What health changes occur in Māori males after retirement from playing rugby league?
He aha ngā huringa hauora e puta ana i roto i ngā tāne Māori i muri i te reti mai i te tākaro i te rīki whutupāoro?

A thesis submitted to Massey University
in fulfilment of the degree of
Doctor of Philosophy

At Massey University, Wellington, New Zealand

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2018

Attestation of Authorship - Whakamanatanga o Kaituhitanga

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any degree or diploma of a university or other institution of higher learning, except where due acknowledgements are made.

………………………….

Trevor Tuwhakaea Clark

3rd August 2018

ABSTRACT

Māori male participation in rugby league is prolific at all levels in New Zealand; however rugby league has a high incidence of injury. The demands of the sport require players to be athletically fit, strong, and healthy during their playing careers. But does any health advantage remain once retired from participation?

This exploratory study is the first health study of Māori men who have retired from playing competitive rugby league in New Zealand. It uses mixed-methods within a Māori-centered approach producing research led by Māori that involves Māori, and is intended for the benefit of Māori. The mixed method approach creates both quantitative and qualitative data and evidence.

This study researched four groups of ex-players at increasing levels of engagement. One hundred and fifty-four Maori men were involved in the initial survey assessment. This survey was followed by a detailed analysis of 25 players who were assessed on multiple measures of health and physiology. This process was repeated 18 months later with 15 returning respondents and elaborated on (A) Physical well-being post-play; (B) Injuries experienced during play (through a retrospective analysis); (C) Self-assessed well-being; and (D) Change over time for a small group. Lastly 10 players took part in 'kanohi ki te kanohi' (face to face) interviews so the players could tell their own stories and their experience of the research in more detail.

As an exploratory study, this research sought to define the factors that contribute to the health status of Māori men who have retired from playing rugby league. The research

tested the use of mixed methods to generate quantitative data from physical and physiological testing, results from self-reported health factors, such as rates of smoking and bodily pain, and the qualitative information about the men's experiences in retirement and of the research experiences from semi structured interviews held kanohi ki te kanohi.

Four key findings come from the study;

1) The health disadvantage for Māori males is also seen in retired Rugby league players, in particular weight gain, pain;

2) Positive changes in repeated measures provide encouraging evidence;

3) Telling personal stories contributed significantly to the research by providing insight into the thinking and experiences of the participants -Whānau (family) was a strong feature in the stories from these men. Most importantly it confirms there is strong potential for intervention to improve and maintain health status for retiring and retired Māori rugby league players, and;

4) The presence of a Māori researcher can positively influence engagement with Māori-centered research.

Results yielded evidence of a positive reduction in body weight, improved cardiovascular fitness and increased motivation in some players simply through their participation in this research, possibly through the Hawthorne or observer effect.

This research explored a previously under-researched area and provided insight into Māori male health. It informs an on-going agenda of health related, rugby research by providing a needed Māori voice and evidence.

Preface - Kupu Whakataki

He piko he taniwha he piko he taniwha Waikato Taniwharau

Waikato (river) of a hundred chiefs at every bend a chief, at every turn a chief

Ko Waikato tōku awa (My river is the Waikato)

Ko Maungatautari tōku maunga (My mountain is Maungatautari)

Ko Waikato-Tainui tōku iwi (I am Waikato-Tainui)

Ko Ngāti Korokī-Kahukura tōku hapū (I also descended from Ngāti Korokī-Kahukura)

Ko Trevor Tuwhakaea Clark taku ingoa (My name is Trevor Tuwhakaea Clark)

Tēna koutou tēna koutou tēna ra koutou katoa (Thank you all)

Whakapapa (my ancestral connection)

The essence of the famous Waikato whakataukī (proverb) serves to highlight the significance of the Waikato River and the strength of my people that live and work along its foreshore (from Taupō to Port Waikato – 425km). There are many chiefs (100) positioned along its pathway, so if you chose to travel along its path be respectful, or be prepared for challenges around every bend. The pull of the river (Waikato) always provided new challenges for me and this applied to everything I learnt throughout my life. There have been many challenges on the sports fields with every bend in the river (injury) requiring me to re-assess my physical effort in training. There have also been just as many off-field challenges (the loss of family) which have caused great sadness, but ultimately new strength and determination. I am proudly Waikato-Tainui and I know the strength and mana (pride) of my people have nurtured me on my journey from the Waikato to far-away places around the world. This thesis is my legacy, for my whānau (family), my iwi (tribal affiliation Waikato-Tainui) my hapū (tribal affiliation-Ngāti Korokī-Kahukura) and many friends from all over the world. It contributes new

knowledge to Māori health research and adds to a greater body of work surrounding the global health rugby codes study.

My Journey

I grew up in Hamilton and spent the first 21 years of my life there. I still call it my home and always will. I started playing rugby league at a relatively late age (16) unfortunately this coincided with one of the most devastating episodes in my life, with the loss of my father at the age of 42 from a heart attack. He only got to see me play a few times during that year but I know from talking to family and friends he was proud of what I had achieved in such a short time playing the game. From that moment onward I chose to dedicate my life to the sport in his memory. The loss of my dad is what drove me as I made my way through club (Melville) and representative (Hamilton) teams to eventually be adjudged the best and fairest player in the district aged 19.

One of the most important periods of my rugby league career came in 1983 when I was selected to play for the New Zealand Māori rugby league team. It was significant at the time as the team toured the United Kingdom later that year. During the tour (after my first game) I was asked by the Leeds Rugby League Chairman (Mr Joe Wareham) if I would be interested in turning professional and playing for Leeds RLFC. As you can imagine my world completely changed from that moment onwards.

The Aotearoa Māori Rugby League team (2nd row standing two in from the right) on the historic 1983 tour to the United Kingdom with the late Dame Te Atairangikaahu (Māori Queen and Patron of AMRL). We returned home undefeated in all 8 matches played on tour. It was the start of my professional career having signed to play for the Leeds Rugby League Club whilst I was on tour, alongside Dean Bell (Kiwi Test Wing).

My Sport

From personal experience of playing (Melville, Huntly South, Hamilton, Waikato, New Zealand Māori, Leeds, Featherstone, Bradford and Taniwharau) and coaching (Melville, Jaradites, Petone, Wellington, New Zealand Universities, Auckland Warriors, Windsor, Erina) rugby league for 30 years, including 12 years as a professional player in the United Kingdom, I'm now coping with the effects of repetitive collision and training injuries suffered during my career in the sport. This has had a detrimental impact on my

current physical activity and overall health status. I suffered from chronic osteoarthritis in both knees and found it very painful to run and descend stairs. The condition was so bad I recently underwent two total bi-lateral knee replacements due to the condition, and complete ruptures of both anterior and posterior cruciate ligaments in both knees.

During my coaching career I have been witness to a multitude of player injuries across many levels of engagement (amateur to professional) and many of these were recorded in published research I also participated in. These injury investigations are ongoing and much of our current research is centred on concussion in sports such as; rugby league, Australian Rules Football (AFL), and rugby union. There is a growing concern within the research and sports medicine community that concussion may lead to debilitating consequences of both physical and mental health simply from participating in these sports. Not only have I had to endure the pain of suffering my own injuries, I also agonised over my two son's injuries through playing rugby league.

My Whānau (My immediate family)

I have two sons who were both born in Pontefract, West Yorkshire, England. My oldest son Regan (born 03/02/1991) retired from playing competitive rugby league at the age of 18 after breaking numerous bones in his body whilst playing. He was a standout player during his junior years winning multiple 'player of the year' awards in both rugby league and athletics. He was a natural athlete during his playing career, blessed with speed and the ability to score at will. He still follows and loves the game but for now he chooses not to play.

My youngest son Mitch (born 30/03/1993) is following in my footsteps and plays full-time in England previously with Doncaster, Bradford and Hull Kingston Rovers; he recently signed a two year contract from 2018 with Castleford Tigers in the Super League. He also played in Sydney for the Penrith Panthers winning the Holden Cup Grand Final in 2013 beating the New Zealand Warriors. He has represented the New Zealand Junior Kiwi Rugby League Team in 2013. He has also suffered a number of injuries including a broken arm and dislocated ankle (both requiring surgery). These injuries resulted in many missed days of both training and playing. He plays as a prop forward, probably the toughest position to play in the team and relishes the collision and challenge of every game.

My Research

During my playing career in England I was fortunate enough to complete a Bachelor of Arts (Hons) and a Master of Science degree at Leeds Becketts University, majoring in exercise physiology and sport psychology. It was my interest and passion for sport and health that led to the development of this study. After all that has happened throughout my playing and coaching career and subsequently my own sons' careers I wondered if the same consequences had befallen other Māori players retired from a lifetime of playing rugby league. This exploratory research project was designed to support the implementation of mixed methods within a Māori-centered approach. My intention was to build a body of new evidence to provide future direction to support players, coaches and health professionals. It is intended that this project will add new knowledge to the field of Māori health research with specific reference to improving health outcomes for male Māori rugby league players who have retired from playing the sport.

Acknowledgements - Nga Mihi

I would like to thank my primary supervisor Professor Chris Cunningham for his patience and faith in me to fulfil one of my lifelong goals.

To Dr Doug King my secondary supervisor and lifetime friend and colleague who inspired and motivated me to become the person I am today. We've travelled many roads together and I look forward to many more.

I would also like to thank Dr Marg Wilkie for her support during the final push toward the try line. It proved invaluable during the examination process. Her Ngāti Porou and Ngāpuhi mana (pride) shone through and served as a constant reminder of the fight needed to succeed.

The New Zealand Health Research Council's financial and political support was immense during tough times during a very scary and sometime gut-wrenching journey, but one well-travelled by so many Māori PhD students who cannot see the roses let alone smell them. I have the deepest respect for the organisation and its leaders.

I'd also like to acknowledge the Tainui Māori Trust Board for their unwavering support. I am Waikato-Tainui which makes the significance of this project especially important.

E rite ahau ki te whakawhetai ki te Tainui Māori Trust Board mo to ratou tautoko, puta noa i toku haere PhD. Ko te he huarahi pakeke, engari te pai

utu te utu. Titiro atu ahau ki hoatu hoki ki taku iwi, Tainui, ki ngā ākonga i

te katoa i runga i te ao.

To my mum Rita who has been my most ardent supporter from day one, often heard shouting from the side-line (during my playing days) – "get off my son" (most often), you have always been a constant which I have treasured every day. To my brothers, sisters, aunties, uncles, cousins and friends it was your support that kept me going when I could have easily thrown in the towel (like that was ever an option for a Tuwhakaea Clark).

A special mention to my beautiful wife Christine who would keep asking me every day "have you worked on your PhD" this was motivation enough to make that commitment to complete the project….and keep her quiet. To my two son's Regan and Mitch, this is as much for you as it is for me. Another challenge to aspire to because all I want is for you both to be proud of me as I am of both of you. You are both my biggest and best achievements in life. To Hollie and Monique, thank you for sharing your lives, it makes your mum and me very happy and content as a family.

To all the players I have played with and coached you know the journey. It is a tough road to tread rugby league, it is never easy, no matter what the score. The thousands of tackles given and taken will never diminish the love for the game we all know so well. Lastly, but not least to all the participants involved in this study who became my rugby league whānau, thank you for being there and giving your time so willingly and unselfishly I will always treasure your contribution to this discovery.

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Chapter 1: Introduction to my Thesis - Whakataki ki taku Tuhinga

1.1 Introduction

This is the first exploratory study of the health of Māori men who have retired from playing competitive rugby league in New Zealand. While primarily concerned with answering the research question posed: 'What health changes occur in Māori males after retirement from playing rugby league? It also explores the feasibility and utility of undertaking such research with a cohort of Māori ex-players and it provides an indication of the type of results a fully powered intervention study might deliver.

An exploratory approach was chosen for two main reasons. First, the research sought to define the *problems* experienced by Māori rugby league players – post retirement – with an eye to identifying whether an intervention to *address these problems* might be possible in the future. Second, the research sought to explore the feasibility and utility of a Māori-centered approach which blends exercise science and Kaupapa Māori methods together to focus on a shared priority – improved Māori health.

While not randomised, or able to be generalised to a whole population of Māori rugby league players, this study explores and elaborates on the following areas of interest:

- The physical/physiological well-being of Māori rugby league players post-retirement;
- The injuries experienced by Māori players (through a retrospective analysis);
- Self-assessed well-being and;
- Prospective change of health status over time for a small group.

The motivation for this study was originally based on my own rugby league career. I had suffered a number of injuries during my playing days and my body was a lot worse for wear. I wondered if other retired male Māori players were in a similar state. My background in exercise physiology and sport performance is firmly based in scientific methodology, where scientists think inductively, deriving general conclusions from particular observations. Examples of my recent work in this discipline appear in the appendices (14-16), but I have deliberately sought to broaden my approach to add both a Māori and a respondent lens to the research agenda.

Exercise science is very different to both Māori-centered research (Durie, 1996; Cunningham, 1998, 2000) and Kaupapa Māori research (Smith, 2012) which may be subjective in nature and put Māori at the centre of the phenomenon of interest, and perceive phenomena from Māori perspectives (Smith, 2012). Māori-centered research is research where Māori are significant participants and the research team are all likely to be Māori, where Māori analysis is undertaken and produces Māori knowledge (Cunningham, 2000). I chose to include methods from each discipline to provide more holistic analyses of a sample of retired male Māori rugby league players. To my knowledge this is the first example of this approach in rugby-league research.

Importantly, my involvement as a Māori rugby league researcher has been a critical element ensuring engagement and participation contributing to the success of the project. The rationale behind the research is that very little is known about the health of retired rugby league players, and even less is known about retired Māori players. This research project has the potential to help shape training methods, and develop predictive indicators of value to players, coaches, clinicians, and sport administrators within rugby

league, as well as other researchers and members of the academy. The findings may also contribute to a strategy to promote long term health in retired Māori players.

The findings may help to describe the trajectory of retired players from active to inactive status and may prove crucial to support healthy ageing in Māori men. It is written from a Māori perspective utilising Māori methodology to provide a baseline of evidence to support the generation of future hypotheses for further testing.

The exploratory research was undertaken with five objectives in mind. These were:

(1) To undertake this study using a Māori-centered approach and including quantitative and qualitative methods drawn from exercise science and Kaupapa Māori;

(2) To explore and describe the health status of retired male Māori rugby league players across a defined timeframe

(3) To identify if there are *problems* for Māori once retired from competitive rugby league

(4) To determine whether an intervention *to address the problems* is possible, to assist retired Māori rugby league players to maintain or improve their health status;

(5) To provide evidence that contributes to the wider body of knowledge of Māori health linked to global health studies within the rugby codes and broader exercise science research.

As a Māori exercise physiologist who is researching at the interface of exercise science and Māori health research, this thesis is a journey to inform my future approach to addressing health issues which have both personal and population implications.

Concurrent with this thesis I have contributed to twelve peer reviewed and published papers from an exercise science perspective covering; training injuries in amateur rugby

league; reducing injury risks for rugby codes; measurement of head impacts in Australian Rules football using an instrument patch; concussion risks at amateur, semi-professional and professional levels of rugby league; head impacts at junior rugby league using wireless head impact sensors; head impact acceleration in junior rugby union players; head impact thresholds for reporting data in contact and collision sports; using the King-Devick test to screen sideline for concussions in junior rugby league; a pooled analysis of of published studies on the incidence of match and training injuries in rugby league; a review of player concussion history in amateur rugby league players; using a rapid visual screening tool for assessment of concussion; injuries over 3 years in amateur rerpesentative rugby league; the nature of impacts that result in injuries in professional rugby league; a retrospective review of the costs to rugby league of head, shoulder and soft tissue and fracture- dislocation injuries from 1999 to 2007; player positions and the nature of tackle-related injuries in professional rugby league matches; neck back and spine injuries in amateur rugby league from 9 years of ACC claims; first aid and concussive knowledge of rugby league team management; using video analysis of tackles in professional rugby league; changes in stress and recovery from premiere rugby league representation and; player perspectives on return to play after match or training injury in amateur rugby league.

