3	18.8%	5	27.8%	8	23.5%
More than 40 seconds	0	0%	1	5.6%	1	2.9%
5-minute Swim						
Less than 200m	7	43.8%	9	50.0%	16	47.1%
More than 200m	9	56.3%	9	50.0%	18	52.9%

Table 3.1 Actual Water Competency in Closed Water by Gender

*Significant differences

Table 3.2 *Actual Water Competency in Open Water by Gender*

	Male (n = 16)		**Female (n = 18)**		**Total**	
	n	***%***	***n***	***%***	***n***	***%***
Deep-water Entry*						
Poor form	0	0%	0	0%	0	0%
Good form	0	0%	6	33.3%	6	17.6%
Excellent form	16	100%	12	66.7%	28	82.4%
Deep-water Exit*						
Poor form	0	0%	3	16.7%	3	8.8%
Good form	5	31.3%	11	61.1%	16	47.1%
Excellent form	11	68.8%	4	22.2%	15	44.1%
Stationary Float						
Less than 15 seconds	0	0%	0	0%	0	0%
15 seconds – 5 minutes	3	18.8%	4	22.2%	7	20.6%
More than 5 minutes	13	81.3%	14	77.8%	27	79.4%
25m Fast Swim*						
Less than 25 seconds	5	31.3%	2	11.1%	7	20.6%
26 – 40 seconds	10	62.5%	8	44.4%	18	52.9%
More than 40 seconds	1	6.3%	8	44.4%	9	26.5%
5-minute Swim						
Less than 200m	16	100%	18	100%	34	100%
More than 200m	0	0%	0	0%	0	0%

Table 3.2 Actual Water Competency in Open Water by Gender

*Significant differences

More than one-half of all participants (52%, n = 18) could swim more than 200 m continuously in five minutes in a pool. None of the participants could swim more than 200 m in five minutes in the open water, nearly all (97%, n = 33) swimming between 25 m and 200 m. Again, there were no significant differences for gender on this competency in either the pool or open water.

Pool versus Open Water Competencies

A paired sample test was completed to compare the pool and open water competencies. Superior performance in form was displayed in open water deep-water entries (t (33) = -2.978, p = 0.005) when compared to the pool. There was no significant difference shown in the deep-water exit. Significant improvement in deep-water floating (t (33) = -6.936, $p \leq 0.000$) was exhibited in the open water compared to the pool, and inferior performance in open water in both the 25 m fast swim (t (33) = 5.338, $p \leq 0.000$) and five-minute swim (t (33) = 6.465, $p \leq 0.000$).

Borg Test for Expected and Actual Difficulty to Complete Skills

A paired sample t-test showed no significant differences in expected difficulty in undertaking each task in the pre-course survey and actual difficulty in post-course survey. Both the 25 m fast swim in open water and five-minute float in a pool showed an increase in the means from pre- to post-, that is, participants found both as more difficult to actually do than what they originally thought.

Perception of Water Competence

All participants (100%) believed they could swim. In the initial survey, two-thirds (65%, n = 22) believed they were *good/very good* swimmers, and one-half (50%, n = 17) estimated they could swim more than 200 m. One-half (50%, n = 17) had swum the estimated distance in the past year, and most (91%, n = 31) had swum the estimated distance in open water. After both the pool and open water testing more perceived themselves as *good/very good* swimmers (74%, n = 25) and thought they could swim more than 200 m (62%, n = 21). The pre- and post- paired sample t-test, in Table 3.3, also showed participants perceived their swimming competence was better at the end of the course (t (33) = -1.358, p = 0.184), although not significantly. Statistical improvement was reported in the means for perceived swimming distance from the beginning to the end of the course (t (33) = -2.51, p = 0.017) despite only one-half (52%) being able to swim

more than 200 m in the pool, and none swimming more than 200 m in open water in five minutes.

In the initial survey, most participants (97%, n = 33) reported confidence in their floating competency, and, of those, three-quarters (73%, n = 24) believed they could float *easily/very easily.* At the end of the testing slightly fewer (91%, n = 31) believed they could float and less were confident in their level of floating competence (61%, n = 19 reported *easily/very easily).* Although the means test showed a decrease in perceived floating competence, it was not significant (t (33) = -1.44, p = 0.160).

Participants also reported a high level of perceived rescue competency. Most (85%, n = 29) thought they could rescue someone in difficulty in open water, almost one-third of those (28%, n = 8) *easily/very easily*. After the testing, all (100%) perceived they could rescue, one-third of those (32%, n = 11) *easily/very easily*. Although more participants believed they could perform a rescue after the course, the change was not significant.

Chi-square tests were undertaken to compare differences in any individual traits (such as gender, ethnicity, or residency) with perception of competence before and after the testing. Pre-testing, females were more likely than males (females 78%, n = 14, vs. males 50%, n = 8) to report they could swim *good/very good* and were significantly more likely (females 72%, n = 13, vs. males 25%, n = 4) to report they could swim more than 200 m ($\chi2(2) = 11.919$, $p = 0.003$). After testing both in the pool and open water, females were less likely than before (67%, n = 12) and males more likely (56%, n = 9) to perceive they could swim more than 200 m, with no statistical differences between the genders. There were no significant differences when analysed by ethnicity, age group or residency.

In the pre-course survey, there was no significant difference reported for rescue competency when analysed by gender. Post-testing females were less likely than males to perceive they could perform a rescue with ease (females 16%, n = 3, vs. males 50%, n = 8) ($\chi2(1) = 4.300$, p = 0.038).

Table 3.3 *Pre- and Post-activity Perceived Water Competency*

	Mean	SD	Mean diff	*t*	*p*
Estimated swimming competency (1 = poor/fair, 2 = good/very good)					
Pre-activity	1.65	0.485			
Post-activity	1.74	0.448	-0.088	-1.358	0.184
Estimated distance* (1 = > 25m, 2 26-200m, 3 = < 200m)					
Pre-activity	2.38	0.697			
Post-activity	2.59	0.557	-0.206	-2.508	0.017
Estimate float 5 minutes (1 = yes, 2 = no)					
Pre-activity	1.03	0.288			
Post-activity	1.09	0.445	-0.059	-1.436	0.160
Estimated floating competency (1 = poor/fair, 2 = good/very good)					
Pre-activity	1.26	0.445			
Post-activity	1.39	0.495	-0.129	-1.161	0.255

Table 3.3 Pre- and Post-activity Perceived Water Competency

Opinions

A series of 10 competencies were evaluated by self-report to elicit self-estimated competency in open water (Table 3.4). Initially most participants (between 82% - 68% for all responses) reported confidence in six of the 10 statements: *floating on back in deep open water (82%), swimming in waves (82%), swimming on back in open water (79%), swimming in open water out of my depth (74%), floating in deep open water without using a lifejacket (71%),* and *swimming without lifeguard supervision at a beach (68%)*. Less confidence was reported for *swimming in cold open water* (47%), *going to help someone else in open water* (41%), *swimming in rough water* (38%), and *swimming underwater in murky water* (38%).

Post-test participants reported increased confidence at the course for six of the 10 statements, including swimming in open water, shifting to 61%. Less confidence was reported in ability to float in deep water without flotation (62%) and swimming at unpatrolled beaches (62%).

There was only one statistical difference in competencies when analysed by gender. Females had significantly less confidence in their ability to rescue someone in open water both pre- ($\chi2(2) = 6.285$, $p = 0.043$) and post-testing ($\chi2(2) = 12.309$, $p = 0.002$).

Attitudes

Most participants reported unsafe drowning attitudes to all bar one of the statements both pre- (59% - 94%) and post-activity (56% - 91%) (Table 3.5). Post-activity, females (6%) were significantly less likely than males (12%) to report reliance on their swimming ability in lieu of wearing a lifejacket ($\chi2(1) = 4.480$, $p = 0.034$). There were no other statistical differences when analysed by gender.

Analysis of the means of pre- and post-activity (Table 3.6) showed a significant change in the requirement to wear a lifejacket, with more disagreeing that 'they didn't need to wear a lifejacket due to their swimming competence' (t (33) = -2.098, $p = 0.044$). Although not significant, participants also showed safer attitudes to reliance on their swim fitness (t (33) = -2.028, $p = 0.051$) and believing others to be at greater risk (t (33) = -1.968, $p = 0.058$). (NB. Three *unsure* responses were dichotomised into the 'more unsafe' answer).

Table 3.4 *Estimated Self-competence Reported as 'Confident' by Gender*

Opinion		Male (n = 16)		Female (n = 18)		Total	
		n	***%***	***n***	***%***	***n***	***%***
Floating on back in deep water	Pre	15	94%	13	72%	28	82%
	Post	15	94%	16	89%	31	91%
Swimming in waves	Pre	14	87%	14	78%	28	82%
	Post	13	81%	13	72%	26	77%
Swimming on back in open water	Pre	14	88%	13	72%	27	79%
	Post	14	88%	17	94%	31	91%
Swimming in open water out of my depth	Pre	11	69%	14	78%	25	74%
	Post	12	75%	14	78%	26	77%
Floating in deep water without a lifejacket	Pre	12	75%	12	67%	24	71%
	Post	11	69%	10	56%	21	62%
Swimming without lifeguard supervision at a beach	Pre	11	69%	12	67%	23	68%
	Post	10	63%	11	61%	21	62%
Swimming in cold open water	Pre	10	63%	6	33%	16	47%
	Post	12	75%	8	47%	20	61%
Helping someone else in open water	Pre*	9	56%	5	28%	14	41%
	Post*	11	69%	4	22%	15	44%
Swimming in rough water	Pre	8	50%	5	28%	13	38%
	Post	8	50%	8	44%	16	47%
Swimming underwater in murky water	Pre	9	56%	4	22%	13	38%
	Post	7	44%	2	11%	9	27%

Table 3.4 Estimated Self-competence by Gender

*Significant differences

Table 3.5 *Water Safety Attitudes Reported as 'Agree' by Gender*

Attitude - Agree		Male (n = 16)		Female (n = 18)		Total	
		n	***%***	***n***	***%***	***n***	***%***
My swimming ability will keep me safe in open water	Pre	15	94%	17	94%	32	94%
	Post	14	88%	17	94%	31	91%
Others are at greater risk than me when swimming in open water	Pre	13	81%	13	72%	26	77%
	Post	9	56%	12	67%	21	62%
My current swimming fitness will keep me safe in open water*	Pre	12	75%	14	78%	26	77%
	Post	12	75%	7	39%	19	56%
My swimming ability means I don't need to wear a PFD in a boat*	Pre	4	25%	3	16%	7	21%
	Post	2	12%	1	6%	3	9%
The risk of drowning is always present when swimming in open water	Pre	11	69%	9	50%	20	59%
	Post	10	63%	15	83%	25	74%
I often feel at risk in rough conditions	Pre	10	63%	12	67%	22	65%
	Post	8	50%	14	79%	22	62%

Table 3.5 Pre- and Post-activity Attitudes by Gender

*Significant differences

Table 3.6 *Pre- and Post-activity Attitudes Toward Water Safety and Risk of Drowning*

1 = agree, 2 = disagree	**Mean**	**SD**	**Mean diff**	***t***	***p***
My swimming ability will keep me safe in open water	1.06 1.09	0.239 0.288	-0.029	-0.572	0.571
Others are at greater risk than me when swimming in open water	1.24 1.38	0.431 0.493	-0.147	-1.968	0.058
My current swimming fitness will keep me safe in open water	1.24 1.44	0.431 0.504	-0.206	-2.028	0.051
My swimming ability means I don't need to wear a PFD in a boat*	1.79 1.91	0.410 0.288	-0.118	-2.098	0.044
The risk of drowning is always present when swimming in open water	1.41 1.26	0.500 0.448	0.147	1.713	0.096
I often feel at risk in rough conditions	1.24 1.35	0.431 0.485	-0.118	-0.941	0.353

Table 3.6 Pre- and Post-activity Attitudes

*Significant differences

Perceptions of Risks

Most participants reported little perception of risk for tipping out of a canoe (pre- 35%, post- 32%) and falling into a river fully clothed (pre- 24%, post- 27%), and none (0%) rated any risk to chasing an inflatable toy into a deep pool (Table 3.7). Most participants perceived a high risk for being swept off isolated rocks (pre- 91%, post- 82%), and two-thirds (65% pre- and post-) rated being caught in a rip at a surf beach as *high* or *extreme* risk.

There was little shift in perception of risk pre-activity to post-activity, and there were no statistical differences when analysed by gender.

Table 3.7 *Pre- and Post-activity Risk Perception*

Risk Perception		**Male (n = 16)**		**Female (n = 18)**		**Total**	
High Risk/Extreme Risk		***n***	***%***	***n***	***%***	***n***	***%***
Tipped upside down in a canoe 100 metres from the shore of a lake	Pre	6	38%	6	33%	12	35%
	Post	6	38%	5	28%	11	32%
Caught in a rip current at a surf beach	Pre	10	63%	12	67%	22	65%
	Post	10	63%	12	67%	22	65%
Chased inflatable toy into deep water at a local swimming pool	Pre	0	0%	0	0%	0	0%
	Post	0	0%	0	0%	0	0%
Fell into deep water fully clothed while walking along a riverbank	Pre	2	13%	6	33%	8	24%
	Post	3	19%	6	33%	9	27%
Swept off isolated rocks by a wave while fishing	Pre	14	88%	17	94%	22	91%
	Post	12	75%	16	89%	28	82%

Table 3.7 Pre- and Post-activity Risk Perception

Borg's RPE scale (Borg, 1998) was used to estimate expected and actual exertion required to complete each of the water competencies, both in a pool and open water (Table 3.8). The top four grades were dichotomised into 'easy' and the bottom four into 'hard'. Most participants rated both expected exertion (62% - 97%) and actual exertion (53% - 100%) as easy. There were no significant differences for gender or pre- and post-activity.

Table 3.8 *Estimated Exertion Levels by Gender*

Exertion Level - Easy		**Male (n = 16)**		**Female (n = 18)**		**Total**	
		n	***%***	***n***	***%***	***n***	***%***
Deep-water entry - pool	Pre	16	100%	17	94%	33	97%
	Post	16	100%	18	100%	34	100%
Deep-water entry – open water	Pre	16	100%	16	89%	28	94%
	Post	16	100%	18	100%	34	100%
Deep-water exit - pool	Pre	16	100%	16	89%	27	94%
	Post	16	100%	17	94%	33	97%
Deep-water exit – open water	Pre	16	100%	13	72%	25	85%
	Post	16	100%	15	83%	31	91%
Swim 25m fast - pool	Pre	13	81%	12	67%	25	74%
	Post	13	81%	16	89%	29	85%
Swim 25m fast – open water	Pre	12	75%	9	50%	21	62%
	Post	10	63%	9	50%	19	56%
Float 5 minutes - pool	Pre	15	94%	17	94%	32	94%
	Post	12	75%	16	89%	28	82%
Float 5 minutes – open water	Pre	13	81%	15	83%	28	82%
	Post	15	94%	18	100%	33	97%
Swim 5 minutes - pool	Pre	11	69%	16	89%	27	79%
	Post	12	75%	17	94%	29	85%
Swim 5 minutes - open water	Pre	10	63%	11	61%	21	62%
	Post	10	63%	8	44%	18	53%

Table 3.8 Estimated Exertion Levels by Gender

Discussion

This study intended to determine if there were any gaps between perceived and actual water competencies, both in closed (swimming pool) and open water, and if there were any relationships between perceptions of those competencies and drowning risk compared with actual water competencies. To enable this, adult participants were asked what their perceptions were of their own water competency in a pool and open water, and their attitudes and perceptions about risks of drowning. They were then tested on five water competencies in a pool and open water environment. Finally, after the activity in the pool and open water, they were asked again what their perceptions were about their water competency and risk.

Gender is a key drowning risk, as evidenced by statistics and the literature, males being four times more likely to drown than females, and significantly more likely to underestimate risk (Gulliver & Begg, 2005; Smith & Brenner, 1995) and overestimate competence (Moran, 2009a; 2010a). To investigate this further, all data were analysed by gender.

Due to ethical concerns about the risk of drowning, injury or hypothermia in open water, participants wore wetsuits and lifejackets for the testing. The restriction of movement and increased buoyancy did affect results of the open water testing.

Participants reported relatively high levels of self-estimated swimming, floating and rescue competence. Most participants were confident in their swimming competence, with one-half estimating they could swim more than 200 m, three-quarters believing they could float ‘easily’, and almost all confident in their ability to rescue someone in open water.

Perceived swimming competency was accurate to their actual competency when compared with the testing undertaken in the pool. Slightly more than one-half could swim more than 200 m in five minutes. Discrepancies in perceived competence were highlighted when the competencies were tested in open water with none of the participants managing to swim more than 200 m in open water within five minutes. Interestingly, neither the distance swimming (five minutes) nor fast swimming (25 m) recorded any gender differences in the pool, although males displayed higher competence levels in open water. Participants rated exertion slightly higher than expected for the swimming competencies in open water, and slightly lower than expected in a pool. Participants also thought the 25 m fast swim in open water to be significantly more difficult

to complete than they originally perceived. It is alarming that at the end of the testing, participants were more confident in their swimming competency, and significantly more likely to believe they could swim more than 200 m, despite only one-half (52%) being able to swim more than 200 m in the pool, and none swimming more than 200 m in open water in five minutes. This raises questions about content for drowning prevention education programmes and opportunities for further research to explore this phenomenon.

The same level of accurate personal assessment was not shown for floating competency in the pool or open water. Despite most participants estimating they could float well, it is concerning that only one-quarter could float for more than five minutes, and a further quarter could not float for more than 15 seconds in a pool. Participants were also significantly better floaters in open water, as most were able to float longer than five minutes, undoubtedly due to the additional flotation. At the end of the testing, although not significant, slightly fewer believed they could float, and fewer were confident in their level of floating competence. Concerningly though, almost two-thirds perceived they could float with ease despite less than one-quarter being able to float for five minutes in a pool. Most males and females inaccurately expected to be able to float with ease, and although not significant, males were more confident in their self-estimation floating competence, although females outperformed males in floating competence in both the pool and open water, corroborating evidence of male overestimation of ability.

Most participants also expected to undertake the entry and exit activities in both the pool and open water with little exertion, and, although not significant, males expected to undertake the in-water tasks with less exertion than females. Indeed, males did significantly perform the deep-water entries and exits with better form. Gender differences in undertaking the exit tasks are likely due to physiological gender variances. Significant improvement in form was displayed in open water deep-water entries for all participants when compared to the pool, which may be due to the safety factor of the pre-teaching requirement in the open water.

Attitudes such as reliance on swimming fitness and ability to keep safe, and others being at greater risk were reported by most participants. These types of attitudes would normally be viewed as unsafe, although maybe not so much if actual competence matched the high perceived level. Although not quite significant, fewer participants reported reliance on swimming fitness post activity showing some change of attitude toward their own possible lack of swimming

fitness as protection from drowning. Despite other unsafe attitudes reported, encouragingly, most participants disagreed about not wearing a lifejacket in a boat, and significantly fewer post-activity. In New Zealand, lifejacket use is legislated through various regional bylaws and legislation may affect attitudes toward their use.

Most participants reported high risk aversion to two of the scenarios, although little regard to risk was shown for the other three settings. Surprisingly, there were no significant gender differences and little change in risk perception was reported pre- and post-activity. It is unclear whether this result may be related to perceived competence (Moran, 2009a; 2010a) or knowledge and experience (McCool et al., 2008; Moran, 2006; 2008a; Morrongiello, Sandomierski, Schwebel et al., 2013; Morrongiello, Sandomierski & Spence, 2013).

Limitations

This study shed new light on perceived and actual adult water competencies in pools and open water. There are, however, a number of limitations in the study to suggest caution in acknowledging these results.

Firstly, the cohort was selected from organisations whose employees worked in or around water. As such, many of the participants had substantial experience around water which may not be reflective of the typical adult population. Increased participation may lead to both increased water competency and a more realistic perception of that competence.

Secondly, the sample size was 34 adults. While this number is similar to other in-water studies (Moran 2015; Moran et al., 2012; Rejman et al., 2020), it does limit the conclusions that can be drawn when analysing relationships such as perceived risks and competencies.

Another limitation was the risk of drowning or hypothermia in the in-water testing, especially in the open water setting. Much of the open water activities were undertaken on Auckland's notorious west coast beaches, albeit in some relatively safe areas. To reduce risk, the open water testing was completed wearing a wetsuit and a lifejacket. The wetsuit and lifejacket assisted buoyancy in the floating competencies and increased difficulty in the swimming competencies. The differences in testing in the pool and open water means it is difficult to compare the results from the pool and open water. Furthermore, it is not known what affect the results achieved while wearing wetsuits and lifejackets had on post-activity perceptions.

Finally, swimming, floating, and entry and exit competencies were the only physical water competencies included in the study - other physical competencies for drowning prevention such as submersion or breath control could be included (Langendorfer et al., 2018; Stallman et al., 2017).

Conclusion

Most adults in this study reported high levels of perceived water competence at the beginning of the study. Most participants reported confidence and ease to complete the entry and exits, and although slightly less could actually perform with ease in the pool and open water, perceptions were fairly accurate in both environments. Self-estimated floating competence was not accurate when tested in the pool (overestimated) or open water (underestimated). Perhaps not so surprising was that perception of swimming competence was accurate to what was achieved in the pool, but not so in the open water, where none of the participants could achieve a 200 m swim. The differences in floating and swimming competencies may have been as a result of donning wetsuits and lifejackets. However, despite the poor swimming competence displayed in open water, and the assistance of buoyancy in the floating, it was concerning that participants still perceived high levels of competence at post-testing, highlighting a continued overestimation of competence. Furthermore, there was little change in water safety attitudes and risk perception before and after the water safety course.

Anomalies in these results may also be due to the probable above average level of water competence and experience around water of the participants, or the inability of the participants to compare the pool and open water because of the addition of lifejackets and wetsuits.

In this pilot study I came to the conclusion that further studies needed to be carried out to determine any discrepancies between perceived and actual water competence with other adult groups more reflective of the adult population or more at-risk of drowning. Amendments to the pilot study should include a larger adult cohort with a range of water competence more likely to reflect the normal population and alignment of the pool and open water testing.

Chapter 4 Study One – How Good is Good Enough? - Perceptions of Risk and Competency Among Parents and their Children

4.1 Introduction

The level of competence is unknown at which people feel that they, or others in their care, are safe to swim in an open water environment. While some evidence is available on parental perceptions of safety and risk at the beach (Moran, 2009a, 2010a), little information is available on what constitutes 'safe' levels of swimming competence for self or others in open water. This study examined the beliefs of parents of their water competence in open water, and their estimations of their children.

Research Questions

1. What is the perceived swimming competence among parents/caregivers and their children?

2. What do parents/caregivers perceive as being a competent swimmer in terms of drowning prevention for themselves and their children?

3. Is the perceived level of safety affected by people's level of swimming competency in open water?

4. What level of swimming competency does the public consider is required to be safe in open water?

The results from Study One were presented at the World Conference on Drowning Prevention Conference. Potsdam in October 2013 and the International Council of Sport Science and Physical Education (AIESEP) Conference, Auckland in February 2014. The manuscript has been published in the *International Journal of Aquatic Research and Education*.

Stanley, T., & Moran, K. (2017). Parental perceptions of water competence and drowning risk for themselves and their children in an open water environment. *International Journal of Aquatic Research and Education 10*(1), 4. http://scholarworks.bgsu.edu/ijare/vol10/iss1/4

4.2 Parental Perceptions of Water Competence and Drowning Risk for Themselves and their Children in an Open Water Environment

Abstract

Little is known about people's perceptions of how much swimming competency is required to provide protection from drowning, especially in open water environments where most drowning incidents occur. This study reports on parental perceptions (n = 309) of swimming competency of themselves and their children and parents' beliefs on their safety when swimming in open water. Most parents (58%) considered themselves *good/very good* swimmers, although more than half (55%) considered that they could swim 25 m or less. Most parents (87%) reported that their children could swim, with more than one-half (52%) believing that their child's swimming competency was *good/very good*, yet most (74%) considered their child could swim only 25 m or less. Most parents (59%) and almost all children (81%) had never actually swum their reported distance in open water. In spite of these low levels of competency, one-half (51%) of parents thought their children were *safe/very safe* in open water. We discuss the implications of holding an overly-optimistic belief in the protective value of minimal levels of swimming competency for open water safety. Further exploration is recommended regarding the differences between real and perceived swimming competency especially among at-risk groups such as male children and adults.

Keywords: real and perceived swimming competency, drowning prevention, child safety, parental perception, water safety

Introduction

Water competence has long been regarded as a critical safety factor in the prevention of drowning. Recent work has identified the dynamic interaction of person, activity and environment and the consequent changing competency base required for the prevention of drowning in recreational activities (Langendorfer, 2011). From a drowning prevention perspective, levels of water competence need to be flexible to allow for the differences between people, activities and environments. The person who can float for a set time or swim a certain distance in a warm pool wearing only a swimsuit may not be able to repeat those same competencies to the same level of competency in a cold, open water environment fully clothed. Further, how people perceive their swimming competency in open water influences their perception of their safety and their potential risk of drowning. The purpose of this paper is to explore the perceptions of swimming competency and drowning risk that informs people's understanding of their safety and that of others in their care in an open water environment.

Traditionally, water competence has been measured by distance swum. Distances have been set arbitrarily, increasing sequentially with age, often tested in isolation without association to other survival competencies. Almost invariably tests have been conducted in the benign conditions of a closed water environment such as a tepid swimming pool. For example, in New Zealand, a distance of 200 m (Water Safety New Zealand, 2015a) is set as a benchmark for all school children to achieve by the time they have completed primary school (approximately 11 years of age). In the UK, the highest level of the ASA *Learn to Swim* Pathway contains a continuous swim of 100 m, 25 m of each of the four competitive strokes and a separate routine of other water competencies (Amateur Swimming Association, 2015). The Canadian Lifesaving Society *Swim to Survive* program standard is set at 50 m but includes a roll into deep water as well as treading water for one minute (Lifesaving Society Canada, 2015). Australia's Royal Life Saving Society's *Swim and Survive* program requires a swim of 150 m swim using various strokes and completion of other water safety skills at Level 4 (Royal Life Saving Society Australia, 2015) - a target set for all children to achieve by the end of primary school (Australian Water Safety Council, 2012). An international position statement recommended completing a minimum distance of 25 m in addition to a range of other water safety skills including water entry/exit, floating and rescue skills (ILSF, 2012). A review of 14 international organisations found variable distance requirements within their tests of water safety with 25 m being the most

frequently reported distance although the authors noted that the skills and competencies will be environment- and task-specific (Quan et al., 2015). A recent study in Bangladesh used a 25 m distance as a measure of 'naturally acquired swimming ability,' the assessment being conducted in open water deeper than the candidates' own height and included being able to exit the water (Rahman et al., 2014).

A major issue regarding the protective value of water competency in drowning prevention is the degree to which those competencies transfer to open water environments. Langendorfer (2011) discussed water competence as part of a 'dynamical system' where water competence may need to change in response to variable demands. Using Karl Newell's (1986) model of motor coordination and control, Langendorfer suggested water competence ought to be viewed as "an emergent and potentially transient systemic behaviour, mediated by interactive relationships among a person's individual characteristics, their perceived goal at any point in time, and the environment context" (p. 237). For example, a person capable of swimming comfortably and continuously in a warm, calm and shallow pool may be severely challenged while swimming the same distance in a rough, cold, open water environment at the beach, lake, or river. In the pool environment, being able to swim 25 m or less may be 'good enough' and the person considered of 'can swim' status; at a surf beach or in a swift moving river, the levels of competency may not meet the demands of the situation and result in fatal consequences.

In addition to the plasticity of swimming competency placed upon it by variable environmental demands, the adequacy of its protective capacity is confounded by people's perception of their competency, both in general and specific to the aquatic situation. The lack of an international measure to define swimming competency is suggested as one reason that people may have an inflated self-efficacy of their swimming competence (Dixon & Bixler, 2007). Research has suggested that an overestimation of competency has significant impact on the risk of drowning in open water, especially for males (Moran, 2008a; McCool et al., 2008; McCool et al., 2009). The 'Can You Swim?' research (Moran et al., 2012; Petrass et al., 2012; Stallman et al., 2010) has shown that gaps exist between perceived and real swimming competence. Collegiate physical education students self-estimated greater competencies for floating and swimming on their backs than they could actually perform when tested in a pool. In an open water environment and with populations of less advanced water competency, these differences

are likely to be even greater. Significant differences between estimations and actual competencies have been shown with other survival competencies such as swimming in moving water (Kjendlie et al., 2013), in clothes (Moran, 2014b; 2015) and exiting the water safely (Moran, 2014a).

Both knowledge and physical competencies affect perception of risk (McCool et al., 2008; Moran, 2006; 2008a; Morrongiello, Sandomierski, Schwebel et al., 2013; Morrongiello, Sandomierski & Spence, 2013). An underestimation of the risk may lead to incidents, injuries, and fatalities. Gaps between the perceptions of risk and the actual risk can lead to at-risk behaviours, often with serious consequences. A low perception of the risk of water-related injury or drowning has been shown to be associated with higher self-reported swimming skill and at-risk swimming behaviours, especially among males (McCool et al., 2008; Moran, 2008a; Moran & Willcox, 2010). When people perceived themselves as being more competent swimmers, they were more likely to engage in riskier behaviours in aquatic environments.

What we currently do not know is the level of competence at which people feel that they, or others in their care, are safe to swim in open water environments. While some evidence is available on parental perceptions of safety and risk at the beach (Moran, 2009a: 2010a), little information is available on what constitutes 'safe' levels of swimming competence for self or others in open water. We hypothesise that when real and perceived swimming competency are widely disparate, the risk of drowning is greater. This study aims to explore the relationship between perceived swimming competency and risk of drowning in an open water environment. To achieve this, we set the following objectives:

1. Determine the perceived swimming competence of parents/caregivers and their children
2. Determine what parents/caregivers perceive to be a competent swimmer in terms of drowning prevention for themselves and their children
3. Determine if actual swimming competency in open water affects the perceived level of safety
4. Determine what level(s) of swimming competency the public consider is required to be safe in open water

Method

This cross-sectional survey study used a self-completed, anonymous questionnaire to gain a greater understanding of the perceptions of parents of their own water competency in open water, and that of their child. A convenience sample of parents of primary-aged children was invited to participate in the study during an autumn school term (May-June). There was no obligation by parents to participate. Paper copies of the surveys were either returned directly to the researcher or to the class teacher. Research ethics approval was obtained from the University of Auckland (Reference number UAHPEC 10065).

Participants

Principals at five primary schools were invited to be involved in the study. The specific schools were selected because of their different geographic locations within the Auckland region and their differing socio-economic status (as measured by the Ministry of Education decile rating based on a composite score of household income, occupation, educational qualifications and income support). Parents or caregivers of primary aged children (5 – 11 years) at the five schools were invited to complete a self-report, written questionnaire. A total of 309 parents or caregivers participated by returning completed surveys.

Research Instrument

The survey was designed to be completed by the parents in their own time at home and take about 10 minutes to complete. The questionnaire consisted of 18 close-ended questions, the first four related to demographic details of age, sex, ethnicity they identify with, and length of residency. The following four questions asked participants about whether they could swim, and, if so, their swimming competence using four response categories ranging from *poor* to *very good*, and how far they thought they could swim. No definition of swimming competency was given as the research was seeking their perception of swimming. Further questions probed when they had last swum the distance in a pool and in open water. The same questions were asked regarding the swimming competence of their children. In addition, parents were asked what level of swimming competency all children should attain by the end of primary school education (11 years). To ascertain their water safety attitudes, a series of six statements using a three response Likert scale of *agree*, *disagree* and *unsure* was included. Two summative questions sought information on their sense of safety when swimming in open water for themselves and their children using four response categories ranging from *very unsafe* to *very safe*. Content validity

was determined via expert opinion with the research tool reviewed by peer appraisal. To ensure reliability, a group of parents not involved in the main study were asked to participate in a test-retest pilot study prior to undertaking the research (Watson et al., 2003). Minor amendments were then made to the questionnaire prior to data gathering in the main study.