My body of research is informed by my training in exercise science, my learning in Māori health and my expertise as a retired rugby league player. This thesis begins to realise the innovation which this intersection provides. Kia ora!

1.2 Thesis Structure

This thesis has two parts – Part 1 provides five chapters and a post-script. Part 2 provides an extensive set of appendices.

Chapter 1: Introduction.

This chapter sets out the research questions, rationale and the broad methodological approach. It also provides a historical overview of the setting for this research

Chapter 2: Approach and Methods.

This chapter describes the research approach and methods which have been applied. From a Māori-centered stance I have blended quantitative methods from exercise science and qualitative methods derived from the growing body of Kaupapa Māori research. This innovation changes my perspective from independent objective researcher to interdependent peer researcher, and the overall approach is exploratory partly to explore the feasibility, utility and responsiveness of this approach.

Chapter 3: Background and Literature. This chapter provides Aotearoa New Zealand context and a review of the international literature evidence of where health is situated in relation to the wider population within New Zealand including Māori health. It also provides Māori rugby league context including game demands, injuries and potential long-term consequences for players.

Chapter 4: Research Findings. Presentation of the research findings gathered from a sample of Māori men, who are retired Māori rugby league players, on various measures of health. It discusses the results of the findings under an increasing level of detail, with reference to mixed method, quantitative, qualitative and Māori methodological frameworks.

Chapter 5: Conclusions. This chapter concludes the study and provides brief recommendations for future research. The overarching theme has been one of discovery and potential. On the one hand, it provides a base of evidence to support current literature. Whilst on the other it offers the opportunity for new beginnings, by creating new pathways for health improvement for Māori men.

Post Script:

Four key areas were identified as a result of this research;

(1)   There is a health disadvantage for male Māori also seen in retired Rugby league players;

(2)   Positive changes in repeated measures are possible with intervention;

(3)   Telling of personal stories contributed significantly to the research by providing insight into the thinking and experiences of the participants, and;

(4)   The presence of a Māori researcher can positively influence engagement with Māori-centered research.

References:

An extensive list of 360 references are included to support this thesis

Appendices 1-16.

1.3 A Setting for the Research

No study of Māori health can be complete without acknowledging the impact of colonisation: the history, the journey, the impacts, the outcomes, and the future.

This chapter takes a brief look at the impact of British migration on life for Māori including loss of land and specific health consequences suffered by many Māori during those times. It includes reference to The Treaty of Waitangi and provides a context of

colonisation in Aotearoa New Zealand from a Māori perspective. It also provides a brief description of Māori rugby league and the relevant health impacts for Māori.

1.3.1 Historical Context

Māori had occupied New Zealand for hundreds of years before the early British settlers migrated during the latter part of the 19th century (Walker, 1990). These were turbulent times for Māori, having to adapt to a new way of life. Perhaps the most troubling for Māori health was the introduction of foreign illnesses that were common in Europe, such as measles, mumps and whooping cough, which took a terrible toll among Māori, who had no immunity to them. Māori population declined steeply over the subsequent period (100,000 in 1769 between 70,000 and 90,000 by 1840 and at its lowest point in 1896 it was around 42,000 (Pool, 2012).

1.3.2 The Treaty of Waitangi

The Treaty of Waitangi, New Zealand's founding document, takes its name from the place in the Bay of Islands where it was signed, on 6 February 1840 (Orange, 1987). The Treaty is an agreement, written in the Māori and English languages, that was made between the British Crown and about 40 Māori rangatira (chiefs). Eventually up to 500 rangatira signed the document, however the meaning of the English version was not exactly the same as the meaning of the Māori translation which led to contentious issues around ownership and governance (Orange, 2012). The Treaty's three articles are the cause of much debate and misunderstanding between the Crown and the core of Māori beliefs. It is this confusion which led to the many protest marches during the 1970's and

one notable land occupation at Bastion Point that lasted 506 days, by Māori who were standing up for the rights of those who had passed and the future generations to come.

Article One

Māori: chiefs gave the queen 'te kawanatanga katoa' – the governance or government over the land.

English: chiefs gave the queen 'all the rights and powers of sovereignty' over the land.

Article Two

Māori: confirmed and guaranteed the chiefs 'te tino rangatiratanga' – the exercise of chieftainship – over their lands, villages and 'taonga katoa' – all treasured things. Māori agreed to give the Crown a right to deal with them over land transactions.

English: confirmed and guaranteed to the chiefs 'exclusive and undisturbed possession of their lands and estates, forests, fisheries, and other properties'. The Crown sought an exclusive right to deal with Māori over land transactions.

Article Three

Māori: The Crown gave an assurance that Māori would have the queen's protection and all rights – 'tikanga' – accorded British subjects. This was close to an accurate translation of the English text.

It is the second and third articles that have caused controversy through the years, mainly because of translation problems (Colenso, 1890). Successive governments believed the

Treaty enabled complete sovereignty over Māori, their lands and resources. But Māori believed that they were merely giving permission for the British to use their land (Orange, 2012). The signing of the Treaty of Waitangi was the beginning of the first wave of colonisation (1840-49) for Māori (Colenso, 1890; Orange, 2012). This period is impacted by the land wars of the 1860s (Ausubel, 1977), alienation from tribal homelands, new laws and institutions (McCarthy, 1997), and a great loss of the Māori population (particularly rangatira - elders) from introduced diseases such as measles, mumps and whooping cough (Statistics New Zealand, 2004) and eventually an economic shift in the 1950s which left many Māori unemployed (van Meijl, 2002).

The importance of the Treaty of Waitangi within the context of this thesis lays in the potential for health inequities as well as conferment of health advantages for Māori. In New Zealand, Māori men portray some of the worst health profiles and often die significantly younger than non-Māori men (Statistics New Zealand, 2004).

1.4. Changing Times

The urbanisation period (1950s-70s) saw many Māori migrate from their rural homelands to urban areas for employment (van Meijl, 2002). In 1945, 25% of Māori lived in urban areas, however by the mid-1970s nearly 75% were urbanised (Statistics New Zealand, 2004). Psychologically, colonial beliefs about the superiority of the British worldview appeared to have become internalised leading many Māori to reject their culture and language (Ausubel, 1977; McCarthy, 1997). Nevertheless, as more Māori sought tertiary education in the 1970s-80s, a period of renaissance occurred. Attempts were made to hold the government responsible for breaches of the Treaty of Waitangi, Māori language pre-schools were developed (Kohanga Reo) and Te Reo

Māori became a national language (van Meijl, 2002). More recently, the 1990s was a period focusing on reducing the socio-economic disparities that existed between Māori and non-Māori and one of these contexts focussed on health (Blakely, Ajwani, Robson, Tobias, & Bonne, 2004).

Positive health has three linked dimensions – social, psychological and physical – which should all be included when measuring health (World Health Organisation, 1986). In New Zealand, Māori health outcomes are of prime importance, specifically with reference to inequalities that are still being observed today, centred on provision, accessibility, and cost (Reid & Robson, 2007). The impact of over 160 years of European colonisation has had a profound effect on Māori for many years (Abel, Park, Tipene-Leach, Finau, & Lennan, 2001). In conjunction with the alienation of land, language and culture, the traditional practices of Māori have either changed or been marginalised resulting in Māori being positioned in the lower socioeconomic strata of New Zealand society (Abel, et al., 2001). This colonisation adversely affected physical, social, emotional, and mental health and the wellbeing of traditional societies (Gracey & King, 2009).

1.4.1 Whānau Ora

'Whānau Ora' (Healthy Families) is a policy created in response to recognition that standard government ways of social, health and education delivery were not working and that outcomes for Māori whānau (family) were not improving. Whānau Ora was, and is, a Māori initiative coordinated through The Ministry of Māori Development - Te Puni Kōkiri with the use of social, health and education vote funding and controlled through three Whānau Ora Commissioning Agencies, with the Ministry of Health, Te

Puni Kōkiri and the Ministry of Social Development. Whānau Ora is an inclusive interagency approach to providing health and social services to build the capacity of all New Zealand families in need (Ministry of Health, 2014). Whānau Ora empowers whānau as a whole rather than focusing separately on individual members and their problems (Te Puni Kōkiri, 2013).

Resolving the poor health status of Māori has been identified as being one of the highest priorities of the Ministry of Health. The undesirable health and disability disparities of Māori compared to non-Māori falls short of the Treaty of Waitangi commitments (Waitangi Tribunal, 2001). The Treaty acknowledges that the wellbeing of Māori as the Tāngata Whenua (people of the land) or indigenous people of New Zealand, be protected alongside all New Zealand residents. In particular, Article 3 oritetanga (equity) guarantees that Māori share equally in the benefits of modern society including equal standards of health care, equality of access to health care, and a general equality of health outcomes. Social, cultural, economic, and political factors cannot be overlooked in terms of their contribution to the health status of this group (Waitangi Tribunal, 2001). However, the reality is somewhat different with Māori still suffering poorer health outcomes than non-Māori across many parts of society and good health is a fundamental right of all people in New Zealand.

1.5 Health Impact

According to the World Health Organisation the health of a nation is measured in a number of ways, including; life expectancy and mortality rates; causes of specific mortality and morbidity; communicable disease control; non-communicable disease (NCD); health service coverage; risk factors; health systems; health expenditure; health

inequities and demographic and socio-economic status. Efforts to compile health statistics – including for the WHO World Health Statistics series – have prompted reflection on how best to measure health as both an outcome and determinant of sustainable development. In order to monitor progress to ensure healthy lives and promote well-being for all at all ages, the WHO has considered several overarching indicators. These include "life expectancy"; "healthy life expectancy"; and "number of deaths before age 70"(World Health Statistics, 2017).

The Ottawa Charter for Health Promotion (World Health Organisation, 1986) provides a strategic framework to implement the health for all principles. It reads:

> Health is a positive concept emphasising social and personal resources, as well as physical capacities. Health promotion therefore, is not only the responsibility of the health sector, but goes beyond healthy life-styles to wellbeing (World Health Organisation, 1986 p. 1)

Great inequalities in socioeconomic position exist between Māori and non-Māori in New Zealand but they might not fully account for the health inequalities noted between the different ethnic groups (Ministry of Health, 2000; Reid, Robson, & Jones, 2000). Indeed, socioeconomic explanations alone are inadequate, since they do not take into account the factors that lead to marginalisation of Māori and unequal distribution of socioeconomic resources by ethnicity in the first place (Sporle, Pearce, & Davis, 2002).

1.5.1 Sport, Physical Activity and Health

The premise that sport and health are inextricably linked is not a new concept (Bize, Johnson, & Plotnikoff, 2007; Vella, Cliff, Magee, & Okely, 2014). Throughout much of the literature surrounding health benefits from sport participation there is strong evidence supporting the link with improved cardiovascular and musculoskeletal function (Ashworth, 2011; Brymer & Schmeitzer, 2013; Eime, Young, Harvey, Charity, & Payne, 2013). Since the seminal work of Morris et al in the 1950s and the early work of Paffenbarger et al in the 1970s there have been numerous long-term prospective follow-up studies that have assessed the relative risk of death from any cause and from specific diseases (e.g., cardiovascular disease) associated with physical inactivity (Blair, Cheng, & Holder, 2001; Lee, Hsieh, & Paffenbarger, 1995; Morris & Heady, 1953; Morris, Heady, Raffle, Roberts, & Parks, 1953; Paffenbarger, Brand, & Sholtz, 1978; Paffenbarger & Hale, 1975; Wannamethee, Shaper, & Walker, 1998). There is a clear link that physical activity is known to have an overall favourable influence on obesity and other biological CVD risk factors such as high-waist circumference, dyslipidaemia and hypertension (Blakely, Fawcett, Hunt, & Wilson, 2006).

Physical activity helps in preventing disease through weight control and improved functioning of the cardiovascular system (Corrao, Rubbiati, Bagnardi, Zambon, & Poikolainen, 2000). While there is evidence showing a benefit to late life mortality risk in very well trained athletes from other sports little is known about the late life mortality risk from playing rugby league (Kokkinos, Sheriff, & Kheirbek, 2011; Warburton, Nicol, & Bredin, 2006; Woodcock, Franco, Orsini, & Roberts, 2011). For instance, being fit or active is associated with a greater than 50% reduction in risk and an increase in physical fitness will reduce the risk of premature death (Erikssen, 2001; Myers,

Kaykha, & George, 2004). However, what is unknown is the relative risk from playing such a high intensity collision sport and what long-term effects these will have on life after sport.

Unfortunately, little is known about the health of retired Māori sports participants who have played rugby league. The rationale for the current study gives rise to the fundamental importance of Māori health and in particular with a focus on male experiences. The health outcomes will be viewed through a cultural lens to ascertain whether any positives are derived and sustained through playing rugby league once retired from active participation.

There is a need to reduce the onset and incidence of diseases such as coronary heart disease (CHD) and cerebrovascular disease (CVA) which still account for 40% of all mortality in New Zealand (Hay, 2002). When compared by ethnicity, Māori are disproportionately affected by chronic disease resulting in severe consequences and usually in early death (Statistics New Zealand, 2007). Yet many of these deaths are premature and preventable (Hay, 2002). Sharpe (2006) identified large and intolerable inequalities in cardiovascular risk, outcomes and access to medical services for Māori. Between 2000 and 2004 the mortality rate of ischaemic heart disease (IHD) of Māori males was three times higher than non-Māori (Barnett, Moon, & Kearns, 2004). These ethnic disparities in IHD have persisted over three decades despite large investment in technology, medical and surgical management and health promotion (Blakely, et al., 2004).

1.5.2 Health impact for Māori

For Māori, the impact of tobacco is significant (The Quit Group & Ministry of Health, 2006). For the period 2000-2004 lung cancer was responsible for nearly a third of Māori cancer deaths, compared with only 17 percent for non-Māori (Robson & Purdie, 2007). Māori death rates from CVD were two times higher than for non-Māori during the same period (Robson & Purdie, 2007). Deaths due to respiratory disease were three times more frequent in Māori than non-Māori (Salmond, Crampton, & Atkinson, 2007). Māori men have a particularly bad prognosis in terms of health and are reported to be the most vulnerable group in New Zealand for developing cardiac related diseases (Brown, et al., 2010). Māori men fare poorly in terms of health status experiencing a disproportionately high burden of disease when compared with other population groups in New Zealand (Jones, Crengle, & McCreanor, 2006). Cardiac related diseases remain the most prolific contributor to the adverse health profile of indigenous people both as a cause of mortality and as a contributor to the life expectancy gap between Māori and the non-Māori population (Statistics New Zealand, 2002).

Whilst all ethnicities in New Zealand co-exist in terms of opportunities available in education, employment, sport and health care, inequalities in health outcomes still exist and in New Zealand they are most pronounced between Māori and European populations (Blakely, et al., 2004; Joshy, Colonne, Dunn, Simmons, & Lawrenson, 2010; Statistics New Zealand, 2004). Māori adults have higher rates of most debilitating health conditions, with differences most notable for asthma, ischaemic heart disease, stroke and diabetes (Hay, 2004; Sharpe, 2006; Statistics New Zealand, 2007). Many health conditions were more common for Māori adults than for other adults. These included ischaemic heart disease (1.8 times more likely), diabetes (2.0), medicated high

blood pressure (1.4), chronic pain (1.3) and arthritis (1.3). Asthma rates were also higher for Māori as 16% of Māori adults were taking medication for this condition (Ministry of Health, 2013). Māori adults are also less likely than non-Māori adults to rate their health as good, very good or excellent (Ministry of Health, 2013).

Part of the reason for differences in health status may be barriers to accessing health care. Māori adults are more likely than non-Māori to report one or more types of unmet need for health care, including being unable to get an appointment at a medical centre within 24 hours; not visiting a doctor or after-hours services when they have a medical problem due to cost or a lack of transport; and not being able to fill a prescription due to cost (Ministry of Health, 2013). Improving access to health care, and ensuring services are appropriate and responsive to Māori, will help improve health outcomes for Māori in the future (Harris, et al., 2006).