Analysis

Data received were entered into IBM SPSS Statistics version 22. Frequency and percentages were calculated to report categorical variables such as demographic information and perceptions of competence and risk. Chi-square tests were used to determine associations between dependent variables such as perception of water competence and independent variables such as gender or length of residency.

Results

A total of 309 parents or caregivers completed the questionnaire. Most (61%, n = 187) were female, mainly aged between 30-44 years (57%, n = 174) and had lived in New Zealand for ten years or longer (77%, n = 239). More than one-third of the participants were New Zealand European in origin (39%, n = 121) and around one-fifth each identified as Māori (17%, n = 53), Pasifika (17%, n = 53) or Asian (13%, n = 35). Two-thirds of participants (67%) considered that they could swim.

When asked to elaborate on their swimming competence, most parents (58%) considered themselves *good/very good* swimmers (see Table 4.1). When self-reported swimming competence was calculated by gender, significant differences ($\chi^2(1) = 8.347$, $p = 0.004$) were found with more males than females likely to perceive their swimming competence to be *good/very good* (68%, vs. 51%). Reporting swimming competence by ethnicity also showed significant differences ($\chi^2(1) = 18.962$, $p = < 0.001$) with parents who identified as New Zealand European and Māori origin more likely to report a *good/very good* level of swimming compared with parents of all other ethnicities (68%, vs. 44%). Although not statistically significant, long-time residents (those who had lived in New Zealand for more than ten years) tended to report *good/very good* swimming competence level compared to more recent residents to New Zealand (61%, vs. 49%).

Table 4.1 *Parent Self-Estimated Swimming Competency in Open Water by Gender*

	Male (n = 119)		**Female (n = 187)**		**Total**	
	n	***%***	***n***	***%***	***n***	***%***
How would you estimate your swimming competency? (*n*=306)						
Good/Very good	81	68.1%	96	51.3%	177	57.8%
Poor/Fair	38	31.9%	91	48.7%	129	42.2%
How far would you estimate you can swim non-stop? (*n*=306)						
Less than 25 m	50	42.0%	117	62.5%	167	54.5%
More than 25 m	69	57.9%	70	37.5%	139	45.3%
Have you ever swum this distance in open water? (*n*=300)						
In open water	62	53.4%	61	33.2%	123	41.0%
Not in open water	54	46.6%	123	66.8%	177	59.0%
When did you swim this distance in a pool? (*n*=267)						
Less than 1 year	71	65.8%	93	58.5%	164	61.5%
More than 1year ago	37	34.2%	66	41.5%	103	38.6%
When did you swim this distance in open water? (*n*=124)						
Open water <1 year	30	48.4%	24	38.7%	54	43.6%
Open water >1 year	32	51.7%	38	61.3%	70	56.5%

Table 4.1 Parent Self-estimated Swimming Competency by Gender

Participants were asked how far they thought they could swim. More than half (55%) considered that they could swim 25 m or less. Cumulatively, almost three-quarters (73%) estimated they could not swim more than 50 m. Significant differences were evident when estimated distance swum was analysed by sex ($\chi^2(4) = 14.244$, $p = 0.007$). Females were almost twice as likely as males to report they could not swim (10%, vs. 5%) or swim 25 m or less (53%, vs. 37%). In contrast, males were twice as likely to report being able to swim more than 200 m (22%, vs. 11%). Significant differences in estimates of distance swum were also evident when reported against ethnicity with New Zealand European-origin parents estimating greater distances than non-European parents ($\chi^2(4) = 50.529$, $p = < 0.001$). Parents who identified as being non-New Zealand European origin were twice as likely to report being able to swim 25 m or less (67%, vs. 29%). New Zealand European-origin parents were more likely to report being able to swim more than 200 m when compared with parents of all other ethnicities (29%, vs. 6%).

Almost two-thirds of respondents (62%) reported they had swum this distance in a pool in the previous year; however, more than one-half (59%) reported never having swum the distance in open water. Significantly more males than females (53%, vs. 33%) reported that they had swum the distance in open water ($\chi^2(1) = 12.116$, $p = 0.001$). Parents who identified as New Zealand European origin were more likely than parents of all other ethnicities (51%, vs. 34%) to report they had swum the distance in open water ($\chi^2(1) = 8.070$, $p = 0.005$).

Table 4.2 shows parental estimates of their child's swimming competency. Almost all parents (87%) reported that their child could swim with more than one-half (52%) believing that their child's swimming competency was *good/very good*. When swimming competence was reported by length of residency in New Zealand, significant differences ($\chi^2(1) = 11.869$, $p = 0.001$) were found with long-term residents (those who have lived in New Zealand for more than ten years) more likely to report *good/very good* child swimming competence compared with those of more recent residency (61%, vs. 39%). Parents who identified as Asian ethnicity (Chinese, Korean, or Indian) were significantly more likely than other ethnicities (63%, vs. 46%) to report a *poor/fair* level of swimming competence ($\chi^2(1) = 4.044$, $p = 0.044$). No significant gender differences were evident in parental estimates of child swimming competence.

Table 4.2 *Parental Estimates of Child Swimming Competency by Gender*

	Male (n = 119)		**Female (n = 187)**		**Total**	
	n	***%***	***n***	***%***	***n***	***%***
How would you estimate your child's swimming competency? (*n*=306)						
Good/Very good	59	49.6%	100	53.5%	159	52.0%
Poor/Fair	60	50.4%	87	46.5%	147	48.0%
How far would you estimate your child could swim non-stop? (*n*=306)						
Less than 25 m	86	72.3%	142	75.9%	228	73.5%
More than 25 m	33	27.8%	45	24.1%	78	25.5%
Has your child ever swum this distance in open water? (*n*=302)						
In open water	22	18.6%	37	20.1%	59	19.5%
Not in open water	96	81.4%	147	79.9%	243	80.5%
When did your child swim this distance in a pool? (*n*=255)						
Less than 1 year	91	92.8%	148	94.2%	239	93.7%
More than 1year ago	7	7.1%	9	5.7%	16	6.3%
When did your child swim this distance in open water? (*n*=59)						
Less than 1 year	18	68.2%	32	89.9%	50	84.8%
More than 1 year	5	21.7%	4	11.1%	9	15.3%

Table 4.2 Parental Estimates of Child Swimming Competency by Gender

When asked how far parents thought their children could swim, three-quarters (74%) considered their child could swim 25 m or less. A small proportion (7%) reported that their child could swim more than 200 m. Most parents (81%) reported their child had not swum the distance in open water with no significant difference between reports by male or female parents. Parents who identified as New Zealand European origin were more likely than those of all other ethnicities (27%, vs. 9%) to report their child could swim more than 50 m ($\chi^2(1) = 22.187$, $p = <0.001$). Asian parents were more likely than other parents (95%, vs.71%) to report their child could swim 25 m or less ($\chi^2(1) = 9.800$, $p = 0.044$). No statistical differences were found when parent estimates of their child's swimming competency were analysed by gender or residency.

When asked how far children should be able to swim at the completion of primary school (approximately 11 years of age in New Zealand), more than half (54%) considered 25 m an appropriate distance. A further 23 per cent of parents considered that all children should be able to swim 50 m while a small proportion thought children should be able to swim 200 m or more. When reported against ethnicity, twice as many New Zealand European parents than other parents (34%, vs. 17%) thought that all children should be able to swim more than 50 m by the completion of primary schooling ($\chi^2(3) = 13.039$, $p = 0.005$).

Parents were asked to respond to six statements about water safety for themselves and their child (see Table 4.3). Two-thirds (66%) of parents agreed that their swimming competence would keep themselves safe in open water, and significantly more males than females (76%, vs. 59%) reported more confidence in the protective nature of their swimming ($\chi^2(2) = 10.018$, $p = 0.007$). Almost one-half (49%) of parents reported that their current swim fitness would keep them safe. Male parents were significantly more likely than females (62%, vs. 40%) to have confidence in their swimming fitness to keep them safe ($\chi^2(2) = 15.423$, $p = <0.001$). Many parents (44%) thought that others were at greater risk than themselves in the water, and, although not statistically significant, quantitatively more males believed that they were safer than others in open water (51%, vs. 39%). Most parents (84%) believed they should wear a lifejacket in a boat and, although not significantly different, slightly more females than males expressed a safer attitude (87%, vs. 79%). Significantly more females than males (90%, vs. 74%) thought that lifejackets should be compulsory on boats for adults ($\chi^2(2) = 17.264$, $p = <0.001$).

Table 4.3 *Attitudes toward Water Safety and Risk of Drowning by Gender*

	Agree		**Disagree**		**Unsure**	
	Male	Female	Male	Female	Male	Female
	n/ %	*n/%*	*n/%*	*n/%*	*n/%*	*n/%*
My swimming ability will keep me safe in open water (*n*=305)	90 76.3%	110 58.8%	17 14.4%	42 22.5%	11 9.3%	35 18.7%
Others are at greater risk than me when swimming in open water (*n*=303)	60 51.3%	73 39.2%	27 23.1%	44 23.7%	30 25.6%	69 37.1%
My current swimming fitness will keep me safe in open water (*n*=304)	73 62.4%	74 39.6%	23 19.7%	66 35.3%	21 17.9%	47 25.1%
My swimming ability means I don't need to wear a lifejacket in a boat (*n*=304)	20 17.1%	22 11.8%	92 78.6%	163 87.2%	5 4.3%	2 1.1%
Wearing of lifejackets on boats should be compulsory for children (*n*=305)	108 91.5%	184 98.4%	6 5.1%	1 0.5%	4 3.4%	2 1.1%
Wearing of lifejackets on boats should be compulsory for adults (*n*=304)	86 73.5%	169 90.4%	22 18.8%	9 4.8%	9 7.7%	9 4.8%

Table 4.3 Attitudes toward Water Safety and Risk by Gender

When asked about their perception of personal safety when swimming in open water, almost two-thirds (64%) of parents considered that they felt *safe/very safe*. Significantly more males than females (76%, vs. 57%) were likely to feel safe in open water ($\chi^2(1) = 11.216$, $p = 0.001$). When compared against their self-estimated swimming competence, parents were more likely ($\chi^2(1) = 41.363$, $p = <0.001$) to report a greater sense of safety in open water if they could swim more than 25 m compared with those parents who estimated they could swim 25 m or less (83%, vs. 48%). One-half (51%) of parents thought that their child was *safe/very safe* when swimming in open water. Significantly more male than female parents (59%, vs. 45%) thought that their child was *safe/very safe* when swimming in open water ($\chi^2(1) = 5.419$, $p = 0.020$). Parents were more likely ($\chi^2(1) = 14.676$, $p = <0.001$) to report a greater sense of safety for their child in open water if they thought that their child could swim more than 25 m compared with parents who estimated their child could swim 25 m or less (69%, vs. 44%).

Discussion

The primary goal of this paper was to establish what level of swimming competency parents considered necessary to be safe in open water for both themselves and their child. This was undertaken by analyzing parental perceptions of their personal swimming competence and that of their child, together with how their level of swimming competency affected their perceived level of safety in open water.

Although most parents (67%) in this study reported that they could swim, and many (58%) perceived their swimming ability to be *good/very good*, most (55%) estimated that they could only swim 25 m or less. The self-reported competency level of parents in this study was much higher than that reported in two studies of other New Zealand-based population groups where only 13% of youth (15-19 years) (Moran, 2008a) and 7% of festival goers (Moran & Stanley, 2013) estimated they could swim up to 25 m. Another international study found that 6% of tertiary students indicated they could swim 50 m or less (Moran et al., 2012; Stallman et al., 2010) although the participants were physical education students where one would anticipate a higher proficiency level. A study of beachgoers in New Zealand (McCool et al., 2008) found that one-third self-reported they could swim less than 25 m. The estimated level of competency in this study is lower than the child population in the LIC of Bangladesh where caregivers or children reported that over half (52%) of all children aged 5-17 years could swim 25 m (Rahman

et al., 2014). Parents in this study are possibly being overly cautious about their swimming proficiency. If their perceived assessment of their swimming competence was relative to their actual competence, there is likely a need to improve competencies required to prevent drowning in open water.

Previous studies have shown that males perceive their swimming competency to be greater than that of females. Moran (2008a) found male youth were more likely to perceive a higher proficiency with significantly more males than females (37%, vs. 26%) indicating they could swim more than 100 m. Male beachgoers (McCool et al., 2008) also were more confident of their swimming competency than females. A study of festival goers also reported differences in gender perception with males more confident about their swimming competence than females (68%, vs. 51%) and females twice as likely as males to estimate they could swim 25 m or less. In contrast, there were no differences in perception of competency by gender for tertiary physical education students (Moran et al., 2012; Stallman et al., 2010).

Those who identified as New Zealand European or Māori ethnicity were more likely to perceive their competence as *good/very good* while Pasifika participants were more likely to perceive a lower swimming competence. These perceptions were reflected in lower swimming distance estimates. As shown in other studies (McCool et al., 2008; Moran & Stanley, 2013), New Zealand European parents were more likely to estimate being able to swim longer distances than all other ethnicities. For those who identified as Māori, a wider gap was evident between how well they thought they could swim when compared with their estimated swimming distance. Further research is required to fully understand whether this apparent disparity between perceived and real swimming competency exists in all sectors of the community, especially among those at greater risk of drowning.

Parental optimism in the swimming competence of their child also was evident. Nearly all parents believed their children could swim with just over half perceiving their child's competency as *good/very good*. Three-quarters (74%) estimated that their child could swim 25 m or less, a distance unlikely to confer a strong protective capacity in open water. Furthermore, this study did not identify any significant gender differences in parental estimations of their child's competency as has been reported in previous studies. Moran, (2009a) reported that male parents at beaches were more likely to report better child swimming competence and lower perceived

risk for both themselves and their child. Differences in perceptions of child competence between ethnicities were also evident. Parents who identified as Asian were more likely than all other ethnicities (61%, vs. 39%) to report a *poor/fair* level of swimming competence for their child with more Asian parents estimating their child could swim 25 m or less (95%, vs. 71%). In summary, it appeared that many parents did not have an accurate perception of the level of swimming competency for themselves or their child that would afford drowning prevention protection in open water. Further research on both real and perceived water competency is required to refute or substantiate this finding.

From a drowning prevention perspective, we were concerned that most of the parents (59%) and almost all children (81%) in this study had never actually swum their reported distance in open water environments where most drownings occur. Other studies have shown the disparities between swimming in a calm pool and a simulated open water environment. The recent 'Can you swim in waves?' study (Kjendlie et al., 2013) showed that the ability to swim a set distance in a warm, calm and clear pool did not necessarily transfer to simulated rough water in the same pool. Children 11 years of age uniformly displayed decreases in performance (8-14%) in rough water compared to what they had achieved under calm pool conditions. The authors concluded that the children were unlikely to achieve the same calm water competency levels in rough, moving water in an emergency. Other studies have found that when testing 10-year-old children who had already swum distances of 25 m and 100 m, many did not have the fundamental skills to keep themselves safe in open water (Junge et al., 2010; Laakso & Stallman, 2010). In addition, more recent evidence suggested that those with minimal swimming competencies were compromised to a greater extent than those with higher levels of competency by wearing clothes under simulated survival situations (Moran, 2014b, 2015).

Underestimation of risk is a serious concern for swimming in open water environments. Even though half (54%) of respondents estimated they could swim only 25 m or less, many (66%) perceived that their swimming competence would keep them safe in open water situations. In addition, one-half (49%) were of the opinion that their current swim fitness levels would keep them safe. In studies about risk of drowning, males were more likely than females to underestimate the risk (Brenner et al., 2003; Gulliver & Begg, 2005). In addition, some

evaluations of high-risk activities such as rock fishing suggested that underestimation of the risk perception may be due to a misdirected faith in their swimming competence (Moran, 2008b).

Evidence shows that parental underestimation of drowning risk for their offspring was also a concern. The majority of parents (64%) in the current study felt safe to swim in open water and one-half (51%) perceived their child was safe swimming in open water. When parents estimated they could swim more than 25 m they were significantly more likely to report a greater sense of safety in open water. This heightened sense of safety also was apparent when they estimated their child could swim more than 25 m. This suggested that most parents believed that being able to swim over 25 m (in a pool) provided them with the protection to keep themselves and their child safe in open water, highlighting a reality gap between what parents perceive to be safe in open water and what most drowning prevention experts believe (Moran et al., 2012; Stallman et al., 2010).

An overly optimistic belief in the protective capacity of swimming in drowning prevention is not new. A study by the authors found that more than one-third of parents (35%) believed their children required less supervision around water after having had swimming lessons (Moran & Stanley, 2006). A study of parental perception of child supervision requirements (Morrongiello, Sandomierski, & Spence, 2013) showed that parents were likely to reduce their level of supervision as they perceived their child's competency improved. Such changes in supervision cause even greater concerns when the level of competency is overestimated. Furthermore, in open water environments such as at the beach, male parents were more likely to underestimate the risk due to greater confidence in their own swimming fitness levels, estimated swimming competence and the perception that they were safer than others in open water (Moran, 2009a). Moran (2009a) reported significantly more male parents estimated higher swimming competence for their 5–9-year-old children and twice as many males than females were likely to estimate no risk of drowning for their 5–9-year-olds.

Confidence that children are safe in open water once they can swim over 25 m is reinforced in the belief by more than half (54%) of the parents that children should be able to swim up to 25 m by the end of primary school. A distance of 25 m is below many of the standards set by international drowning prevention organisations in their award schemes (for example, Royal Life Saving Society Australia, Lifesaving Society Canada, Amateur Swimming

Association, Water Safety New Zealand) where longer distances, together with demonstrating other water safety competencies, are required as a basic level of proficiency.

Limitations

The results of this study go some way toward giving us a greater understanding of how people perceive the relationship between swimming competency and safety when swimming in open water situations. There are several limitations which must be considered in interpreting these results. First, the participants of this study were parents whose child attended one of the five schools chosen as a convenience sample by the researchers. Whilst the schools were chosen from a range of decile ratings and geographic areas, they and the parents who volunteered to complete the surveys were not randomised and may not have been reflective of the general population. Second, no clear definition of swimming competency in relation to drowning prevention was presented to respondents (since none existed in the drowning prevention literature at the time of this study) and this may have led to ambiguity in responses. Third, swimming competency was self-estimated and may not necessarily be a valid indicator of swimming competence (Moran et al., 2012; Stallman et al., 2010). Similar concerns about self-reporting have been identified in other health behaviors (Mickalide, 1997; Nelson, 1996; Robertson, 1992). Fourth, accuracy of recall decreases with time so self-reporting of past swimming experience such as open water swimming and swimming distances are likely to be approximate only and reflect recall bias. Fifth, results were not explored by decile rating which may have provided some analysis of different socio-economic groups. These limitations notwithstanding, the results of this study are suggestive of people's understanding of swimming competency and its influence on the open water safety of adults and children.

Conclusion

This study is important because it indicates what many parents believe is the level of swimming competency required to keep themselves and their children safe in an open water environment. The results suggested that many parents considered themselves and their children to be good swimmers even though estimates of swimming distance for most adults and children were 25 m or less in a pool, and most had never swum that distance in open water. This level of optimism in the protective capacity of a minimal level of swimming competency is a cause for concern because it suggests that parents may underestimate the risk to themselves and their children when

swimming in open water environments. Further research is required to determine if this minimal level of competence is perceived as being safe for open water activity by other sectors of the community, and whether perceptions of swimming competency match the reality of open water swimming demands.

Chapter 5 Study Two – Perceived Water Competencies among Māori and Pasifika Adults - A reality gap in perception?

5.1 Introduction

Having found an overly optimistic view of water competence among parents and their children, I decided to investigate whether perceptions of water competence were similar for high-risk drowning groups in New Zealand. Māori and Pasifika ethnicities are at high risk of drowning, overrepresented in the New Zealand drowning statistics. This study aims to report on the perception of competency and risk of drowning in open water in an adult population at high risk of drowning (Māori and Pasifika), to determine if this perceived safe level of competence is the same as the parental study for high-risk Māori and Pasifika adult population groups.

Research Questions

1. What is the perceived swimming competence among population groups who are at a high risk of drowning in closed water environments?

2. What is the perceived swimming competence among population groups who are at a high risk of drowning in open water environments?

3. What is their perceived competence to rescue others in open water?

4. What are the attitudes towards risk for open water scenarios among population groups who are at a high risk of drowning?

5. What is the ability to assess risks in open water environments among high drowning risk groups?

A presentation on this study was delivered to the World Conference on Drowning Prevention in Penang, Malaysia, November 2015, and the manuscript has been published in the *Journal of Education and Human Development.*

Stanley, T., & Moran, K. (2018). Self-estimates of swimming and rescue competence, and the perceptions of the risk of drowning among minority groups in New Zealand – lifesaving or life threatening? *Journal of Education and Human Development, 7*(1), 82-91. http://jehdnet.com/journals/jehd/Vol_7_No_1_March_2018/10.pdf

5.2 Self-Estimates of Swimming and Rescue Competence, and the Perceptions of the Risk of Drowning among Minority Groups in New Zealand – Life Saving or Life Threatening?

Abstract

Analysis of drowning and rescue statistics suggests that some population groups (such as males, youth, and minority groups) are at greater risk than others. This study reports on the perceived water competency of minority groups, and its potential to mitigate the risk of drowning when swimming in open water. Of the 194 Māori and Pasifika adults that took part in the study, most (91%) believed they could swim, and over two-thirds (70%) considered their competence to be *good/very good*, although most (72%) estimated they could swim 25 m or less. Most participants reported undesirable attitudes which could account for the over-representation of these minority groups in drowning statistics. Significant gender differences were evident for all risk perceptions. This study suggests that males from disadvantaged lower SES minority groups may be at greater risk of drowning because of their lack of competency and their tendency to overestimate this, with regard to swimming and rescue competence in open water environments.

Keywords:

Drowning prevention, water safety, minority groups, swimming competency, risk perception

Running title

New Zealand minority groups and drowning risk

Introduction

Analysis of mortality statistics worldwide suggests that minority groups, especially those of lower socio-economic status, are at greater risk of premature death from non-communicable diseases such as drowning (Stringini et al., 2017; Tobias, 2017). While the circumstances surrounding drowning incidents have been well reported (Martyn, 2014a; Martyn, 2014b), little is known about what competencies, physical and cognitive, people from low socio-economic minority groups bring to the aquatic environment, or what knowledge informs their judgement of safety and risk (Petridou & Tursz, 2001; Quan, 2014; Shaw et al., 2005). Further, it is unknown if they, or any other groups, can accurately assess their own competency in open water when confronted with exacerbating environmental factors (such as cold, waves and currents), or when engaged in high-risk activities (such as rock-based fishing or boating). It is the purpose of this study to explore the self-estimated swimming and rescue competencies, and the perceived risk of drowning, of low socio-economic status minority groups with particular reference to open water environments where most drowning occurs.

Three key demographic factors appear to influence drowning mortality and morbidity – gender, ethnicity, and socio-economic status. Males comprise 49% of the New Zealand population (Statistics NZ, 2016), yet account for 80% of the drowning fatalities (Water Safety New Zealand, 2016). Similar overrepresentation of males in drowning statistics has been previously reported (Gulliver & Begg, 2005; Howland et al., 1996; Langley et al., 2001; Moran, 2009b; Smith & Brenner, 1995). In a study on the perception of swimming competence and risk of drowning of parents and their children (Stanley & Moran, 2017), males were twice as likely as females (22%, vs. 11%) to estimate they could swim more than 200 m, and more likely to feel safe when swimming in open water (76%, vs. 57%). Male parents were more likely to express confidence in their swimming competency, whereas female parents were more likely to report positive water safety attitudes. Furthermore, a previous study by the authors reported male overestimation extended to perceived rescue competency in open water (Moran & Stanley, 2013).

Some evidence suggests that ethnic minorities (Mael, 1995; McCool et al., 2009; Quan et al., 2006) and those of lower socio-economic status (Cubbin et al., 2000; Hong et al., 2010; Huong et al., 2006; Petridou & Tursz, 2001; Rahman et al., 2006; Shaw et al., 2005) are at greater risk of drowning. In New Zealand, two of the ethnic groups identified as being

overrepresented in drowning statistics are Māori and people from the Pacific Islands. Māori, the indigenous people of New Zealand, comprise 15% of the total population (Statistics NZ, 2016) yet account for 21% of the annual drowning toll (Water Safety New Zealand, 2016). Pacific peoples (hereafter referred to as Pasifika) comprise 7% of the population (Statistics NZ, 2016) and account for 8% of the annual drowning toll (Water Safety New Zealand, 2016) and up to 30% of drowning in the Auckland region (Water Safety New Zealand, 2020a).

Māori and Pasifika have been identified in New Zealand as of lower socio-economic status (Marriott & Sim, 2014; Pollock, 2012; Statistics NZ, 2013), with increasing inequality over the past decade (Marriott & Sim, 2014; Statistics NZ, 2013; 2016). In addition, Māori and Pasifika have reported lower participation in aquatic activity. Sport New Zealand (2015) has linked groups of low socio-economic deprivation with less participation in all sport or recreation, including swimming. Swimming is the second most popular recreational activity with almost one-third (30%) of New Zealanders having participated in swimming in the previous year (Sport NZ, 2015). Lower participation in swimming was reported for those of lower socio-economic status (high SES 33.5%, low SES 26.7%), and Māori (27.8%) and Pasifika (20.4%). Furthermore, the study found that lower socio-economic groups were more likely to take part in activities in natural settings, which, for aquatic pursuits, means the open water where most drowning fatalities occur (Water Safety New Zealand, 2016). Evidence also suggests differences in perception of water competency are apparent for both socio-economic status and ethnicity among youth (Moran, 2006; Moran, 2008a). Students from low socio-economic status schools estimated significantly lower swimming competence than their peers from higher socio-economic status schools, and fewer Māori (44%) and Pasifika (27%) youth than European youth (53%), estimated being able to swim more than 100 m.

Differences in perceived water competencies by gender, socio-economic status and ethnicity reported above, led the authors to focus on Māori and Pasifika males because they are overrepresented in the drowning statistics. In addition, little is known about how these high-risk groups perceive their risk of drowning and their perceived capacity to cope with that risk. The research questions that underpin this study therefore focus on the perceptions of swimming and rescue competency and the risk of drowning in an adult Māori and Pasifika population, by exploring:

- perceived swimming competency in closed and open water

- perceived rescue competency in open water
- perceptions of the risk associated with various open water scenarios
- water safety attitudes in relation to open water environments

Method

This study used a cross-sectional design with self-complete written survey methodology. Adult members of the workforce from 12 manufacturing organisations in South Auckland, New Zealand were invited to take part in the study during the 2013/2014 summer. South Auckland was chosen because it is a recognised area of low socio-economic status (Department of Public Health, 2014) with a high Māori/Pasifika population (Auckland Council, 2013). Manufacturing workplaces were selected because of their high number of Māori and Pasifika employees, ethnicities with high representation in injury data, including drowning. The organisations completed an employer sponsored health and safety program with water safety being one of the components. Research ethics approval was obtained from The University of Auckland Human Participants Ethics Committee (UAHPEC) (Reference number 10065).

Participants

A total of 221 employees in the 12 workplaces completed the self-complete written questionnaire after a brief water safety presentation (approximately 30 minutes) as part of an employee health and safety initiative. From this workforce, responses from Māori and Pasifika employees (*N* = 194) were selected for analysis.

Survey Instrument

The survey was designed to be completed in about 10 minutes during the series of presentations that related to water safety. The questionnaire consisted of 14 closed questions based on previously validated studies (Moran, 2003; 2006; 2008b; McCool et. al., 2009; Moran & Stanley, 2013). The first four questions assessed socio-demographic characteristics including gender, age (*15–19 years, 20-29 years, 30–44 years, 45-64 years, 65+ years*), self-identified ethnicity (*New Zealand European, Māori, Pasifika, Asian* and "*Other*" ethnic groups) and length of residency in New Zealand *(<1 year, 1-4 years, 5-9 years, >10 years*).

Five questions sought information on swimming competency by asking participants whether they could swim and, if so, how they would rate their swimming competency using four response categories (*poor, fair, good, very good*) and how far they estimated could swim non-stop (Moran, 2003). In addition, information was sought on when and where they had swum the

distance (*last month, last year, last 5 years, last 10 years*), how easily they thought they could swim the distance estimated in open water (*very easily, easily, with difficulty, with great difficulty*) and how often they had swum in open water (*daily, weekly, about once a month, less than once a month, never*).

Participants were also asked if they thought they could rescue someone in open water, and, if so, how easily (*very easily, easily, with difficulty, with great difficulty*) (Moran & Stanley, 2013). To determine water safety attitudes, participants were asked a series of six statements (Q. 12) using a three-point response scale of *agree*, *disagree* and *unsure* (Moran 2008b, McCool et al., 2009). A series of 10 statements (Q. 13) designed to ascertain their estimated water competency in open water used a three-point response scale of *confident*, *anxious* and *unsure.* Finally, perception of the risk of drowning was determined using a series of five statements (Q.14) (for example, when being caught in a rip current at a surf beach or being swept off isolated rocks by a wave while fishing) with a four-point response scale (*extreme risk, high risk, slight risk, no risk*) (Moran, 2008b, Moran et.al., 2012).

Data analysis

All data were transferred from paper and entered into SPSS Statistics Version 22 (Armonk, NY, USA) for statistical analysis. Data was double checked by a second researcher. Frequency and percentages were generated to report categorical variables such as demographic data and perceptions of competence and risk. Chi-square tests were used to determine the association between dependent variables (such as perceived swimming competency and risk) and independent variables (such as gender, age and ethnicity). Where multiple responses were included (for example, swimming and rescue competency), results were dichotomised for ease of interpretation with *poor* and *fair* grouped as *poor/fair* and *good* and *very good* grouped as *good/very good*.

Results

A total of 194 employees who self-identified as Māori or Pasifika participated in the study. Most were male (80%, n = 156), had lived in New Zealand for 10 years or longer (80%, n = 157), and were aged between 20-64 years (20-29 years 28%, 30-44 years 34%, 45-64 years 30%). Three-quarters (75%, n = 145) self-identified as Pasifika with the remaining participants self-identifying as Māori (25%, n = 49). No significant differences were found in competency

estimates or perception of risk when analysed by age groups or length of residency in New Zealand and therefore results are tabulated by gender which did show significant variability.

Self-estimated swimming and rescue competency

Table 5.1 shows self-estimated swimming and rescue competency by gender. Most participants (91%) believed they could swim, and over two-thirds (70%) considered their competence to be *good/very good*, although most (72%) estimated they could swim 25 m or less.

While no significant gender difference was found in competency estimates (see Table 5.1), significantly more males ($\chi2$ (1) = 5.068, p = 0.024) estimated they could swim more than 25 m (31%, vs. 13%). Female (87%) participants were more likely to estimate a swimming distance of less than 25 m. Two-thirds (66%) of participants reported they had swum the distance in deep, open water. Significantly more males than females (73%, vs. 40%) recounted having swum their estimated swimming distance in open water ($\chi2$ (1) = 15.487, $p \leq 0.001$).

Most participants (60%) thought they could rescue someone in open water, and one-half (50%) believed they could perform a rescue with ease. When analysed by gender, significantly more males than females (64%, vs. 42%) were confident of their ability to rescue ($\chi2$ (1) = 6.542, p = 0.011). Almost all males and very few females (92%, vs. 8%) thought that they could perform a rescue with ease ($\chi2$ (1) = 15.839, $p < 0.001$).

Water safety attitudes

Participants were asked to respond to six statements about their attitudes to water safety (see Table 5.2). Almost three-quarters (73%) of participants believed their swimming ability would keep them safe when swimming in open water, and, although not significant ($\chi2$ (2) = 5.752, p = 0.056), more males than females (76%, vs. 58%) were confident that their swimming capacity would be protective in a drowning emergency.

Table 5.1 *Self-Estimated Swimming and Rescue Competency in Open Water by Gender*

	Male		Female		Total	
	n	***%***	***n***	***%***	***n***	***%***
Estimated swimming competency						
Good/Very good	114	73.1%	22	57.9%	136	70.1%
Poor/Fair/Cannot swim	42	26.9%	16	42.1%	58	29.9%
Estimated swimming distance*						
25 m or less	107	68.6%	33	86.8%	140	72.2%
More than 25 m	49	31.4%	5	13.2%	54	27.8%
Swum distance in open water*						
In open water	114	73.1%	15	39.5%	129	66.5%
Not in open water	42	26.9%	23	60.5%	65	33.5%
Could rescue in open water*						
Yes	101	64.7%	16	42.1%	117	60.3%
No	55	35.3%	22	57.9%	77	39.7%
Rescue confidence in open water*						
Easily/ Very easily	89	57.1%	8	21.1%	97	50.0%
With difficulty/ With great difficulty / Could not rescue	67	42.9%	30	78.9%	97	50.0%

Table 5.1 Self-estimated Swimming and Rescue Competency by Gender

*Significant difference between males and females (p <.05)

Table 5.2 *Water Safety Attitudes by Gender*

	Male		Female		Total	
	n	***%***	***n***	***%***	***n***	***%***
Swimming ability will keep me safe						
Agree	119	76.3%	22	57.9%	141	72.7%
Disagree	22	14.1%	11	28.9%	33	17.0%
Unsure	15	9.6%	5	13.2%	20	10.3%
Swimming fitness will ensure my safety						
Agree	100	64.1%	19	50.0%	119	61.3%
Disagree	34	21.8%	11	28.9%	45	23.2%
Unsure	22	14.1%	8	21.1%	30	15.5%
Risk of drowning is omnipresent						
Agree	100	64.1%	24	63.2%	124	63.9%
Disagree	32	20.5%	9	23.7%	41	21.1%
Unsure	24	15.4%	5	13.2%	29	14.9%
Others are at greater risk than me*						
Agree	96	61.5%	12	31.6%	108	55.7%
Disagree	36	23.1%	18	47.4%	54	27.8%
Unsure	24	15.4%	8	21.1%	32	16.5%
Often feel at risk when conditions are rough*						
Agree	47	30.1%	27	71.1%	74	38.1%
Disagree	88	56.4%	8	21.1%	96	49.5%
Unsure	21	13.5%	3	7.9%	24	12.4%
Swimming ability no lifejacket in a boat						
Agree	32	20.5%	3	7.9%	35	18.0%
Disagree	108	69.2%	32	84.2%	140	72.2%
Unsure	16	10.3%	3	7.9%	19	9.8%

Table 5.2 Water Safety Attitudes by Gender

*Significant difference between males and females ($p < 0.05$)

More than one-half (56%) of participants agreed that others were at a greater risk of drowning than themselves, and significantly more males than females (62%, vs. 32%) believed they were safe when swimming in open water ($\chi2$ (2) = 12.000, p = 0.002). Almost two-thirds (61%) of respondents had faith in their swimming fitness to ensure their safety in open water, although a similar percentage (64%) reported the risk of drowning was always present when swimming in open water. Almost one-fifth (18%) of participants believed that their swimming ability was good enough to not require the wearing of a lifejacket in a boat, and, although not significant ($\chi2$ (2) = 3.821, p = 0.148), more males than females (21%, vs. 8%) reported unsafe attitudes towards the wearing of lifejackets. Over one-third of respondents (38%) agreed that they often felt at risk swimming in rough conditions with significantly more females than males (71%, vs. 30%) feeling at risk in rough conditions ($\chi2$ (2) = 21.902, $p \leq 0.001$).

Open Water Confidence

Table 5.3 shows the confidence of participants in open water by gender. One-half of respondents felt confident about going to help someone in open water (52%), swimming in deep, open water (51%), swimming at a beach without lifeguard supervision (50%), or swimming on their back in open water (48%).

Significantly more males than females (58%, vs. 21%) reported confidence in deep water ($\chi2$ (2) = 20.322, $p \leq 0.001$), and more males than females (54%, vs. 32%) were confident about swimming without lifeguard supervision at a beach ($\chi2$ (2) = 7.550, p = 0.023). Participants were less confident of swimming in rough water (35%), cold water (38%) and waves (41%), although significantly more males than females reported confidence in rough water (40%, vs. 16%) ($\chi2$ (2) = 8.004, p = 0.018) and swimming in cold water (43%, vs. 18%) ($\chi2$ (2) = 7.966, p = 0.019).

Table 5.3 *Open Water Confidence by Gender*

	Confident		Anxious		Unsure	
	Male *n/%*	Female *n/%*	Male *n/%*	Female *n/%*	Male *n/%*	Female *n/%*
Going to help someone in open water	86 (55.1%)	15 (39.5%)	31 (19.9%)	12 (31.6%)	39 (25.0%)	11 (28.9%)
Swimming in open water out of my depth*	91 (58.3%)	8 (21.1%)	30 (19.2%)	19 (50.0%)	35 (22.4%)	11 (28.9%)
Swimming without lifeguard supervision at a beach*	84 (53.8%)	12 (31.6%)	41 (26.3%)	18 (47.4%)	31 (19.9%)	8 (21.1%)
Swimming on my back in open water	79 (50.6%)	14 (36.8%)	45 (28.8%)	12 (31.6%)	32 (20.5%)	12 (31.6%)
Swimming in waves	69 (44.2%)	11 (28.9%)	48 (30.8%)	15 (39.5%)	39 (25.0%)	12 (31.6%)
Swimming in cold water*	67 (42.9%)	7 (18.4%)	54 (34.6%)	20 (52.6%)	35 (22.4%)	11 (528.9)
Swimming in rough water*	62 (39.7%)	6 (15.8%)	54 (34.6%)	20 (52.6%)	40 (25.6%)	12 (31.6%)

Table 5.3 Open water Confidence by Gender

*Significant difference between males and females (p <.05)

Perception of Risk of Drowning

Most respondents rated the risk to drowning as *extreme* or *high* for being swept off isolated rocks while fishing (86%) and being caught in a rip at a surf beach (73%), and over one-half believed the risk of drowning was *extreme* or *high* for being tipped out of a canoe offshore (55%) or falling into a river fully clothed (53%). As expected, most participants rated the risk of drowning as *slight* or *no risk* when chasing an inflatable toy into a pool (88%).

Table 5.4 *Perception of Risk of Drowning by Gender*

	Extreme / High Risk		**Slight / No Risk**	
	Male *n/%*	Female *n/%*	Male *n/%*	Female *n/%*
Swept off isolated rocks by a wave while fishing*	130 (83.3%)	37 (97.4%)	26 (16.7%)	1 (2.6%)
Caught in a rip current at a surf beach*	107 (68.6%)	35 (92.1%)	49 (31.4%)	3 (7.9%)
Tipped upside down in a canoe 100 m from the shore of a lake*	76 (48.6%)	31 (81.6%)	80 (51.3%)	7 (18.4%)
Fell into deep water fully clothed while walking along a riverbank*	73 (46.8%)	31 (81.6%)	83 (53.2%)	7 (18.4%)
Chased inflatable toy into deep water at a local swimming pool*	12 (7.7%)	12 (31.6%)	144 (92.3%)	26 (68.4%)

Table 5.4 Perception of Risk of Drowning by Gender

*Significant difference between males and females (p <.05)

Significant gender differences were evident for all risk perceptions (see Table 5.4). Females perceived the risks to be higher than males for being swept off rocks (97%, vs. 83%) ($\chi2$ (1) = 5.024, p = 0.025), getting caught in a rip (92%, vs. 69%) ($\chi2$ (1) = 8.612, p = 0.003), tipping out of a canoe (82%, vs. 49%) ($\chi2$ (1) = 13.340, $p \leq 0.001$) and falling clothed into a river (82%, vs. 47%) ($\chi2$ (1) = 14.866, $p \leq 0.001$). Even in the least dangerous activity, that of chasing a toy into the deep end of a pool, significantly more females than males (32%, vs. 8%) considered this to be a high-risk activity ($\chi2$ (1) = 16.083, $p \leq 0.001$).

Discussion

The primary purpose of this paper was to explore the self-estimated perceptions of swimming and rescue competency and perceptions of the risk of drowning in open water among a group of Māori and Pasifika adults who are overrepresented in New Zealand drowning statistics. Swimming competence has traditionally been regarded as critical in drowning prevention although other competencies such as water safety skills and knowledge are now accepted among

water safety experts as being just as critical (Moran, 2013a). Most participants (91%) thought they could swim, and most (70%) considered themselves to be *good/very good* swimmers, even though most estimated that they could only swim 25 m or less, a swimming distance that is unlikely to afford a great deal of protection in many open water environments as previously reported (Moran & Stanley, 2013; Stanley & Moran, 2017).

Males were twice as likely as females (31%, vs. 13%) to estimate that they could swim more than 25 m, and females were more likely to estimate they could swim less than 25 m (87%, vs. 69%). A previous study on parental perceptions of swimming competency by the authors (Moran & Stanley 2017) found that parents who identified as being European were less likely to estimate a lower swimming competence than non-European parents (29%, vs. 67% able to swim less than 25 m), and more likely to indicate their children could swim more than 50 m (27%, vs. 9%). Māori and Pasifika are less likely to have been formally taught swimming via private swimming lessons or be taught aquatics in schools as children (Moran, 2009b). They may not have had the opportunity to develop water competencies in adulthood making the accurate estimation of competency problematic. The provision of affordable lessons for minority groups may facilitate enhanced water competency and a more realistic estimation of its protective effect in preventing drowning.

As was the case with self-estimated swimming competency, estimates of rescue competency appeared to be optimistic among participants in this study. One-half of all participants believed they could complete a rescue with ease, with males more confident in their ability to perform a rescue with ease. Previous studies have shown rescue competence is related to gender, socio-economic status and ethnicity (Franklin & Pearn, 2011; Moran, 2008a; Moran & Stanley, 2013; Moran et al., 2016). A study of respondents attending a multicultural festival in Auckland found that most males would jump in to save someone (55%) and most females would seek the help of lifeguards (65%) (Moran & Stanley, 2013). A recent study of parents with children at in-water aquatic lessons reported that significantly more males were confident in their ability to perform a rescue (63% males, vs. 27% females) (Moran et al., 2016). These results indicate the differences between genders for confidence may be wider for Māori and Pasifika groups. This overconfidence may predispose their overrepresentation in the rescuer drowning statistics (Moran & Stanley, 2013).

A fundamental issue with the reliance upon swimming competency in the prevention of drowning is the transference of swimming competency to the open water environment. Māori and Pasifika adults were more likely to have completed their estimated swimming distance in open water (66%) than reported in an earlier study of parents (41%) (Stanley & Moran, 2017). This may be a reflection of a greater prevalence among lower socio-economic groups to take part in activities in natural settings (Sport NZ, 2015), an aquatic environment where most drowning fatalities occur. Males and Māori were more likely to have swum in open water. Reasons for this may be the greater likelihood of male exposure to aquatic activity (Howland et al., 1996) or the cultural importance of gathering seafood (*kaimoana*) for Māori. Further research is required to see if their perceived swimming and rescue competence matches real competence in the open water.

Many participants in the study reported unsafe attitudes towards swimming in open water (see table 2). In spite of low self-estimations of distance swum, most believed their swimming competency would keep them safe in open water, most felt safe swimming in rough water, and most believed that others were more at risk than themselves. Males were more likely to estimate greater swimming distance, believe that others were more at risk than themselves and that their swimming ability was good enough to not require the wearing of a lifejacket in a boat. Participants in this study reported more unsafe attitudes than parents that took part in a similar study on open water risk of drowning (Stanley & Moran, 2017). Males in this study also expressed confidence in their behaviours in open water, reporting greater confidence than females in their ability to swim without lifeguard supervision at a beach, to swim in rough water, or in deep open water. To change unsound attitudes and behaviours, specifically targeted water safety programmes could be promoted at school and community level where these minority groups are easily accessed.

Potential overestimation of competency has also been linked to the risk of drowning (Kjendlie et al., 2013; Moran et al., 2012; Petrass et al., 2012; Stallman, 2011). Most respondents in this study were correctly able to recognise the high-risk scenarios around open water. Males reported a lesser severity of risk in the most extreme risk settings, that of being swept off rocks when fishing (83%, vs. 97%) or getting caught in a rip current (67%, vs. 92%). Such gender differences in drowning risk perceptions suggest that males from minority groups are more likely to be risk takers in the aquatic environment while females from the same background are more

likely to be risk averse. Similar findings of male underestimation of risk have been previously reported (Gulliver & Begg, 2005; Moran, 2006; 2009a; 2009b). One possible reason for the male underestimation of risk may be the reported lesser water safety knowledge for male Māori/Pasifika youth (Moran, 2007) and other ethnic minorities (Moran 2006; Moran & Willcox, 2010: 2013), which may influence their perception of risk. Education programmes that promote accurate risk assessment and risk management processes may help counter this widely accepted notion of male underestimation of risk.

Limitations

Overall, results from this study provide useful insight into why minority groups in New Zealand are at greater risk of drowning and over-represented in drowning statistics. The results should be treated with some caution in light of several methodological limitations. First, the data were obtained from a convenience sample of adult members of the workforce at 12 selected workplaces, identified because of their high number of Māori and Pasifika employees. As a consequence, the sample population varied from the national population demographics with more males and more Pasifika taking part in the study. Second, information wasn't sought from individuals on their socio-economic status, this was assumed from their area of employment together with their ethnicity. Third, although often used in water safety research, self-reporting of swimming competence can result in measurement error and might not accurately express true competence (Mickalide, 1997; Robertson, 1992; Watson et al., 2003). Fourth, no explanation of swimming competency in relation to drowning prevention was given to respondents which may have led to vagueness in responses. Fifth, the questionnaire was completed at the end of a water safety presentation, which may have influenced responses. Finally, swimming distances and rescue competencies were the only water competencies included in the study, further studies should consider the inclusion of other water competencies, both physical and cognitive for minority, and other, groups (Stallman et al., 2017).

Conclusion

This study reinforces earlier research that suggests that many, especially males, may overestimate their competence in being able to swim and rescue others as well as underestimate the risks involved in open water environments. Even though most participants estimated that they could swim a relatively short distance (<25 m), almost three-quarters (73%) of participants believed their swimming ability would keep them safe when swimming in open water. Māori and

Pasifika are less likely to have participated in aquatics lessons which may account for misconceptions about their ability to protect themselves from drowning in the open water. The greater likelihood for Māori and Pasifika adults to swim in open water environments compared to the general population further increases their risk of drowning, as most drowning occurs in the open water environment.

Specifically targeted programmes that include comparisons of real and perceived water competence, education on safe rescue techniques and transference of skills to the open water are recommended to address the drowning risk. In addition, further research is proposed within high-risk minority groups to explore any variances between real and perceived water competencies when swimming in open water.

Chapter 6 Study Three - Older, Wiser, Riskier: Perceptions of Water Competencies, Risks and Aquatic Activities among Older Adults

6.1 Introduction

Older adults are becoming more susceptible to drowning in New Zealand and other high-income countries (Peden et al., 2018). Although older adults are an increasing proportion of the whole population in many high-income countries such as New Zealand, their proportion of the drowning toll is growing at even greater rates. This study investigates aquatic participation, attitudes and perceived risk and water competence for older adults. The aims of this study are to determine the nature and extent of aquatic recreation among older New Zealanders, and explore their perceptions of their practical water competency, and their understanding and practice of water safety when engaged in aquatic recreation.

Objectives:

i. To determine if older adult aquatic participation differs from other population groups

ii. To determine the drowning risks for older adults relating to their drowning incidents and participation

iii. To determine if older adults differ from other population groups in their perceptions of water safety and risk of drowning

iv. To determine the water safety attitudes and behaviours of older adults and if they differ from other age groups

v. To determine the perceptions of water competencies among older adults and how those relate to risk perception and aquatic participation

A presentation on this study was delivered to the World Conference on Drowning Prevention in Durban, South Africa, October 2019, and the manuscript has been submitted to the *International Journal of Aquatic Research and Education.*

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6.2 Perceptions of Water Competencies, Drowning Risk and Aquatic Participation among Older Adults

Abstract

New Zealand has an aging population and, despite falling drowning tolls in all other age groups (Water Safety New Zealand, 2019c), older adults have continued to drown in both increasing numbers and proportion. The reasons for this are not well understood since very little research has focused on older people. A water safety survey (N = 389) seeking information on older adults' aquatic recreational practices and perceptions of safety was conducted at the end of the summer season, 2019. Most adults (86%, n = 335) reported some aquatic activity in the previous year, but those aged 65+ years (66%) were significantly less likely than younger age groups to engage in aquatic recreation. Respondents aged 65+ years were less likely (74%) to perceive they could swim more than five minutes non-stop. The implications of lower perceived swimming and floating competence and less frequent participation in aquatic activities on risk of drowning are discussed.

Keywords: water safety, drowning prevention, older adults, aquatic recreation, perceived and real water competencies

Introduction

In recent years, an increased incidence of drowning among older adults has been reported in many high-income countries (Hu & Baker, 2010; Michalaki et al., 2015; Peden et al., 2020). It is unknown if this is a consequence of any or all of the following factors: increased numbers of older adults (baby boomers); greater disposable income and leisure time resulting in increased exposure to drowning risk; changing health and medical conditions among older adults; greater length of time since undertaking any water safety education or skill development; over estimation of competence and/or underestimation of risk.

Aging populations are an increasing proportion of the whole population in many high-income countries. The population group aged over 65 years is projected to double the under-five year age group by 2050 (World Health Organisation, 2011), and, in New Zealand, increase to one-quarter of the total population by 2050 (Ministry of Health, 2019; Wilson, 2018). While some research shows the impact of the aging population in the workforce (for example, Flower et al., 2019), its impact on recreation has not been well investigated. Physical recreation is reasonably steady throughout adulthood before dropping off at 65 years (Sport Australia, 2019; Sport England, 2019). Recreational participation in, on and around water remains popular for all ages, with swimming, fishing, kayaking and boating the most popular aquatic activities (Sport Australia, 2019; Sport England, 2019; Sport New Zealand, 2015; Brown et al., 2013).

In New Zealand, swimming is the second most popular activity for all ages (Sport New Zealand, 2015; 2018), and the most popular aquatic activity with almost one-third (30%) of New Zealand adults having swum in the previous 12 months (Water Safety New Zealand, 2018a). One-fifth (20%) participated in fishing, and almost a tenth (8%) in canoeing/kayaking. In addition, almost one-half (42%) of adult New Zealanders either own or spend time on a recreational boat (Griffiths et al., 2018). Most aquatic activity (40%) occurred at a beach or by the sea and more than one-quarter (29%) in or on the sea (Sport New Zealand, 2015). Fishing increased in popularity from 25 to 64 years, but swimming declined in popularity as people aged, whereas canoeing/kayaking rises in popularity during the ages 35–49 years.

Despite decreasing overall drowning rates in many high-income countries, drowning has been increasing for older adults in countries such as Australia (Peden et al., 2018), the United

States (Hu & Baker, 2010), Canada (Drowning Prevention Research Centre Canada, 2018) and the UK (National Water Safety Forum, 2018), in spite of a decline in aquatic recreation with age. In the ten years to 2014, more than one-third of fatal drownings in Australia, Canada and New Zealand were adults aged over 65 years (Peden, Franklin, & Clemens., 2019).

In New Zealand for the five years to 2018, the oldest adult age group (65+ years) is the second highest age group in drowning fatalities (16% of all drowning), surpassed only by the youth age group (15-24 years at 19%) (Water Safety New Zealand, 2019a; 2019c). Furthermore, the 65+ age group saw the highest number of hospitalisations as a consequence of non-fatal drowning ever with an increase of 18% from 2017 and 37% on the 2013-2017 average (Water Safety New Zealand, 2019c). As is the case for drowning fatalities of all ages, older male adults were more likely to drown than older females (Water Safety New Zealand, 2018b). Males were more likely to drown in the ocean and from boating incidents when compared to females, and females were more likely to drown while bathing, in swimming pools and due to unintentional immersion (Water Safety New Zealand, 2018b).

Some evidence suggests an association between alcohol consumption and medical conditions with drowning among older adults. An Australian study covering 15 years to June 2017 and 803 unintentional drowning deaths of 65+ years (Pearn et al., 2019) reported that although less than a quarter of older Australians who drowned after consuming alcohol, most (74%) were aged 65–74 years (Pearn et al., 2019), highlighting concern around the implication of the effect of alcohol on those taking prescribed medications. In New Zealand, alcohol was a factor in 16% of New Zealand drownings among those aged over 50 years (Water Safety New Zealand, 2018b).

Medical conditions are likely to be linked to aging, and two-thirds (64%) of older Australians who drowned in the 15 years to 2017 had a known pre-existing medical condition, and for another third (31%) it was unknown rather than not present (Pearn et. al., 2019). Those with medical conditions were twice as likely to be on some form of medication when they drowned compared to those without pre-existing medical conditions. They were also more likely to be affected by the medication, and more likely to drown from falling and while swimming or recreating (Mahony et al., 2017; Peden, Franklin, Pearn, et al., 2019). In New Zealand, medical issues were considered a contributing factor in over one-quarter (27%) of all drowning victims

aged 50+ years from 2008–2017 (Water Safety New Zealand, 2018b), almost three-quarters (72%) related to a cardiac event or heart disease. In 2018, two-thirds (65%) of the 65+ year drownings were from accidentally being immersed in water (Water Safety New Zealand, 2019c).

Little is known about what older adults know, think and do to keep safe in, on and around water during their aquatic recreation. Participants in a *Boating Participation* study reported safer attitudes and behaviors with increasing years (Griffiths et al., 2018). Awareness of safety messages or activities was higher for those aged 65+ years when compared with all ages (45%, vs. 41%), and those aged 35-44 years were less likely to recall safety messages. Safety behavior was also more likely to improve with increased age for carrying lifejackets (87%), carrying a cell phone in a waterproof bag (55%) and carrying flares (27%) on board (Maritime New Zealand, 2018).

Females are consistently reported as being more risk averse, and males more confident in the water (Gulliver & Begg, 2005; Howland et al., 1996; Moran 2003; Moran & Stanley, 2013; Stanley & Moran, 2017), however, little is known about perceptions of drowning risk among older age groups. One study has reported younger adults as less likely than older adults, to agree that injuries in or on the water are preventable, and that they could personally do anything to improve their safety (Titchener et al., 2011). The Water Safety New Zealand *Attitudes and Behaviour* research (Water Safety New Zealand, 2018a) reports most age groups perceive other age groups to be at greater risk of drowning than themselves. Those aged over 65 years were most likely to perceive those aged 15-24 years at the highest risk of drowning, rather than acknowledging their own elevated risk (Water Safety New Zealand, 2019b).

Previous studies focusing on adult assessment of personal water competency reported that although most adults perceived they could swim well, male parents were twice as likely as females to estimate they could swim more than 200 m, were more likely to feel safe when swimming in open water (Stanley & Moran, 2017), and more male adults than females were confident of their ability to rescue (Stanley & Moran, 2018).

The aims of this study are to determine the nature and extent of aquatic recreation among older New Zealanders, explore their perceptions of their practical water competency and their understanding and practice of water safety when engaged in aquatic recreation.

Method

Participants

Adult customers visiting six large Do It Yourself (DIY) stores in Waikato and Auckland, or attending the 2019 Auckland Boat Show were asked to complete an anonymous electronic survey about their aquatic recreation, perceptions of their water competencies and risk of drowning. Participants were provided with a Participant Information Sheet (PIS) and were asked to give informed, verbal consent before voluntarily taking part in the survey. A total of 389 adults completed the survey, 172 at four city stores, 64 at two regional stores and 152 at the Auckland Boat Show. The research was granted ethical approval by the University of Auckland Human Participants Ethics Committee, Reference Number 016725. Participants were invited to enter a draw for a NZ$1000 voucher as appreciation of completion of the survey.

Survey Instrument

The questionnaire, designed to be completed in 5-10 minutes, consisted of 27 closed and two open questions based on previously validated studies (Moran, 2003; 2006; 2008b; McCool et al., 2009; Moran & Stanley, 2013; Stanley & Moran, 2018).

The first six questions assessed socio-demographic characteristics including gender, age (*20-44 years, 45-64 years, 65+ years*), self-identified ethnicity (*New Zealand European, Māori, Pasifika, Asian, Indian and "other*" ethnic groups), length of residency *(<1 year, 1-4 years, 5-9 years, >10 years*), state of employment (*employed, unemployed, retired*) and whether or not they had a known medical condition that precluded participation in aquatic recreation. Participants were asked four questions to determine their participation in aquatic recreation. The first question asked whether or not they had participated in any recreation around water in the past year, the second asked what type of recreation they had engaged in *(for example, swimming in a pool, swimming in open water, surfing, stand up paddling (SUP), or canoe/kayak paddling, boating, fishing or "other"*). Two further questions sought information on how often they participated in aquatic activity during the summer months (*never, monthly, weekly, daily*) and whether it had increased recently, and if so, why.

Seven questions sought information on self-estimated swimming and floating competencies by asking participants whether they could swim or float, and, if so, how they would rate their swimming and floating competency using four response categories (*poor, fair,*

good, very good) and how far and how long they estimated could swim non-stop or float without moving and without flotation aids (Moran, 2003; Stanley & Moran, 2018). In addition, information was sought on when they had last swum the distance (*last month, last year, last 5 years, last 10 years*), how easily they thought they could swim the distance estimated, or float the estimated time, in open water (*very easily, easily, with difficulty, with great difficulty*), if they swam for fitness (*never, occasionally, often, very often*) and how often they swum in open water during summer months (*daily, weekly, about once a month, less than once a month, never*).

To determine water safety attitudes, participants were asked a series of seven statements with *agree or disagree* response options (Moran, 2008b, McCool et al., 2009). Perception of the risk of drowning was determined using a series of five scenarios (for example, being caught in a rip current at a surf beach) with a four-point response scale (*extreme risk, high risk, slight risk, no risk*) (Moran, 2008b, Moran et al., 2012). Participants were asked about their confidence in open water on a four-point response scale (*very anxious, anxious, confident, very confident*).

The survey was uploaded onto Survey Gizmo and was completed by participants on tablets, either self-complete by the individual, or led orally by the researcher, depending on the preference of the participant.

Data Analysis

All data were downloaded onto SPSS Statistics Version 25 (Armonk, NY, USA) for statistical analysis. Frequency and percentages were created to report categorical variables such as demographic data and perceptions of competence and risk. Chi-square tests were used to determine the association between dependent variables (such as perceived swimming or floating competency) and independent variables (such as gender, age and ethnicity). Where multiple responses were included (for example, swimming and floating competency), results were dichotomised for ease of interpretation with *poor* and *fair* grouped as *poor/fair* and *good* and *very good* grouped as *good/very good*.

Previous studies have varied in their chronological definition of older and younger age groups (Hu & Baker, 2010; Lee et al., 2019; Pearn et al., 2019; Peden et al., 2018). For ease of testing statistical significance, this study identified younger adults as those aged less than 65 years and older adults as those aged 65 years and older.

Results

A total of 389 adults participated in the survey. Over one-half (55%, *n* = 213) were male (female 45%, *n* = 176). Almost all participants (90%, *n* = 351) had lived in New Zealand for 10 years, very few (1%, *n* = 4) had lived in New Zealand for less than one year. Three-quarters (77%, *n* = 300) identified as European New Zealander, 7% (*n* = 27) as Māori, 4% (*n* = 15) as Indian, 3% (*n* = 12) as Pasifika, 3% (*n* = 11) as Asian and 6% (*n* = 24) as "other". Participants were categorised into three age brackets: 20–44 years 39% (*n* = 153); 45–64 years 43% (*n* = 166); and over 65 years 18% (*n* = 70). The mid-point of each age bracket was used to determine a mean age of 49.55 years (*SD* = 15.84). Most participants (94%, *n* = 366) reported no known medical conditions that limited their aquatic participation, with no significant differences in medical conditions by age (20–44 years 95%, *n* = 146; 45–64 years 94%, *n* = 156; 65+ years 91, *n* = 64). Most participants were employed, either full or part-time, (81%, *n* = 313), a small proportion were unemployed (6%, *n* = 22) and the remainder were retired (14%, *n* = 54). Over half (60%, *n* = 42) of retirees were aged over 65 years.

Aquatic Participation

When aquatic participation was analysed by age, an expected decline in participation by older age groups was evident. Fewer participants aged over 65 years participated in aquatic recreation and were less likely to have swum in a pool, been boating, or fishing (Table 6.1). Adults 65+ years were also less likely than the two younger age groups to have increased their aquatic participation recently, most likely to report they seldom or never participated in summer aquatic activity or swam at beaches during the summer months, and more likely to report that they had last swam more than one year ago.

Table 6.1 *Aquatic Participation by Age*

	20-44 Years		45-64 Years		65+ Years		Total	
	n	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Aquatic participation in past 12 months								
Yes	137	89.5%	152	91.6%	46	65.7%	335	86.1%
No	16	10.5%	14	8.4%	24	34.3%	54	13.9%
What activity?								
Swimming in a pool	106	69.3%	99	59.6%	26	37.1%	231	59.4%
Swimming in open water	110	71.9%	114	68.7%	38	54.3%	262	67.4%
Boating	111	72.5%	101	60.8%	30	42.9%	242	62.2%
Fishing	105	68.6%	89	53.6%	30	42.9%	224	57.6%
Summer aquatic participation frequency								
Seldom/never	38	24.8%	47	28.3%	40	57.2%	125	32.1%
Occasionally (once per month)	65	42.5%	84	50.6%	18	25.7%	167	42.9%
Often (daily/weekly)	50	32.7%	35	21.1%	12	17.1%	97	24.9%
Summer beach swimming frequency								
Seldom/never	50	32.7%	72	43.4%	45	64.3%	167	42.9%
Occasionally (once per month)	46	30.1%	51	30.7%	10	14.3%	107	27.5%
Often (daily/weekly)	57	37.3%	43	25.9%	15	21.4%	115	29.6%
Has aquatic participation increased?								
Yes	78	51.0%	80	48.2%	20	28.6%	178	45.8%
No	75	49.0%	86	51.8%	50	71.4%	211	54.2%

Table 6.1 Aquatic Participation by Age

When age was dichotomised (<65 years and ≥65 years), significant differences in participation in aquatic recreation were found. Those aged 65 years and older were less likely to have taken part in aquatic recreation in the past 12 months (65+ years, 66%, $n = 46$; <65 years, 91%, $n = 289$) ($\chi2$ (1) = 29.727, $p \leq 0.001$) or have swum in a pool (65+ years, 49%, $n = 265$; <65 years, 67%, $n = 205$) ($\chi2$ (1) = 6.503, $p = 0.011$). Although not statistically significant, fewer had been boating in the previous 12 months (65+ years, 57%, $n = 30$; <65 years, 70%, $n = 212$) ($\chi2$ (1) = 3.433, $p = 0.064$). They were also more likely report seldom or never having swum at a beach during summer months (65+ years, 43%, $n = 30$; <65 years, 27%, $n = 85$) ($\chi2$ (2) = 24.482, $p \leq 0.001$) and more likely than younger adults ($\chi2$ (2) = 29.701, $p \leq 0.001$) to report they last swam more than one year ago (65+ years, 71%, $n = 50$, <65 years 36%, $n = 115$).