1.6 Rugby League in New Zealand

The sport of rugby league evolved from rugby union in the late 1800's. Rugby union was played in many countries around the world but it was controlled by strict amateur regulations by the Rugby Football Union (RFU in England) and by the New Zealand Rugby Football Union (NZRFU in New Zealand) (Collins, 2006). According to Coffey and Wood (2007) rugby league began in England when 22 of the strongest clubs in Lancashire and Yorkshire broke away from the London-based Rugby Football Union in 1895 to form the Northern Union. One of the main reason for this split was so that players could receive compensation for taking time off work to play sport (Haynes, 1996).

The origin of rugby league in New Zealand was a very secretive affair and the two men leading the rugby league revolution in New Zealand were Albert Henry Baskerville and George William Smith (Coffey, 1987). According to Haynes (1996), the genesis of professional rugby league in both Australia and New Zealand stemmed from the actions of a group of top New Zealand national and provincial rugby players. They were disenchanted by the lack of financial support afforded to them after returning from the 1905/06 All Black tour penniless and without employment (Coffey & Wood, 2008). This eventually led to the organisation of the 1907 All Golds tour to England and Australia. While this tour was certainly the catalyst for the introduction of the new code to these shores it was but one of a number of factors that influenced the development of the sport in New Zealand. Rugby league was introduced to New Zealand on Saturday the 13th of June 1908, when the first official rugby league match on New Zealand soil was played as a fundraising benefit match at Athletic Park in Wellington (Coffey & Wood, 2007).

Māori have been involved in rugby league since its introduction to New Zealand in the early 1900's and by the mid-1930s many Māori had developed a strong affinity to rugby league. Māori had proved integral to the development of the sport in New Zealand and around the world, particularly in Australia. Two Māori brothers, Albert and Ernie Asher are credited with much of the early development of Māori rugby league and organised the first overseas tour by a Māori rugby league team in 1908 to Australia. The book by John Coffey and Bernie Wood – 100 Years of Māori Rugby League 1908-2008 provides a detailed account of the exploits of these early pioneers and subsequent success of Māori rugby league (Coffey & Wood, 2008).

A separate body from the New Zealand Rugby League, the Aotearoa New Zealand Māori Rugby League (ANZMRL), was formed in 1934 to administer the game. The ANZMRL board were to oversee the administration and development of Māori rugby league initially in Māori communities, but would be expanded to a national body over time. The body was later renamed the Aotearoa Māori Rugby League (AMRL) and in 1992 was registered as an incorporated society, to provide a central authority for provincial and tribal rugby league organisations, each recognised as affiliate bodies of the AMRL (Coffey and Wood, 2008). The Aotearoa Māori Rugby League has always enjoyed a strong affiliation with the Tainui people. This relationship came with an endorsement by the Kīngitanga (the Māori King Movement). The Kīngitanga movement emerged out of growing Māori concerns surrounding Treaty of Waitangi related grievances at the hands of the Crown and growing colonial influences (King, 2003). The first Māori King was Waikato-Tainui chief Potatau Te Wherowhero who was crowned in 1858. Te Wherowhero was succeeded by his son King Tawhiao in 1860 and following Tawhiao, Mahuta, Te Rata and in 1933 the fifth king, King Korokī who became royal patron of Aotearoa Māori Rugby League. The mana (pride, strength, authority) of rugby league to Māori can be evidenced by this gesture. The symbolism associated with the Māori royal family becoming the patrons of Māori rugby league shows a deep affiliation between Māori and the sport. King Korokī daughter Te Arikinui Te Atairangikaahu, followed her father's footsteps with the utmost level of mana, and affection for Māori rugby league. Dame Te Atairangikaahu was also succeeded by her son King Tuheitia who has now assumed the role of AMRL patron. The aligning of the Māori royal family and the sport indicates that rugby league was a sport embraced by a broad Māori community in addition to players and fans.

Māori participation rates in rugby league today are still very high and therefore given the physical demands of the sport an observer would be forgiven for thinking that Māori players would be fit, strong and healthy (Anderson, 2009). But does any health advantage remain once retired from participation?

1.7 Conclusion

It is clear that Māori have undergone tremendous upheaval during colonisation in terms of health outcomes and reparation for many wrong doings. Māori today still suffer from poorer health outcomes on many indices; most notably asthma, ischaemic heart disease, stroke and diabetes. Māori men have a particularly poor prognosis in terms of health and are reported to be the most vulnerable group in New Zealand for developing cardiac related diseases. Consistent with the overall pattern of Māori health, retired Māori Rugby league players show a relative health disadvantage. The rationale for the current study gives rise to the fundamental importance of Māori health and in particular from a male viewpoint. Rugby league and physical activity play an important role in the lives of some Māori adults. Unfortunately, little is known about the health of retired Māori sports participants who have played rugby league.

The focus of the following chapter explores the feasibility of undertaking such research with a cohort of Māori ex-players using mixed methods and following a Māori-centered research approach.

Chapter 2: Approach and Methods - Tikanga o te Rangahau

2. 1 Introduction

This chapter discusses the approach and methods used in this research. As blended research a focus on Māori specific approaches within the research literature is appropriate. Therefore I include an overview of three Māori health models that are commonly used to assess, analyse and report research with a health/hauora focus. Some of the elements that are common in these three models are subsequently used in the analysis of the research findings in order to highlight the holistic Māori view of wellbeing (hauora).

2.1.1 Mixed Methods

The study utilised a mixed methods approach to research enabling a triangulation of findings that both describe and explain the experiences of Māori males who are retired rugby league players. Mixed methods research has been called multi-trait/multi-method research which recognizes the use of several quantitative methods in a single investigation; integrated or combined, in the sense that two forms of data are blended together from quantitative and qualitative methods, which acknowledges that the approach is actually a combination of methods (Steckler, McLeroy, Goodman, Bird, & McCormick, 1992). Mixed methods research encourages the use of multiple worldviews or paradigms rather than the typical association of certain paradigms for quantitative researchers and others for qualitative researchers (Creswell, 2014).

The specific method of 'kānohi ki te kānohi' (face to face) interviews was included as this approach is regarded within Māori communities as culturally critical when one has an important purpose. Māori work with those they trust and that trust is earned over time. Expecting them to reveal their knowledge and open up before solid relationships are forged is unrealistic and can put an end to the interaction before it has begun, or worse result in deliberately misleading answers. Because of my own personal journey in rugby league and my history within the game I was quickly able to build a strong working relationship with all the participants in the project. Kānohi ki te kānohi discussion with Māori enables use of all their senses as complementary sources of information for assessing and evaluating the advantages and disadvantages of becoming involved (Pipi, et al., 2004). This approach was utilised so the retired Māori rugby league participants could provide descriptive examples of their own individual trajectory from active to inactive status and the associated physiological changes they reported since they had stopped playing competitive rugby league.

This exploratory research was undertaken using Māori methodology that is research by Māori, involves Māori, for the benefit of Māori.

2.2 Māori Health Models

Numerous health models have been developed from previous research to conceptualise and locate Māori individuals according to characteristics of Māori identity, culture, well-being and knowledge. They have all sought to capture the key aspects which best describe Māori, to provide measures (qualitative and quantitative) for specific purposes, and to distinguish Māori experience and realities from non-Māori (Durie, 1995). Three

models; Te Whare Tapa Whā (Durie, 1985); Te Wheke (Pere, 1982) and Te Pae Mahutonga (Durie, 1999b) are significant examples of Māori philosophies of health that are by nature holistic and give strong emphasis to Māori wellbeing and vitality. There are some parallels between the Māori models of health and some of the elements considered in the process of this research, for example between some of the domains of the Short-Form 36 Version 2.0 (SF-36v2) and the Whare Tapa Wha and Te Wheke models.

2.2.1 Te Whare Tapa Whā (four-sided house)

There are Māori specific perspectives on health that need to be considered (Durie, 1998). The holistic interpretation model of Te Whare Tapa Whā constructs health as having four dimensions (Durie, 1985). With its strong foundations and four sides of equal importance, the symbol of the wharenui (big house) illustrates the four dimensions of Māori well-being. Should one of the four dimensions be missing or in some way damaged, a person, or a collective may become unbalanced and subsequently unwell. For many Māori, modern health services lack recognition of taha wairua (the spiritual dimension). In a traditional Māori approach, the inclusion of the wairua, the role of the whānau (family) and the balance of the hinengaro (mind) are as important as the physical manifestations of illness (Durie, 1994).
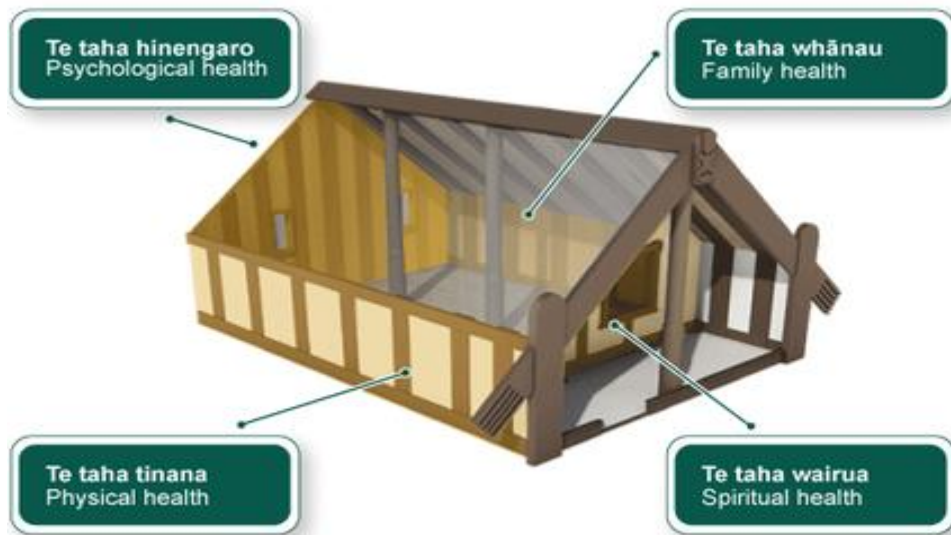
Figure 1   Te Whare Tapa Whā Māori Health Model (Durie, 1985)

Source: http://qualifiedsocialworkernewzealand.weebly.com/maori.html

The four sections or sides (taha) of Māori Health (hauora) are whānau (family health) tinana (physical health) hinengaro (mental health) and wairua (spiritual health) (Durie, 1985).

(1) **Taha wairua (spiritual health)** the traditional Māori analysis of physical manifestations of illness will focus on the wairua or spirit, to determine whether damage here could be a contributing factor.

(2) **Taha hinengaro (thoughts and feelings)** the capacity to communicate, to think and to feel mind and body are inseparable. Thoughts, feelings and emotions are integral components of the body and soul which is uniquely Māori and the perception that others have of us.

(3) **Taha tinana (physical health)** the capacity for physical growth and development for Māori is just one aspect of health and well-being and cannot be separated from the aspect of mind, spirit and;

(4) **Taha whānau (the health of family)** the capacity to belong, to care, whānau provides us with the strength of our ancestors, our ties with the past, the present and the future. The importance of whānau is fundamental to understanding Māori health issues.

In Te Whare Tapa Whā, health is viewed as an interaction between these four aspects, with taha wairua pivotal to all other aspects of health. Durie (1995) contends that;

> Without spiritual awareness and mauri (spirit or vitality, sometimes
>
> called the life-force) an individual cannot be healthy and is more prone
>
> to illness or misfortune (Durie, 1985 p. 1).

Wairua may also be used to explore relationships with the environment, between people, or with heritage. The breakdown of this relationship could be seen in terms of ill health or lack of personal identity (Durie, 1999a). When confronted with a problem Māori do not seek to analyse its separate components or parts but ask in what larger context it resides, incorporating ancestors or future generations to discussions (Durie, 1998). In relation to Māori mental health specifically, Durie (1985) described three institutions as foundations for good health. These were whenua (land), whānau (family) and te reo (Māori language, i.e. communication). Durie argued that good mental health required a firm anchoring on all three foundations and, conversely, poor health resulted when access to any was eroded or blocked.

2.2.2 Te Wheke (The Octopus)

Dr Rangimarie Rose Pere (1984) introduced her model of Māori health at the Hui Whakaoranga. Utilising the concept of an octopus (see Figure 2), Pere was able to illustrate the major features of health from a Māori whānau perspective. The octopus is symbolic to Māori as, according to some traditions, the octopus guided Kupe from the ancestral homeland of Hawaiiki to Aoteaora New Zealand (Pere, 1984). As a model of wellness, Te Wheke incorporates the parts of the body to represent the different structural components of the total person within a socio-cultural framework. Each of the eight tentacles symbolised a particular aspect of health while the body and the head (Waiora) represented the family unit as a whole (Pere, 1982).

Figure 2   Te Wheke Māori Health Model (Pere, 1997)
Source: Ministry of Health

http://www.health.govt.nz/our-work/populations/Māori-health/Māori-health-models

The eight dimensions of Te Wheke are each represented by one arm of the octopus (Pere, 1997):

        (1) Wairuatanga (spirituality);

        (2) Tinana (physical);

        (3) Hinengaro (mental);

        (4) Whānaungatanga (family);

        (5) Mana ake (uniqueness of the individual);

(6) Mauri (vitality);

(7) Hā-a-koro-mā-a-kui-mā (inspiration from ancestors); and

(8) Whatumanawa (emotions).

These eight components take into consideration human complexities symbolised by each tentacle. These tentacles represent the many facets contained within each of the configurations of life. Whaiora (total wellbeing) is reflected in the eyes of the octopus with interdependence of all parts of the model being a crucial factor, symbolised by intertwining tentacles (Pere, 1997). This interconnectedness of the different components is explicit in Te Wheke, whereas it is more implicit in the Te Whare Tapa Whā model (McNeill, 2009).

Te Wheke uses four elements of Māori health (family, spiritual, physical and psychological) and introduces four more dimensions - mana ake (uniqueness of individuals) where every individual has a place within the wider whānau group; mauri (vitality) for Māori is the life force and provides energy to all beings. Hā-a-koro-mā-a-kui-mā (inspiration from ancestors) is the breath of life from those who have lived in the past where strength is derived from their being, and whatumanawa (emotions) which drive our inner most thoughts and feelings (Pere, 1997).

2.2.3 Te Pae Māhutonga (Southern Cross Star Constellation)

Te Pae Māhutonga is the name for the constellation of stars popularly referred to as the Southern Cross (see Figure 3). Te Pae Māhutonga has long been used as a navigational aid and is closely associated with the discovery of Aotearoa New Zealand.
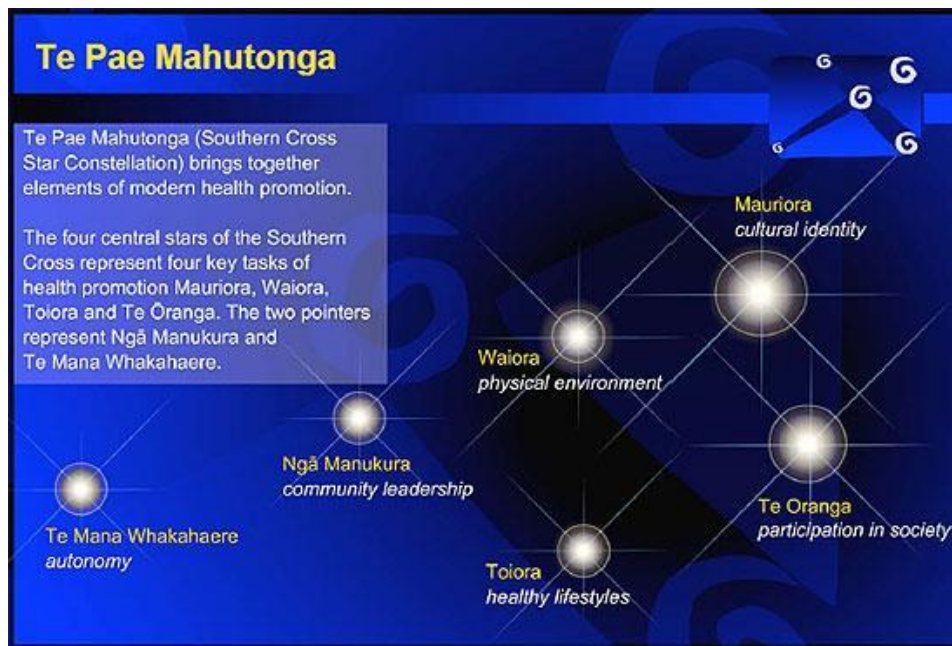
Figure 3   Te Pae Māhutonga (Durie, 1999b)
Source: Ministry of Health
https://www.health.govt.nz/system/files/documents/pages/maori_health_model_tepaemahutonga_0.pdf

In Te Pae Māhutonga, Durie (1999b) advocates redressing Māori cultural deprivation through accessibility to a range of different Māori cultural experiences. These include marae and other distinctively Māori social contexts. However, this notion of accessibility must take into account Māori spirituality. It is possible that despite the best intentions, the provision of Māori cultural experiences has the potential to cause mental un-wellness (Durie, 1999a).

Te Pae Māhutonga has four central stars arranged in the form of a cross, and there are two stars arranged in a straight line which point towards the cross. They are known as the two pointers. The four central stars represent the four key tasks of health promotion and are named accordingly to reflect particular goals of health promotion. These are:

(1) **Mauriora (cultural identity)** encompasses inner strength, vitality and a secure cultural identity.

(2) **Waiora (physical environment)** is linked more specifically to the external world and to a spiritual element that connects human wellness with cosmic, terrestrial and water environments.

(3) **Toiora (healthy lifestyles)** major threats to health come from the risks that threaten health and safety and have the capacity to distort human experience.

(4) **Te Oranga (participation in society)** is dependent on the terms under which people participate in society and on the confidence with which they can access good health services, or the school of their choice, or sport and recreation.

The two pointers represent community leadership and autonomy and are named accordingly. These are:

(1) **Nga Manukura (community leadership)** the focus is to urge health professionals to play important roles in their communities and not to replace the leadership which exists in communities. Māori structures and strong leadership patterns are important for the maintenance of good health

(2) **Te Mana Whakahaere (autonomy)** the unique aspirations of a community (hapori) , iwi (tribe) and hapū (Sub Tribe) can be described as vehicles for health promotion and care and ngā tohunga (elders and healers) are seen as leaders in advocating for good health (Durie, 1999b).

Because the Southern Cross is representative of New Zealand, and Te Pae Māhutonga has served as a guide for successive generations it can also be used as a symbolic map

for bringing together the significant components of health promotion, as they apply to Māori health, and also as they might also apply to other New Zealanders (Durie, 1999b).

2.3 Whānau (family)

Whānau has been described as the building block of Māori society (Ministry of Health, 2002). The terms family and whānau are not the same although are regularly used interchangeably. Historical definitions of whānau have been based around the household unit and could include extended whānau and up to four generations in one household (Walker, 2015). Family and whānau relationships affect our physical, mental, emotional and spiritual wellbeing and our productivity. For Māori, whānau is about extended relationships rather than the western nuclear family concept (Durie, 1985).

A contemporary understanding of whānau could also include communities, such as sporting clubs. This concept of whānau or family was often espoused within clubs where I have played rugby league. Having been involved with both the Taniwharau and Petone Panther rugby league clubs, the major guiding principle of both clubs was whānau. In simple terms it meant we support each other as we would our own whānau by giving our time unselfishly and being accountable for our actions. The study group under investigation became a rugby league whānau with close knit bonds being formed during the data collection process.

Maintaining family relationships is an important part of life and caring for young and old alike is paramount as everyone has a place and a role to fulfil within their own whānau (Durie, 1998). It is important to understand that a person carrying an ancestral

name will often be seen as having the qualities of their namesake (Durie, 1985). However, this measure is limited in its ability to capture whānau relationships which often extend across many households rather than being contained within a single household (Hodgson & Birks, 2002).

Whānau is a difficult concept to measure in quantitative analysis, as the meaning of whānau is varied and cannot be described through a simple categorisation (Cunningham, Stevenson, & Tassell, 2005). Metge (1995) defines two kinds of whānau; whakapapa-based whānau and kaupapa-based whānau. Kaupapa-based whānau place particular stress on the other characteristic feature of the whakapapa-based whānau, that is, whānau values and the ways of working derived from them (Metge, 1995). Therefore, most individual data in New Zealand cannot be aggregated up to the whānau level without explicitly asking the participant their own definitions and inclusion in different types of whānau (McKenzie & Carter, 2010). The notion of whānau is largely subjective to the individual and often individuals identify with more than one whānau, which can be a mixture of both whakapapa and kaupapa whānau (Cunningham, et al., 2005).

Common definitions of whānau discussed in the literature (Te Puni Kōkiri, 2003) include:

(1) **Whakapapa whānau** − refers to individuals with a shared ancestry or common line of descent;

(2) **Kaupapa whānau** – refers to individuals who may not have the same ancestor but share a common bond, such as geographical location or shared purpose; and

(3) **Statistical whānau** – can refer to family, whānau or household interchangeably.

In modern times (2000 onward) there are whānau who still have three generations in one household for a period of time, but it is no longer as common (Statistics New Zealand, 2006). In a report for the Ministry of Education, using data from the fourth wave of Te Hoe Nuku Roa (collected between 2004 and 2005), the authors found that participants often identified with more than one whānau, with the majority members of whānau including three or more generations (Cunningham, et al., 2005). They also found that most people belonged to one or more kaupapa whānau groups, with the most common of these being kōhanga, kura or wānanga (children's preschool, compulsory schooling and other education).

Most individuals identified with more than one whānau, which are often a mixture of both whakapapa and kaupapa whānau (Cunningham, et al., 2005). Most of the research on whānau in New Zealand has been qualitative in nature rather than involving quantitative studies. Thus, to measure changes in whānau quantitatively may require a longitudinal study to be set up specifically for this purpose. A number of Māori researchers see qualitative methods as being particularly well suited to Māori as they see it as enabling a more equal conversation to take place where power can be negotiated in ways that are not generally considered or thought possible in more quantitative approaches. A statistical whānau might be either a family nucleus or

extended family. An 'extended family' was defined as a family nucleus with other related persons, or more than one family nucleus residing together (Statistics New Zealand, 2006).

In the 2006 census the family nucleus was defined as:

> A couple with or without children, or one parent and their child usually resident in the same dwelling. The children do not have partners or children of their own living in the same household (Statistics New Zealand, 2006 p. 11)

2.4 Whakapapa (genealogy)

One of the foundations of whānau is whakapapa or genealogy, which has great importance in Māori society. It is through whakapapa that interactions and relationships are established, developed and maintained within the whānau, and their whanaunga (relatives), marae, sacred mountains, rivers and ultimately the universe (Durie, Rangitäne, & Raukawa, 2003). Whakapapa establishes the identity of an individual and assists them to clarify themselves in their relationships with others. Whakapapa also enables the individual to understand their position in relationship to their whānau, community and society and as such their roles and responsibilities (Dobbs & Eruera, 2014).

Many of the study participants' whakapapa can be traced back to the Waikato region which is one of the original strong holds of the game of rugby league because of the mining and meat industries in and around the townships of Huntly and Ngāruawahia. Rugby league is well supported in the Waikato region. The Taniwharau Rugby League

Club (based in Huntly) is situated next to Waahi Marae (the principal Marae of Ngaati Mahuta of Waikato and home of the Kaahui Ariki, the paramount family in the King Movement). Whilst the Tūrangawaewae Rugby League Club (based in Ngāruawahia) is situated over the road from the Tūrangawaewae marae the birthplace of Te Kīngitanga (The King movement-circa 1850) which was an alliance of tribes throughout New Zealand to promote Māori authority in order to protect the land from being confiscated and sold. History tells us of the confiscation of millions of acres of tribal territory after the Waikato war of the 1860s. The government wanted to obtain the fertile Waikato lands for Pākehā settlement, but the King movement, centered in Waikato, resisted the loss of land and control. British and colonial forces crossed the Mangatāwhiri Stream on 12 July 1863 resulting in war However, the mana (pride) of the Waikato people was such that after the battle of Ōrākau (31 March–2 April 1864) the famous declaration of defiance was uttered 'Ka whawhai tonu mātou, āke, āke! We shall fight on forever! More recent history also informs us that a process of reparation has taken place in New Zealand. The late Dame Te Ātairangikaahu (6th heir to Te Kīngitanga), and her brother Sir Robert Mahuta, brought to conclusion the Waikato raupatu (confiscation) claim in 1995. A settlement delivered compensation for the 1860s confiscation of lands and an apology from the Crown.

An inherent trait of Māori traditional customs (tikanga) are the connections Māori trace back to the central core of their beginnings, from the time there was Te Kore (the Nothingness); from there legends tell of Rangi, the Sky Father, and Papa, the Earth Mother, being separated by their son Tāne to bring about night and day. Tāne then created the human form by breathing life into clay moulded into the form of a woman. These ancient beginnings associated with the spirit world have formulated Māori

connectedness to the whenua (land), the rivers, lakes and sea, flora, fauna and all that is. Therein lays the whakapapa of Māori − ancient histories from which comes traditional information and knowledge. Whakapapa places people in the whole context of relationships and therefore how Māori relate to each other and how we work with each other, argue with each other and live with each other (Metge, 1995). It is what gives Māori a strong sense of belonging or grounding. To know where you came from is paramount in Te Ao Māori (Royal, 1998).

Whakapapa is an organising principle. It is through whakapapa that individuals often get their names, their identities, their sense of belonging, tūrangawaewae (place to stand − their ancestral land), and access to knowledge, rights and responsibilities (Walker, Eketone, & Gibbs, 2006). The policy of past governments that encouraged many Māori to move off the land and into the cities to become urbanised had the effect, in many cases, of disbanding whānau, and they no longer know who they are and where they come from (Walker, et al., 2006). This has led to a breakdown of whānau structures (Metge, 1995).

Royal (1998) contends that whakapapa is an analytical tool employed by Māori to understand the nature of phenomena, its origin, connections and relationships to other phenomena, describing trends in phenomena, locating phenomena, extrapolating and predicting future phenomena. Royal identifies that:

> It is by understanding the paradigms of Māori knowledge and the application of whakapapa that the evolution of Mātauranga Māori (knowledge) will recommence (Royal, 1998 p. 8)

Whakapapa is often described as the foundation of a Māori worldview (Nicholls, 1998). Whakapapa is the process that records the evolution and genealogical descent of all living things, the interconnectedness of relationships between people and the environment, both spiritual and physical, as well as people to each other in an ordered process (Henare, 1988). Therefore, whakapapa embodies the origins and nature of relationships (Kruger, et al., 2004):

> Whakapapa describes the relationships between te aō kikokiko (the physical world) and te aō wairua (the spiritual world). The reciprocity and obligatory nature of whakapapa means that it can be used to create productive and enduring relationships to support change. Whakapapa establishes and maintains connections and relationships and brings responsibility, reciprocity and obligation to those   relationships
>
> (Kruger et al. 2004 p. 16).

For Māori, whakapapa serves to acknowledge where people come from and to whom their whānau is related either directly or indirectly. These strong family connections come from a sense of belonging somewhere and to somebody (marae, iwi, hapū, awa (river) and whenua). Because many of the participants originated in the Waikato region (Tainui) and have strong generational ties with the sport of rugby league, when whānau moved away for employment (mahi) they would often seek the comfort of staying nearby other whānau to maintain their sense of belonging and whakapapa.

2.5 Kaupapa Māori Research (Māori Philosophy Research)

Kaupapa Māori Research (KMR) naturalises Māori epistemologies, methodologies and practices so that Māori are not articulated as the other. It is subjective in nature and it puts Māori at the centre of the phenomena and perceives phenomena from Māori perspectives (Smith, 2012). It is research where Māori are significant participants and the research team are all Māori, where Māori analysis is undertaken and produces Māori knowledge (Cunningham, 2000).

Smith (1990) states Kaupapa Māori is founded on three themes:

(1) Taking for granted our right to be Māori,

(2) Ensuring the survival of the Māori language and customs, and

(3) Acknowledging the central place occupied by our struggle to control our own cultural well-being.

In other words, the core of Kaupapa Māori is a catch-cry: to be Māori is the norm (Smith, 1997). There is a growing theorisation and practice of Kaupapa Māori across, education, health, justice and social services (Smith, 1990). Kaupapa Māori informs practice, research and policy within these disciplines and within mainstream, where Māori groups operate in Māori and iwi contexts (Cram, 2009). Moewaka Barnes (2000) further emphasises three defining principles for the conducting of Kaupapa Māori approach. This current research followed these three defining principles and at its core it was centred on whānau as the driving force.

(1) It is by Māori, for Māori;

(2) Māori worldviews are the normative frame; and

(3) Research is for the benefit of Māori (Moewaka Barnes, 2000).

Durie reported that Western approaches to enquiry and knowledge production involve inductive methodologies. The object under examination is broken down into progressively smaller pieces and the individual parts examined (Durie, 1999a).

Conversely, Māori approaches to enquiry and knowledge production usually involve looking outwards, developing relationships and connections. It is important to be aware for Māori, a person's identity is gleaned by asking where are you from, rather than what is your name? (Durie, 1997). Māori identity is based upon an ancestral Waka (canoe) a physical landmark, which is usually a Maunga (mountain), a body of water Awa (river), Moana (sea) and significant Tupuna (ancestors). Once this is known, people can then share a common bond. This is common practise in Te Ao Māori and considered to be traditional to all Māori regardless of location or boundaries in Aotearoa New Zealand (Durie, 1997).

Smith (1997) states that a Kaupapa Māori foundation is related to being Māori and being connected to Māori philosophy and principles, and with such a foundation the validity and legitimacy of Māori knowledge is taken for granted. At its core, a Kaupapa Māori way of doing things privileges Māori values, attitudes and practices, and asserts the strength and resilience of Māori voices, experiences and conditions (Smith, 1999). This approach acknowledges and respects the strengths, capacities and resilience of Māori communities and has been found to increase the chances of transformational change (Mertens, 2009).

Te Ao Māori (the Māori world) will always have significance to Māori regardless of their uncertainty over te reo (language) me ona tikanga (and customs) (Durie, et al.,

2003). However, there will always be a place for it to flourish and prosper (Kohanga Reo – learning nest). Finding the balance between Te Ao Māori and Te Ao Hurihuri (the world at large) is often a complex dilemma faced by many Māori who do not understand or associate with Mātauranga Māori (Māori knowledge). However, through the methodologies of Kaupapa Māori Research and a Māori-centered approach the significance of each world may become clearer for Māori through a Māori lens and allow the discovery of new knowledge (Durie, et al., 2003).

An important component to this research project was getting access to past players and acceptance from the respective national bodies that the research was going to be carried out in the best interests of the players and the game itself. One of the key positives was the fact I had previously represented New Zealand Māori Rugby League and had also played professionally in England for three clubs (Leeds, Featherstone and Bradford) over 12 years. This allowed me access to the inner environment of the study group as I was trusted within the context of the environment. The research approach also demanded a sound understanding of tikanga and kaupapa Māori processes (Durie, 1985). While all participants were Māori, there were only a small minority who were fluent speakers of Te Reo Māori (Māori language). However all participants had a good understanding of tikanga and whakapapa and a strong sense of whānau. This was of crucial importance to the project by developing manākitanga, nurturing relationships, looking after people, and being careful about how others were treated (Mead, 2003). This became their bond to one another, to complete the project during the data collection period over 18 months. The participants were an inspiration to the research team, especially during fasted blood tests, followed by exercise tests of strength and aerobic fitness during the physical assessments.