Perceived Competence

Perceived swimming and floating competence varied considerably throughout adulthood (Table 6.2). Adults in the two younger age groups were more likely to report that they were *good/very good* swimmers. Respondents aged 65+ years were more likely to estimate that they could swim less than five minutes non-stop when compared with younger adult age groups (30%, vs. 20% and 22% respectively), and less likely to report they could float for more than one hour (17%, vs. 28% and 36% respectively).

Adults in the 65+ year age group were less confident than the younger age groups about their safety in open water (51%, vs. 37% and 34% respectively). The older age group were also less confident about their ability to float in open water compared to younger adults (64%, vs. 52% and 46% respectively) and were less likely to have swum their estimated swimming distance in open water (51%, vs. 67% and 66% respectively).

Table 6.2 *Self-Estimated Swimming and Floating Competency in Open Water by Age*

	20-44 Years		45-64 Years		65+ Years		Total	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Estimated swimming competency								
Good/Very good	111	72.5%	109	65.7%	32	45.7%	252	64.8%
Poor/Fair/Cannot swim	42	27.5%	57	34.3%	38	54.3%	137	35.2%
Estimated non-stop swim time								
Less than 5 minutes	31	20.3%	37	22.3%	21	30.0%	89	22.9%
5 minutes to 1 hour	83	54.2%	100	60.2%	45	64.3%	228	58.6%
More than 1 hour	39	25.5%	29	17.5%	4	5.7%	72	18.5%
Estimated swimming distance								
200 m or less	57	62.6%	67	67.0%	24	66.7%	158	65.0%
More than 200 m	40	37.3%	33	33.0%	12	33.3%	85	35.0%
Swum distance in open water								
In open water	103	67.3%	110	66.3%	36	51.4%	249	64.0%
Not in open water	50	32.7%	56	33.7%	34	48.6%	140	36.0%
Swimming competence to keep safe in open water								
Agree	112	73.2%	110	66.3%	43	61.4%	265	68.1%
Disagree	41	26.8%	56	33.7%	27	38.6%	124	31.9%
Estimated non-stop float time								
Less than 5 minutes	48	31.4%	30	18.1%	21	30.0%	99	25.4%
5 minutes to 1 hour	63	41.2%	77	46.4%	37	52.9%	117	30.1%
More than 1 hour	42	27.5%	59	35.5%	12	17.1%	113	29.0%
Floating confidence in open water								
Easily/ Very easily	74	48.4%	89	53.6%	25	35.7%	118	48.3%
With difficulty/great difficulty / Cannot float	79	51.6%	77	46.4%	45	64.3%	201	51.7%
Safety confidence in open water	57	37.3%	57	34.3%	36	51.4%	150	38.6%
Anxious/Very anxious								
Confident/Very confident	96	62.7%	109	65.7%	34	48.6%	239	61.4%

Table 6.2 Self-estimated Competency in Open Water by Age

Analysis of perceived competence by dichotomised age groups (<65 years and ≥65 years) showed significant differences. Significantly more adults aged less than 65 years (70%, n = 220, vs. 46%, n = 32) rated themselves as *good/very good* swimmers ($\chi2$ (1) = 11.629, p = 0.001) and self-estimated higher floating competency (68%, n = 163, vs. 52%, n = 25) appraising themselves as being able to float *very easily/easily* ($\chi2$ (1) = 4.424, p = 0.035). Significantly fewer older adults (6%, n = 4, vs. 22%, n = 68) estimated that they could swim more than one hour non-stop ($\chi2$ (2) = 8.732, p = 0.013) or float for more than one hour (19%, n = 12, vs. 36%, n = 101) ($\chi2$ (1) = 7.156, p = 0.028). Furthermore, adults in the older age group were significantly less confident about their safety in open water (49%, n = 34, vs. 64%, n = 204) ($\chi2$ (1) = 5.966, p = 0.015).

Risk Perceptions

The oldest age group (65+ years) estimated a higher risk of drowning than the younger age groups (20-44 years and 45-64 years) if they were swept off isolated rocks while fishing (96% compared with 84% and 88% respectively). More adults in the two older age groups expressed greater risk of drowning if caught in a rip current (74% and 71% compared with 63%). The other three risk scenarios (engine failure in a dinghy, falling in when clothed and assisting a person in trouble) did not elicit marked differences in risk perception between younger and older participants.

The older age group (≥65 years) reported significantly higher risk estimation in only one of the five scenarios, that of being swept off isolated rocks while fishing ($\chi2$ (1) = 5.118, p = 0.024) (<65 years, 86%, n = 274; 65+ years, 96%, n = 67). No statistical differences were evident for the other four risk perceptions.

Table 6.3 *Perception of Risk of Drowning by Age*

	Extreme / High Risk			Slight / No Risk		
	20-44 Years *n (%)*	45-64 Years *n (%)*	65+ Years *n (%)*	20-44 Years *n (%)*	45-64 Years *n (%)*	65+ Years *n (%)*
Swept off isolated rocks by a wave while fishing	128 (83.7%)	146 (88.0%)	67 (95.7%)	25 (16.3%)	20 (12.0%)	3 (4.3%)
Caught in a rip current at a surf beach	97 (63.4%)	123 (74.1%)	50 (71.4%)	56 (36.6%)	43 (25.9%)	20 (28.6%)
Engine failure in a dinghy 100m from the shore	48 (31.4%)	44 (26.5%)	20 (28.6%)	105 (68.6%)	122 (73.5%)	50 (71.4%)
Fell into deep water fully clothed while walking along a riverbank	79 (51.6%)	87 (52.4%)	34 (48.6%)	74 (48.4%)	79 (47.6%)	36 (51.4%)
Assisting a person in trouble in deep water at a swimming pool	66 (43.1%)	54 (32.5%)	25 (35.7%)	87 (56.9%)	112 (67.5%)	45 (64.3%)

Table 6.3 Perception of Risk of Drowning by Age

Attitudes

When questioned on beliefs about their water safety, a range of attitudes, both safe and unsafe, were evident (Table 6.4). Most reported a heightened awareness of the risk of drowning associated with open water (74-81%) and increased risk in rough water (73-81%), but most considered others were at greater risk than themselves (66-69%). Table 6.4 also shows that the oldest age group reported more risk averse attitudes than the two younger age groups. They were less confident of the protective value of their swimming fitness (41% compared with 61% and 51% respectively), their rescue competency (44% compared with 73% and 46% respectively) and greater risk awareness in rough water (81% compared with 73% and 76% respectively).

Table 6.4 *Water Safety Attitudes by Age*

	20-44 Years		45-64 Years		65+ Years		Total	
	n	***%***	***n***	***%***	***n***	***%***	***n***	***%***
The risk of drowning is always in the back of my mind when swimming in open water								
Agree	113	73.9%	135	81.3%	52	74.3%	300	77.1%
Disagree	40	26.1%	31	18.7%	18	25.7%	89	22.9%
My swimming competence means I don't need to wear a lifejacket in a boat								
Agree	27	17.6%	13	7.8%	6	8.6%	46	11.8%
Disagree	126	82.4%	153	92.2%	64	91.4%	343	88.2%
I often feel at risk swimming when conditions are rough								
Agree	112	73.2%	126	75.9%	57	81.4%	295	75.8%
Disagree	41	26.8%	40	24.1%	13	18.6%	94	24.2%
My swimming competence means I am capable of rescuing others in open water								
Agree	86	73.2%	76	45.8%	31	44.3%	193	49.6%
Disagree	67	26.8%	90	54.2%	39	55.7%	196	50.4%
My current swimming fitness will ensure my safety in open water								
Agree	93	60.8%	84	50.6%	29	41.4%	206	53.0%
Disagree	60	39.2%	82	49.4%	41	58.6%	183	47.0%
Others are at greater risk than me when swimming in open water								
Agree	106	69.3%	101	60.8%	46	65.7%	253	65.0%
Disagree	47	30.7%	65	39.2%	24	34.3%	136	35.0%

Table 6.4 Water Safety Attitudes by Age

Significant differences were evident in only one attitude when analysed by the dichotomised age groups. Older adults (65+ years) were less likely to have confidence in their swimming fitness to keep them safe ($\chi 2$ (1) = 4.553, p = 0.033) (<65 years, 56%, n = 177; 65+ years, 41%, n = 29). No significant differences were found for any of the other six questions on attitude.

Discussion

This study reported on the influence of aging on participation in aquatic recreation and how perceptions of self-competence and the risk of drowning shaped their safety in, on and around water.

Inherent in the risk of drowning is the extent of exposure to that risk. Adults in this study reported similarly high levels of aquatic activity to findings of other New Zealand and overseas studies (Sport Australia, 2019; Sport England, 2019; Sport New Zealand, 2015; 2018), and, as with active recreation in other countries (Sport Australia, 2019; Sport England, 2019), participation dropped off significantly in older age groups. Increased drowning numbers among older adults is not likely due to increased exposure to risk, so reasons for increased rates of drowning must lie elsewhere.

In addition to the lesser frequency, participation in aquatic recreation was also less recent for older adults. Adults over 65 years were more likely to have last swum more than one year ago and unlikely to swim in pools or at beaches in the summer months which may suggest that their capacity to accurately assess their current practical water competencies might be compromised. The lower frequency of participation and increased time between aquatic activity suggests a possible disparity between how older adults perceive their water competence and their actual competence to cope with drowning risk. Accurate assessment of physical water competencies requires regular and current in-water practice of all practical water competencies if they are to provide some protection against the risks associated with aquatic recreation, especially in and around open water settings. Further research on perceived versus actual water competence for older adults is recommended.

Although most adults reported similarly high perceived competency levels of swimming and floating as with adults in other studies (Stanley & Moran, 2017; 2018), estimated levels of

swimming and floating competency are significantly lower for older adults. Reliance on perceived competence in the prevention of drowning is a concern if perception does not match reality. Adults who may not have ever swum or floated for prolonged periods in deep, open water where most drownings occur, may not be able to accurately assess competence. Older adults who have less confidence in their water competence may be protected from drowning if it results in safer behaviors. Many older adult drownings occur, however, after accidental immersions where people may not have expected, or planned, to enter the water (Water Safety New Zealand, 2018b). To prepare for unexpected entry into water, the practice of floating, swimming and the other practical water competencies required in the prevention of drowning (Langendorfer et al., 2018; Stallman et al., 2017) and the in-water practice and testing of these competencies is recommended for older adults to ensure an accurate assessment of personal competency both in the pool and open water settings.

Surprisingly, few participants in this study reported any known existing medical conditions that would potentially limit aquatic participation, and there were no significant increases within older age groups. Pre-existing medical conditions have shown to contribute considerably to older adult drowning internationally (Lee et al., 2019; Pearn et al., 2019) and in New Zealand (Water Safety New Zealand, 2018b). It is possible that participants in this study could be unaware of underlying medical conditions that may increase drowning risk, and it is recommended that older adults especially have regular health checks before partaking in aquatic recreation.

Older adults in this study did not report any significant heightened awareness of the risk of drowning than younger age groups. Previous studies reported younger adults as less likely to improve their safety because of any enhanced sensitivity to the risk of drowning (Titchener et al., 2011), while those aged over 65 years were least likely to acknowledge their own elevated drowning risk (Water Safety New Zealand, 2018a). It was anticipated that older adults would report greater perception of personal risk than was apparent in this study so further investigation is required to determine whether increasing age results in enhanced risk awareness, or whether other factors, such as a perceived wealth of experience, create potentially dangerous misconceptions of risk perception. The low levels of risk perception among older adults in this

study is unlikely to offer protection from drowning as reported in previous studies (Moran et al., 2018).

In addition to the lack of significantly higher risk perception, older adults (65 years and over) in this study did not to report safer attitudes about drowning risks in open water and in rough conditions, contradicting previous boating participation studies (Griffiths et al., 2018; Maritime New Zealand, 2018). Unsafe attitudes such as rescuing others, believing swimming competence was good enough not to wear a lifejacket on a boat, or thinking others are at greater risk were prevalent in all age groups including those over 65 years. These attitudes are unlikely to precipitate risk aversive, safer behaviors that could prevent drowning (Moran et al., 2018).

Limitations

Results from this study provide new understanding about why older adults in New Zealand are at greater risk of drowning and increasing proportion in drowning statistics. However, the results should be treated with some caution in light of several methodological limitations. First, the data were obtained from a convenience sample of adult members of the public visiting selected DIY stores in Auckland and Waikato, and the Auckland Boat Show, identified because of their likely high older adult inclusion. Consequently, the sample population varied from the national population demographics with more NZ Europeans taking part in the study. In addition, participants at the Boat Show are likely to have more interest and participation in aquatic recreation which may not be reflective of the general population. Third, although often used in water safety research, self-reporting of swimming competence may not accurately report actual competence and can result in measurement error (Mickalide, 1997; Robertson, 1992; Watson et al., 2003). Finally, swimming and floating competencies were the only physical water competencies included in the study, and although risk perception and personal assessment of water competency was included, it is recommended further older adult studies consider the inclusion of other water competencies, both physical and cognitive (Langendorfer et al., 2018; Stallman et al., 2017).

Conclusion

This research study on New Zealand's older adults identified the nature and extent of their aquatic recreation participation, their perceptions of their own practical water competency and their understanding and practice of water safety when engaged in aquatic recreation. The study's

finding of lower exposure to risk attributable to lesser frequency and levels of participation of aquatic recreation when compared with adults of all ages does not readily explain their increased incidence of drowning in recent years.

Other findings that may have some explanatory power in relation to increased drowning among the aged are a continuing lack of water safety practice even though aquatic activity is reduced; entrenched unsafe attitudes toward open water participation; an underestimation of the risks inherent in aquatic activity and an overly optimistic perception of their capacity to cope with that risk. Further research involving practical assessment of older adults' actual and perceived water competencies and enquiry around risks and attitudes is recommended. To address these potentially life-threatening issues, targeted water safety programmes for older adults would benefit from risk and competency assessment activities preferably associated with simulated practical experiences. Further exacerbating the risk of drowning, older adults in the study rarely reported underlying medical conditions that might curtail their aquatic activity. It is recommended that regular health checks be a necessary precaution for the older person, especially prior to occasional seasonal aquatic recreation.

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Disclosure statement

The authors confirm that there are no relevant financial or non-financial competing interests to report.

Chapter 7 Study Four - Real and Perceived Water Competencies and Risk of Drowning for Adults in Open Water

Introduction

The review of drowning literature has identified a lack of evidence available around actual adult water competencies, especially in open water environments where most people drown. This study aimed to provide knowledge on levels of adult water competencies in both closed pool and open water environments, people's perceptions of their competence and any relation to the risk of drowning. Three earlier studies, in Chapters 4, 5 and 6 of this research - adult perceptions with parents of young children (Stanley & Moran 2017), adults from high-risk ethnic minority groups (Stanley & Moran, 2018) and older adults (Stanley & Moran, in press), highlighted overestimation of their perceived water competence. Furthermore, a pilot study reported in Chapter 3 of this research, completed in a pool and open water with adults, reported differences between real and perceived water competencies in open water.

The pilot study (see Chapter 3) involved 38 employees from five workplaces with working environments in or around water. Four were excluded due to their previous lifeguarding experience. The participants were experienced and confident in and around water, and thus not representative of the normal adult population in terms of water competence.

Participants reported high levels of self-estimated swimming, floating and rescue competence relative to the previous three studies, and generally the actual testing in a pool confirmed this. Just over half the group could swim 200 m in five minutes and were largely proficient in entries and exits. Concerningly though, when asked to float for a maximum of five minutes, only one-quarter of participants could last the five minutes in a pool.

Participants accurately rated their perceived swimming competency when tested in the pool. However, after the testing in open water, perceived confidence in their swimming competence had increased, with more believing that they could swim more than 200 m in open water despite only one-half (52%) being able to swim more than 200 m in the pool, and none swimming more than 200 m in open water in five minutes. Little correlation was found between perception of floating competency and what they could achieve in the pool, and perceived swimming competency and the distance swum in open water.

Due to the risk of drowning and hypothermia, it was decided that participants in the pilot study would wear wetsuits and lifejackets in the open water environments. This improved actual floating competence in the open water and reduced swimming competence. It also may have affected their perceptions of swimming and floating competence.

I decided to repeat the pilot study, to improve on it with five key changes. The first change was to increase the sample size. The second was to ensure participants who were more reflective of the adult drowning data, which in New Zealand is one-third (30%) Māori or Pasifika and predominantly adult (90%) males (80%) (Water Safety New Zealand, 2020a). The third change was to add extra lifeguards during the open water testing to enable the activities to be competed without wetsuits or lifejackets. I also introduced procedures to limit the non-wetsuit time in open water to help offset hypothermia, and participants were told they could exit the water at any time if they became too cold. Finally, minor amendments in layout and clarification of questions were made to the pre- and post-course survey to improve the data collected.

This fourth study reports on actual water competencies and compares actual to perceived water competencies and risk in an adult population, in particular to explore:

- perceived swimming and floating competence in closed and open water
- actual swimming and floating competence in closed and open water
- self-estimated difficulty of competencies in pool and open water environments
- water safety attitudes
- perceived risk of various open water scenarios

Research Questions

1. What do adults perceive water competence to be?
2. What are the actual water competencies in a closed pool environment for adults?
3. What are the actual water competencies in an open water environment for adults?
4. What water safety attitudes do adults have?

5. What are the drowning risk perceptions of adults?

6. What are the relationships between perceptions of drowning risk and actual water competencies?

Methodology

This study used a cross-sectional design with self-complete written survey methodology and practical water-based competency assessment. Adult members from seven community groups or workplaces in Auckland were invited to take part in the study during the 2017/18 summer and autumn. The workplace organisations completed an employer-sponsored two-day water safety programme (entitled Coastal Awareness Course) as part of a workplace health and safety initiative. These employees were from workplaces not consistently working in or around water. The groups from the community were ethnic minority groups who completed a programme (entitled *Wai*Wise) of eight to ten sessions held over several weeks. Both courses were taught by Drowning Prevention Auckland staff. The research activities for this study were included in both programmes. Research ethics approval was obtained from The University of Auckland Human Participants Ethics Committee (UAHPEC) (Reference number 016725). An Organisation Information Sheet was distributed, and a signed Organisation Consent Form was completed before the course began.

Participants

A Participant Information Sheet (PIS) was distributed to participants and a signed individual Consent Form was obtained before participation. A total of 63 adults from three workplace (n = 16) or four community (n = 47) organisations completed a pre- and post-self-completion written questionnaire during their water safety course. The water safety programme that adults participated in covered extensive water safety knowledge including knowledge of local beach hazards and risk mitigation. In addition, the participants competed five practical water competencies in a swimming pool during a pool-based educational session and completed the same five competencies in open water.

Survey Instrument

The pre- and post-course surveys were designed to be completed in about 10 minutes at the beginning and end of each two-day course. The questionnaire consisted of 14 closed questions based on previously validated studies (McCool et. al., 2009; Moran, 2003, 2006, 2008b; Moran

& Stanley, 2013). The first four questions assessed socio-demographic characteristics including gender, age (*15–19 years, 20-29 years, 30–44 years, 45-64 years, 65+ years*), self-identified ethnicity (*New Zealand European, Māori, Pasifika, Asian* and "*Other*" ethnic groups) and length of residency in New Zealand *(<1 year, 1-4 years, 5-9 years, >10 years*).

Twelve questions sought information on physical water competency by asking participants whether they could swim and, if so, how they would rate their swimming competency using four response categories (*poor, fair, good, very good*) and how far they estimated they could swim non-stop (Moran, 2003). I introduced a new question on how long they thought they could swim non-stop for *(less than one minute, less than five minutes, less than 15 minutes, less than one hour, more than one hour*). In addition, information was sought on when and where they had swum the estimated distance (*last month, last year, last 5 years, last 10 years*), how easily they thought they could swim the distance estimated in open water (*very easily, easily, with difficulty, with great difficulty*) and how often they swam in open water (*daily, weekly, about once a month, less than once a month, never*). Participants were asked: if they could float; if so, how they rated their floating competency using four response categories (*poor, fair, good, very good*); how long they estimated they could float for non-stop (*less than one minute, less than five minutes, less than 15 minutes, less than one hour, more than one hour*); if they thought they could float that long in open water; and, if so, how easily (*very easily, easily, with difficulty, with great difficulty*).

Borg's RPE scale (Borg, 1998) was used again to determine the exertion expected (pre) or actual (post) to complete five practical skills, using estimates from 6-20, with 6 = the easiest and 20 = most difficult.

To determine water safety attitudes, participants were asked to provide ratings on a series of seven statements using a three-point response scale of *agree*, *disagree* and *unsure* (McCool et al., 2009; Moran 2008b). Perception of the risk of drowning was determined using a series of five statements (for example, when being caught in a rip current at a surf beach, or being swept off isolated rocks by a wave while fishing) with a four-point response scale (*extreme risk, high risk, slight risk, no risk*) (Moran, 2008b, Moran et.al., 2012).

Finally, two questions around bystander rescue and survival floating positions were asked to elicit water safety knowledge.

Practical testing

Five practical skills were chosen to elicit a level of water competency amongst the adults - deep-water entry, deep-water exit, fast 25 m swim, five-minute float, and a five-minute swim. Each of these tasks was completed in a pool and an open water environment on separate days.

The entry and exit were rated on a scale of 1–4 as follows: *did not complete; completed with poor form; completed with good form;* and *completed with excellent form.* The form was graded by the researcher with poor being assessed as either incorrect form or completed with great difficulty, good was assessed as able to complete correctly with some difficulty, and excellent form was correctly performed with ease. Participants were instructed on safe and unsafe types of entry. The 25 m swim was scaled for time swum non-stop to 25 m with no stroke or speed specified (time achieved assessed on a 3-point scale): 1, *more than 1 min*; 2, *between 30-60 sec*; 3 *less than 29 sec*). The stationary float was completed in deep water, with participants instructed to have minimal swimming motion and timed on a 4-point scale: 1, *less than 15 sec*; 2, *15-59 sec*; 3, *1 - 5 min*; 4, *more than 5 min*. The distance swim was completed non-stop in five minutes with no stroke or speed specified (distance achieved assessed on a 3-point scale): 1, *less than 25 m*; 2, *26- 100 m*; 3, *more than 100 m*.

Data analysis

All data were entered anonymised into SPSS Statistics Version 25 (Armonk, NY, USA) for statistical analysis. All four components of the research were matched to each individual participant. Frequencies and percentages were generated to report categorical variables such as demographic data and perceptions of competence and risk. Chi-square tests were used to determine any association between dependent variables (such as perceived swimming competency and risk) and independent variables (such as gender, age and ethnicity) with statistical significance reported when $p < 0.05$. Where multiple responses were included (for example, swimming and floating competency), results were dichotomised for ease of interpretation with *poor* and *fair* grouped as *poor/fair* and *good* and *very good* grouped as *good/very good*. Paired sample *t*-tests were undertaken to compare pre- and post-activity results and pool and open water testing.

Results

Demographics

Seven groups with a total of 63 participants completed the four components of the study as part of a wider water safety education programmes delivered by Drowning Prevention Auckland. Three groups were completing a two-day workplace Coastal Awareness course and four groups were participating in an 8-10 session community *Wai*Wise course targeting high-risk ethnic minority groups. One-quarter each identified as NZ European (22%, *n* = 14) and Māori (25%, *n* = 16). Almost one-half of the participants identified as Pasifika (44%, *n* = 28) and there was a small group of other ethnicities from Australia, Europe, and South America (8%, *n* = 5). Almost three-quarters of participants were male (71%, *n* = 45; female 29%, *n* = 18). Over one-third of participants were aged 16-19 years (40%, *n* = 25), then age groups were evenly spread throughout the working age population (20-29 years 22% (*n* = 14), 30-44 years 19% (*n* = 12), 45-64 years 17% (*n* = 11), over 65 years 2% (*n* = 1)). Most (91%, *n* = 57) had lived in New Zealand all their lives (68%, *n* = 43), or for more than 10 years (22%, *n* = 14). This cohort is not reflective of the New Zealand adult population, although it is more in line with populations most at-risk of drowning in New Zealand.

Perception of Water Competence

Almost all participants (98%, *n* = 62) believed they could swim. In the pre-course survey, more than half (54%, *n* = 34), believed they were *good/very good* swimmers, and one-quarter estimated they could swim more than 200 m non-stop (22%, *n* = 14) and swim longer than 15 minutes (25%, *n* = 16). Three-quarters (73%, *n* = 45) had swum the distance in the past year and most (79%, *n* = 50) had swum the distance in open water. After the pool and open water testing, slightly fewer participants (94%, *n* = 59) responded they could swim, although slightly more perceived themselves as *good/very good* swimmers (63%, *n* = 38). More thought they could swim more than 200 m (29%, *n* = 18) and could swim longer than 15 minutes (34%, *n* = 21). The pre- and post- paired sample *t*-test, in Table 7.1, shows the significant improvement reported in the means for estimated swimming distance.

In the pre-course survey most participants (91%, *n* = 57) perceived they could float, and, of those, only one-third (36%, *n* = 21) believed they could float *easily/very easily*, although two-thirds (71%, *n* = 42) thought they could float for more than five minutes, and most (92%, *n* = 56) thought they would be able to float this long in open water. At the end of the testing slightly

fewer (84%, n = 53) believed they could float, and more participants were more were confident in their level of floating competence (66%, n = 35 reported being able to float *easily/very easily)*. Fewer participants thought they could float for more than five minutes (62%, n = 35) or be able to float that long in open water (79%, n = 50). The means test (Table 7.1) shows a significant increase in perceived open water floating competence.

Chi-square tests were undertaken to compare differences based on any individual traits such as gender, ethnicity, age group or residency with perception in competence before and after the testing (Table 7.2). Pre-activity males were significantly more likely than females to perceive that they could swim well (males 64%, vs. females 29%; $\chi2(1) = 6.958$, $p = 0.008$), report that they had swum in open water (males 91%, vs. females 50%; $\chi2(1) = 13.269$, $p \leq 0.001$) and that they could float (males 96%, vs. females 78%; $\chi2(1) = 4.716$, $p = 0.030$); however males were less likely to report they could swim for less than one minute (males 33%, vs. females 67%; $\chi2(2) = 6.813$, $p = 0.033$). At post-activity, males were still significantly more likely than females to estimate they could swim well (males 75%, vs. females 31%; $\chi2(1) = 9.671$, $p = 0.002$).

When analysed by ethnicity (Table 7.2), pre-activity Māori and Pasifika were significantly more likely than New Zealand European to estimate they could swim for less than one minute (Māori and Pasifika 59%, vs. New Zealand European 7%; $\chi2(4) = 20.926$, $p \leq 0.001$) and less than 25 m (Māori and Pasifika 52%, vs. New Zealand European 14%; $\chi2(4) = 12.546$, $p = 0.014$). Post-activity Māori and Pasifika adults were still more likely to perceive they could swim for less than one minute (Māori and Pasifika 41%, vs. New Zealand European 7%) and less than 25 m (Māori and Pasifika 33%, vs. New Zealand European 5%). There were no statistical differences for floating competency when analysed by ethnicity.

There were no significant differences across all parameters when analysed by age group or residency.

Table 7.1 *Pre- and Post-activity Perceived Water Competency*

	Mean	SD	Mean diff	*t*	*p*
Estimate can swim (1 = yes, 2 = no)					
Pre-activity	1.02	0.126			
Post-activity	1.06	0.246	-0.048	-1.761	0.083
Estimated distance* (1 = >25m, 2 26-200m, 3 = <200m)					
Pre-activity	1.84	0.772			
Post-activity	2.05	0.734	-0.210	-2.032	0.047
Estimated swim time (1 = >1 minute, 2 = 2-15 minutes, 3 = <15 minutes					
Pre-activity	2.44	1.272			
Post-activity	2.74	1.223	-0.295	-1.712	0.092
Estimate can float (1 = yes, 2 = no)					
Pre-activity	1.10	0.296			
Post-activity	1.16	0.368	-0.063	-1.070	0.289
Estimate float 5 minutes (1 = yes, 2 = no)					
Pre-activity	2.62	0.657			
Post-activity	2.53	0.696	0.094	0.843	0.403
Float open water*					
Pre-activity	1.08	0.277			
Post-activity	1.21	0.413	-0.131	-2.398	0.020

Table 7.1 Pre- and Post-activity Perceived Water Competency

*Significant difference

Table 7.2 *Pre- and Post-activity Perceived Water Competency by Gender and Ethnicity*

	Male	Female	NZ European	Māori and Pasifika	Total
	n	*n*	*n*	*n*	*n*
	%	%	%	%	%
Estimate swim *well/very well*					
Pre-activity	29	5	8	22	34
	64.4%*	27.8%*	57.1%	50.0%	54.0%
Post-activity	33	5	8	25	38
	86.8%*	13.2%*	57.1%	61.0%	63.3%
Estimate swimming time (>1min)					
Pre-activity	15	12	1	26	27
	33.3%*	66.7%*	7.1%*	59.1%*	42.9%
Post-activity	12	6	1	17	18
	26.7%	37.5%	7.1%*	40.5%*	29.5%
Estimated swimming distance* (>25m)					
Pre-activity*	14	11	2	23	25
	31.1%	44.0%	14.3%*	52.3%*	39.7%
Post-activity	8	7	1	14	15
	17.8%	41.2%	7.1%	32.6%	24.2%
Estimate can float					
Pre-activity	43	14	12	40	57
	95.6%*	77.8%*	85.7%	90.9%	90.5%
Post-activity	38	15	12	37	53
	84.4%	83.3%	85.7%	84.1%	84.1%

Table 7.2 Pre- and Post-activity Perceived Water Competency by Gender and Ethnicity

*Significant difference

Actual Water Competencies

Five water competencies were tested first in a pool and then in the open water on a separate day. Results for the competencies tested in the pool are shown in Table 7.3 and for open water in Table 7.4.

The water competence level displayed in both the pool and open water was at a very low level, much lower than the group in the pilot study. Compared to the pilot study where all participants could perform deep-water exits, in this group there was a significant proportion who could not perform a deep-water exit in a pool (16%) or open water (33%). In the pilot group one-quarter (24%) could float in a pool for more than five minutes compared to just one participant (2%) in this group. In the Study Four group, three-quarters could not swim more than 100 m in a pool compared to over half (53%) in the pilot study swimming more than 200 m.

One-fifth of Study Four participants could either not complete or completed the deep-water entry with poor form in the pool (22%), although this task was improved in open water (8%). Almost one-half (47%) could complete the deep-water entry with excellent form in the pool and three-quarters (72%) in open water. There was no statistical difference for entry competence when analysed by gender or ethnicity.

Almost one-half of participants could exit deep water with excellent form in both the pool (49%) and the open water (43%), although a sixth (16%) could not exit a pool from deep water and one-third (33%) from open water. Males reported significantly better proficiency than females in the deep-water exits being more likely to perform a deep-water exit with excellent form in both the pool (males 56%, vs. females 11%; $\chi2(3) = 12.471$, $p = 0.006$) and open water (males 60%, vs. females 17%; $\chi2(3) = 14.537$, $p = 0.002$). Females were significantly more likely to not be able to exit the pool (females 33%, vs. males 9%) and open water (females 56%, vs. males 23%). In the pool there were no differences when analysed by ethnicity; however, in open water Māori and Pasifika adults were less likely than New Zealand European to complete an exit from the water (Māori and Pasifika 43%, $n = 19$, vs. New Zealand European 7%, $n = 1$).