2.5.1   Research at the Interface

Writing about the interface between science and indigenous knowledge, Mason Durie (2004) said that 'indigenous knowledge cannot be verified by scientific criteria nor can science be adequately assessed according to the tenets of indigenous knowledge. Each is built on distinctive philosophies, methodologies, and criteria…Māori researchers have been able to apply the methods and values of both systems in order to reach more comprehensive understandings of health and illness (Durie, 2004 p. 1138).

Durie also noted that 'indigenous researchers have a crucial role in straddling the divide between science and indigenous knowledge, acting as agents at the interface. Not only do they have access to indigenous populations … but they also have access to two systems of knowledge and subscribe to both …[with] possibilities that two world views, two bodies of knowledge can be brought closer together' (Durie, 2004 pp. 1142-43).

The approaches used in this research are drawn from two bodies of knowledge, firstly the disciplines of exercise science and exercise physiology to generate quantitative data for comparison with results from previous studies. The second body of knowledge draws on kaupapa Māori, framing a Māori-centered qualitative approach for interviews with respondents held kanohi ki te kanohi (face to face) and the analysis of the data generated from those sources.

2.6 Ethical approval

Ethical approval was sought, and granted, through the Central Regional Health and Disability Ethics Committee for Part A (CEN/09/09/067) and Part B (CEN/09/12/104) of the study (see Appendix 11 and 12). Additional support was sought, and obtained, from the New Zealand Rugby League (see Appendix 6) and the Wellington Rugby League (see Appendix 7) to undertake data gathering of players in a regional district.

While the first section of this Chapter has described the research approach, the next section of this Chapter describes the detailed research methods used.

2.7 Methods

This current research was informed by a comprehensive literature review that identified the knowledge available about not only the Māori centred and Kaupapa Māori approaches to the research, the arena of Māori health and wellbeing and also, from the domain of Exercise Science, the types of testing, assessment and formats for reporting of information. The findings on these elements in the literature appear in more detail in the following chapter.

The research design for the quantitative methods was created from within the context of my wider body of research training in Exercise Physiology and Sport Psychology (see also Appendix 14 listing relevant peer reviewed publications I contributed to during my doctoral candidacy).

In the evaluation of physical health, participants were asked to complete various assessments and these varied depending upon the location of the recruitment. This part of the study was undertaken in two parts.

> **Part A:** Data was collected from a total of 154 participants attending two separate tournaments in New Zealand. The first was a National Masters Tournament in Auckland. The second was a National Māori rugby league tournament held in Rotorua. The information obtained included anthropometric data and a short form health survey completed in a designated area near the competition grounds. This was undertaken to identify the current health state of male Māori rugby league players who have stopped playing competitive rugby league in a regular competition.

> **Part B:** Data was collected from 25 players based in Wellington - a zonal region of New Zealand Rugby League. The information obtained comprised of anthropometric assessment, body composition, lung function, blood pressure (BP), fasting blood glucose levels, strength data, and a short form health survey. The assessment was repeated 18 months later to compare the results and to identify if any changes had occurred. Both data collection activities were completed in an approved exercise laboratory at Massey University (Wellington campus) and were carried out by an accredited exercise physiologist and clinical nurse specialist.

All of the participants who were enrolled in Part B were also invited to undertake kānohi ki te kānohi (face-to-face) discussions with the researcher, utilising an open-ended questioning technique (see Appendix 1). The selection of these participants into

this aspect of the research was undertaken as ongoing access enabled kānohi ki te kānohi discussions to be undertaken at a venue and time, which was agreeable with the participant. By enabling the participant to pick the place to meet, at their own time, it was hoped that they would be more open in the kānohi ki te kānohi interactions.

2.8 Inclusion / exclusion criteria

The inclusion criteria established for enrolment in this study were;

(1)   Male adult (older than 18 year) rugby league players

(2)   Of Māori descent/ethnicity, and

(3)   Retired from playing competitive (senior grade) rugby league no longer than 15-years previously

The exclusion criteria established for non-inclusion were:

(1)   Non-male players

(2)   Non-Māori descent/ethnicity, and

(3)   Currently still participating in regular rugby league competitions.

2.8.1 Participants

One hundred and seventy nine (179) participants were enrolled in the study. This comprised 154 participants from the two tournaments and 25 from the Wellington zonal region. All participants were provided with a clear explanation of the study (see Appendix 2) and written consent was obtained before players were enrolled (see Appendix 3).

To recruit participants for Part A of the study, permission was sought from the organising bodies of the respective tournaments; the Masters of Rugby League (see Appendix 4) and the New Zealand Māori Rugby League (see Appendix 5). Once permission was obtained, information handouts were distributed to all the participating team managers and coaches, and when they arrived at the tournament venue, contact was personally made with the team coaches and managers to encourage recruitment into the study.

2.8.2 Rugby League Tournaments

The Masters of Rugby League tournament is held annually and is a derivative of the full rugby league game where retired players are able to meet and participate in rugby league match activities in a safe environment. Originally developed in New Zealand, the Masters competitions are held nationally, and internationally, where players above the age of 35, who are no longer participating in any competitive matches, are able to compete. The game is focused on participation and all games end in a draw. The modifications are age related and players are identified by coloured shorts. Players can either be involved in full tackles (White shorts; ages 35 to 39) through to touch only and no tackling (Gold shorts; age 60+).

The New Zealand Māori Rugby League Tournament is also an annual event usually played in Rotorua, but latterly has been held in Auckland. Teams (regional and iwi) from all over New Zealand gather to compete in two divisions of competition (Rohe and Waka – region and whakapapa based) over two days. The competition on the field is fierce and the rivalry between teams is intense as the players represent their whānau,

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marae, hapū and iwi even before the whistle is blown to start the game. A major feature of this tournament is the traditional haka (commonly known as war dance) performed prior to every game being played. Haka is offered as a challenge to raise the spirits of warriors before embarking in battle. These battles are a feature of the tournament and every player is considered a modern day warrior representing their people in sport. The retired players enrolled into this research from the tournament were made up of coaches, trainers and managers attending the event as many were known to the lead researcher from his playing and coaching days. All participants in Part A completed the physiological assessment and filled in a questionnaire in front of the researcher.

For Part B of the project, permission was sought and obtained from the New Zealand Rugby League (Appendix 6) and Wellington Rugby league (Appendix 7). Once this was obtained, players were approached directly to participate in the research. Participants in Part B completed the physiological assessment and filled in the questionnaires in front of the researcher. This was all undertaken in the same venue for the baseline and the re-testing 18 months later. All participants in Part B were invited to participate in kānohi ki te kānohi interviews.

2.9 Physical Assessments

A range of relevant physical assessments were identified from literature reviewed during the development of this study and applied in two parts.

2.9.1 Part A: Tournament based players

Height and body mass were the physical assessments utilised. Participants also completed a medical history questionnaire (see Appendix 8) and a short form health survey (Short-Form 36 Version 2.0 (SF-36v2) (see Appendix 9), (Ware, 2000; Ware & Kosinski, 1997; Ware, Kosinski, & Keller, 1994) . The whole process for each player took between 15-30 minutes to complete, although there was no time limit placed on the players to do so.

2.9.2 Part B: Zonal based players

Finger prick fasting (12hr) cholesterol and glucose blood tests were measured first. Players then underwent the physical assessments which included height, body mass, submaximal oxygen uptake, leg/back and hand grip strength, blood pressure, lung function and body composition (body fat, free fat mass and fat mass assessments). Part B participants also completed a medical history questionnaire and the SF-36v2. The whole process for each player took approximately 45-60 minutes to complete, although there was no time limit placed on the players to do so.

2.9.2.1 Blood tests

All players enrolled in part B completed finger-prick sampling of their blood. This included fasting (12hr) cholesterol and glucose assessment utilizing a CardioChek PA Cholesterol Analyser and an Optium Xceed glucose meter respectively. These tests were carried out by a clinical nurse specialist who followed the recommended

guidelines specified by the manufacturers of each device. The CardioChek PA is a hand-held, battery-operated, reflectance spectrophotometer. It has fast turn-around time (2 minutes) and reliable results (Polymer Technology Systems, 2007). The analyser measures total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and automatically calculates low-density lipoprotein cholesterol (LDL-C) from a small quantity (approximately 40 μl) of blood (finger prick or venous) within a few minutes (Panz, Raal, Paiker, Immelman, & Miles, 2005). The Optium Xceed glucose meter requires a tiny blood sample size of just 0.3 μl placed on an Abbott Optium Plus test strip. The small blood sample size using the shallowest depth setting on the lancing device means testing is less painful and can return a test result in under five seconds.

For comparison with known standards, the blood lipid thresholds utilised to calculate the prevalence of hyperlipidaemia were taken from the National Heart Foundation guidelines (see Table 1) (Tonkin, et al., 2005).

Table 1   **National Heart Foundation (2005) guidelines for Lipid thresholds utilised to calculate the prevalence of hyperlipidaemia.**

High cholesterol	≥4.0 mmol/L;
Low HDL	<1.0 mmol/L;
High LDL	≥2.5 mmol/L;
High triglycerides	≥1.7 mmol/L;
High cholesterol to HDL ratio	≥4.5 mmol/L;
Fasting Plasma Glucose	≥5.6 mmol/L

HDL = high-density lipoprotein; LDL = low-density lipoprotein
≥ = Equal to or greater than
(Source: Tonkin, et al., 2005)

Participants who were identified as having any of their results equal to or above any of these thresholds were advised to see their own health practitioner and were provided with a copy of the results obtained.

2.9.2.2 Physiological Evaluation

Participants undertook physiological evaluations for the assessment of the player. These evaluations included anthropometric, body composition medical and health questionnaires and blood testing.

2.9.2.3 Anthropometric Assessment

Height was measured using the SECA 214 Portable Stadiometer and body mass were measured with calibrated digital scales using previously described methods (Ministry of Health, 2008). The height and body mass results were used to calculate Body Mass Index (BMI = weight in kg x height in metres squared).

2.9.2.4 Physiological Capacity Assessments

The participant's submaximal oxygen uptake, leg/back and hand grip strength, blood pressure, lung function and body composition were measured. The submaximal oxygen uptake was evaluated utilising the Åstrand-Ryhming cycle test on a Monark 828E Ergomedic Exercise Bike (Åstrand & Rohdahl, 1970; Åstrand & Ryhming, 1954) . Leg/Back and Grip strength were assessed by a dynamometer. Blood pressure was measured by an Omron Adult Sphygmomanometer and an Omron Sprague Rappaport Stethoscope. Lung function was evaluated by a MICROLAB 3500 UK v6.00 spirometry. Waist and hip girths were measured to the nearest 0.5 cm by a SECA 200 Girth Measure Tape.

Body composition, including total body water, fat free mass, body fat percentage and lean muscle mass, was estimated using a segmental Bio-impedance Analyser operating at frequencies of 20 and 100 kHz, pre-set by the manufacturer to assess extracellular fluid and total body water and introduced into the body in ascending order of frequency (Polymer Technology Systems, 2007). The InBody 230 using Tetra-polar 8-point tactile electrodes located in the handgrips and the footpads is quick (>30secs) to provide results compared with standard four-electrode devices that require time to normalize body fluid distribution before testing.

2.9.2.5 Short-Form 36 Version 2.0 (SF-36v2)

Designed to measure health-related quality of life the SF-36v2 has been utilised to measure population health status and in clinical studies (Elley, et al., 2008; McCallum, 1995; McHorney, Ware, & Raczek, 1993; Ware & Kosinski, 1997; Ware, et al., 1998; Ware, et al., 1994). The SF-36v2 questionnaire is a generic measure allowing for evaluation of both physical and mental health.

The questionnaire consists of 36 questions defining eight aspects (domains) of health. These eight aspects (domains) are:

(1) Physical Functioning (PF) – 10 questions;

(2) Role - Physical (RP) – 4 questions;

(3) Bodily Pain (BP) – 2 questions;

(4) General Health (GH) – 5 questions;

(5) Vitality (Vt) – 4 questions;

(6) Social Functioning (SF) – 2 questions;

(7) Role - Emotional (RE) – 3 questions, and

(8) Mental Health (MH) – 5 questions.

It is worth noting the similarity of these domains to those used in Te Whare Tapa Wha and Te Wheke models of Māori health.

The SF-36v2 yields scale scores for each of the eight health domains, as well as two summary measures.

These were:

(1) Physical Component Score (PCS): A combination of PF, RP, BP and GH 1- 4 above and;

(2) Mental Component Score (MCS): a combination of Vt, SF, RE and MH 5-8 above.

An additional question was added to the SF-36v2 questionnaire relating to smoking. This question was - Are you now currently smoking? The answer required the participant to answer either Yes or No

The score scales are the sum of all the components in the specific scale. The SF-36v2 scores range from 0 to 100 with a norm based score of 50 ±10. The higher the score: the better the health. Scale scores can be interpreted based on the deviation from the mean with 10 points being 1 standard deviation. Scores are described as below average (0 to 49), average (50) and above average (51 to 100). An advantage of the SF-36v2 is the ability to compare results internationally and, within local populations (Stephens,

Alpass, Baars, Towers, & Stevenson, 2010). For a more detailed explanation of the domains and components of the SF-36v2 please see Appendix 10.

2.9.2.6 Medical History questionnaire

To establish an injury history a medical history questionnaire (MHQ) was utilised (see Appendix 9). The questionnaire has been used in previous rugby league research by a clinical nurse specialist (King, 2007; King & Gabbett, 2009). A clinical nurse specialist reviewed the medical history questionnaires once the participants completed them. Any issues identified on the questionnaire were discussed with the participant and, if required, the participant was referred on to their own primary health practitioner. No participant was identified as not being able to undertake any of the assessments for this research as a result of their MHQ.

2.10 Kānohi ki te kānohi Interviews

All players enrolled in Part B of the research were invited to participate in kānohi ki te kānohi interviews. Only 67% (10/15) of participants agreed to be part of this process and these interviews took place at a venue of the participant's choice. Each interview was conducted with the participant giving verbal consent for the interview to be recorded on a digital recorder and typically took place in a semi-formal setting with a coffee and something to eat. The use of open-ended questions was employed in the interview based on a semi-structured interview format. An example of the questions from the semi-structured interviews is included as Appendix 1. The use of the semi-structured interview allows for replication of the same questions with each participant but is less controlled allowing for focusing on key issues or topics if they are identified

throughout the interview process. This method allows for the interviewer to attain a rich understanding of the participants first hand experiences of their journey during and after competitive participation in rugby league (Bluff, 2005). Once the interview was concluded, the interview was transcribed verbatim for further analysis

2.11 Testing Procedures

All participants were given a brief explanation of the purpose of the study (see Appendix 2), and allowed an opportunity to ask any questions and signed the consent form before they were enrolled in the study.

2.11.1 Part A:

Once the participants had given their formal fully informed consent to be part of the research they would then have an anthropometric assessment completed in the following order:

       i.   **Height.** To measure their height the participant stood on a stadiometer. The stadiometer was placed against a firm wall facing out from the wall. Participants were asked to remove their shoes and face outwards on the stadiometer with their head raised and eyes looking forwards placing the head in the Frankfort plane. The height was measured where the marker was felt to be firm against the crown of the head. When that was completed the participant was asked to step away from the stadiometer. Two measurements were conducted to ensure the correct height was obtained to the nearest millimetre.

ii.   **Mass.** To measure body mass the participant stood on calibrated digital scales. The scales were placed on a flat hard surface and were calibrated prior to being used. Participants were asked to just wear shorts and a t-shirt / singlet. Each participant was asked to stand on the centre of the scales without support, with their arms loosely by their sides, their head facing forward and with their weight distributed evenly on both feet. Once the reading was displaced this was recorded to the nearest 0.1 kg.

iii.   **SF-36v2.** Participants were asked to complete the SF-36v2 paper questionnaire using a pencil and answering directly on the SF-36v2. Once this was completed the results were entered into an Excel spreadsheet for later analysis. Hard copies of the SF-36v2 were retained by the researcher to enable revision of the data at a later date.

2.11.2 Part B:

All players initially invited to participate in this part B of the study resided in the Wellington region of New Zealand. Previous evidence on physical activity from Sport and Recreation Council (SPARC) indicate that Māori living in the Wellington region compare favourably with the rest of New Zealand on many indices of participation in sport and physical activity (93% compared with 87%) (Sport and Recreation New Zealand, 2003b).

All players enrolled in Part B of the study were given a detailed explanation of the purpose of the study and allowed an opportunity to ask any questions and signed the consent form (Appendix 3) before any data collection commenced. Players were

assembled in groups (10 maximum) on specific days for testing according to their availability. They were asked to attend different timeslots (30min) in order to avoid waiting around to be tested. All testing took place within an approved exercise science laboratory at Massey University (Wellington campus) and was carried out by an accredited exercise scientist and clinical nurse specialist. These assessments were repeated 18 months later to ascertain whether any changes had taken place within that timeframe.

All players were required to have fasted 12 hrs prior to the assessments that were conducted in the morning to decrease the risk of players' non-fasting. The players were required to complete the testing in a systematic order. This was replicated at the repeated testing phase in the identical order:

i. **Fasting Blood Tests**. This was undertaken to identify fasting (12hr) cholesterol and glucose utilizing the CardioChek PA Cholesterol Analyser and the Optium Xceed glucose meter. Participants provided a finger on their left hand where 40 µl of blood (finger prick or venous) was withdrawn through a pipette following a finger prick with a lancet for the fasting lipid test. Participants provided a finger on their right hand where 0.3 µL of blood was drawn from a finger prick lancet for the blood glucose test.

ii. **Height**. As described previously for Part A

iii. **Body Mass**. As described previously for Part A

iv. **Waist Girth.** To measure waist girth the aim was to find the narrowest circumference of the abdomen at the point between the lower costal (10th rib) border and the top of the iliac crest, perpendicular to the long axis of the trunk. The cross-hand technique was used for measuring waist girth. The objective was

to minimise the gaps between the tape and the body surface, and to minimise indentations of the body surface wherever possible. The participant was asked to stand upright in a relaxed manner, feet comfortably apart, weight evenly balanced on both feet and with their arms hanging by their side.

v. **Hip Girth**. To measure hip girth the participants were asked to stand upright in a relaxed manner, feet comfortably apart, with their weight evenly distributed between both feet (i.e. feet slightly apart) ensuring they do not tense the gluteal muscles. Two measurements were taken to ensure the correct size was recorded to the nearest 1mm.

vi. **Blood Pressure**. The blood pressure (BP) of participants was measured using an Omron Adult Sphygmomanometer and an Omron Sprague Rappaport Stethoscope. Participants sat upright in a seat with their arms loosely at their sides and allowed to rest for five minutes. The left arm was used to measure the blood pressure by the clinical nurse specialist. Three readings were completed ensuring there was a 2 minute rest period between readings. The average BP of the three measurements was recorded.

vii. **Bio-impedance assessment**. This assessment was virtually the same as recording body mass and followed the same protocol as specified by the manufacturer (Deurenberg, 1994). Participants stood on the InBody230 with feet matching the footprint provided on the machine. They also had both hands wrapped around the handles of the InBody230 ensuring the thumb was in the correct position. They were asked to breathe evenly and remain as still as possible. The analyser would take approximately 90-120 seconds to measure body composition.

viii. **Leg and back strength.** All participants were instructed on the purpose of the test. They were asked to stand on the platform of the dynamometer with their feet a comfortable distance apart for balance, and shoulder width distance. While maintaining an upright posture with the arms straight, place the palms of their hands on the front of their thighs and flex at the hips until the tips of the fingers were level with the knees. The chain was adjusted so that the bar was just at finger-tip level. Bending forward at the hips, grasping the bar with one palm facing forward and the other backward and chest forward the participants were told they should inhale, and as they slowly exhale, attempt to forcefully extend the trunk and the hips by pulling upwards on the bar, while trying to straighten the legs. The final position should be just short of the upright position. Two measurements were taken and the highest of the two measurements was recorded;

ix. **Grip Strength** (left and right hand). Participants were instructed to adjust the dynamometer so that they felt comfortable with it in their hand. They then held it with a straight arm above their head and instructed to inhale deeply, quickly followed by a forceful contraction of the fingers while exhaling and lowering the dynamometer toward the ground. This process was repeated for both hands after a rest period of at least 30 seconds between attempts. Two measurements were taken for each hand and the highest of the two measurements was recorded;

x. **Lung Function.** The Microlab 3500 Mk6 Spirometer is a highly accurate portable respiratory monitor that offers real time graphic displays of either Flow/Volume or Volume/Time curves. All participants were fitted with nose clips and given instructions to breathe in until their lungs were completely full, seal their lips around the mouthpiece and blow out as hard and fast possible until

they could not push any more air out and then breathe in fully immediately after the expiratory manoeuvre, thus completing the Flow Volume loop.

xi. **Submaximal oxygen uptake**. All players were given specific instructions to follow the Åstrand-Rhyming submaximal exercise cycle protocol (Åstrand & Ryhming, 1954). The VO2max was estimated using the Åstrand-Rhyming nomogram corrected for age (Åstrand & Ryhming, 1954).

xii. **SF-36 v2:** All participants completed the SF-36v2 using a pencil and answering directly on the SF-36v2 form. Players were provided with a muffin, some fruit and a drink when they were completing the SF-36 v2.

All measurements completed were in compliance with previously established protocols to ensure continuity of the results (Åstrand & Rohdahl, 1970; Åstrand & Ryhming, 1954; Robson & Purdie, 2007; Ware & Kosinski, 1997; Ware, et al., 1998). Other health indicators (cigarette smoking, illnesses and injuries) were also included in the SF-36v2 questionnaire to track progress through different stages of retirement from playing rugby league. All results were reviewed by the clinical nurse specialist and, if any were of concern the participants were referred to their own health practitioner for further evaluation.

To assist with the assessment of taha wairau, taha hinengaro and taha whānau, a qualitative approach was undertaken in the form of kānohi ki te kānohi (face to face) discussions.

2.12 Quantitative analysis

All quantitative data was entered onto an Excel spreadsheet for further analysis. As no repeat tests were utilised for the Part A participants the anthropometric and SF-36v2 results were reported as mean with standard deviation (SD). For Part B participants, the data was compared to the baseline with the retest results 18 months later. The participants were also sub-categorised into three retirement groups for further analysis (years from retirement; YFR). These were (1) 0-5 yrs., (2) 6-10 yrs., and (3) 11 to 15 yrs. A one way analysis of variance (ANOVA) was used to compare the SF-36v2 by total and retirement groups.

A two-tailed t-test was used to compare anthropometric data by total and retirement groups. Pearson's correlation coefficient (r) statistics were calculated to determine the direction and the strength of the association of the measured results of the Åstrand-Rhyming submaximal cycle test. Serum fasting cholesterol and glucose was not normally distributed so a Wilcoxon-signed rank test was used to compare total and retirement groups. Agreement between measured parameters was assessed by Bland-Altman analysis. Data were reported as mean ±SD and 95% Confidence Interval (CI). All data was analysed on SPSS v 22.0. The statistical significance was set at $p<0.05$.

2.13 Qualitative analysis

The qualitative data obtained from ten recorded interviews that were transcribed verbatim into a Word document. The data were analysed by first reading the transcripts where potential themes were identified and collated. Each theme had its own sub-theme with further comments. By incorporating a grounded theory approach, the transcribed

recordings underwent data reduction, data display, semantic analysis and conclusion drawing (Miles & Huberman, 1994; Neuman, 2014; Ryan & Bernard, 2000). Once all ten transcripts had been analysed these were reviewed to assess for any themes. Several themes were identified and these were then all reviewed to identify group themes. A review of these group themes further established there were two different focus points and the themes were able to be placed within these points. As a result the qualitative data was analysed under the following themes with two main focus points. The two focus points were; (1) Whānau and (2) Game related issues, whilst the four thematic aspects were:

(1) Injury;

(2) Health;

(3) Life-skills; and

(4) Team environment

2.14 Conclusion

While informed by both Kaupapa Māori and exercise physiology methods, the study adopted a Maori-centred approach and had a sole focus on Māori who have retired from playing rugby league. A mixed-methods approach using quantitative and qualitative methods contributes substantial evidence on the topic of interest.

The study researched four groups of retired rugby league players, at increasing levels of engagement with 154 involved in the initial survey assessment. This was followed by a more detailed analysis of 25 players who were assessed on multiple measures of health. This process was repeated 18 months later with 15 returning respondents and elaborated

on (A) Physical well-being post-play; (B) Injuries experienced during play (through a retrospective analysis); (C) Self-assessed well-being; and (D) Change over time for a small group. Players enrolled in Part B of the research were invited to participate in kānohi ki te kānohi interviews and 10 of the 15 participants agreed to be part of this process.

This study considers Māori culture in rugby league and while it has one foot firmly embedded in the disciplines of Exercise Science and Physiology it applies a Māori-centered process, for example in the engagement of participants, and using a Māori-centered analytical lens.

This exploratory research uses standard Exercise Science methods for collection and analysis of the quantitative data. However in adopting a Maori-centred approach the research differs from Exercise Science in three main ways;

1) The researcher is Māori and a retired rugby league player – an 'insider' acknowledging a subjective approach and understanding compared with the Exercise Science approach which assumes an objective, independent scientific method;

2) Blending in the qualitiative methods of interview that are not a typical feature of Exercise Science;

3) The exploratory research identifies and verifies the potential to intervene positively on the health of Māori who have retired from playing rugby league or any other contact sport and attaches less priority to statistical analysis than is usual in Exercise Science

The following chapter presents information about the background to the issues revealed by the exploratory research and consideration of literature that informs the research topic, question and approaches.

Chapter 3: Background and Literature
Tātaritanga ā Rangahau Hāngai

3. Introduction

The purpose of this chapter is threefold. First I present a general introduction to the Māori population – including some demographics and socio-economic factors. Second, I provide a general description of Māori health status, including some of the specific areas where I will collect and analyse data in my own research. Third, I provide a description of the context of Māori involvement in sport, and rugby league in particular where I give a summary of the relevant research literature.

Finally, I also provide a description of the parallel research I have undertaken during the course of this thesis. I identify the relevance of my wider research contribution to this thesis.

3.1 The Māori Population

The estimated resident population of New Zealand at 30 June 2013 was 4,442,100. This represents an increase of 257,500 since 30 June 2006, or an average annual increase over the seven years of 36,800 (0.8 %) (Statistics New Zealand, 2014). The 2013 estimated resident populations for the main ethnic groups in New Zealand are European (3.31million), Māori (692,300), Asian (541,300) and Pacific peoples (344,400). In 2013: 598,605 people identified with Māori ethnic group, whilst 692,300 people were of Māori descent (see Table 2).

Table 2   **Māori ethnic group population summary**

Census	Māori ethnic group population
1991	434,847
1996	523,371
2001	526,281
2006	565,329
2013	598,605

Source: Statistics New Zealand, 2014

This equates to 14% and 16% of the resident population respectively (Statistics New Zealand, 2014). Māori are incorporated in the New Zealand Census of Population and Dwellings by two methods. These are: (i) Ethnicity, and (ii) Māori descent. Ethnicity records the population who state they are Māori as being their sole ethnic group, or one of several ethnic groups. Māori descent refers to those people who are a descendent of a person of the Māori race of New Zealand. Māori descent counts form the basis of iwi (tribal) statistics.

In comparison with non-Māori, Māori constituted a very youthful population with 35 percent aged less than 15 years, compared with 19% of non-Māori (Statistics New Zealand, 2013a). Between 2011 and 2026, the Māori population was predicted to grow by 21 percent, whereas the non-Māori population was predicted to grow by only 11 percent (Statistics New Zealand, 2014). Māori population has a high growth rate (average annual increase of 1.4%) relative to non-Māori (average annual increase of 0.7%) (Statistics New Zealand, 2013a). Alongside this high annual increase, Māori have an estimated eight year life expectancy discrepancy when compared with non-Māori (Robson & Purdie, 2007). The estimated Māori population at 30 June 2017 had risen to 734,200, an increase of 41,900 across four years, or 5.7 percent total growth. The median age for Māori males was 22.9 years, and for Māori females it was 25.9 years (Statistics New Zealand, 2017).

Māori are poorly represented in positive health and wellbeing statistics in New Zealand (Blakely, Ajwani, Robson, Tobias, & Bonne, 2004). However, an extensive review of Māori Health in New Zealand highlighted key indicators relating to the socioeconomic determinants of health, risk and protective factors for health, health status, health service utilisation and the health system for Māori (Ministry of Health, 2010). Factors such as income, employment status, housing and education have been reported to have both direct and indirect impacts on health and cumulative effects over lifetimes (Ministry of Health, 2010). Māori health outcomes, incomes, and other measures of well-being are most sensitive to how the Māori population is defined. Māori who are of Māori descent, but not solely of Māori ethnicity, have outcomes distributed similarly to Pākehā (New Zealand European), while those with sole Māori ethnicity are concentrated significantly among those with poorer health, income, and educational outcomes (Statistics New Zealand, 2004).

3.1.1 Health Loss

Health loss is estimated using a measure called the disability-adjusted life year (DALY) (see Figure 4). The DALY combines information on both fatal outcomes (early death) and non-fatal outcomes (illness or disability) in a way that makes it possible to compare the effects of different diseases and injuries across population groups and over time (Ministry of Health & Accident Compensation Corporation, 2013). In 2006, New Zealanders sustained health losses totalling almost one million years of healthy life (955,000 DALYs) (Ministry of Health, 2013a).

The disability-adjusted life year (DALY)

The DALY is calculated as follows: DALY = YLL + YLD.

YLL (years of life lost) measures health loss from early death, taking into account the age when death occurred.

YLD (years lived with disability) measures health loss from time spent in less than full health, taking into account the severity of ill health or disability.