Very low floating competence was performed in both the pool and open water, only one participant (2%) could float more than five minutes in both settings. In the pool almost one-third (29%) could not float more than 15 seconds and two-thirds (60%) not more than one minute.

Table 7.3 *Actual Water Competency in Closed Water by Gender* *Significant differences by gender

	Male (n = 45)		Female (n = 18)		Total	
	n	***%***	***n***	***%***	***n***	***%***
Deep-water Entry						
Did not complete	0	0%	2	11.1%	2	3.2%
Poor form	10	22.2%	2	11.1%	12	19.0%
Good form	14	31.1%	6	33.3%	20	31.7%
Excellent form	21	46.7%	8	44.4%	29	46.0%
Deep-water Exit*						
Did not complete	4	8.9%	6	33.3%	10	15.9%
Poor form	5	11.1%	2	11.1%	7	11.1%
Good form	11	24.4%	8	44.4%	19	30.2%
Excellent form	25	55.6%	2	11.1%	27	42.9%
Stationary Float*						
Less than 15 seconds	12	26.7%	6	33.3%	18	28.6%
15 seconds – 1 minute	18	40.0%	2	11.1%	20	31.7%
1 - 5 minutes	15	33.3%	9	50.0%	24	38.1%
More than 5 minutes	0	0%	1	5.6%	1	1.6%
25m Fast Swim						
Less than 29 seconds	7	15.5%	1	5.6%	8	12.7%
30 – 60 seconds	30	66.7%	10	55.5%	40	63.5%
More than 1 minute	8	17.8%	7	38.9%	15	23.8%
5-minute Swim						
Up to 25m	5	11.1%	5	27.8%	10	15.9%
26 – 100m	36	80.0%	13	72.2%	49	77.8%
101 - 200m	4	8.9%	0	0%	4	6.3%

Table 7.3 Actual Water Competency in Closed Water by Gender

Table 7.4 *Actual Water Competency in Open Water by Gender* *Significant differences by gender

	Male (n = 16)		Female (n = 18)		Total	
	n	***%***	***n***	***%***	***n***	***%***
Deep-water Entry						
Did not complete	0	0%	1	5.6%	1	1.6%
Poor form	4	9.1%	1	5.6%	5	8.1%
Good form	10	22.7%	3	16.7%	13	21.0%
Excellent form	30	69.8%	13	72.2%	43	69.4%
Deep-water Exit*						
Did not complete	10	22.7%	10	55.6%	20	31.7%
Poor form	2	4.4%	4	22.2%	6	9.5%
Good form	6	13.3%	1	5.6%	7	11.1%
Excellent form	27	60.0%	3	16.7%	30	47.6%
Stationary Float						
Less than 15 seconds	6	13.3%	3	16.7%	9	14.3%
15 seconds – 1 minute	10	22.2%	0	0%	10	15.9%
1 – 5 minutes	29	64.4%	14	77.8%	43	68.3%
More than 5 minutes	0	0%	1	5.6%	1	1.6%
25m Fast Swim						
Less than 29 seconds	8	17.8%	2	11.1%	10	15.9%
30 – 60 seconds	26	57.8%	9	50.0%	35	55.6%
More than 1 minute	11	24.4%	7	38.9%	18	28.6%
5-minute Swim*						
Up to 25m	7	15.6%	8	44.4%	15	23.8%
26 – 100m	37	82.2%	10	55.6%	47	74.6%
101 - 200m	1	2.2%	0	0%	1	1.6%

Table 7.4 Actual Water Competency in Open Water by Gender

Floating competence was improved in open water where only one-third (31%) were not able to float more than one minute, perhaps due to the increased density of salt water assisting buoyancy task. When analysed by gender, although not significant, males were more likely than females to be unable to float for more than one minute in a pool ($\chi2(3) = 7.017$, $p = 0.071$; males 67%, vs. females 44%) and open water ($\chi2(3) = 6.935$, $p = 0.074$; males 36%, vs. females 17%). No ethnic differences in floating competence were recorded.

Most participants completed the 25 m fast swim in 30-60 seconds in both the pool (64%) and open water (56%). There were substantial numbers in the pool (24%) and in open water (29%) who took longer than one minute to complete 25 m. No statistical differences were found when analysed by gender; however, Māori and Pasifika adults were more likely to take longer than one minute to complete 25 m in the pool (Māori and Pasifika 30%, $n = 13$) as compared with New Zealand European (14%, $n = 2$).

None of the adults could swim more than 200 m continuously in five minutes in a pool or open water. Four participants (7%) could swim more than 100 m in a pool, and one (2%) more than 100 m in open water. Most participants could swim between 26 m and 100 m continuously in five minutes both in the pool (78%) and in open water (75%). There were no significant differences for gender found in the pool-based activities; however, males were significantly more likely than females to swim more than 25 m in five minutes in open water ($\chi2(2) = 6.132$, $p = 0.047$; males 84%, vs. females 56%). Ethnicity analysis reported Māori and Pasifika ethnicities as being more likely to swim less than 25 m in both the pool (Māori and Pasifika 23%, $n = 10$, vs. New Zealand European 0%, $n = 0$) and open water (Māori and Pasifika 32%, $n = 14$, vs. New Zealand European 7%, $n = 1$).

Pool versus Open Water Competencies

A paired sample test was completed to compare the pool and open water competencies. Superior performance was displayed in deep-water entries (t (61) = -3.411, $p = 0.001$) from the pool to open water. Although there was no improvement in those who could float more than five minutes, there was improvement in deep-water floating (t (62) = -4.309, $p \leq 0.000$) where significantly more participants were able to float for at least one minute in open water compared to the pool. Significantly poorer swimming competence for the five-minute continuous swim was

recorded in open water (t (62) = 2.395, p = 0.020). There was no statistical difference recorded between the pool and open water for the deep-water exit or the fast 25 m swim.

Borg's Test for Expected and Actual Exertion to Complete Activities

Borg's RPE scale was used once more to estimate expected (pre-course survey) and actual (post-course survey) exertion required to complete each of the five practical activities, both in a pool and open water (Table 7.5). The top four grades reported (6-12) were divided into 'easy' and the bottom four (12-20) into 'hard'. Most participants rated both expected exertion levels (53% - 94%) and actual exertion levels (68% - 90%) as 'easy'.

A paired sample t-test was completed to determine any changes in the expected difficulty to undertake each task in the pre-activity survey and the actual exertion experienced reported in the post-activity survey. Significantly more thought it easier to swim 25 m in a pool post-activity (t (62) = 2.555, p = 0.013). No other statistical differences were reported.

When analysed by gender, statistical difference was reported for only one pre-activity, the 25 m open water swim ($\chi2(1) = 4.093$, $p = 0.043$). Post-testing reported significant variances by gender for many activities; including deep-water exit pool ($\chi2(1) = 8.029$, $p = 0.005$), deep-water exit open water ($\chi2(1) = 8.991$, $p = 0.003$), 25 m fast swim pool ($\chi2(1) = 4.050$, $p = 0.044$), 25 m fast swim open water ($\chi2(1) = 4.710$, $p = 0.030$), and five-minute swim open water ($\chi2(1) = 3.875$, $p = 0.049$). There were no differences across ethnicity in expected or actual exertion for the activities.

Water Safety Attitudes

Water safety attitudes were determined by responses to questions about the protective nature of participants' swimming competence and feelings toward risk of drowning as shown in Table 7.6. Most participants reported unsafe attitudes to both pre- and post-activity around swimming competence (pre- 75%, post- 84%) and swimming fitness (pre- 57%, post- 68%). Less safe attitudes were also reported post-activity for rescuing others (pre- 41%, post- 60%) and thinking others were at greater risk (pre- 38%, post- 51%). Safer attitudes, both pre-activity and improved post-activity, were reported for attitudes toward the risk of drowning being present (pre- 65%, post- 71%) and feeling at risk in rough conditions (pre- 62%, post- 65%).

Table 7.5 *Estimated Self-competence Reported as 'Confident' by Gender*

Exertion Level - Easy		**Male (n = 45)**		**Female (n = 18)**		**Total**	
		n	***%***	***n***	***%***	***n***	***%***
Deep-water entry - pool	Pre	38	84%	15	83%	53	84%
	Post	42	93%	15	83%	57	91%
Deep-water entry – open water	Pre	34	76%	13	72%	47	75%
	Post	40	89%	14	78%	54	86%
Deep-water exit - pool	Pre	38	84%	15	83%	53	84%
	Post*	41	91%	11	61%	52	83%
Deep-water exit – open water	Pre	34	76%	12	67%	46	73%
	Post*	37	82%	8	44%	45	71%
Swim 25m fast - pool	Pre	29	64%	8	44%	37	59%
	Post*	38	84%	11	61%	49	78%
Swim 25m fast – open water	Pre*	30	67%	7	39%	37	59%
	Post*	35	78%	9	50%	44	70%
Float 5 minutes - pool	Pre	33	73%	14	78%	47	75%
	Post	37	82%	14	78%	51	81%
Float 5 minutes – open water	Pre	34	76%	12	67%	65	73%
	Post	38	84%	13	72%	51	81%
Swim 5 minutes - pool	Pre	29	64%	10	56%	39	62%
	Post	35	78%	13	72%	48	76%
Swim 5 minutes - open water	Pre	27	60%	7	39%	34	54%
	Post*	34	76%	9	50%	43	68%

Table 7.5 Estimated Self-competence by Gender

*****Significant differences

Table 7.6 *Water Safety Attitudes Reported as 'Agree' by Gender*

Attitude - Agree		Male (n = 45)		Female (n = 18)		Total	
		n	***%***	***n***	***%***	***n***	***%***
My swimming competence will keep me safe in open water*	Pre	41	91.1%	6	33.3%	47	74.6%
	Post	39	86.7%	14	77.8%	53	84.1%
My current swimming fitness will keep me safe in open water*	Pre	32	71.1%	4	22.2%	36	57.1%
	Post	36	80.0%	7	38.9%	43	68.3%
My swimming competence means I am capable of rescuing others in open water*	Pre	23	51.1%	3	16.7%	26	41.3%
	Post	32	71.1%	6	33.3%	38	60.3%
Others are at greater risk than me when swimming in open water	Pre	19	42.2%	5	27.8%	24	38.1%
	Post	26	57.8%	6	33.3%	32	50.8%
My swimming competence means I don't need to wear a lifejacket in a boat*	Pre	13	28.9%	3	16.7%	16	25.4%
	Post	10	22.2%	1	5.6%	11	17.5%
The risk of drowning is always present when swimming in open water	Pre	28	62.2%	13	72.2%	41	65.1%
	Post	32	71.1%	13	72.2%	45	71.4%
I often feel at risk in rough conditions	Pre	27	60.0%	12	66.7%	39	61.9%
	Post	28	62.2%	13	72.2%	41	65.1%

Table 7.6 Water Safety Attitudes by Gender

*Significant differences

At pre-testing, males were significantly more likely than females to rely on their swimming competence (males 91%, vs. females 33%; $\chi2(2) = 22.653$, $p \leq 0.001$) and fitness (males 71%, vs. females 22%; $\chi2(2) = 20.270$, $p \leq 0.001$) to stay safe in open water and that they have the competence to rescue others in open water (males 91%, vs. females 33%; $\chi2(2) = 11.445$, $p = 0.003$).

Post-activity, males were still significantly more likely than females to rely on swimming competence (males 87%, vs. females 33%; $\chi2(2) = 5.987$, $p = 0.050$) and fitness (males 80%, vs. females 39%; $\chi2(2) = 11.120$, $p = 0.004$) for their safety. In addition, males were still more confident in their ability to rescue others (males 71%, vs. females 33%: $\chi2(2) = 7.728$, $p = 0.021$).

When analysed by ethnicity, pre-activity Māori and Pasifika adults were more likely than New Zealand European adults to report the more unsafe attitude relying on their swimming competence instead of wearing a lifejacket (Māori and Pasifika 32%, $n = 14$, vs. New Zealand European 7%, $n = 1$). Māori and Pasifika adults were, however, more likely to hold a safer attitude in acknowledging the feeling or risk in rough conditions both pre-activity (Māori and Pasifika 75%, $n = 33$, vs. New Zealand European 36%, $n = 5$) and post-activity (Māori and Pasifika 73%, $n = 32$, vs. New Zealand European 57%, $n = 8$).

Analysis of the means of pre- and post-activity showed significant change in participants reporting confidence in their competence to rescue others in open water (t (62) = 2.490, $p = 0.015$). Although not significant, participants also showed safer attitudes toward reliance on their swimming competence to stay safe (t (62) = 1.180, $p = 0.075$).

Adults who perceived they could swim further were significantly more likely pre-activity to rely on their swimming competence (<25 m 56%, $n = 14$, 26-200 m 79%, $n = 19$, >200 m 100%, $n = 14$; $\chi2(4) = 14.848$, $p = 0.005$) and swimming fitness (<25 m 32%, $n = 8$, 26-200 m 67%, $n = 16$, >200 m 86%, $n = 12$; $\chi2(4) = 14.577$, $p = 0.006$) to stay safe in open water, or not feel at risk in rough conditions (<25 m 28%, $n = 7$, 26-200 m 17%, $n = 4$, >200 m 50%, $n = 7$; $\chi2(4) = 10.364$, $p = 0.035$). Post-activity those who estimated increased perception of swimming competence were more likely than those with lower estimation to feel more confident to rescue

others (<25 m 40%, n = 10, 26-200 m 67%, n = 16, >200 m 86%, n = 12; $\chi2(4) = 10.480$, p = 0.033). Perception of floating competence show no differences in water safety attitudes.

Perceptions of Risks

Most participants rated *high* or *extreme* risk for getting swept off isolated rocks (pre- 84%, post- 89%) and being caught in a rip current (pre- 59%, post- 64%), whereas most were unlikely to perceive high risk in getting tipped out of a canoe (pre- 33%, post- 41%) or chasing a ball into a deep-water pool (pre- 10%, post- 18%) (Table 7.7).

Pre-activity, males were significantly less likely than females to be risk averse toward falling into a river fully clothed (males 34%, vs. females 61%; $\chi2(1) = 3.830$, p = 0.050). Post-activity there were no differences when analysed by gender.

Analysis by ethnicity showed that pre-activity Māori and Pasifika were more concerned than New Zealand European ethnicity about being caught in a rip current (Māori and Pasifika 73%, n = 32, vs. New Zealand European 36%, n = 5) and post-activity being tipped out of a canoe (Māori and Pasifika 55%, n = 24, vs. New Zealand European 14%, n = 2) and falling into a river fully clothed (Māori and Pasifika 68%, n = 30, vs. New Zealand European 43%, n = 6).

Perception of risk also varied considerably by perceived swimming competence. Adults with lower perceived swimming competence were significantly more likely, both pre- and post-activity, to be concerned about being tipped out of a canoe (pre- <25 m 52%, n = 13, 26-200 m 21%, n = 8, >200 m 0%, n = 0; $\chi2(2) = 10.920$, p = 0.004; post- <25 m 60%, n = 9, 26-200 m 45%, n = 13, >200 m 17%, n = 3; $\chi2(2) = 6.844$, p = 0.033) and falling into a river fully clothed (pre- <25 m 64%, n = 16, 26-200 m 39%, n = 9, >200 m 7%, n = 1; $\chi2(2) = 12.033$, p = 0.002; post- <25 m 73%, n = 11, 26-200 m 69%, n = 20, >200 m 33%, n = 6; $\chi2(2) = 7.393$, p = 0.025). Pre-activity, adults with lower perceived swimming competence were also more likely to report a higher risk rating for being caught in a rip (<25 m 70%, n = 19, 26-200 m 58%, n = 14, >200 m 29%, n = 4; $\chi2(2) = 8.331$, p = 0.016), and, although not quite significant, being swept off isolated rocks (<25 m 88%, n = 22, 26-200 m 92%, n = 22, >200 m 64%, n = 9; $\chi2(2) = 5.430$, p = 0.066). Reflecting the reported water safety attitudes, perception of floating competence had little effect on perception of risk.

Table 7.7 *Pre- and Post-activity Risk Perception*

Risk Perception		**Male (n = 45)**		**Female (n = 18)**		**Total**	
High Risk/Extreme Risk		***n***	***%***	***n***	***%***	***n***	***%***
Swept off isolated rocks by a wave while fishing	Pre	36	80.0%	17	94.4%	53	84.1%
	Post	38	84.4%	18	100%	56	88.9%
Caught in a rip current at a surf beach	Pre	24	53.3%	13	72.2%	37	58.7%
	Post	27	60.0%	13	72.2%	40	63.5%
Fell into deep water fully clothed while walking along a riverbank	Pre	15	34.1%	11	61.1%	26	41.9%
	Post	28	62.2%	10	55.6%	38	60.3%
Tipped upside down in a canoe 100 metres from the shore of a lake	Pre	14	31.1%	7	38.9%	21	33.3%
	Post	21	46.7%	5	27.8%	26	41.3%
Chased inflatable toy into deep water at a local swimming pool	Pre	3	6.7%	3	16.7%	6	9.5%
	Post	7	15.6%	4	22.2%	11	17.5%

Table 7.7 Pre- and Post-activity Risk Perception

Analysis of the means of pre- and post-activity showed significantly higher risk aversion among all adults toward falling into a river fully clothed (t (62) = 2.378, p = 0.021), and although not significant, greater awareness of risk was shown in all other scenarios.

Water Safety Knowledge

Two questions were asked about water safety to elicit some level of water safety knowledge. Pre-activity most adults (71%, n = 45) could correctly answer how to assist someone in deep water without putting themselves at risk and almost half (43%, n = 27) could describe a survival position. Following the programme almost all participants knew how to safely assist someone in trouble (98%, n = 57) and could describe a survival position (88%, n = 51). A paired sample means test showed significant improvement in water safety knowledge for both answers from pre- to post-activity (assist rescue t (57) = 3.907, $p = \leq 0.001$; survival position t (57) = 5.806, $p = \leq 0.001$). There were no variances in water safety knowledge when analysed by gender or ethnicity.

Discussion

This study intended to determine if there were any gaps between perceived and actual water competencies, both in closed (swimming pool) and open water, and if there were any relationships between perceptions of those competencies and drowning risk with actual water competencies. To enable this, adult participants were asked what their perceptions were of their own water competency in a pool and open water, and their attitudes and perceptions about risks of drowning. They were then tested on five water competencies in a pool and an open water environment. Finally, after the activity in the pool and open water, they were asked again what their perceptions were about their water competency and risk.

Results from this study built on the previously undertaken pilot study, highlighting differences in perceived adult open water competence and what adults achieved when tested in open water. In the pilot study, actual floating competence was better in open water than perceived. This was not so for swimming, however, where none of the participants in the pilot study could achieve a 200 m open water swim, yet they still perceived high levels of competence at post-activity testing. Key limitations of the pilot study included a small cohort, the wearing of lifejackets and wetsuits in open water and the participants' prior experience and confidence in and around water.

Study Four built on the pilot study recommendations that participants should be more reflective of the adult population who were more at-risk of drowning, include a larger participant group and ensuring alignment of the pool and open water testing by not allowing wetsuits or lifejackets to be worn in open water.

A significant finding from Study Four is the relatively poor physical swimming and floating water competencies displayed within this cohort. Most participants in this study could not swim more than 100 m in five minutes in a pool (94%) or float for more than one minute in a pool (60%). Furthermore, although significantly more thought it easier than expected to swim 25 m in a pool, one-quarter (24%) took longer than one minute to complete a 25 m fast swim, a competence that could be required when escaping from a sinking boat or exiting from a rip current. Swimming competencies were also poor when tested in open water. Slightly more could not swim more than 100 m in five minutes (98%) or complete a 25 m fast swim in under one minute (71%). The level of swimming and floating competence demonstrated was much lower

than in the pilot study where one-half (53%) were able to swim 200 m in a pool in five minutes and one-quarter (24%) could float longer than five minutes stationary and unassisted. It is also lower than what is suggested for an American Red Cross 'water competency' definition to enter closed, deep-water environments, from a study of 1,024 adults (Quan et al., 2015). The level suggested for 'water competency' included a one-minute float as well as 25 m propulsion on back or front. It was also recognised that this level of competence may not transfer to other tasks and environmental contexts. The level of swimming and floating competence displayed in this study is unlikely to provide protection in high-risk open water situations such as floating to wait for assistance or swimming to a safe exit point.

Participants in this study identified predominantly with minority ethnic groups (69% Māori or Pasifika). An earlier study on self-estimations of water competency of 194 Māori or Pasifika adults (Stanley & Moran, 2018) identified lower socio-economic status as a contributing reason for lower levels of estimated swimming competence. Māori and Pasifika may not have had the opportunity to attend formal swimming lessons and are less likely to participate in aquatic sport or recreation. Lower swimming and floating competence may be one reason why Māori and Pasifika are overrepresented in New Zealand drowning statistics.

Despite the very low swimming competence recorded, most (63%) participants in this study still perceived themselves as proficient swimmers after the testing in the pool and open water, suggesting an anomaly between what adults perceive as a proficient swimmer. In addition, post-activity more participants perceived they could swim longer, and significantly more thought they could swim further than they perceived initially, estimating they could swim more than 200 m regardless of no participants being able to do so in the 5-minute time period. Previous studies of adult perceptions among parents with young children (Stanley & Moran 2017), adults from high-risk ethnic minority groups (Stanley & Moran, 2018) and older adults (Stanley & Moran, 2020) reported similar overestimation in competence. This gap between their perceived and actual swimming competence is likely to be problematic in preventing drowning and may be one of the reasons for overrepresentation of some groups in drowning among adults in open water.

Males were significantly more likely than females to perceive they could swim well both pre- and post-activity, and more likely to report they could swim further. Although there were no significant differences by gender found in the pool, males were significantly better swimmers in

open water. This finding supported their estimation of being significantly more likely than females to have swum their distance in open water and to have found the activity easier to accomplish. Recent studies measuring perceived swimming competence and actual competence in a pool have found a similar higher estimation for both genders among children (Costa et al., 2020). Furthermore, Rejman et al. (2020) found that adolescent males were also more likely to also rate themselves higher in the challenging conditions. In this study however, Māori and Pasifika adults were accurate in their perception of lower swimming competence, displaying lower levels of swimming both in the pool and open water than other ethnicities.

Open water floating competence was another activity where Study Four participants were significantly more inclined to report improvement post-activity. Here, though, there was a statistical improvement from the pool to open water, with almost three-quarters (70%) of participants being able to float for more than one minute in open water. The improved level of competence may be due to the salination of the sea water in the open water setting, causing the water to be denser, thereby exerting more buoyancy, or the learned effect from already having experienced floating in the pool. However, a further gap between perception and reality was demonstrated in floating competence where two-thirds (62%) of participants believed they could float for more than five minutes despite most (98%) being unable to do so in both the pool and open water. A difference in perceived and real floating competence was shown among males where, although not significant, females rated themselves as better floaters, but males were more likely to be confident in their floating competence.

Being able to safely enter water or escape from open water to a safe exit point are key competencies to prevent drowning. As in the pilot study, improvement in form was displayed in deep, open water entries and exits for all Study Four participants when compared to the pool, which may be due to the safety factor of the pre-teaching requirement in the open water. Most participants in this study were able to enter the water safety with *good* or *excellent* form in both the pool (78%) and open water (90%). Most lower scores were due to unsafe entry rather than inability to enter the water, a higher risk activity that may further increase risk of drowning (Moran, 2008c). It is concerning that many participants were unable to exit the water at all, one sixth (16%) in the pool and one-third (32%) in open water; these results are not too dissimilar to

a study of youth exiting the water, where one-quarter of youth were unable to exit the deep end of a pool (Moran, 2014b).

Over half of participants in this study expected and reported both the entries and exits in the pool and open water to be easy to complete with low exertion; however, one-third of participants were unable to exit open water, highlighting a further gap between perceived and real competence. Females were almost three times less likely than males to be able to exit the pool or open water, and Māori and Pasifika less likely than New Zealand European, to exit open water. Moran (2014b) provided evidence that exiting competence does not appear to be related to swimming or floating competence, those who may be able to exit proficiently may not be competent swimmers or floaters. These results, however, suggest that females, and Māori and Pasifika adults, with lower swimming competence, may also have lesser competence to exit water.

Also alarming are the unsafe attitudes reported by most in regard to reliance on their swimming competence (pre- 75%, post- 84%) and swimming fitness (pre- 57%, post- 68%), despite almost all (98%) being unable to swim more than 100 m in open water. An unreal estimation of competence and its protective capacity may lead to an underestimation of open water risks and one's ability to survive emergency situations (Moran, 2009a; Moran 2010a). Males were more likely than females to report unsafe attitudes both pre- and post-testing, reporting significantly more reliance on swimming competence and swimming fitness to stay safe in open water and significantly more confidence in their ability to perform deep-water rescues.

It is expected that those with higher perceived water competence may rely on that perceived competence to stay safe in open water. However, it is concerning that, when tested, knowledge of actual competence has not enabled a change in attitudes. This overestimated level of competence may provide a false sense of security in one's safety. Males, who displayed increased open water swimming distance and exiting competence, but not entry or swimming speed competence, and were not as competent at floating as females, but were still significantly more likely to rely on their competence. Furthermore, minority ethnicities both perceived themselves as less capable swimmers and displayed lower actual water competence but did not

modify their water safety attitudes to alleviate the risk, and even showed riskier attitudes toward the wearing of lifejackets.

Although most participants recognised the high-risk scenarios such as fishing off isolated rocks (pre 84%, post 89%), being caught in a rip current (pre 59%, post 64%) and falling into deep water fully clothed (pre 42%, post 60%), the gap between their actual competence to keep themselves safe in a drowning circumstance, and what they think they could do, may encourage unsafe behaviours. Adults reporting lower perceived swimming competence were significantly more risk averse. Māori and Pasifika adults reported significantly more risk aversion compared with New Zealand European ethnicity. Surprisingly, unlike prior to the activity, post-activity there were no gender differences recorded for risk perception. This suggests a change toward more realistic sense of risk within males.

It is accepted that increased water safety knowledge results in more positive water safety attitudes, and consequently safer behaviours (Blitvich, 2014b; Moran, 2008: Petrass & Blitvich, 2014), and therefore a greater likelihood of a higher perception of risk (Weber, 2003). The water safety programme that adults participated in covered extensive water safety knowledge and resulted in significant improvement in knowledge. It is unclear why the enhanced water safety knowledge may have resulted in a more realistic perception of risk without any change in attitudes.

Results from this study showed significant disparities when analysed by gender, supporting previous literature of greater male overestimation of competence (Moran, 2009b, 2010a; Stanley & Moran, 2017, 2018) and underestimation of risk (Gulliver & Begg, 2005; Moran 2006; Smith & Brenner, 1995) as key factors in the overrepresentation of males in drowning statistics (Water Safety New Zealand, 2020; World Health Organisation, 2014). This study, however, shows that the reasons for minority groups, such as Māori and Pasifika, being overrepresented in drowning (Water Safety New Zealand, 2020), may be more related to their understanding of proficiency in water competence in open water.

Limitations

This study provides valuable awareness of identified gaps in perceived and actual water competencies and sheds new light on perceived and actual adult water competencies in both

closed pool and open water environments. There are, however, some limitations in the study that suggest caution in reading these results.

First, because the participants were selected from courses aimed at adults participating in workplace or community drowning prevention education, Māori and Pasifika ethnicities and males are over-represented in the study. In, addition the study did not include the high-risk older adult age. It is recommended further research is completed with this age group. Second, because participants were part of a workplace or community group enrolled in a water safety programme, it is possible that their interest in water safety is not representative of all adults, and their willingness to take part in the research introduced a response bias. Third, for safety reasons all practical testing was completed in a pool before undertaking the same the testing in open water, and safety information, such as safe entry, was delivered which may have introduced a learning effect in the open water (Creswell, 2013; McDaniel et al., 2007). Finally, swimming, floating, entry and exit competencies were the only physical water competencies included in the study; it is recommended other physical competencies for drowning prevention be included, such as submerging, and wearing clothes or lifejackets (Langendorfer et al., 2018; Stallman et al., 2017).

Conclusion

Study Four provides new evidence on the reasons why adults drown in open water. It may be the first study where adults, predominantly high-risk males and minority ethnic groups, have been tested on their water competence in the pool and open water. The study included many of the 15 water competencies recommended for preventing drowning (Stallman et al., 2017), including five psychomotor tests and a pre- and post-course survey eliciting information on knowledge, attitudes and risk perception.

Almost all adults were assessed with very low levels of water competence, both in the pool and even more so in open water, especially in the floating, swimming and exiting the water competencies. The performance levels recorded in this study were lower than other studies of adults and would not meet the levels recommended for children by the end of primary school (Royal Life Saving Society Australia, 2015; Water Safety New Zealand, 2020b), and would not be likely to provide much protection from drowning in open water. Further knowledge was gained in that despite these low levels of personal water competence, most perceived themselves

as proficient, highlighting a discrepancy between what they believe is proficient, and what competency is required to be safe in open water.

Study Four has developed new insight on the gap between what adults think they can do and what they can actually do, especially in open water. Most adults reported an overestimation of their competence, and the gap was greater for males, supporting the supposition that the greater the gap between reality and perception, the greater the risk of drowning.

Adults reporting lower perceived swimming competence were significantly more aware of risks, and even more so after the intervention. However, a key problem in preventing drowning may be the lack of safe attitudes reported toward water safety, especially among males and high-risk ethnic groups. Overreliance on swimming competency did not change even after establishing actual swimming competency suggesting that entrenched attitudes within these groups may be difficult to shift.

It is recommended that further in-water studies be completed to determine any discrepancies between perceived and actual water competence with other adult groups at-risk of drowning such as older adults.

Chapter 8 Conclusion

This research has provided new knowledge about adult water competence in open water, highlighting gaps between adult perception of risk and actual safety in open water, and what people estimate their competence to be and their actual competence in open water.

Study One (Stanley & Moran, 2017) determined parental perceptions of water competence for themselves and their child. The study found that not only were parents overly confident about their own swimming competence in open water, but they were also very confident about the swimming level of their child. This was despite over half of parents and three-quarters of their primary age children estimated themselves or their children capable of swimming less than 25 m, and most never having swum this distance in open water. Furthermore, one-half of parents believed their child to be safe swimming in open water.

In Study Two (Stanley & Moran, 2018), Māori and Pasifika adults reported even higher estimates of swimming and rescue competency than in Study One (Stanley & Moran, 2017), especially among males. Even though most adults in this study estimated they could swim only a relatively short distance (less than 25 m), most believed their swimming competence was at a high level and would keep them safe in open water. Although Māori and Pasifika were more likely to have swum in open water, they were also more likely to report more unsafe attitudes toward swimming in open water when compared with parents in the earlier study, possibly with more likelihood to underestimate risks in open water environments.

Older adults in Study Three (Stanley & Moran, in-press) were more conscious of the effect of aging, and less likely to estimate high water competence. Reduced frequency and recency of aquatic recreation reduces opportunities for drowning among older adults, but may, however, increase prospects for inaccurate assessment of water competence. Unknown medical conditions may also increase risk of drowning among older adults. Surprisingly, water safety attitudes among older adults reported were no more safe than other adults in this study, defying the adage of improved wisdom with age.

Finally, in Study Four, actual testing in the pool and open water showed both discrepancies in water competence relative to what adults thought they could do, and in what they could actually do, and what they could achieve in a pool compared to in open water. Adults

were tested for swimming distance in a pool and in open water; however, post-activity responses showed most adults perceived they could swim further than they could in fact achieve either in the pool or open water. Responses post-activity after a water safety intervention resulted in improved knowledge and greater perception of risk, but no significant change in water safety attitudes.