Figure 4   The disability-adjusted life year calculation
Source: Ministry of Health & Accident Compensation Corporation, 2013

Māori sustain greater health loss than non-Māori in most condition groups and on an absolute scale, 26% of the excess burden experienced by Māori was caused by vascular disorders, 15% by cancers, 12% by mental illness, 11% by injury, and 9% by diabetes and other endocrine disorders (Ministry of Health, 2013a). Interestingly, for Māori, the absolute burden is not dominated by old age – unlike the situation for non-Māori, but rather more than half (54%) of healthy life lost among Māori occurred before middle age, compared with one-third among non-Māori (Ministry of Health, 2013a) (see Figure 5).
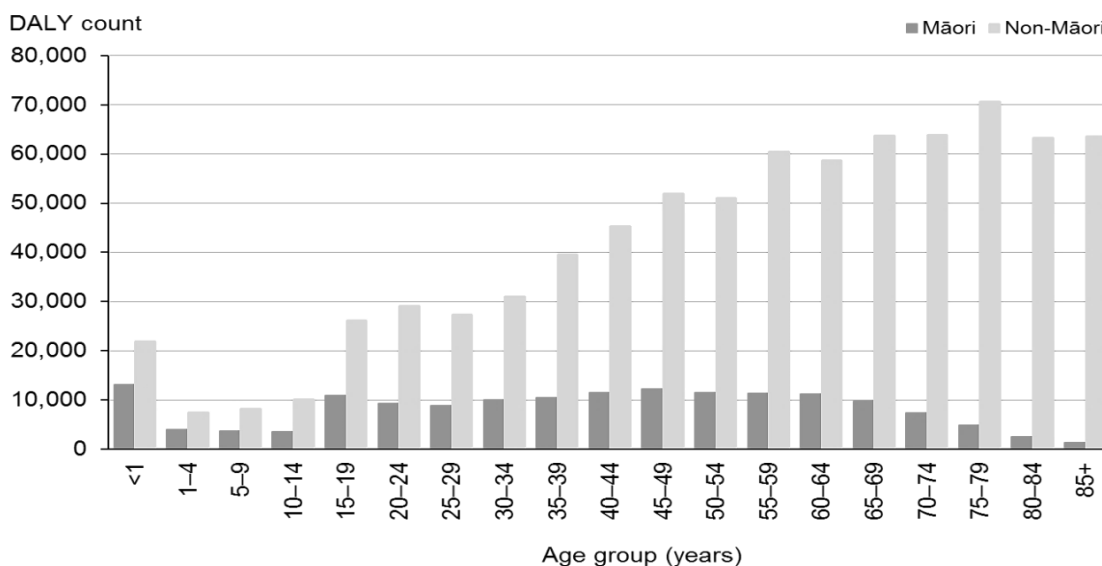
Figure 5   DALY counts reported in 2006 Ministry of health loss for Māori and non-Māori in New Zealand by age group
Source: Ministry of Health, 2013a

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The Māori burden currently peaks in middle age, reflecting both a different distribution of risks (e.g. tobacco use) and a younger population age structure (Ministry of Health, 2013a). Adjusting for population size, Māori have higher rates (per 1000 DALY) of health loss than non-Māori at all ages (see Figure 6).
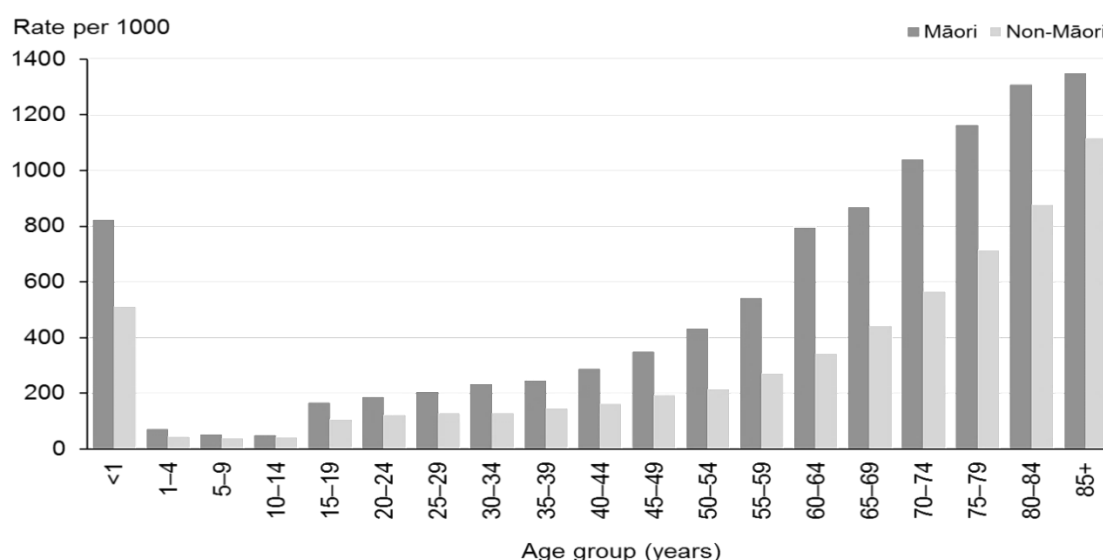
Figure 6 DALY rates, reported in 2006 Ministry of health loss for Māori and non-Māori in New Zealand by age group.
Source: Ministry of Health, 2013a

Just over half (51%) of this total health loss resulted from fatal outcomes, with non-fatal outcomes accounting for 49% (Ministry of Health, 2013a). Older people (65+ years) sustained over one-third (37%) of the total health loss despite making up only 12% of the population (Ministry of Health, 2013a). Adjusting for age, males experienced 55% more fatal health loss than females but a lighter burden of non-fatal health loss (16% less). Adjusting for age and population size, health loss in Māori was almost 1.8 times higher than in non-Māori, with more than half of Māori health loss occurring before middle age (Ministry of Health, 2013c).

If Māori had experienced similar rates of health loss to non-Māori at all ages, health loss among Māori would have been 42% less and that of the whole population 7% less.

Total DALYs lost were projected to increase from 955,000 in 2006 to 1.085 million in 2016, a rise of 13.4% (Ministry of Health & Accident Compensation Corporation, 2013). This assumes a continuation of recent demographic trends (population growth and ageing) and epidemiological trends (disease and injury incidence and mortality). Projected increases in population size and ageing explain 80% of this trend, with epidemiological changes explaining the remaining 20% (Ministry of Health, 2013e).

3.1.2 Life Expectancy

According to the latest Census data for Māori in New Zealand, (see Figure 7), Māori are a youthful population group with the median age of 23.9 years (half are older, and half are younger, than this age) in the 2013 Census compared with 22.7 years in 2006 (Statistics New Zealand, 2014).
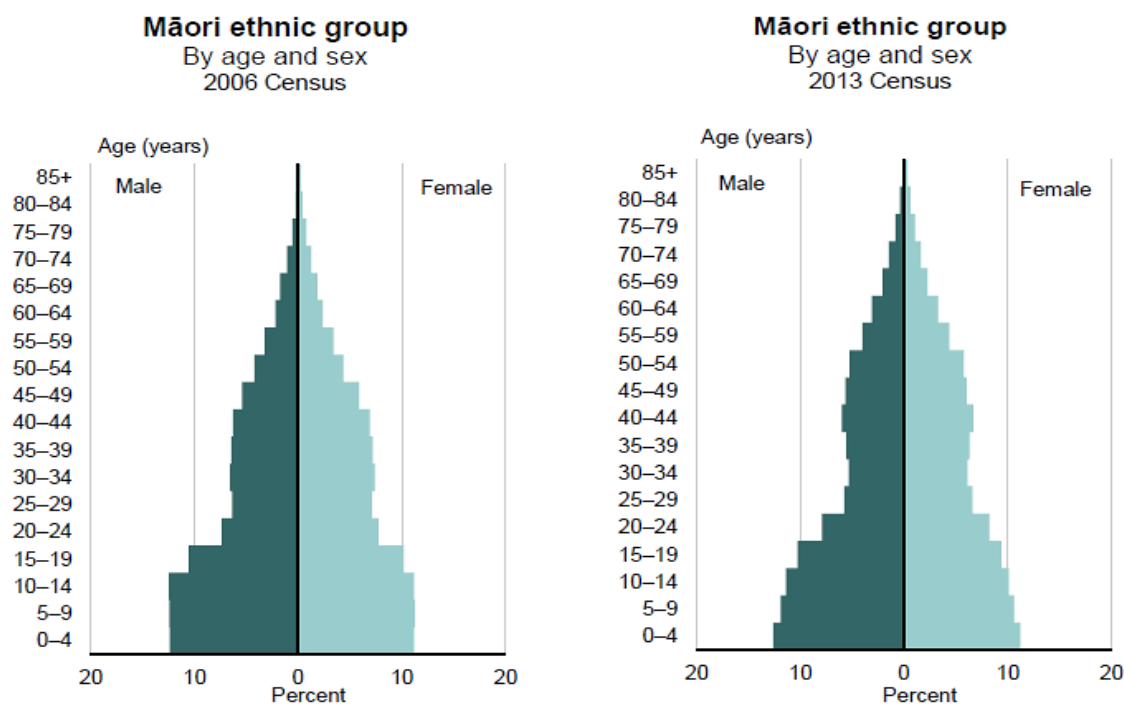
Figure 7   **Population demographics of Māori residents in New Zealand for male and female by age group as reported in 2006 census (left graph) and in 2013 census (right graph)**   *Source: Statistics New Zealand, 2014.*

Similarly, the median age for Māori females was 25.4 years, and the median age for Māori males was 22.2 years in 2013, whilst this compares with 24.1 years for females and 21.3 years for males in 2006. In 2013, 51.8% of Māori were female and 48.2% were male. The proportion of Māori aged 65 years and over increased from 4.1 percent in 2006 to 5.4 percent in 2013. The largest increase in the Māori population since 2006 has been in the older working-age group (30 to 64 years), up 17,154 people or 8.5% from 2006. The size of the Māori population aged under-15 years has continued to grow. However, as a percentage of the total Māori population, it has decreased from 35.4% in 2006 to 33.8% in 2013 (Statistics New Zealand, 2013a).

Māori life expectancy at birth was at least eight years less than for non-Māori for both genders (Robson & Purdie, 2007). This may be related to the low socioeconomic strata with nearly a quarter of Māori (24%) living in decile 10 (most deprived) identified areas when compared to non-Māori (7%) (Blakely, Tobias, & Atkinson, 2007). Whilst non-Māori appear to live longer they also suffer from many of the same related causes (Hypertension, CVD, Diabetes) leading to illness and eventual loss of life (Hay, 2002). However, the biggest concern is the reported early onset of chronic disease in Māori compared to non-Māori (Ministry of Health, 2013d). In New Zealand, longstanding ethnic and socioeconomic disparities have been well documented for CVD mortality which may also contribute to the lower life expectancy of Māori when compared with non- Māori (Robson & Purdie, 2007).

Māori and non-Māori life expectancy has continued to converge. Māori male life expectancy increased by nearly 19 years between 1950 and 2010 (Statistics New Zealand, 2013c). The differences between Māori and non-Māori life expectancy at birth

was 7.3 years less based on death rates in 2010–12, compared with 8.2 years in 2005–07 and 8.5 years in 2000–02 (Statistics New Zealand, 2013b). Life expectancy at birth is 76.5 years for Māori females and 72.8 years for Māori males, compared with 83.7 years for non-Māori females and 80.2 years for non-Māori males (Statistics New Zealand, 2013c).

Ethnic differences in survivorship, particularly for Māori at middle age, and from causes that are largely preventable, persist. About 60 percent of the difference between Māori and non-Māori life expectancy comes from higher death-rates at ages 50 to 79 years. More generally, some people can remain active into old age, while others experience debilitating illness and disability at relatively young ages (Tobias, et al., 2009). New Zealand's indigenous population trends mirror other nations around the world and in particular our closest neighbouring country, as at 30 June 2013, the estimated Australian Indigenous population was 698,583 people (Australian Indigenous Health InfoNet, 2014). The Australian Indigenous population also have a young age profile. In 2006, 38% of Indigenous people were aged 14 years and under, compared with 19% of the non-Indigenous population. In Australia, life expectancy rates for both male and female Aboriginal and Torres Strait Islanders are far lower than non-Indigenous. Based on 2005-2007 data, the life expectancy at birth of Indigenous people was estimated to be 67.2 years for males and 72.9 years for females. This represents a gap between Indigenous and non-Indigenous life expectancy at birth of 11.5 years for males and 9.7 years for females (Steering Committee for the Review of Government Service Provision, 2011). Whilst life expectancy is a key measure of overall population health it is by no means all-encompassing as it is a broad indicator of a population's long-term health and well-being. It can be affected by many outcomes, like access to

high quality healthcare, income and education levels. Lifestyle factors are also important, including nutrition, exercise and use of drugs, tobacco and alcohol (Steering Committee for the Review of Government Service Provision, 2011).

From the annual update of key findings 2015/16 for Māori in NZ, it would appear there have been few changes from the 2011/12 health survey (see Table 3), but there were some when compared to 2006/7 (Ministry of Health, 2016). The most noticeable changes included reductions in physical activity (6.7%) and an increase in obesity (5.5%). These are both negative steps for all of NZ. The evidence is damning and underlines the importance of maintaining health throughout the lifespan.

Table 3   **Health status, health behaviours and risk factors for Māori adults by percent of population in the 2006/07, 2011/12 and 2015/16 reporting periods and differences from 2006/16**

Indicator	Percentage of population			Change	
	2006/07	2011/2	2015/16	Since 2006/07	Since 2011/12
Health status, health behaviours and risk factors					
Excellent, very good or good self-rated health	86.5	84.2	81.0	↓	↓
Current smoking	42.1	39.2	38.6	↓	=
Daily smoking	39.2	36.1	35.5	=	=
Hazardous drinking	33.5	30.9	31.1	↓	=
Vegetable intake (3+ servings per day	59.9	60.9	58.1	=	=
Fruit intact (2+ servings per day	55.2	49.3	46.4	↓	↓
Physically active	56.3	47.0	49.6	↓	=
Obesity	41.6	47.4	47.1	↑	=

Source: Ministry of Health, 2016

3.1.3 Burden of Disease and Risk Factors

Data analysed from the 2010 Global Burden of Disease (GBD) study revealed that out of the top ten risk factors (for disability-adjusted life-years), there was evidence for high risk-factor prevalence for Māori people for 9 of these factors (Wilson & Blakely, 2013);

(1) High body-mass index;

(2) Tobacco smoking (and for a gradient for second-hand smoke exposure);

(3) High blood pressure;

(4) Alcohol use (for hazardous use, not total consumption);

(5) Physical inactivity and low physical activity (sedentary behaviour only);

(6) High fasting plasma glucose;

(7) Diet low in fruit;

(8) High total cholesterol; and

(9) Drug use (particularly cannabis)

It is important to acknowledge that most of these risk factors are inter-related which is crucial when tracking and monitoring intervention programs. Addressing nine of the top ten risk factors from the GBD 2010 has the potential to reduce ethnic health inequalities in Aotearoa New Zealand. This could be achieved if interventions were structural, for example tobacco and alcohol taxes, and were appropriately targeted, through effective mass media campaigns using Māori television and Māori radio, and involving culturally appropriate health services. A particular priority to reduce health inequalities would appear to be tobacco control interventions, given that these can be pro-equity and generally appear to be cost effective. The risk factor difference was particularly high for current tobacco smoking for Māori men (41%) when compared with European or other

ethnic origins (17%) in 2011–12 (national survey of 12,370 adults). Māori men were 2.5 times more likely to be smokers than non-Māori after adjusting for age and sex differences (Wilson & Blakely, 2013).

Despite the overwhelming pressure of societal determinants to depress the health of Māori, some individual behaviour may improve Māori health status such as;

> (1) Taking sufficient exercise
>
> (2) Observing healthy nutrition
>
> (3) Attaining a minimum of 7 hours of quality sleep
>
> (4) Surrounding with positivity (King, Smith & Gracey, 2009).

All these factors reportedly contribute to an overall state of health and wellness which is often sought, but rarely observed, by the masses and perhaps more so by Māori. The New Zealand cardiovascular guidelines (Crooke, 2007) identify Māori, Pacific Peoples and people from the Indian subcontinent as being high-risk groups that should be targeted for risk assessment. It is recommended that risk assessment should be started ten years earlier for Māori, Pacific Peoples and people from the Indian subcontinent than for New Zealand Europeans (Grey, et al., 2010).

Durie (2003) indicates that although disparities in health outcomes for Māori are often the most stark, the underlying problems lay in other areas such as housing, education, and employment. These areas may have contributed to disparities by fostering illness, delaying care seeking, and discouraging good adherence to treatment. Quite often the one aspect of disparity that is highlighted is in the health sector. The determinants of inequalities in health for Māori are often outside the health sector domain, but the health

sector picks up the results of these disparities (Durie, 2003). As a result of this a different approach is required to make the next level of progress towards parity in healthcare (Alcorn, 2011).

The root causes of poor health 'the social determinants of health' are generally to blame for the state of the population health, and in particular indigenous health (Marmot, 2007). Although disparities persist within comparable income groups, they are more prominent amongst the lower socio-economic group (Alcorn, 2011). Such determinants are universally thought to include the classic socioeconomic indicators defined by the 1986 Ottawa Charter for Health Promotion which are:

    (1) Peace
    (2) Shelter
    (3) Education
    (4) Food
    (5) Income
    (6) A stable eco-system
    (7) Sustainable resources, and
    (8) Social justice and equity (World Health Organisation, 1986).

3.1.4 Income

Total personal income for Māori has varied across the previous data census collection with the $30,000 to $40,000 income group being the most common for Māori (see Table 4). It also reveals a deficit in the total median income for Māori compared with non-Māori being 25% lower in 2001, 17% in 2006 and 27% in 2013 (Statistics New Zealand, 2014).