Gaps

The Drowning Prevention Model developed (Figure 8.1) was used to test the hypotheses of the present research. The dynamic constraints model (Langendorfer, 2011; Newell, 1986) of individual, task and environment suggests the individual level of competence to stay safe varies continuously across the environment and the environmental conditions present, and the activities undertaken. Studies One to Four focussed on the activity of swimming in pools and the open water environment, although the model could be used for other activities such as boating or fishing and environments such as rivers, or waterholes. Even within the open water environment, conditions are ever-changing with varying levels of risk. Tranquil, benign-looking but cold lakes present different dangers to the murky waters and tidal currents prevalent in estuaries and harbours, or surf beaches with waves and calm-looking rip currents. People's perception of their water competence in open water is relative to their understanding and experiences in open water environments. As expected, disparities in perceived and actual adult water competence in open water were found in all four studies. These gaps are grouped below in four key areas.

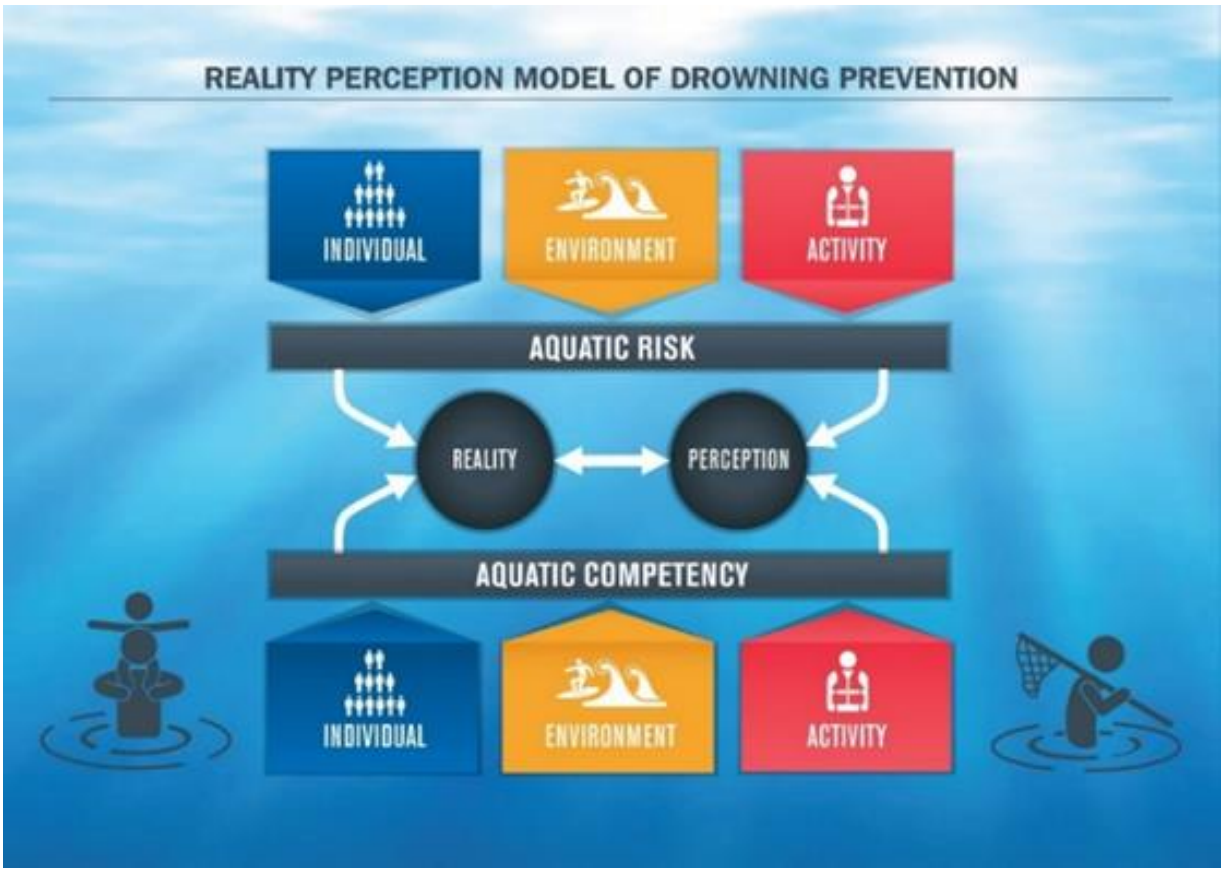

Figure 8.1 Drowning Prevention Model

Understanding of Proficiency

Firstly, in each of these studies, most adults consistently thought themselves to have a high level of swimming competence despite more than half in all studies estimating they could swim less than 25 m. A swimming distance of 25 m is not consistent with what most international drowning prevention organisations consider would offer protection from drowning (Amateur Swimming Association, 2015; Australian Water Safety Council, 2012; Lifesaving Society Canada, 2015; Royal Life Saving Association Australia, 2015; Water Safety New Zealand, 2015a), highlighting a gap between perceived proficiency and actual proficiency of water competence. Furthermore, adult perception of their water competence was related to gender, ethnicity and age. Males, Pasifika ethnicities and younger adults were significantly more likely to estimate higher water competence proficiency than females, other ethnicities, and older adults in the studies completed.

Over-confidence in Competence and Underestimation of Risk

The second area is over-confidence. Over-confidence in competence is concerning, and the gap between what adults perceive is competent, and what really constitutes water competence in open water, may provide answers around underestimation of risk. Previous reports of risky behaviours as possible contributing factors toward drowning have been reported for youth (Moran, 2006), 21-year-old males (Gulliver & Begg, 2005), rock fishers in New Zealand (Moran, 2008b) and youth in a United States study (Smith & Brenner, 1995). In addition, older adults have been reported as being more risk averse to health and safety domains, and less likely to engage in risky health and safety behaviours (Bonem et al., 2015). Most adults in Studies One to Four perceived high or extreme risks toward two of the five scenarios, although there was little heightened awareness of the risk of drowning among older adults compared with younger age groups. I posit that adults perceive the ostensible risk to be considerable but, in their overestimation of water competence, they underestimate the actual risk. Study Four reported an improvement in risk perception after a water safety intervention, showing a shift toward a more realistic perception of risk. On the other hand, unsafe water safety attitudes were reported by adults in these studies both pre- and post-activity, such as relying on their competence to be safe in open water or believing others to be more at risk. It is expected that improved water safety knowledge will develop positive water safety attitudes and behaviour (Blitvich, 2014b; Moran, 2008a: Petrass & Blitvich, 2014). Unexpectedly, older adults in Study Three (Stanley & Moran, in-press), and adults after the water safety intervention in Study Four, showed little change toward safer attitudes, suggesting entrenched attitudes that may be hard to shift.

Difference Between Estimated and Actual Water Competencies

The third gap shown in these studies is between perceived and actual practical water competencies. Reasons for this are varied. The last time people may have been tested for water competence may have been in their later primary years at school. Consequently, they recall being able to achieve a certain level, oblivious of the effect of aging, fitness and health on their current water competence levels. Alternatively, there may be an aspect of bravado, overconfidence, or just a delay in recognising the reality of aging effects. In Study Three (Stanley & Moran, in-press), more than one-third of 389 adults thought they could swim more than 200 m in five minutes and almost one-third anticipated they could float for more than one hour. In Study Four, one-quarter of 63 adults estimated they could swim more than 200 m and almost two-thirds

could float more than five minutes. In reality, Study Four reported that only four of the adults (6%) could swim 200 m and only one adult (2%) could float for five minutes in a pool. Other water competencies tested in Study Four reinforced this lack of realistic assessment. Most adults (males, 84%; female, 83%) reported confidence in exiting a deep-water pool, and although most males (91%) could do so, one-third of females were not able to exit a pool in deep water.

Differences Between Pool and Open Water Competencies

Finally, actual water competency in a swimming pool did not equate with that in open water. Testing of water competencies in Study Four showed that although many adults do have a realistic understanding of their swimming competence level in a pool, this competence expectation does not apply in open water. In many open water environments, such as those with moving water from tidal or rip currents, or cold, murky or choppy water, achieving water competencies will be even more difficult. Swimming, even a short distance such as 25 m, or floating are likely to be even more arduous, although buoyancy aided by salt water is a challenge in assessing floating competence. As in previous studies of children unable to attain the same level of water competence in simulated open water environments (Kjendle et al., 2013), adults in this study were also less competent in open water conditions. Over one-half of females (56%) and one-fifth of males (23%) could not exit deep open water. Three of the four adults who could swim 200 m in a pool, could not do so in open water. It is not realistic to assume a level of water competence can be transferred equally to open water environments, and this gap between pool and open water competence is problematic.

Drowning – A Wicked Problem

The multi-faceted, complex nature of drowning intimates that prevention of drowning cannot be one-dimensional. Personal factors, such as age, gender, ethnicity, residency, socio-economic status, and experience, along with the nature of the activity being undertaken, utilisation of equipment, environmental conditions and weather, are all factors that may contribute to the likelihood of a drowning occurring. Perception of water competence and risk, and actual competence and risk, add another dimension for consideration. Solving the drowning problem is equally complex and multi-faceted. It is without doubt, a wickedly, complex problem. As previously discussed in Chapter 3, this research has utilised the theory of ‘wicked problems’ as a framework to discuss the problem of drowning.

Ten aspects of wicked problems (Australian Government, 2007; Rittel & Webber, 1973; Whyte & Thompson, 2011) can be applied to drowning and water competence in open water settings.

1. Difficulty in clearly defining 'drowning'

Wicked problems are often difficult to define. The difficulty in defining the drowning problem and its solution starts with terminology. Although a definition for fatal drowning has been internationally accepted after the 2002 World Congress on Drowning (ILSF, 2020a), until recently, there has been no such universally accepted definition for non-fatal drowning WHO, 2018). In non-fatal drowning, the process of respiratory damage is stopped before death. Preventing the fatality can be by way of a self-escape, or a preventative action or rescue by a bystander or a lifeguard, all terms without a current accepted understanding. Furthermore, data collection of drowning incidents is dependent upon definitions (Szpilman et al., 2021), so that international drowning data sets are not strictly comparable (Peden, Franklin, & Clemens, 2019), generally supporting the notion that drowning deaths are underrepresented internationally. Drowning by boating, natural disasters, suicide, homicide, road traffic, or workplace incidents may or may not be collated in national drowning data (for example, Peden, Franklin, Mahony, et al., 2017), even in countries with efficient and effective methods of collation. Within New Zealand, where incidents of all these types are categorised, national stakeholder bodies in the sector are still unable to compare the data collected by each organisation due to mismatched terminology for rescue, searches, assists, as well as equipment and environmental conditions (Maritime New Zealand 2018; Water Safety New Zealand, 2020a). Different stakeholders have differing priorities of the issues, for example, Ministry of Health determinants for a 'hospitalisation' after a rescue will vary from what Surf Life Saving needs to record (Peden, Franklin, Mahony, et al., 2017). This lack of consistent terminology hinders the collation of consistent and transferable data available to assist the development of solutions.

From the perspective of water competencies in open water, terms such as 'swim and survive', which infer that a competent level of swimming will result in survival, are also misleading. The competence required to stay safe in open water has historically been defined in terms of swimming distance rather than the currently accepted 15 water competencies (Langendorfer et al., 2018; Stallman et al., 2017). Furthermore, the lack of a publicly accepted understanding for

swimming competency may cause an overestimation of swimming competence (Dixon & Bixler, 2007). Most participants in all four studies of the present research self-reported confidence in their water competence. A lack of consistent and appropriate water competence levels for open water environments may be one reason for adult overestimation of their swimming competence.

2. Drowning has many interdependencies and is multi-causal

The second characteristic of a wicked problem is that there are many interdependencies within the issue and the problem is often multi-causal. Agreement of terminology across stakeholders is one example of interdependencies, as stakeholders are often focussed on different causal drowning factors. In New Zealand, Maritime New Zealand focusses on promoting safe boating, Surf Life Saving New Zealand on preventing drowning at beaches, and New Zealand Search and Rescue on recovery and rescue on land or sea; however, none have a primary focus of drowning prevention education (Maritime New Zealand, 2021; New Zealand Search and Rescue, 2021; Surf Life Saving New Zealand, 2021).

Historically people have been taught to swim primarily for fun or competition, rather than to prevent drowning (Moran, 2010a). Changing the focus of aquatic lessons from learning competitive swimming strokes to teaching the recommended 15 water competencies to prevent drowning may require a change in emphasis within school or swim school curricula. Both education systems and swim school providers may struggle to implement this with the existing organisational goals of competitive swimming or profit generation.

The dynamic constraints model (Langendorfer, 2011; Newell, 1986) of task-person-environment shows that the interdependence of the activity, the person characteristics and the environment that may lead to a drowning. Study Four found that a person who is swimming-competent in a pool may not be so competent in deep, open water.

The environment is a factor also noted in the drowning prevention model (Figure 8.1). The risk of swimming in open water is dependent on environmental conditions, and drowning numbers rise or fall dependent upon environmental conditions. Most drowning occurs in New Zealand's warm summer months, and years with favourable summer weather show higher drowning numbers (Water Safety New Zealand, 2020a), presumably due to increased aquatic participation. The COVID-19 pandemic saw a predictable drop in drowning numbers when lock-

down caused a drop in participation (Water Safety New Zealand, 2021); however, predictions for the coming 2021 summer are concerning with retailers citing more people, who are unable to travel overseas, purchasing new equipment for aquatic pursuits they may not be prepared for or have the competence to safely do so. Despite these concerns any significant increase in fatal drowning did not appear to eventuate (Water Safety New Zealand, 2021).

Furthermore, the drowning prevention model (Figure 8.1) highlights the link between perceived and actual water competence and risk for these factors. A key interdependence in the present research is the gap between perceived and actual water competence in open water. As highlighted in Study Four of this research, adults often perceive their water competence level as what they can attain in a pool, and this does not translate to what is achievable in open water. A crucial factor in reducing drowning in open water will be determining how to close this gap between reality and perception.

3. Unforeseen outcomes when addressing drowning

In attempting to address wicked problems, unforeseen consequences may occur. In teaching young children swimming and water safety, parents and caregivers reported a high reliance on their child's competence as protection from drowning, in place of adult supervision (Moran & Stanley, 2006), potentially increasing their risk of drowning. Evidence from the present research shows that adults in these studies also put themselves at increased risk by reporting a high reliance on their competence in protecting themselves from drowning. Surprisingly, Study Four reported that after the water safety course, more adults thought they could swim 200 m in five minutes than at the beginning of the programme, despite few of them actually achieving this distance in a pool or open water. The experience of learning and participating in a pool and open water may provide unforeseen outcomes for unwarranted confidence in their competence.

Lifeguards and safety equipment are further measures introduced to save lives but may increase the risk of drowning. Lifeguarded areas are promoted as safer areas to participate in aquatic activities, possibly increasing participation, and therefore risk, compared with where lifeguards were not present. People who recreate at lifeguarded pools and beaches may also take risks, consciously or subconsciously, and become reliant on lifeguard supervision rather than being responsible for those in their care (Moran, 2010b; Wildavsky & Dake, 1990). The promotion of lifejacket use in open water may result in a reduction in learning floating and other

water competencies if the need to learn to float is seen as not required when wearing lifejackets (Moran, 2008b; Moran et al., 2018; Moran & Stanley, 2013). Other non-standard buoyancy aids and toys could also result in a reduction of water competence and a lesser quality of adult supervision.

Another unforeseen outcome may arise from health promotion. Swimming is promoted by health and aquatic organisations as a healthy activity (Ministry of Health, 2021; Swimming New Zealand, 2021); however, this participation may increase risk, especially in open water environments for those with low experience and competence levels. There is a risk, as shown in Study Four that developing open water competence may lead to an overestimation of competence and an underestimation of risk. Additionally, most older adults in Study Three (Stanley & Moran, in-press) reported no known medical conditions that would prevent aquatic recreation. Drowning data records show two-thirds of older Australians had an unknown pre-existing medical condition at the time of their drowning (Pearn et. al., 2019), highlighting further risk in promoting aquatic recreation among older adults.

4. Instability and lack of endpoint to drowning

Another aspect to wicked problems is that there is no foreseeable endpoint to the wicked problem. Although targets can be implemented within strategies to reduce drowning, there may be no likelihood of eliminating drowning in total, and there may be no definitive validity or tests to prove whether the intervention is successful. Although countries such as Australia and New Zealand have introduced drowning reduction targets in recent national strategies (Australian Water Safety Council, 2016; Water Safety New Zealand, 2015b) it is hoped, but not expected, that drowning will be eradicated. Peden et al. (2020) reported that despite a reduction in Australian child fatal drowning, continued investment and implementation of interventions would be required to eliminate child drowning. People expect ongoing recreation and enjoyment of open water environments. This ongoing participation means there will continue to be ongoing risk. Closing pools or beaches to eliminate participation, and therefore risk, is not an optional solution.

In addition, the changing ages and stages of life provide new opportunities for people to participate in open water environments, needing continuous public drowning prevention education and advocacy. Study Three (Stanley & Moran, in-press) reported that as people age,

risk is reduced through less exposure and lower perception of their water competence, although a lack of corresponding change in water safety attitudes suggests a need for ongoing public advocacy targeting adult water safety. Furthermore, immigrants such as 'new' New Zealanders often pose a higher risk of drowning as they arrive without experience in the environments or activities and individual water competence to safely participate in aquatic recreation in New Zealand's particular open water settings (Moran & Willcox, 2013; 2010).

5. No definitive solution to drowning

A further characteristic of a wicked problem is that there are innumerable solutions to solve the problem. Each intervention may assist in preventing drowning but may not prevent drowning on its own. Using the Drowning Prevention Model (Figure 8.1) drowning could be also reduced through environmental design or placement of lifeguards, safer equipment design for activities, or developing individual water competence through education.

Environmental design such as the placement of carparks may encourage or discourage activity within areas supervised by lifeguards, such as at Auckland's notorious North Piha beach. Location and design of lifeguard structures and services could also assist in identifying and preventing drowning. In New Zealand, the only open water settings with lifeguards are beaches, despite significant drownings occurring in other open water settings such as rivers, lakes and waterholes (Water Safety New Zealand, 2020b). Environmental design could also be used to enhance individual water competencies. Exit ladders that people can climb erected on permanent or temporary floating structures such as wharves or diving features, or permanent fastenings to equipment such as paddleboards or kayaks, could be implemented to recognise the inability of many adults in this study that are able to exit deep water (Connolly, 2014a).

Developing competence so that people learn practical skills, water safety knowledge, critical thinking and safe attitudes is recommended to prevent drowning (Langendorfer et al., 2018; Stallman et al., 2017). Concerns remain about overly optimistic levels of competence, overreliance on that water competence, and the education to change entrenched attitudes shown in the present research toward safety around water. Innovative and flexible approaches and interventions are recommended that reduce the gap between perceived and actual water competencies in open water.

6. Drowning is socially complex

The wicked problem has many social intricacies. In the case of drowning, gender, age and ethnicity are shown to affect drowning statistics (Water Safety New Zealand, 2020), and have been highlighted in this research as factors that increase the gap between perceptions and reality in the Drowning Prevention Model (Figure 8.1). Gender, ethnicity, and age have been reported as associative factors in the gaps between perceived and real water competencies.

In New Zealand, most people (80%; Water Safety New Zealand, 2020a) who drown are male. Although more targeted, it would not make sense to only teach males water competence to prevent drowning. It is recognised females are more risk averse to drowning for both themselves and their children (Stanley & Moran, 2018; Moran & Stanley, 2006) and there is an opportunity to provide a significant role in preventing drowning for themselves and their families. In the current research males have consistently shown higher estimation of competence and lower awareness to drowning risk than females, previously reported as a key factor in their higher rate of drowning (Moran, 2008a). Actual water competency results suggest little evidence to support the higher estimation of competency by males. Study Four showed that females demonstrated superior floating competency, although many were unable to exit deep water. Most males were able to exit deep water with higher proficiency, and although there was little difference in swimming speed and distance in the pool when analysed by gender, males showed higher proficiency overall in open water.

Older adults are drowning in both increasing numbers and rates in New Zealand, especially in recent years (Water Safety New Zealand, 2020a). Study Three (Stanley & Moran, in-press) reported that adults with prior experience and competence may find themselves more at risk in open water due to their infrequency of participation as they age or unknown medical conditions. Infrequent participation may lead to an inaccurate assessment of their current competence. Furthermore, the water safety attitudes of older adults did not reflect their increased vulnerability.

Drowning is also directly associated with ethnicity. Māori and Pacific people drown at higher rates than European New Zealanders (Water Safety New Zealand, 2020a). Study One (Stanley & Moran, 2017) reported that parents who identified as New Zealand European were five times more likely to estimate being able to swim 200 m or more, although Study Two (Stanley &

Moran, 2018) conveyed higher self-perceived swimming competency of Māori and Pasifika adults when compared with adults in the other studies of the present research. The gap between perceived competence and actual competence for Māori and Pasifika may exacerbate their rate of drowning in New Zealand.

Furthermore, Māori, as the indigenous people of New Zealand, have customs and beliefs that emphasise wai (water) as central to Māori identity. As a result, Māori have many traditions that involve water. One is the gathering, preparing and sharing of kaimoana (seafood) to show hospitality and respect for visitors and whānau (family). Many Māori customary food gathering sites are risky, relying on safe knowledge and practices to be passed on to those who are fishing or diving.

7. Drowning prevention has more than one organisation responsible

Like other wicked problems, solving the drowning problem involves collaborative and coordinated action from a range of stakeholders at local, regional, national and international levels. More than one organisation is required to solve the problem. Government and local governments departments, marae, non-government organisations, commercial businesses, volunteer, not-for-profit, regional, community, sport and recreational organisations are all involved in the aquatic recreation industry. From an international perspective, drowning links to the United Nations Sustainable Development Goals (3, 6, 10 and 14) (United Nations, 2020) are diverse and thus justify multi-sectoral collaboration (Ma et al., 2021). The ILSF has taken leadership for lifeguarding, sport and drowning prevention (ILSF, 2020b).

With drowning being multidimensional, many organisations are involved in the drowning problem, each with expertise and an integral role in preventing drowning. In New Zealand, the ‘wet sector’, as it is known, is comprised of numerous sports, health and recreational organisations, either government, not-for-profit or commercial, that are involved with drowning prevention. Forty organisations are members of WSNZ, many with a focus that is not drowning prevention (such as Swimming New Zealand (2021), NZ Marine (2021), Aotearoa Women’s Surfing Association (2021), NZ Jet Sports Boating Association (2021), Motutapu Outdoor Education Camp Trust (2021). The Collective Impact Model is a good example of how organisations can unify toward a common goal (Collective Impact Forum, 2020).

Collaboration and coordination are more difficult if there are conflicting goals across organisations. Success is more likely when organisations accept their role in the 'jigsaw' of the problem to ensure most effective use of expertise and resources (Collective Impact Forum, 2020). Within open water drowning prevention, organisations may focus on advocacy, rescue and recovery, research, education, legislation, or provision of equipment. Consensus on drowning prevention strategies will assist in drowning reduction, and agreement on work streams will ensure a lack of duplication. Most importantly though, for the open water drowning problem, is the acceptance within organisations, of the 15 recommended water competencies needed in the prevention of drowning.

8. Preventing drowning requires changing behaviour

Sustained behavioural change is required to solve wicked problems and the goal of most social concerns. Behavioural change can transpire by way of legislation or education. Legislation exists in New Zealand for open water recreation through regional bylaws for lifejacket use and through no-swimming zones (for example, Auckland Council, 2014). Conversely, swimming in safe swimming areas patrolled by surf lifeguards is recommended, but voluntary.

One successful example where behavioural change has been measured to reduce open water drowning is the documented behaviour change for rock fishers at Auckland's west coast beaches in wearing lifejackets and the subsequent reduction in rock fisher drownings (Moran, 2008b). The consensus among drowning prevention organisations is that teaching water safety knowledge as part of water competence development will encourage safer water safety attitudes, leading to safer behaviour in aquatic environments (Blitvich, 2014b; Moran, 2008a: Petrass & Blitvich, 2014). Water safety interventions, such as in Study Four in this research, often report improved water safety knowledge in their evaluations. It is less common to report changes in attitudes. The Australian study measuring changes in youth understanding after a water safety intervention (Petrass & Blitvich, 2014) reported no changes observed in water safety attitudes despite significant improvements in knowledge and swimming ability. Study Four of the present research reported a similar lack of change in safer attitudes. Furthermore, results from the studies in this research show a correlation between groups with higher drowning rates and more unsafe water safety attitudes. Study Two (Stanley & Moran, 2018) highlighted less safe water safety attitudes among Māori and Pasifika adults when

compared with the general adult cohort of Study One (Stanley & Moran, 2017). Older adults in Study Three (Stanley & Moran, in-press) reported no more safer attitudes than younger adults despite their lower perceived competence. In Study Four, males, when compared with females, and Māori and Pasifika, when compared with New Zealand European, were more likely to report unsafe attitudes toward aquatic recreation scenarios.

Research regarding behavioural psychology and education is required around changing entrenched water safety attitudes, especially among those at higher risk, for protection from drowning. Specific solutions for various social groups may be necessary. One successful example of changing behaviour among Pasifika in open water recreation has been in the uptake of wearing of lifejackets. Behaviours are changing whereby Pasifika are more likely to access lifejackets from contacts within their own communities. Drowning Prevention Auckland has collaborated with Pacific church leaders to develop lifejacket hubs based at Pacific churches or community groups (WaterSafe Auckland, 2013). However, there is no clear link with a reduction in fatal drowning among Pasifika.

As with other indigenous people world-wide, Māori have a cultural connection with wai (water). Wai is fundamental to Māori identity, health and welfare, and is considered a taonga (treasure) (Kia Maanu Kia Ora, 2020). One method to bring about sustained behavioural change for Māori may be through the Wai Puna model (Phillips, 2020). The Wai Puna model draws on three core pillars: Whakapapa (Knowing who you are and where you belong), Mātauranga (Māori knowledge and ways of knowing) and Tikanga (The value of customs and practices for water safety). This model could be used to prevent drowning by implementing the evidence developed in this, and previous, research into each of the three pillars in advocacy and educational programmes.

9. Drowning is characterised by chronic policy failure

Wicked problems may be characterised by chronic policy failure. One example within New Zealand regarding drowning is the lack of consistent national policy applying to the wearing of lifejackets on vessels. Each local authority has its own by-law which differ by region in terms of the length of vessel requiring compulsory lifejacket use, whether lifejacket use is limited to children, or for both adults and children, and other craft where lifejackets are compulsory (such

as stand-up paddleboards) (Auckland Council, 2014). This inconsistency makes knowledge of each region's by-laws more difficult, and the by-laws therefore less likely to be adhered to.

Policy failure has also been displayed in New Zealand through the water safety strategies funded and implemented. As recently as five years ago, WSNZ, as the lead water safety advocacy agency in New Zealand, was promoting 200 m swimming distance as the sole requirement to provide drowning protection in open water (Water Safety New Zealand, 2015a). While this policy has since changed (Water Safety New Zealand, 2020c), there are generations of adults who may rely on their ability to swim 200 m achieved when they were a child. Furthermore, their 200 m swimming tests were likely to be undertaken in a swimming pool. Study Four reported how adults in the study were likely to perceive their swimming competency in open water as to what they could achieve in a pool, even though when tested, swimming and other competencies were not transferable from a pool to open water. The challenge to New Zealand society now is educating adults about the 15 water competencies recommended to prevent drowning, and how the competency level varies in open water settings, as knowledge is the first step to create behavioural change (Blitvich, 2014b; Laughery & Wogalter, 2014; Moran, 2008: Petrass & Blitvich, 2014; Weber, 2003). This national chronic policy failure may be one reason for the increased risk of adults, especially older adults, toward drowning in New Zealand.

10. The drowning problem is unique

Every wicked problem is different. Despite wicked problems that seem similar, solutions for other wicked problems may not solve open water drowning. Specific solutions for other issues that have been described as wicked, such as poverty or obesity, will not solve the drowning problem (Rittel & Webber, 1973). Some of the methods to solve problems such as poverty or obesity, such as a multi-strategy, cross-sectoral approach may prove useful, however, due to the "wickedity" of drowning, the problem needs to be solved from a holistic view ensuring all aspects of drowning, and subsequently all solutions, are considered.

The traditional method in New Zealand to prevent drowning in open water has been through 'learn to swim' lessons. Many swim schools have a standard curriculum of swimming stroke improvement required to progress levels, the same curriculum for all participants. Bore and Wright (2009) noted the failure of the 'one size fits all' solution in trying to solve a multi-faceted issue. More recently, the 15 water competencies have been recommended to prevent

drowning (Langendorfer et al., 2018; Stallman et al., 2017). Teaching these requires a more flexible curriculum designed for individual needs. As well as practical skill achievement, some of the competencies, such as knowledge of local hazards and critical thinking to minimise risks, require cognitive development. Furthermore, using the dynamic constraints model (Newell, 1986) and Langendorfer's adaption (2011), each of the person-task-environment factors, and their relationships needs to be included in the education.

In summary, drowning in open water is a wicked problem. As such, the solution for the wicked problem of drowning requires a complex and multi-faceted solution.

Closure

Wicked problem thinking has been used to demonstrate how drowning in open water is a complex and multi-faceted issue. The characteristics of wicked problems can be used to offer solutions to close the gaps found in this research between perception and reality in the Drowning Prevention Model (Figure 8.2).

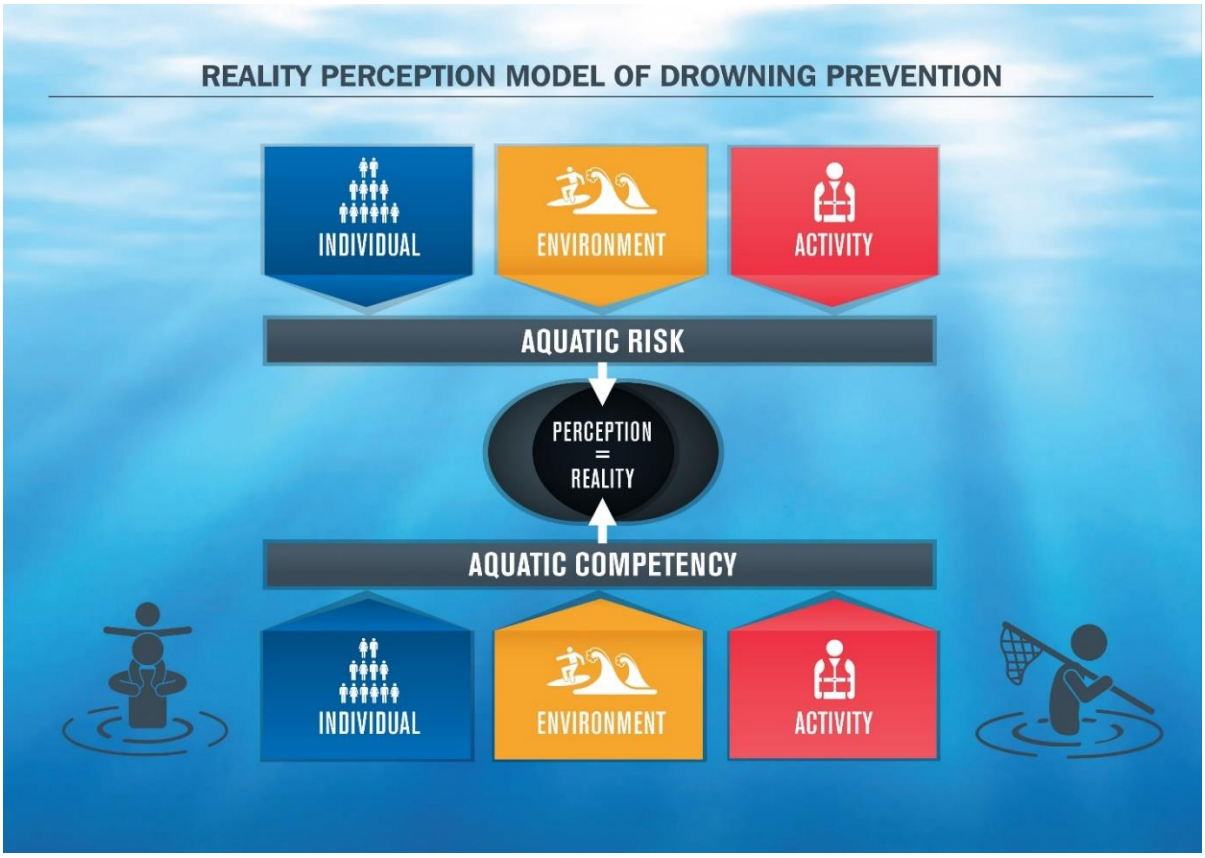

Figure 8.2 Drowning Prevention Model - Closure of Gaps

The first gap needing closure to reduce open water drowning is that between perceived and actual proficiency of open water competence. The dynamic constraints model (Newell, 1986) of person-task-environment means there is not a single level of competence in open water. A further barrier is that it is difficult to test exactly what level of each of the 15 competencies is sufficient for safety. A drowning suggests a failure in at least one of the competencies, and a fatal drowning offers limited opportunity to elucidate where the weakness was presented. Coronial reports and interviews with the deceased family or friends provide some insight to their competence. Non-fatal drowning incidents may offer an opportunity for further research. Nonetheless, it is recommended that levels of individual competence be developed and clarified, for each of the 15 competencies, based on common environments and activities. As not one organisation is solely responsible for the drowning problem, this framework of competency will need to be developed by expert consensus across the water safety sector. With knowledge recognised as the first step toward behavioural change, and to dispel previous incorrect promotion within New Zealand of 'swim 200 m equals safe', the open water competency framework will need to be publicly promoted. This will be especially so for males, Pasifika ethnicities and younger adults who were significantly more likely to estimate higher water competence proficiency in the current research. If based on current best-practice research, a competency framework such as this should ensure there is no further chronic policy failure in this area.

The second gap to address in reducing drowning is ensuring actual risk equals perceived risk in open water, although in the studies in the present research that gap was more clearly demonstrated by water safety attitudes; in contrast, increased awareness of risks was reported because of the water safety intervention among adults in Study Four. However, there was little movement toward safer water safety attitudes. Furthermore, attitudes were reported to be socially complex in terms of individual attributes such as gender, ethnicity and age. Older adults in Study Three (Stanley & Moran, in-press), who reported other attributes to protect them from drowning, did not document the expected safer attitudes toward water safety. Adults in Study Four reported even more unsafe water safety attitudes after the water safety intervention, especially among males. Innovative and socially complex solutions will need to be developed to shift ingrained and unsafe water safety attitudes to enable a move toward a more realistic appraisal of risk and a change to safer behaviours. The Wai Puna Model (Phillips, 2020) with the pillars of knowledge

identity (Whakapapa), Māori knowledge (Mātauranga) and the value of customs and practices for water safety (Tikanga), may prove successful in reducing inequity of drowning among Māori. If so, it may provide a framework to reduce drowning among other ethnic and cultural groups.

The third gap shown in these studies requiring closure is between perceived and actual practical water competencies. When tested to check levels of competence, many adults participating in Study Four overestimated their water competence in a pool, even after the testing, highlighting the need for Water Competence 13 (Assessing Personal Competency) (Langendorfer et al., 2018; Stallman et al., 2017) to be included in all aquatic education. In Study Four, participants were aware of the distances and times they had swum or floated in both the pool and open water, although their actual achievement levels were not part of their education process. It is recommended that as part of aquatic lessons, personal levels of competence are discussed and related to open water settings. Further, a nationwide programme for the public to measure their water competence is recommended to enable a current 'warrant of fitness 'for aquatic participation, similar to the requirement for vehicle safety standards in New Zealand. Public pools, such as those aligned to Poolsafe Quality Management Scheme (Recreation Aotearoa, 2020) could offer regular, preferably free, testing of water competencies. As an additional step, this could be measured against the water competency framework, and against medical health checks, to provide guidance on appropriate activities and open water environments for participation.

Perhaps the most dangerous gap reported in the present research relevant to open water, where most drownings occur, is that actual water competency in a swimming pool did not match that in open water. Many people mistakenly assumed they could attain the same level of competence in open water as what they achieved in a pool. The challenge is to change people's perception of their water competence in open water to reflect the open water environment. Obvious solutions have already been recommended in the 15 water competencies (Langendorfer et al., 2018; Stallman et al., 2017;). Implementation of these water competencies suggest introducing simulated open water activities into aquatic education and could include simulating moving water or experiencing cold water. Further suggestions are completing activities without swim goggles, or experiencing these activities wearing clothing and lifejackets, more closely replicating the open water environment, as well as learning about local hazards and how to cope

with them. Teaching of the 15 water competencies recommended to prevent drowning in aquatic lessons will likely reduce drowning among adults in future. It is recommended that adults now are provided with the opportunity to develop competence in open water. To avoid increasing risk through increased participation or introducing an overconfidence in competence, there is a moral obligation to provide education for safe aquatic experiences for adults in open water. Water safety educators could provide water competence specific to ethnic, gender or age groups' needs throughout New Zealand. Open water swimming event promoters might provide educational sessions in open water. Another option is promotion of the open water competency framework by retailers selling open water equipment. Retailers selling aquatic recreational equipment could offer safety sessions, for example in kayaking or stand-up paddle boarding, before purchase. The many outdoor education providers, who typically target school children through school camps or outdoor education, could target adults during weekends or after-work hours to experience open water activities or test current adult open water competence. Councils and tourist organisations need to ensure safety is omnipresent when promoting the amazing open water opportunities in New Zealand.

A 'tame', linear solution will not solve the complex and multi-faceted open water drowning problem. Wicked problem theory provides a framework to discuss the explanations for open water drowning reported through the Drowning Prevention Model (Figure 8.2). The innovative, coordinated, integrated, but specialised solutions above may provide inroads to close the gaps between reality and perception to change behaviours and reduce drowning in open water.

Conclusion

The present research informs the water safety sector by adding to our knowledge around perceived and actual open water competence and perceived risk to be safe in open aquatic environments. My starting assumption was that people drown because of a gap between real and actual water competencies in open water, and the greater the gap, the greater the risk of drowning.

The present research has confirmed that the problem is not so much that people are unable to swim or float, but they are unable to swim or float as well as they thought they could in open water and sometimes even protected waters such as the pool environment. It is this

inaccurate assessment of competency which leads to an underestimation of risk and subsequent performance of unsafe behaviours. It perhaps explains the reasons why the man in my first rescue at 14 years of age got into trouble, since he was swimming alone, out of his depth, and struggling to stay afloat.

My research has provided new knowledge about adult water competence in open water, highlighting gaps between adult perception of risk and actual safety in open water, and what people estimate their competence to be and their actual competence in open water.

My overarching research question examined the wicked problem that underpins open water drownings in New Zealand. I used the drowning prevention model (Figure 8.1) to answer the specific research questions in each of the four distinct studies.

Collectively, the four studies have found that:

i. There are gaps between what people think is competent in open water and what most drowning prevention organisations would consider water competent

ii. Unsafe water safety attitudes and perception of risk show an underestimation of actual risk in open water

iii. Water safety interventions may not always reduce the gap between perceived and actual risk

iv. Gaps exist between perceived water competence and actual water competence both in a pool and open water

v. The gaps are larger for demographic groups at high risk of drowning

Framing drowning as a wicked problem has allowed me to address the multi-faceted and complex relationship between perceived and actual open water competencies as they influence the incidence of drowning in open water. It has also provided a framework for providing complex and integrated solutions that I hope may assist in the prevention of open water drowning.

Undertaking this dissertation has been a journey in developing an understanding of water competencies required for safety in open water. My research shows that there are gaps between perception of water competence and what people can achieve in open water. The evidence also shows, however, that the relationship is much more complex than a difference in practical skills. Attitudes, gender, ethnicity, and risk perception are all factors that affect what level of competence people think they can achieve.

Addressing some of these issues in practice will be easier than others. At Drowning Prevention Auckland, we will instil a component about assessing competency in all our in-water courses as a measure to encourage more accurate assessment of water competency. Other concerns, such as changing ingrained unsafe attitudes, will require more investigation. I hope that the knowledge gained in this research will be implemented in other appropriate settings to assist in reducing drowning.

This research has also been a learning journey for me personally. From my advantaged background, with immense opportunities and experience in aquatic recreation, it is challenging at times to comprehend the behaviours of others around water. The knowledge I have gained has helped me answer my questions about why some people behave the way they do around water. My research has helped me close my own gap between what I perceive people should understand about water safety and what they understand in reality about their water competency. It provides me with the opportunities to encourage behavioural change from an informed position so that I can enable others to also enjoy the many benefits of open water recreation safely.

Limitations

By necessity, decisions have to be made that both enable the research to be conducted, but also constrain the possible outcomes. While the limitations for each study have been included within each relevant chapter, it is important to highlight three further limitations that frame the present research. These are:

1. The current research has only considered swimming in open water and does not reflect other activities such as surfing, diving, or boating, or environments such as lakes, rivers, or waterfalls, that may also affect the incidence of fatal drowning. Additionally, as a high-income

country, New Zealand's most significant drowning age group is adults, and this research has concentrated on the adult population.

2. The recommendations for high-risk of drowning groups are suggested from a New Zealand perspective. Further research is needed to find if these recommendations would transfer to other countries and their contexts.

3. Other factors, such as unemployment or social deprivation may also be related to drowning in ways that have not been accommodated or overlooked in this research. In Study One results were not explored by decile rating. There is a future opportunity to examine these results which may provide some analysis of different socio-economic groups. There is, however, a risk associated stereotyping drowning cause with a social bias based on gender, age, or ethnicity. As a wicked problem, drowning should always be seen as a symptom of other wicked problems.

Recommendations

Recommendations have been suggested through the current research. A synopsis of these recommendations are as follows:

- Further research should:
    - consider the inclusion of other water competencies for drowning prevention, both physical and cognitive
    - consider other determinants of health, such as socio-economic status
    - be undertaken on perceived versus actual water competence among older adults
    - be undertaken to further develop the understanding of the relationship between perceived risk and water competence in an actual risk situation of a rescue, or fatal or non-fatal drowning
    - investigate actual and perceived levels of water competence and risk of drowning of non-fatal (rescued people) and fatal victims
    - explore the lack of positive attitudinal change after drowning prevention initiatives
- High-risk groups identified should

    - participate in targeted programmes that include comparisons of real and perceived water competence, and transference of those competencies to the open water in real life settings
- Older adults should:
    - prepare for unexpected entry into water by the in-water practice and testing of practical water competencies to ensure a more accurate assessment of personal competency both in the pool and open water settings
    - have regular health checks before partaking in aquatic recreation in open water

In addition, it is recommended that organisations providing drowning prevention education should:

- discuss personal levels of water competence with participants and relate these to open water settings as part of all swimming and aquatic lessons
- develop innovative and flexible approaches and interventions that reduce the gap between perceived and actual adult water competencies in open water
- teach all 15 of the recommended water competencies required in the prevention of drowning, including within schools and swim schools
- provide adults with opportunities to develop water competence, possibly as part of a nationwide programme for adults to measure their water competence to check for current 'warrant of fitness' for aquatic participation
- develop progressive and developmentally appropriate guidelines for water competencies to prevent drowning in open water for each of the 15 competencies, based on common environments and activities

Appendices

Appendix A Pilot Study – Organisational Information Sheet

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date	**Epsom Campus**
	Gate 3, 74 Epsom Ave
Name of Addressee	Auckland, New Zealand
Manager / CEO	**T** +64 9 623 8899
Organisation	**W** education.auckland.ac.nz
Mailing address	**The University of Auckland**
City	Private Bag 92601
New Zealand	Symonds Street
	Auckland 1135
	New Zealand

ORGANISATION INFORMATION SHEET

Project title: Real and perceived water competencies and risk of drowning among adults

Name of Researcher: Teresa Stanley

My name is Teresa Stanley and I am a student in a doctoral degree programme in the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy. I am also Research & Development Manager at WaterSafe Auckland. My supervisor is Dr Kevin Moran.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. As members of the general public, your workforce is

invited to participate in this research, and I am requesting your assistance in passing on this invitation to your staff in order to participate.

This study involves four phases, about 90 minutes in total. The first is self-completion of a written questionnaire which should take no longer than fifteen minutes to complete. Completion of the survey implies consent. The questionnaire is confidential, and your confidentiality is guaranteed, you are requested not to write your name on the questionnaire. The second involves testing of water competencies in a pool, and the third, testing of the same competencies in an open water environment. A final self-completed survey will ask you to reflect on the activities. Your participation is voluntary. Aquatic participation will be completed in groups of ten, and qualified and experienced lifeguards will monitor safety.

If you agree to your organisation participating in this research, I require assurance that participation, or non-participation, will not affect the employment status of the participants.

Data will be stored in a locked cupboard with no identifying records for six years at the University of Auckland by the Supervisor, after which it will be destroyed in a secure environment. Electronic data will be stored on a password protected University of Auckland computer, backed up by a server for six years before being deleted.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. You will be provided with a summary of findings.

If you agree to participating in this research could you please complete the Organisational Consent Form, and return it to the researcher, Teresa Stanley, at the email contact overleaf.

Contact Details

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz, Phone 09 306 0809

Supervisor: Dr Kevin Moran, k.moran@auckland.ac.nz , Phone 09 623 8899 extn 48620

HOS: Associate Professor Helen Hedges, h.hedges@auckland.ac.nz , Phone 09 373 7999 extn 48606.

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 6/12/16 for 3 years, Reference Number 016725.

Appendix B Pilot Study – Organisation Consent Form

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date

Name of Addressee

Manager / CEO

Organisation

Mailing address

City

New Zealand

Epsom Campus

Gate 3, 74 Epsom Ave

Auckland, New Zealand

T +64 9 623 8899

W education.auckland.ac.nz

The University of Auckland

Private Bag 92601

Symonds Street

Auckland 1135

New Zealand

ORGANISATION CONSENT FORM

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project Title: Real and perceived water competencies and risk of drowning among adults

Researcher: Teresa Stanley

I have read the Participant Information Sheet, have understood the nature of the research and why my organisation has been selected. I have had the opportunity to ask questions and have them answered to my satisfaction.

☐ I agree to support participation in this research.

☐ As a Manager or CEO, I give assurance that participation, or non-participation, will not affect the employment status of participants. Participants have the right to withdraw from participation at any time. The questionnaire is confidential and confidentiality is guaranteed.

☐ I understand that I will receive a summary of findings for distribution to my staff.

☐ I understand that data will be kept for 6 years, after which electronic records will be deleted and paper data destroyed in a secure environment at the University of Auckland.

Name _____

Signature _____

Date _____

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 6/12/16 FOR 3 YEARS. REFERENCE NUMBER 016725.

Appendix C Pilot Study – Participant Information Sheet

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date

Name of Addressee

Manager / CEO

Organisation

Mailing address

City

New Zealand

Epsom Campus

Gate 3, 74 Epsom Ave

Auckland, New Zealand

T +64 9 623 8899

W education.auckland.ac.nz

The University of Auckland

Private Bag 92601

Symonds Street

Auckland 1135

New Zealand

PARTICIPANT INFORMATION SHEET

Project title: Real and perceived water competencies and risk of drowning among adults

Name of Researcher: Teresa Stanley

My name is Teresa Stanley and I am a student in a doctoral degree programme in the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy. I am also Research & Development Manager at WaterSafe Auckland. My supervisor is Dr Kevin Moran.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. Members of your employment organisation are invited to participate in this study.

This study involves four phases, about 90 minutes in total. The first is self-completion of a written questionnaire which should take no longer than fifteen minutes to complete. To remain

confidential, you are requested not to write your name on the questionnaire. The second component involves testing of water competencies in a pool, and the third, testing of the same competencies in an open water environment. A final self-completed survey will ask you to reflect on the activities. Results will not be identifiable in any reporting. Your participation is voluntary. Aquatic participation will be completed in groups of ten, and qualified and experienced lifeguards will monitor safety.

Surveys will be collected by the researcher. Data will be stored in a locked cupboard with no identifying records for six years at the University of Auckland by the Supervisor, after which it will be destroyed in a secure environment. Electronic data will be stored on a password protected University of Auckland computer, backed up by a server for six years before being deleted.

Your Manager or CEO has given assurance that participation, or non-participation, will not affect the employment status of participants. Your Manager or CEO will not have access to any identifiable results from this research. You have the right to withdraw from participation at any time, without needing to provide a reason. You may withdraw any data provided up until one month after final stage.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. Your Manager or CEO will be provided with a Summary of Results.

If you agree to participating in this research, please complete the Consent Form and return it to your Manager.

Contact Details and Approval Wording

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz , Phone 306 0809

Supervisor: Dr Kevin Moran, k.moran@auckland.ac.nz , Phone 623 8899 extn 48620

HOS: Associate Professor Helen Hedges, h.hedges@auckland.ac.nz , Phone 09 373 7999 extn 48606.

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 6/12/16 for 3 years, Reference Number 016725

Appendix D Pilot Study – Participant Consent Form

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date	**Epsom Campus**
	Gate 3, 74 Epsom Ave
Name of Addressee	Auckland, New Zealand
Manager / CEO	**T** +64 9 623 8899
Organisation	**W** education.auckland.ac.nz
Mailing address	**The University of Auckland**
City	Private Bag 92601
New Zealand	Symonds Street
	Auckland 1135
	New Zealand

CONSENT FORM

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project Title: Real and perceived water competencies and risk of drowning among adults

Researcher: Teresa Stanley

I have read the Participant Information Sheet, have understood the nature of the research and why I have been selected. I have had the opportunity to ask questions and have them answered to my satisfaction.

- I agree to take part in this research.
- I understand that I am free to withdraw participation at any time. The questionnaire is confidential, and identity of the participant will be treated as confidential data. Results will be not be identifiable in any reporting.

- I understand my Manager will receive a summary of the findings for distribution to employees. Your Manager will not have access to any identifiable results from this research.
- I understand that participation, or non-participation, will not affect my employment status.
- I understand that data will be kept for 6 years, after which electronic records will be deleted and paper records destroyed.

Name

Signature

Date

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 6/12/2016 FOR 3 YEARS. REFERENCE NUMBER 016725

Appendix E Pilot Study – Pre-course Survey

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Number: **WATER SAFETY SURVEY (PRE)**

Assurances in regard to anonymity and confidentiality are guaranteed.

To ensure confidentiality, please do not write your name on this form.

This questionnaire is designed to gather information about your swimming competency and water safety. Some of the questions ask for your views and feelings about water safety. Please do not take too long over each question – normally your first answer is the best. If you have any queries please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. How would you best describe yourself?

☐ European New Zealander ☐ Māori ☐ Pasifika ☐ Chinese ☐ Korean ☐ Indian

☐ Other (please state)_____

2. Are you? ☐ Male ☐ Female

3. How old are you?
   ☐ 16-19 years ☐ 20-29 years ☐ 30-44 years ☐ 45-64 years ☐ 65+ years

4. How long have you lived in New Zealand?

☐ Less than 1 year ☐ 1-4 years ☐ 5-9 years ☐ More than 10 years ☐ All my life

5. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how far can you swim non-stop? (25 metres = 1 length of pool) _____

6. How long ago did you swim this distance in a pool?
   ☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years

7. Do you think you could swim this distance in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

8. Do you think you could float without flotation aids for 5 minutes in open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

How often do you swim in open water (beach, lake or waterhole) during the summer months?

☐ Daily ☐ Weekly ☐ About once a month ☐ Less than once a month ☐ Never

9. Could you rescue someone in difficulty in open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

10. What do you think about the following statements?	**Agree**	**Disagree**	**Unsure**
a) My swimming ability will keep me safe when swimming in open water	☐	☐	☐
b) Others are at greater risk than me when swimming in open water	☐	☐	☐
c) My current swimming fitness will ensure my safety in open water	☐	☐	☐
d) My swimming ability means I don't need to wear a lifejacket in a boat	☐	☐	☐
e) The risk of drowning is always in the back of my mind when swimming in open water	☐	☐	☐
f) I often feel at risk swimming when conditions are rough	☐	☐	☐

11. **How do you feel about:**	**Confident**	**Anxious**	**Unsure**
Swimming in open water out of my depth	☐	☐	☐
Swimming in rough water	☐	☐	☐
Swimming on my back in open water	☐	☐	☐
Swimming underwater in murky water	☐	☐	☐
Swimming in cold open water	☐	☐	☐
Swimming without lifeguard supervision at a beach	☐	☐	☐
Swimming in waves	☐	☐	☐
Floating on my back in deep open water	☐	☐	☐
Floating in deep open water without using a lifejacket	☐	☐	☐
Going to help someone else in open water	☐	☐	☐

12. **Rate the risk to your life in the following situations:**	**Extreme Risk**	**High Risk**	**Slight Risk**	**No Risk**
Tipped upside down in a canoe 100 metres from the shore of a lake	☐	☐	☐	☐
Caught in a rip current at a surf beach	☐	☐	☐	☐
Chased inflatable toy into deep water at a local swimming pool	☐	☐	☐	☐
Fell into deep water fully clothed while walking along a riverbank	☐	☐	☐	☐
Swept off isolated rocks by a wave while fishing	☐	☐	☐	☐

13. **Using Borg's Rate of Perceived Exertion (RPE) scale, use the following estimates from 6-20, with 6 = the easiest and 20 = most difficult to describe the exertion required for you to complete the competencies in the following situations (eg swim 25m fast in a pool = 6, float 5 minutes in open water = 12, etc)**

	6 or less	**7-8**	**9-10**	**11-12**	**13-14**	**15-16**	**17-18**	**19-20**
Deep-water entry in a pool								
Deep-water entry in open water								
Deep-water exit in a pool								
Deep-water exit in open water								
Swim 25m fast in a pool								
Swim 25m fast in open water								
Float for 5 minutes in a pool								
Float for 5 minutes in open water								
Swim for 5 minutes non-stop in a pool								
Swim for 5 minutes non-stop in open water								

Thank you for your time. Please return the completed form to the researcher.

Appendix F Pilot Study - Post-course Survey

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Number: **WATER SAFETY SURVEY (POST)**

Assurances regarding anonymity and confidentiality are guaranteed.

To ensure confidentiality, please do not write your name on this form.

This questionnaire is designed to gather information about your swimming competency and water safety. Some of the questions ask for your views and feelings about water safety. Please do not take too long over each question – normally your first answer is the best. If you have any queries, please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how far can you swim non-stop? (25 metres = 1 length of pool) _____

2. Do you think you could swim this distance in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

3. Do you think you could float without flotation aids for 5 minutes in open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

4. Could you rescue someone in difficulty in open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

5.	**What do you now think about the following statements?**	**Agree**	**Disagree**	**Unsure**
g)	My swimming ability will keep me safe when swimming in open water	☐	☐	☐
h)	Others are at greater risk than me when swimming in open water	☐	☐	☐
i)	My current swimming fitness will ensure my safety in open water	☐	☐	☐
j)	My swimming ability means I don't need to wear a lifejacket in a boat	☐	☐	☐
k)	The risk of drowning is always in the back of my mind when swimming in open water	☐	☐	☐
l)	I often feel at risk swimming when conditions are rough	☐	☐	☐

6. How do you now feel about:	Confident	Anxious	Unsure
Swimming in open water out of my depth	☐	☐	☐
Swimming in rough water	☐	☐	☐
Swimming on my back in open water	☐	☐	☐
Swimming underwater in murky water	☐	☐	☐
Swimming in cold open water	☐	☐	☐
Swimming without lifeguard supervision at a beach	☐	☐	☐
Swimming in waves	☐	☐	☐
Floating on my back in deep open water	☐	☐	☐
Floating in deep open water without using a lifejacket	☐	☐	☐
Going to help someone else in open water	☐	☐	☐

7. Rate the risk to your life in the following situations:	Extreme Risk	High Risk	Slight Risk	No Risk
Tipped upside down in a canoe 100 metres from the shore of a lake	☐	☐	☐	☐
Caught in a rip current at a surf beach	☐	☐	☐	☐
Chased inflatable toy into deep water at a local swimming pool	☐	☐	☐	☐
Fell into deep water fully clothed while walking along a river bank	☐	☐	☐	☐
Swept off isolated rocks by a wave while fishing	☐	☐	☐	☐

8. **Using Borg's Rate of Perceived Exertion (RPE) scale, use the following estimates from 6-20, with 6 = the easiest and 20 = most difficult to describe the exertion required for you complete the competencies in the following situations (eg swim 25m fast in a pool = 6, float 5 minutes in open water = 12, etc)**

	6 or less	**7-8**	**9-10**	**11-12**	**13-14**	**15-16**	**17-18**	**19-20**
Deep-water entry in a pool								
Deep-water entry in open water								
Deep-water exit in a pool								
Deep-water exit in open water								
Swim 25m fast in a pool								
Swim 25m fast in open water								
Float for 5 minutes in a pool								
Float for 5 minutes in open water								
Swim for 5 minutes non-stop in a pool								
Swim for 5 minutes non-stop in open water								

9. **Please comment on your expectations and experience of completing the activities in the pool.**

_____

10. **Please comment on your expectations and experience of completing the activities in the open water.**

_____

Thank you for your time. Please return the completed form to the researcher.

Appendix G Pilot Study – Practical Testing Criteria

Practical Testing Criteria - Pilot Study	
Activity	**Rating**
Deep-water entry pool	**1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)**
Deep-water exit pool	**1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)**
Swim 25m fast pool	**Time swum non-stop for 25m with no stroke or speed specified (time achieved assessed on a 5-point scale: 1 > 1 min; 2 > 45 sec; 3 >30 sec; 4 > 15 sec; 5 < 15 sec)**
Float for 5 minutes pool	**Stationary floating in deep water with minimal swimming motion (5-point scale) 1 < 15 sec; 2 15 sec - 1 min; 3 1 - 3 min; 4 3 - 5 mins; 5 > 5 mins**
Swim 5 minutes pool	**Distance swum non-stop in 5 min with no stroke or speed specified (distance achieved assessed on a 5-point scale: 1 < 25m; 2 < 100m; 3 < 200m; 4 < 400m; 5 > 400m)**
Deep-water entry open water	**1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)**
Deep-water exit open water	**1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)**
Swim 25m fast open water	**Time swum non-stop for 25m with no stroke or speed specified (time achieved assessed on a 5-point scale: 1 > 1 min; 2 > 45 sec; 3 >30 sec; 4 > 15 sec; 5 < 15 sec)**
Float for 5 minutes open water	**Stationary floating in deep water with minimal swimming motion (5-point scale) 1 < 15 sec; 2 15 sec - 1 min; 3 1 - 3 min; 4 3 - 5 mins; 5 > 5 mins**
Swim 5 minutes open water	**Distance swum non-stop in 5 min with no stroke or speed specified (distance achieved assessed on a 5-point scale: 1 < 25m; 2 < 100m; 3 < 200m; 4 < 400m; 5 > 400m)**

Appendix H Study One – Organisation Information Sheet

Faculty of Education

Curriculum and Pedagogy

74 Epsom Avenue, Epsom
Auckland 1023, New Zealand

Phone: +64 9 623 8899

The University of Auckland

Private Bag 92019

Auckland, New Zealand

ORGANISATION INFORMATION SHEET

Principal

School

Address

Project title: Water safety and drowning prevention.

Name of Researcher: Teresa Stanley

Teresa Stanley is completing a PhD at the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy and is Business Manager at WaterSafe Auckland.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. As members of school communities, your school is

invited to participate in this questionnaire, and I am requesting your assistance in passing on this invitation to your parents in order to complete this.

This study involves self-completion of a written questionnaire. It should take no longer than fifteen minutes to complete. Participation is voluntary. I seek assurance that participation, or non-participation, will not affect the status of students or their parents.

Data will be stored in a locked cupboard for six years at the University of Auckland, after which it will be destroyed in a secure environment at the University of Auckland.

The questionnaire is anonymous, and confidentiality of responses is guaranteed. I also request that you collate completed returns for the researcher to collect.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. You will be provided with a summary of findings.

Contact Details

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz, Phone 306 0809

Supervisor: Dr Kevin Moran, k.moran@auckland.ac.nz , Phone 623 8899 extn 48620

HOD: Professor Judy Parr, jm.parr@auckland.ac.nz , Phone 623 8899 extn 88998.

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 87830/83761. Email: humanethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 10 September 2013for 3 years, Reference Number 10065

Appendix I Study One - Organisation Consent Form

Faculty of Education

Curriculum and Pedagogy

74 Epsom Avenue, Epsom
Auckland 1023, New Zealand

Phone: +64 9 623 8899

The University of Auckland

Private Bag 92019

Auckland, New Zealand

ORGANISATIONAL CONSENT FORM

Principal

School

Address

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project Title: Water safety and drowning prevention

Researcher: Teresa Stanley

I have read the Participant Information Sheet, have understood the nature of the research and why my school has been selected. I have had the opportunity to ask questions and have them answered to my satisfaction.

☐ I agree to support participation in this research.

☐ I agree to collate completed returns for the researcher to collect.

☐ As a Principal, I give assurance that participation, or non-participation, will not affect the status of participants. Participants have the right to withdraw from participation at any time, although once submitted surveys are unable to be withdrawn. The questionnaire is anonymous, and confidentiality is guaranteed.

☐ I understand that I will receive a summary of findings,

☐ I understand that data will be kept for 6 years, after which they will be destroyed in a secure environment at the University of Auckland.

Name _____

Signature ____

Date _____

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 10 September 2013 FOR 3 YEARS REFERENCE NUMBER 10065

Appendix J Study One – Participant Information Sheet

Faculty of Education

Curriculum and Pedagogy

74 Epsom Avenue, Epsom
Auckland 1023, New Zealand

Phone: +64 9 623 8899

The University of Auckland

Private Bag 92019

Auckland, New Zealand

PARTICIPANT INFORMATION SHEET

Project title: Water safety and drowning prevention.

Name of Researcher: Teresa Stanley

Teresa Stanley is completing a PhD at the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy and is Business Manager at WaterSafe Auckland.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. Parents of school children are invited to participate in this questionnaire.

This study involves self-completion of a written questionnaire. It should take no longer than fifteen minutes to complete. Your participation is voluntary. Completion of the survey implies consent.

Please return surveys to your child's teacher. Data will be stored in a locked cupboard for six years at the University of Auckland, after which it will be destroyed.

Your Principal has given assurance that participation, or non-participation, will not affect the status of you or your child. You have the right to withdraw from participation at any time,

although once submitted surveys are unable to be withdrawn. The questionnaire is anonymous, and your confidentiality is guaranteed, you are requested not to write your name on the questionnaire.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. Your Principal will be provided with a Summary of Results.

Contact Details and Approval Wording

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz , Phone 306 0809

Supervisor: Dr Kevin Moran, k.moran@auckland.ac.nz , Phone 623 8899 extn 48620

HOD: Prof Judy Parr, jm.parr@auckland.ac.nz , Phone 623 8899 extn 488998 .

For any queries regarding ethical concerns, you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 87830/83761. Email: humanethics@auckland.ac.nz.

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS

ETHICS COMMITTEE ON 10 September 2013 for 3 years, Reference Number 10065

Appendix K Study One - Survey

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

WATER SAFETY SURVEY

Completion of this questionnaire implies consent. Assurances in regard to anonymity and confidentiality are guaranteed.

To ensure confidentiality, please do not write your name on this form.

This questionnaire is designed to gather information about your swimming safety and the safety of any youngsters who are in your care. Please do not take too long over each question – normally your first answer is the best. If you have any queries please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. How would you best describe yourself?

☐ European New Zealander ☐ Māori ☐ Chinese ☐ Korean ☐ Indian

☐ Pasifika (please state)_____ ☐ Other (please state)_____

2. Are you? ☐ Male ☐ Female

3. How old are you?
   ☐ 16-19 years ☐ 20-29 years ☐ 30-44 years ☐ 45-64 years ☐ 65+ years

4. How long have you lived in New Zealand?

☐ Less than 1 year ☐ 1-4 years ☐ 5-9 years ☐ More than 10 years ☐ All my life

5. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

6. How far can you swim non-stop? (25 metres = 1 length of pool) _____

7. How long ago did you swim this distance in a pool?
   ☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years

8. Have you swum this distance in open water? ☐ Yes ☐ No

If **Yes**, when? ☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years
If you have a child, please answer questions 9-12.

9. Can your child swim? ☐ Yes ☐ No

If **Yes**, how well would you say your child can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

10. How far can your child swim non-stop? (25 metres = 1 length of pool) _____

11. How long ago did your child swim this distance in a pool?
☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years

12. Has your child swum this distance in open water? ☐ Yes ☐ No
If **Yes**, when? ☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years

13. From a water safety point of view, how far do you think all children, by the end of primary school, should be able to swim? (25 metres = 1 length of pool) _____

14. What do you think about the following statements?

		Agree	**Disagree**	**Unsure**
a.	My swimming ability will keep me safe in open water	☐	☐	☐
b.	Others are at greater risk than me when swimming in open water	☐	☐	☐
c.	My current swimming fitness will ensure my safety in open water	☐	☐	☐
d.	My swimming ability means I don't need to wear a lifejacket in a boat	☐	☐	☐
e.	Wearing of lifejackets on boats should be compulsory for children	☐	☐	☐
f.	Wearing of lifejackets on boats should be compulsory for adults	☐	☐	☐

15. Finally, how safe do you think your child is when swimming in open water?

☐ Very unsafe ☐ Unsafe ☐ Safe ☐ Very safe

Thank you for your time

Appendix L Study Two – Organisation Information Sheet

Faculty of Education

Curriculum and Pedagogy

74 Epsom Avenue, Epsom
Auckland 1023, New Zealand

Phone: +64 9 623 8899

The University of Auckland

Private Bag 92019

Auckland, New Zealand

ORGANISATION INFORMATION SHEET

Manager/CEO

Organisation

Address

Project title: Water safety and drowning prevention.

Name of Researcher: Teresa Stanley

Teresa Stanley is completing a PhD at the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy and is Business Manager at WaterSafe Auckland.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. As members of the general public, your workforce is invited to participate in this questionnaire, and I am requesting your assistance in passing on this invitation to your staff in order to complete this.

This study involves self-completion of a written questionnaire. It should take no longer than fifteen minutes to complete. Participation is voluntary. I seek assurance that participation, or non-participation, will not affect the employment status of the participants.

Data will be stored in a locked cupboard for six years at the University of Auckland, after which it will be destroyed in a secure environment at the University of Auckland.

The questionnaire is anonymous, and confidentiality of responses is guaranteed. I also request that you place a drop box in your workplace for the secure collection of completed returns.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. You will be provided with a summary of findings.

Contact Details

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz, Phone 306 0809

Supervisor: Dr Kevin Moran, k.moran@auckland.ac.nz , Phone 623 8899 extn 48620

HOD: Professor Judy Parr, jm.parr@auckland.ac.nz , Phone 623 8899 extn 88998.

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-

7599 extn. 87830/83761. Email: humanethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS

COMMITTEE ON 10 September 2013 for 3 years, Reference Number 10065

Appendix M Study Two – Organisation Consent Form

Faculty of Education

Curriculum and Pedagogy

74 Epsom Avenue, Epsom
Auckland 1023, New Zealand

Phone: +64 9 623 8899

The University of Auckland

Private Bag 92019

Auckland, New Zealand

ORGANISATION CONSENT FORM

Manager / CEO

Organisation

Address

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project Title: Water safety and drowning prevention

Researcher: Teresa Stanley

I have read the Participant Information Sheet, have understood the nature of the research and why my organisation has been selected. I have had the opportunity to ask questions and have them answered to my satisfaction.

☐ I agree to support participation in this research.

☐ I agree to place a drop box in my workplace for the secure collection of completed returns.

☐ As a Manager or CEO, I give assurance that participation, or non-participation, will not affect the employment status of participants. Participants have the right to withdraw from participation at any time, although once submitted surveys are unable to be withdrawn. The questionnaire is anonymous, and confidentiality is guaranteed.

☐ I understand that I will receive a summary of findings for distribution to my staff.

☐ I understand that data will be kept for 6 years, after which they will be destroyed in a secure environment at the University of Auckland.

Name _____

Signature ____

Date _____

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 10 September 2013 FOR 3 YEARS REFERENCE NUMBER 10065

Appendix N Study Two – Participant Information Sheet

Faculty of Education

Curriculum and Pedagogy

74 Epsom Avenue, Epsom
Auckland 1023, New Zealand

Phone: +64 9 623 8899

The University of Auckland

Private Bag 92019

Auckland, New Zealand

PARTICIPANT INFORMATION SHEET

Project title: Water safety and drowning prevention.

Name of Researcher: Teresa Stanley

Teresa Stanley is completing a PhD at the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy and is Business Manager at WaterSafe Auckland.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. Members of the public are invited to participate in this questionnaire.

This study involves self-completion of a written questionnaire. It should take no longer than fifteen minutes to complete. Your participation is voluntary. Completion of the survey implies consent.

Please return surveys to the locked drop box supplied. Data will be stored in a locked cupboard for six years at the University of Auckland, after which it will be destroyed.

Your Manager or CEO has given assurance that participation, or non-participation, will not affect the employment status of participants. You have the right to withdraw from participation at any time, although once submitted surveys are unable to be withdrawn. The questionnaire is anonymous, and your confidentiality is guaranteed, you are requested not to write your name on the questionnaire.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. Your Manager or CEO will be provided with a Summary of Results.

Contact Details and Approval Wording

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz , Phone 306 0809

Supervisor: Dr Kevin Moran, k.moran@auckland.ac.nz , Phone 623 8899 extn 48620

HOD: Prof Judy Parr, jm.parr@auckland.ac.nz , Phone 623 8899 extn 488998 .

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 87830/83761. Email: humanethics@auckland.ac.nz.

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 10 September 2013 for 3 years, Reference Number 10065

Appendix O Study Two - Survey

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

WATER SAFETY SURVEY

Completion of this questionnaire implies consent. Assurances in regard to anonymity and confidentiality are guaranteed.To ensure confidentiality, please do not write your name on this form.

This questionnaire is designed to gather information about your swimming safety. Please do not take too long over each question – normally your first answer is the best. If you have any queries please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. How would you best describe yourself?

☐ European New Zealander ☐ Māori ☐ Chinese ☐ Korean ☐ Indian ☐ Pasifika

☐ Other (please state)_____

2. Are you? ☐ Male ☐ Female

3. How old are you?
   ☐ 15-19 years ☐ 20-29 years ☐ 30-44 years ☐ 45-64 years ☐ 65+ years

4. How long have you lived in New Zealand?

☐ Less than 1 year ☐ 1-4 years ☐ 5-9 years ☐ More than 10 years ☐ All my life

5. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

6. How far can you swim non-stop? (25 metres = 1 length of pool) _____

7. How long ago did you swim this distance in a pool?
   ☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years

8. Do you think you could swim this distance in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

9. How often do you swim in open water (beach, lake or waterhole) during the summer months?

☐ Daily ☐ Weekly ☐ About once a month ☐ Less than once a month ☐ Never

10. Have you ever experienced a life-threatening incident when swimming in **open** water? ☐ Yes ☐ No

If **Yes**, what effect did it have?

☐ I am now too afraid to take part in any water activity

☐ I can take part but I am very cautious

☐ Not affected, I take part confidently in water activities

11. Could you rescue someone in difficulty in open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

12. What do you think about the following statements?	**Agree**	**Disagree**	**Unsure**
m) My swimming ability will keep me safe when swimming in open water	☐	☐	☐
n) Others are at greater risk than me when swimming in open water	☐	☐	☐
o) My current swimming fitness will ensure my safety in open water	☐	☐	☐
p) My swimming ability means I don't need to wear a lifejacket in a boat	☐	☐	☐
q) The risk of drowning is always in the back of my mind when swimming in open water	☐	☐	☐
r) I often feel at risk swimming when conditions are rough	☐	☐	☐

13. How do you feel about:	**Confident**	**Anxious**	**Unsure**
Swimming in open water out of my depth	☐	☐	☐
Swimming in rough water	☐	☐	☐
Swimming on my back in open water	☐	☐	☐
Swimming underwater in murky water	☐	☐	☐
Swimming in cold open water	☐	☐	☐
Swimming without lifeguard supervision at a beach	☐	☐	☐
Swimming in waves	☐	☐	☐
Floating on my back in deep open water	☐	☐	☐
Floating in deep open water without using a lifejacket	☐	☐	☐
Going to help someone else in open water	☐	☐	☐

14. Rate the risk to your life in the following:

	Extreme Risk	High Risk	Slight Risk	No Risk
Tipped upside down in a canoe 100 metres from the shore of a lake	☐	☐	☐	☐
Caught in a rip current at a surf beach	☐	☐	☐	☐
Chased inflatable toy into deep water at a local swimming pool	☐	☐	☐	☐
Fell into deep water fully clothed while walking along a riverbank	☐	☐	☐	☐
Swept off isolated rocks by a wave while fishing	☐	☐	☐	☐

Thank you for your time

Appendix P Study Three – Organisation Information Sheet

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date

Name of Addressee

Manager / CEO

Organisation

Mailing address

City

New Zealand

Epsom Campus

Gate 3, 74 Epsom Ave

Auckland, New Zealand

T +64 9 623 8899

W education.auckland.ac.nz

The University of Auckland

Private Bag 92601

Symonds Street

Auckland 1135

New Zealand

ORGANISATION INFORMATION SHEET

Project title: Real and perceived water competencies and risk of drowning among older adults

Name of Researcher: Teresa Stanley

My name is Teresa Stanley and I am a student in a doctoral degree programme in the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy. I also work in Research & Development at Drowning Prevention Auckland. My supervisor is Dr Alan Ovens.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. As members of the general public, your older

customers are invited to participate in this research, and I am requesting your assistance in allowing us to request their participation.

This study involves an anonymous oral survey, responses will be entered into a tablet. This should take no longer than 5-10 minutes. Participants will be given the opportunity to enter into a draw to win a $1000 voucher from Mitre10. Participants may be invited to participate in a follow-up pool session and post-course survey.

Completion of the survey implies consent. The questionnaire is confidential, any collation of names will be kept separately to the survey. Participation is voluntary, and participants have a right to withdraw at any time.

If you agree to your organisation participating in this research, you have assurance that participation, or non-participation, will not affect your customers.

Data will be stored in a locked cupboard with no identifying records for six years at the University of Auckland by the Supervisor, after which it will be destroyed in a secure environment. Electronic data will be stored on a password protected University of Auckland computer, backed up by a server for six years before being deleted.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal. You will be provided with a summary of findings.

If you agree to participating in this research could you please complete the Organisational Consent Form, and return it to the researcher, Teresa Stanley, at the email contact below.

Contact Details

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz, Phone 09 306 0809

Supervisor: Dr Alan Ovens, a.ovens@auckland.ac.nz , Phone 09 623 8899 extn 48620

HOS: Professor Helen Hedges, h.hedges@auckland.ac.nz , Phone 09 373 7999 extn 48606.

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 23 November 2018 for 3 years, Reference Number 016725.

Appendix Q Study Three - Organisation Consent Form

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date	**Epsom Campus**
	Gate 3, 74 Epsom Ave
Name of Addressee	Auckland, New Zealand
Manager / CEO	**T** +64 9 623 8899
Organisation	**W** education.auckland.ac.nz
Mailing address	**The University of Auckland**
City	Private Bag 92601
New Zealand	Symonds Street
	Auckland 1135
	New Zealand

ORGANISATION CONSENT FORM

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project Title: Real and perceived water competencies and risk of drowning among older adults

Researcher: Teresa Stanley

I have read the Participant Information Sheet, have understood the nature of the research and why my organisation has been selected. I have had the opportunity to ask questions and have them answered to my satisfaction.

☐ I agree to support participation in this research.

☐ As a Manager or CEO, I give assurance that participation, or non-participation, will not affect my customers. Participants have the right to withdraw from participation at any time. The questionnaire is confidential, and confidentiality is guaranteed.

☐ I understand that I will receive a summary of findings.

☐ I understand that data will be kept for 6 years, after which electronic records will be deleted and paper data destroyed in a secure environment at the University of Auckland.

Name _____

Signature ___

Date _____

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 23 November 2018 FOR 3 YEARS. REFERENCE NUMBER 016725.

Appendix R Study Three – Participant Information Sheet

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Date	**Epsom Campus**
	Gate 3, 74 Epsom Ave
Name of Addressee	Auckland, New Zealand
Manager / CEO	**T** +64 9 623 8899
Organisation	**W** education.auckland.ac.nz
Mailing address	**The University of Auckland**
City	Private Bag 92601
New Zealand	Symonds Street
	Auckland 1135
	New Zealand

PARTICIPANT INFORMATION SHEET

Project title: Perceptions of water competencies, risks and aquatic activities among older adults

Name of Researcher: Teresa Stanley

My name is Teresa Stanley and I am a student in a doctoral degree programme in the University of Auckland in the Faculty of Education, School of Curriculum and Pedagogy. I also work in Research & Development at Drowning Prevention Auckland. My supervisor is Dr Alan Ovens.

This study aims to provide information on public perception of swimming competency to assist in directing drowning prevention education. As members of the general public, your older customers are invited to participate in this research, and I am requesting your assistance in allowing us to request their participation.

This study involves an anonymous oral survey, responses will be entered into a tablet. This should take no longer than 5-10 minutes. Participants will be given the opportunity to enter into a draw to win a $1000 voucher from Mitre10. Participants may be invited to participate in a follow-up pool session and post-course survey.

Completion of the survey implies consent. The questionnaire is confidential, any collation of names will be kept separately to the survey. Participation is voluntary, and participants have a right to withdraw at any time. **The identity of the participant will be treated as confidential data.**

Data will be stored in a locked cupboard with no identifying records for six years at the University of Auckland by the Supervisor, after which it will be destroyed in a secure environment. Electronic data will be stored on a password protected University of Auckland computer, backed up by a server for six years before being deleted.

All data will be aggregated, analysed using standard quantitative data analysis and written up for publication in an appropriate journal.

Contact Details

Researcher: Teresa Stanley, t.stanley@auckland.ac.nz, Phone 09 306 0809

Supervisor: Dr Alan Ovens, a.ovens@auckland.ac.nz , Phone 09 623 8899 extn 48620

HOS: Professor Helen Hedges, h.hedges@auckland.ac.nz , Phone 09 373 7999 extn 48606.

For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Research Office, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 extn. 83711. Email: ro-ethics@auckland.ac.nz

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 23 November 2018 for 3 years, Reference Number 016725.

Appendix S Study Three - Survey

EDUCATION AND SOCIAL WORK

Drowning Prevention Auckland

WATER SAFETY SURVEY

The identity of the participant will be treated as confidential data.

This questionnaire is designed to gather information about your swimming competency and water safety. Some of the questions ask for your views and feelings about water safety. Please do not take too long over each question – normally your first answer is the best. If you have any queries, please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. How would you best describe yourself?

☐ European New Zealander ☐ Māori ☐ Pasifika ☐ Chinese ☐ Korean ☐ Indian

☐ Other (please state)_____

2. Are you? ☐ Male ☐ Female

3. How old are you?
   ☐ 20-44 years ☐ 45-64 years ☐ 65+ years

4. How long have you lived in New Zealand?

☐ Less than 1 year ☐ 1-4 years ☐ 5-9 years ☐ More than 10 years ☐ All my life

5. Are you ☐ employed (part or full time)

   ☐ unemployed

   ☐ retired

6. Have you taken part in any recreation in and around water in the past year? ☐ Yes ☐ No

If Yes, what? ☐ Swimming in a pool

☐ Swimming in open water

☐ Surfing, SUPing, Paddling

☐ Boating

☐ Fishing

☐ Other _____

7. How often do you participate in recreation around water in the summer months?

☐ Never ☐ Monthly ☐ Weekly, or 2-3 times per month ☐ Daily or 4 or more times per week

8. Has it increased in recent times? ☐ Yes ☐ No

If yes, why? _____

9. How often do you wear a lifejacket when boating, fishing or paddling?

☐ Always ☐ Usually ☐ Sometimes ☐ Never

10. Do you have a medical condition that limits your participation in aquatic activity? ☐ Yes ☐ No

11. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how long could you swim for non-stop? ☐ Less than 1 minute

☐ Less than 5 minutes ☐ Less than 15 minutes ☐ Less than 1 hour ☐ More than 1 hour

If **Yes**, how far can you swim non-stop in 5 minutes? (25 metres = 1 length of pool) _____

12. How long ago did you swim this distance in a pool?
☐ Last month ☐ Last 6 months ☐ Last year ☐ More than a year ago

13. Do you swim for fitness?

☐ Never ☐ Occasionally (about 1/month) ☐ Often (1/ week) ☐ Very often (more than 1/ week)

14. Do you think you could swim this distance in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

15. How often do you swim in open water (beach, lake or waterhole) during the summer months?

☐ Daily ☐ Weekly ☐ About once a month ☐ Less than once a month ☐ Never

16. Can you float without moving and without flotation aids? ☐ Yes ☐ No

If **Yes**, how well would you say you can float? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how long could you float? ☐ Less than 1 minute ☐ Less than 5 minutes

☐ Less than 15 minutes ☐ Less than 1 hour ☐ More than 1 hour

17. Do you think you could float this long in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

18. What do you think about the following statements? **Agree** **Disagree**

s)	My swimming competence will keep me safe when swimming in open water	☐	☐
t)	Others are at greater risk than me when swimming in open water	☐	☐
u)	My current swimming fitness will ensure my safety in open water	☐	☐
v)	My swimming competence means I don't need to wear a lifejacket in a boat	☐	☐
w)	The risk of drowning is always in the back of my mind when swimming in open water	☐	☐
x)	My swimming competence means that I am capable of rescuing others in open water	☐	☐
y)	I often feel at risk swimming when conditions are rough	☐	☐

19. Rate the risk to your life in the following situations:	**Extreme Risk**	**High Risk**	**Slight Risk**	**No Risk**
Engine failure in a dinghy 100 metres from the shore	☐	☐	☐	☐
Caught in a rip current at a surf beach	☐	☐	☐	☐
Assisting a person in trouble in deep water of a swimming pool	☐	☐	☐	☐
Fell into deep water fully clothed while walking along a river bank	☐	☐	☐	☐
Swept off isolated rocks by a wave while fishing	☐	☐	☐	☐

20. How confident do you feel about your safety in open water?

☐ Very Anxious ☐ Anxious ☐ Confident ☐ Very confident

21. Do you have any further comments? _____

Thank you for your time. Please return the completed form to the researcher.

Appendix T Study Four - Pre-course Survey

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

EDUCATION AND SOCIAL WORK

Name: **WATER SAFETY SURVEY – Pre-course**

The identity of the participant will be treated as confidential data.

This questionnaire is designed to gather information about your swimming competency and water safety. Some of the questions ask for your views and feelings about water safety. Please do not take too long over each question – normally your first answer is the best. If you have any queries, please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. How would you best describe yourself?

☐ European New Zealander ☐ Māori ☐ Pasifika ☐ Chinese ☐ Korean ☐ Indian

☐ Other (please state)_____

2. Are you? ☐ Male ☐ Female

3. How old are you?
   ☐ 16-19 years ☐ 20-29 years ☐ 30-44 years ☐ 45-64 years ☐ 65+ years

4. How long have you lived in New Zealand?

☐ Less than 1 year ☐ 1-4 years ☐ 5-9 years ☐ More than 10 years ☐ All my life

5. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how long could you swim for non-stop? ☐ Less than 1 minute

☐ Less than 5 minutes ☐ Less than 15 minutes ☐ Less than 1 hour ☐ More than 1 hour

If **Yes**, how far can you swim non-stop in 5 minutes? (25 metres = 1 length of pool) _____

6. How long ago did you swim this distance in a pool?
   ☐ Last month ☐ Last year ☐ Last 5 years ☐ Last 10 years

7. Do you think you could swim this distance in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

8. How often do you swim in open water (beach, lake or waterhole) during the summer months?

☐ Daily ☐ Weekly ☐ About once a month ☐ Less than once a month ☐ Never

9. Can you float without moving and without flotation aids? ☐ Yes ☐ No

If **Yes**, how well would you say you can float? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how long could you float? ☐ Less than 1 minute ☐ Less than 5 minutes

☐ Less than 15 minutes ☐ Less than 1 hour ☐ More than 1 hour

10. Do you think you could float this long in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

11. What do you think about the following statements?	**Agree**	**Disagree**	**Unsure**
a) My swimming competence will keep me safe when swimming in open water	☐	☐	☐
b) Others are at greater risk than me when swimming in open water	☐	☐	☐
c) My current swimming fitness will ensure my safety in open water	☐	☐	☐
d) My swimming competence means I don't need to wear a lifejacket in a boat	☐	☐	☐
e) The risk of drowning is always in the back of my mind when swimming in open water	☐	☐	☐
f) My swimming competence means that I am capable of rescuing others in open water	☐	☐	☐
g) I often feel at risk swimming when conditions are rough	☐	☐	☐

12. Rate the risk to your life in the following situations:	**Extreme Risk**	**High Risk**	**Slight Risk**	**No Risk**
Tipped upside down in a canoe 100 metres from the shore of a lake	☐	☐	☐	☐
Caught in a rip current at a surf beach	☐	☐	☐	☐
Chased inflatable toy into deep water at a local swimming pool	☐	☐	☐	☐
Fell into deep water fully clothed while walking along a riverbank	☐	☐	☐	☐
Swept off isolated rocks by a wave while fishing	☐	☐	☐	☐

13. **Using Borg's Rate of Perceived Exertion (RPE) scale, use the following estimates from 6-20, with 6 = the easiest and 20 = most difficult to describe the exertion required for you to complete the competencies in the following situations (eg swim 25m fast in a pool = 6, float 5 minutes in open water = 12, etc)**

	6 or less	**7-8**	**9-10**	**11-12**	**13-14**	**15-16**	**17-18**	**19-20**
Deep-water entry in a pool								
Deep-water entry in open water								
Deep-water exit in a pool								
Deep-water exit in open water								
Swim 25m fast in a pool								
Swim 25m fast in open water								
Float for 5 minutes in a pool								
Float for 5 minutes in open water								
Swim for 5 minutes non-stop in a pool								
Swim for 5 minutes non-stop in open water								

14. Name one type of way to help someone in the water without getting in the water yourself:

_____

15. Name one survival position (if you don't know the name, describe it)

_____

Medical History

16. Please state any medical conditions below that may impact your ability to participate in the practical components of the course:

_____

17. Please list medication for conditions

- _____

Thank you for your time. Please return the completed form to the course provider or your manager.

Appendix U Study Four - Post-course Survey

EDUCATION AND SOCIAL WORK

Name: **WATER SAFETY SURVEY – Workplace Post-course**

Your identity will be treated as confidential.

This questionnaire is designed to gather information about your swimming competency and water safety. Some of the questions ask for your views and feelings about water safety. Please do not take too long over each question – normally your first answer is the best. If you have any queries, please ask the researcher who will be happy to assist you. Many thanks for your assistance.

1. Can you swim? ☐ Yes ☐ No

If **Yes**, how well would you now say you can swim? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how long can you swim for non-stop? ☐ Less than 1 minute

☐ Less than 5 minutes ☐ Less than 15 minutes ☐ Less than 1 hour ☐ More than 1 hour

If **Yes**, how far can you swim non-stop in 5 minutes? (25 metres = 1 length of pool) _____

2. Can you swim this distance in clothes? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

3. Can you swim this distance in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

4. Can you float without moving and without flotation aids? ☐ Yes ☐ No

If **Yes**, how well would you now say you can float? ☐ Poor ☐ Fair ☐ Good ☐ Very Good

If **Yes**, how long could you float? ☐ Less than 1 minute ☐ Less than 5 minutes

☐ Less than 15 minutes ☐ Less than 1 hour ☐ More than 1 hour

5. Can you float this long in deep, open water? ☐ Yes ☐ No

If **Yes**, ☐ Very Easily ☐ Easily ☐ With difficulty ☐ With great difficulty

6. What do you think about the following statements?	Agree	Disagree	Unsure
a) My swimming competence will keep me safe when swimming in open water	☐	☐	☐
b) Others are at greater risk than me when swimming in open water	☐	☐	☐
c) My current swimming fitness will ensure my safety in open water	☐	☐	☐
d) My swimming competence means I don't need to wear a lifejacket in a boat	☐	☐	☐
e) The risk of drowning is always in the back of my mind when swimming in open water	☐	☐	☐
f) My swimming competence means that I am capable of rescuing others in open water	☐	☐	☐
g) I often feel at risk swimming when conditions are rough	☐	☐	☐

7. Rate the risk to your life in the following situations:	Extreme Risk	High Risk	Slight Risk	No Risk
Tipped upside down in a canoe 100 metres from the shore of a lake	☐	☐	☐	☐
Caught in a rip current at a surf beach	☐	☐	☐	☐
Chased inflatable toy into deep water at a local swimming pool	☐	☐	☐	☐
Fell into deep water fully clothed while walking along a riverbank	☐	☐	☐	☐
Swept off isolated rocks by a wave while fishing	☐	☐	☐	☐

8. **Using Borg's Rate of Perceived Exertion (RPE) scale, use the following estimates from 6-20, with 6 = the easiest and 20 = most difficult to describe the exertion required for you when you completed the competencies in the following situations (eg swim 25m fast in a pool = 6, float 5 minutes in open water = 12, etc)**

	6 or less	7-8	9-10	11-12	13-14	15-16	17-18	19-20
Deep-water entry in a pool								
Deep-water entry in open water								
Deep-water exit in a pool								
Deep-water exit in open water								
Swim 25m fast in a pool								
Swim 25m fast in open water								

Float for 5 minutes in a pool								
Float for 5 minutes in open water								
Swim for 5 minutes non-stop in a pool								
Swim for 5 minutes non-stop in open water								

9. Please comment on your expectations and experience of completing the activities in the pool.

_____

10. Please comment on your expectations and experience of completing the activities in the open water.

_____

11. Name one type of way to help someone in the water without getting in the water yourself:

_____

12. Name one survival position (if you don't know the name, describe it)

_____

13. What further support would be useful for you?

_____

14. How satisfied are you with our delivery after completing the programme?

☐ Very satisfied ☐ Fairly satisfied ☐ Not at all satisfied

15. Any other questions or comments?

_____

_____

_____

Thank you for your time. Please return the completed form to the course provider.

Appendix V Study Four – Practical Testing Criteria

Practical Testing Criteria	
Competence	**Attainment Level**
Deep-water entry pool	From approximately 1 metre: 1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)
Deep-water exit pool	1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)
Swim 25m fast pool	Time swum non-stop for 25m with no stroke or speed specified (time achieved assessed on a 3-point scale) 1 < 29 seconds, 2 30-60 seconds, 3 > 1 minute
Float for 5 minutes pool	Stationary floating in deep water with minimal swimming motion (4-point scale) 1 < 15 sec; 2 = 15 sec - 1 min; 3 = 1 - 5 min; 4 > 5 mins
Swim 5 minutes pool	Distance swum non-stop in 5 min with no stroke or speed specified (distance achieved assessed on a 4-point scale) 1 < 25m; 2 = 26-100m; 3 = 101-200m; 4 > 200m
Deep-water entry open water	From approximately 1 metre 1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)
Deep-water exit open water	1 = did not complete, 2 = completed with poor form (great difficulty, difficulty), 3 = with good form (easily), and 4 = with excellent form (very easily)
Swim 25m fast open water	Time swum non-stop for 25m with no stroke or speed specified (time achieved assessed on a 3-point scale) 1 < 29 seconds, 2 30-60 seconds, 3 > 1 minute
Float for 5 minutes open water	Stationary floating in deep water with minimal swimming motion (4-point scale) 1 < 15 sec; 2 = 15 sec - 1 min; 3 = 1 - 5 min; 4 > 5 mins
Swim 5 minutes open water	Distance swum non-stop in 5 min with no stroke or speed specified (distance achieved assessed on a 4-point scale) 1 < 25m; 2 = 26-100m; 3 = 101-200m; 4 > 200m

Appendix W Permission to Include Published Works

From: Stephen John Langendorfer <slangen@bgsu.edu>
Sent: Tuesday, 10 November 2020 4:31 pm
To: Teresa Stanley <Teresa.Stanley@dpanz.org.nz>
Subject: RE: [EXTERNAL] Permission to include in thesis

Hello, Teresa!

Since you and Kevin hold the copyright to your articles in IJARE, you don't need my permission. Since we moved to bepress Scholarworks and are open access, you own your own articles. If Uni Auckland needs a note from me to that effect, let me know.

By the way, congrats on the dissertation! Hurray!

Steve

-------- Original message --------
From: Teresa Stanley <Teresa.Stanley@dpanz.org.nz>

Date: 11/9/20 9:55 PM (GMT-05:00)

To: Stephen John Langendorfer <slangen@bgsu.edu>

Subject: [EXTERNAL] Permission to include in thesis

Hello Steve

I'm hoping to submit my thesis by way of publication next month at the University of Auckland. Can you please provide consent for me to include the two articles below in my thesis?

Stanley, T., & Moran, K. (2017). Parental perceptions of water competence and drowning risk for themselves and their children in an open water environment. *International Journal of Aquatic Research and Education 10*(1), 4. http://scholarworks.bgsu.edu/ijare/vol10/iss1/4

Stanley, T., & Moran, K. (in press). Perceptions of water competencies, drowning risk and aquatic participation among older adults. *International Journal of Aquatic Research and Education.*

Do you have any stipulations in terms of branding and formatting?

Many thanks

Teresa

Teresa Stanley | Research and Development

Drowning Prevention Auckland

-----Original Message-----
From: Executive Editor, ARIPD Journals <editor@aripd.org>
Sent: Wednesday, 11 November 2020 9:19 pm
To: Teresa Stanley <Teresa.Stanley@dpanz.org.nz>
Subject: Re: Permission to include published article in thesis.

Okay. Not a problem.

Editor

On 11/9/20, Teresa Stanley <Teresa.Stanley@dpanz.org.nz> wrote:
> Hello
> I am submitting my PhD thesis next month at the University of
> Auckland, by way of publication.
>
> Could you please provide consent for me to include the article
> published in your journal (referenced below) in my thesis?
>
> Stanley, T., & Moran, K. (2018). Self-estimates of swimming and rescue
> competence, and the perceptions of the risk of drowning among minority
> groups in New Zealand - lifesaving or life threatening? Journal of
> Education and Human Development, 7(1), 82-91.
> http://jehdnet.com/journals/jehd/Vol_7_No_1_March_2018/10.pdf
>
> Could you please let me know of any formatting or branding
> stipulations you may have.
>
> Kind regards
> Teresa Stanley
>
> Teresa Stanley | Research and Development
Drowning Prevention Auckland

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