Table 4   **Total personal income of resident New Zealand Māori population by census year**

Total personal income	2001 Census	2006 Census	2013 Census
Loss	2,619	2,277	2,484
Zero Income	16,845	19,410	38,355
$1–$5,000	32,901	28,911	27,801
$5,001–$10,000	46,923	31,968	26,760
$10,001–$15,000	46,290	41,322	38,361
$15,001–$20,000	30,726	32,430	34,728
$20,001–$25,000	25,434	29,031	26,904
$25,001–$30,000	26,001	29,400	24,960
$30,001–$40,000	30,816	49,248	45,471
$40,001–$50,000	14,550	26,352	32,148
$50,001–$70,000	9,864	21,942	38,379
$70,001–$100,000	2,892	7,047	18,363
$100,001 or More	2,100	4,080	9,225
Total people stated	287,958	323,427	363,936
Not Stated	41,841	41,979	32,346
Total people	329,799	365,406	396,288
Median income ($)Māori	14,800	20,900	22,500
Median income ($) ALL	18,500	24,400	28,500

Source: Statistics New Zealand, 2014

The gap between the national (total) median personal income and the median personal income for Māori increased from 2006 to 2013. Māori earned $3,500 less than the $24,400 national median income in 2006 (and was 85.7 percent of the national median income). Whilst the median personal income for Māori was $6,000 less than the $28,500 national median income in 2013 (and was 78.9 percent of the national median income) (Statistics New Zealand, 2014).

3.1.5 Education

In 2013, 36,072 Māori identified that they had attained a bachelor's degree or higher as their highest qualification (see Table 5), up 56.4% from 2006. Nearly 13% of Māori women and 7.4% of Māori men identified they had attained a bachelor's degree or

higher as their highest qualification (Statistics New Zealand, 2014). This is up from

8.4% for women and 5.6% for men in 2006. Of the Māori who identified they had

attained a bachelor's degree or higher as their highest qualification in 2013 there were;

(1) 75.0% had bachelor's degrees

(2) 13.2% had post-graduate and honours degrees

(3) 10.0% had master's degrees

(4) 1.8% had doctorate degrees

Māori have made positive gains in education and especially at the tertiary level as seen

by increases in academic qualifications reported (Ministry of Health, 2013d).

Table 5 **Identified highest academic qualification attained of resident New Zealand Māori population by number at the 2006 and 2013 census.**

Highest qualification	2006 Census	2013 Census
No qualification	130,146	119,544
Level 1 Certificate	56,325	60,894
Level 2 Certificate	37,620	46,467
Level 3 Certificate	30,843	40,542
Level 4 Certificate	27,450	31,533
Level 5 or Level 6 Diploma[2]	19,566	22,458
Bachelor's Degree and Level 7 Qualifications	17,907	27,057
Post-Graduate and Honours Degrees	2,532	4,752
Master's Degree	2,244	3,600
Doctorate Degree	387	666
Overseas Secondary School Qualification	1,464	1,770
Total people stated	**326,481**	**359,286**
Not Elsewhere Included	38,925	37,002
Total people	**365,406**	**396,285**

Source: Statistics New Zealand, 2014

Research evidence shows that 'those with higher levels of education are more likely to

participate in the labour market, face lower risks of unemployment, as well as having

greater access to further training and receive higher earnings on average' (Ministry of

Education, 2017)

3.1.6 Employment/ Unemployment

Māori men were more likely to be in full-time employment in 2013 than Māori women at 52.9% and 35.1%, respectively. While there were 223,926 Māori aged 15 years and over in full-time or part-time employment, a slight decrease of 0.6% since 2006.

The unemployment rate is defined as the number of unemployed people expressed as a percentage of the labour force (Ministry of Education, 2017). In the 2013 Census, the unemployment rate rose to 15.6%, up from 11.0% in 2006 (Ministry of Health, 2013d). By 2016, Māori had an unemployment rate of 11 percent, a slight decrease from the 12 percent in 2015. For Europeans the unemployment rate was 3.9 percent in 2016, down from 4.1 percent in 2015. The Māori unemployment rate is three times greater than the European unemployment rate. This difference in employment and subsequently their income is a contributing factor to Māori health and wellbeing status reported at lower rates than the New Zealand European population.

3.2 Quality of Life (QOL)

The Quality of Life Project was initiated in New Zealand in 1999 by collaboration between six of the largest cities represented in New Zealand's Local Government and Metro Sector forum (Auckland, Christchurch, Manukau, North Shore, Waitakere and Wellington) (Quality of Life Project, 2001). The project was a conjoint survey covering six cities to begin with, representing 40% of the NZ population, and then expanding to eight cities with 46% of the NZ population, (Quality of Life Project, 2003) then to 12 cities in the 2008 report (Quality of Life Project, 2008). Aimed at measuring NZ residents' perceptions of overall QOL the project was brought about in response to

growing pressure on urban communities, concerned about the impacts of urbanisation and the effects of this on the well-being of residents in New Zealand (Quality of Life Project, 2003).

The surveys (Quality of Life Project, 2001, 2003, 2007, 2008, 2012) presented of the largest cities and provided a lot of information obtained through indicators of social well-being for all New Zealanders. The most recent Survey (Quality of Life Project, 2014) found that the majority (82%) of the respondents in the Six Council areas rate their overall quality of life positively, with 20% rating it as extremely good and 62% as good. However, these reports tended to focus on population or universal indicators of well-being which are common to all New Zealanders but not specific to Māori. There is limited information on QOL indicators which are specific to Māori. One reason for this is the lack of data or poor quality data available on Māori specific indicators (Te Puni Kōkiri, 2007).

Durie (2003) noted that the important outcomes for Māori are likely to include outcomes relevant to the rest of society, such as good health and a high standard of living. An example of this can be seen from the 18th and 19th centuries where, groups as diverse as Māori, Australian Aborigines, native Hawaiians, the Saami of Norway, native Americans, and the First Nations of Canada were nearly decimated by infectious diseases brought in by colonisers such as measles, typhoid fever, tuberculosis, and influenza (Durie, 1998).

There is a paucity of studies conducted on QOL indicators pertaining to exercise in a general population. However, one study (Sach, et al., 2007) compared the relationship

between body mass index (BMI) and health-related quality of life (HRQL). A total of 1,865 patients responded with a mean BMI of 26.0 kg/m^2, including 16% obese (BMI >/=30). Patients with back pain, hip pain, knee pain, asthma, diabetes or osteoarthritis were also significantly more likely to be obese.

All survey measures indicated that, relative to a normal BMI, obesity is associated with a lower HRQL, even after controlling for patient characteristics and co-morbidity. These three measures are reportedly sensitive to the HRQL effects of obesity and can be used to estimate the cost-effectiveness of interventions designed to alleviate obesity (Sach, et al., 2007).

In another study addressing QOL and lifestyle intervention in primary health care, a total of 151 men and women, aged 18 to 65 years, were followed up and randomized to one of two groups (Eriksson, et al., 2010). These groups were (1) Lifestyle intervention group with supervised exercise sessions and dietary counselling for 3 months and (2) Control group for a three year follow up period. Changes in QOL were measured with several survey tools including the Short Form-36 and SF-36 Health Survey. At the end of the study period, those in the lifestyle intervention group had an improved sense of physical functioning, less bodily pain, and better vitality and social functioning than the control group (Eriksson, et al., 2010).

A pooled analysis of 9 cohort studies supports previous findings (Cesari, et al., 2009; Cesari, et al., 2005; Markides, et al., 1999) that a measure as simple as gait speed is a powerful predictor of an elderly person's longevity and functional status, thereby improving QOL (Studenski, et al., 2011). This review collected information from nine

different cohorts between 1986 and 2000. The data was analysed from 34,485 community-dwelling adults of both sexes, all older than 65 years. Every person enrolled in the study had their gait speed analysed at baseline. Subsequent follow-up lasted from 6 to 21 years and was dependent on the length of time to each participant's death. Although the predicted 10-year survival across the range of gait speeds varied from study to study, gait speed was nonetheless associated with survival in all of the studies (Ferrucci, Bandinelli, & Benvenuti, 2000; Lavsky-Shulan, et al., 1985; Markides, et al., 1999; Orwoll, et al., 2005; Visser, Deeg, Lips, Harris, & Bouter, 2000). Significant ($p<0.05$) increments in survival were noted for every 0.1ms increase in a person's gait speed (Studenski, et al., 2011).

A cross-sectional study of morbidity and health related quality of life of former rugby union players compared with (v) a matched general population based in the United Kingdom found that diabetes (2% v 9%), high blood pressure (28% v 37%) and heart related problems (18% v 24%) is significantly reduced in former elite rugby participants. Whereas for osteoporosis (4% v 1%), osteoarthritis (60% v 15%), joint replacement (24% v 6%), hip replacement (15% v 4%) and knee replacement (9% v 3%) they were significantly worse off after retiring from playing (Davies, et al., 2017). Morbidities that did not significantly differ between cohorts in sensitivity analyses were asthma, stroke, depression and dementia. There is the potential for these findings to be translated into increased provision of population-wide targeted player welfare for former elite rugby players. Participants have demonstrated some health deficits and some health advantages when compared to an age-matched representative general population sample, and strategies such as osteoarthritis-management and advice may be

feasible to implement and help improve health status for retiring elite players, and players in the future (Davies, et al., 2017).

3.3 Chronic Disease

Chronic disease affects the quality of life of many people in Aotearoa New Zealand and particularly Māori as health inequalities vary widely across condition groups (Blakely, et al., 2007). Adjusting for differences in population size and age structure, Māori sustain higher health loss than non-Māori for most condition groups (Ministry of Health, 2013a).

Leading specific conditions causing health loss in Māori in 2006 (see Table 6) indicate coronary heart disease is by far the leading cause of health loss for Māori, followed by anxiety and depressive disorders (Ministry of Health, 2013c).

Table 6   **Reported leading specific conditions causing health loss in resident New Zealand Māori in 2006 ranked by DALY and percentage.**

Condition	DALYs	Percent	Rank
1. Coronary heart disease	13,897	8.8	1st
2. Anxiety and depressive disorders	7964	5.0	2nd
3. Diabetes	6910	4.4	3rd
4. Lung cancer	6155	3.9	4th
5. Traumatic brain injury	6072	3.8	5th

Source: Ministry of Health, 2013c

There is a need to reduce the onset and incidence of diseases such as coronary heart disease (CHD) and cerebrovascular disease (CVA) which still account for 40% of all mortality in New Zealand (Hay, 2002). When compared by ethnicity, Māori are disproportionately affected by chronic disease resulting in severe consequences and usually in early death (Statistics New Zealand, 2007). Yet many of these deaths are

premature and preventable (Hay, 2002). Sharpe (2006) identified large and intolerable inequalities in cardiovascular risk, outcomes and access to medical services for Māori. Between 2000 and 2004 the mortality rate of ischaemic heart disease (IHD) of Māori males was three times higher when compared with non-Māori (Barnett, Moon, & Kearns, 2004). These ethnic disparities in IHD have persisted over three decades despite large investment in technology, medical and surgical management and health promotion (Blakely, et al., 2004).

In terms of diabetes and coronary heart disease, the health loss in Māori is at least 2.5 times higher when compared with non-Māori (Ministry of Health & Accident Compensation Corporation, 2013). However, Māori experience greater social and economic disadvantage that is reflected in persistent health inequalities including ischaemic heart disease IHD (Reid & Robson, 2007). Lung cancer was another leading cause of health loss for Māori in 2006, but was not in the top five (see Table 10) for non-Māori (Ministry of Health, 2013a). Diabetes featured in the top five causes of health loss for both Māori and non-Māori of either gender (Ministry of Health, 2013a). However, the rank order differs (see Table 7) between the ethnic groups, with diabetes, lung cancer, and traumatic brain injury being more highly ranked among Māori (although also quite highly ranked among non-Māori).

Table 7   **Reported leading specific conditions causing health loss in resident total population in New Zealand in 2006 ranked by DALY and percentage.**

Condition	DALYs	Percent	Rank
1. Coronary heart disease	89,159	9.3	1st
2. Anxiety and depressive disorders	50,954	5.3	2nd
3. Stroke	37,688	3.9	3rd
4. Chronic obstructive pulmonary disease (COPD)	35,339	3.7	4th
5. Diabetes	28,808	3.0	5th

Source: Ministry of Health 2013a

The burden of anxiety and depressive disorders increased from 5.3% to 6.9% of total DALYs over the 2006-2010 reporting period when the indirect impact of these disorders as a risk factor for suicide, self-harm and coronary heart disease is included (Ministry of Health, 2013a). Suicide was the fourth leading cause of death for Māori males and the second leading cause of death for non-Māori males (Ministry of Health, 2010). Apart from suicide for males, the major cause of death were all chronic diseases, regardless of gender or ethnicity (Ministry of Health, 2009b). The demographic socioeconomic position has been reported to be a major determinant for the health of the Māori population with those living in lower socio-economic households experiencing poorer health outcomes and a shorter life expectancy (Ministry of Health, 2008b).

Healthy older adults who regularly participated in physical activity of at least moderate intensity for more than one hour per week had higher health related quality of life (HRQL) measures in both physical and mental domains than those less physically active (Acree, et al., 2006). Therefore, incorporating more physical activity into the lifestyles of sedentary or slightly active older individuals may improve their HRQL and reduce risk of early death (Acree, et al., 2006). Although New Zealander's are now living longer, not all of this time is spent in good health. The small expansion estimated in poor health between 2006 and 2016 adds impetus to prioritising policies that reduce morbidity as well as mortality (Ministry of Health, 2013a).

New Zealand is undergoing a 'disability transition', with 50% of health loss now accounted for by non-fatal, disabling conditions such as type II diabetes mellitus, high BMI, hypertension, hyperlipidaemia, and physical inactivity, and this proportion is

projected to increase (Ministry of Health, 2013e). On an absolute scale, the major contributors to health loss in Māori are different, with 26% of the total excess burden accounted for by vascular disorders, 15% by cancers, 12% by mental disorders, 11% by injury and 9% by diabetes and other endocrine disorders (Ministry of Health, 2013a) and this is projected to increase (Ministry of Health, 2013e). Further evidence indicates that several conditions which, though not necessarily major contributors on an absolute scale, dominate the picture on a relative scale. Among these, rheumatic heart disease, viral hepatitis, cardiomyopathy, hypertensive heart disease, bronchiectasis and drug use disorder are particularly noteworthy because health loss per capita is at least four times as high in Māori as in non-Māori (Ministry of Health, 2013c).

On-going and new challenges facing both Māori and non-Māori include mental health disorders, neurological conditions (including dementia), musculoskeletal conditions (including osteoarthritis and back disorders), chronic pain syndromes, sleep disorders and reproductive disorders (Ministry of Health & Accident Compensation Corporation, 2013). There is considerable scope for prevention, with tobacco use, diet, physical activity, alcohol, obesity and diabetes all important potentially modifiable risks to health (Ministry of Health, 2013a, 2013c, 2013e; Ministry of Health & Accident Compensation Corporation, 2013).

Results from current New Zealand surveys indicate an increasing prevalence of most chronic diseases over the next decade, and probably longer (Ministry of Health, 2013a, 2013d). This means more people will be living with chronic diseases. However, increasing prevalence does not usually result from rising incidence (new cases) of disease, with the exception of diabetes. Instead, increasing prevalence occurs because

mortality rates are declining more quickly than incidence, which means the number of people living with chronic diseases rises.

3.3.1 Ischaemic Heart Disease (IHD)

Ischaemic heart disease (IHD) is a condition where there is insufficient blood and oxygen flow to heart muscle (myocardium), primarily due to a mismatch of supply and demand. This is most commonly as a result of coronary artery disease (CAD) due to atherosclerosis (the process of progressive inflammation, lipid deposition and narrowing of medium to large blood vessels) reducing the blood supply to the myocardium (National Health Committee, 2013).

More common in males, and Māori, the IHD mortality rate has been steadily declining across all subgroups since a peak in the 1960s and 1970s (Hay, 2002). Of the disparities observed across all socioeconomic determinants of health the mortality and morbidity indicators report IHD as the leading cause of death for both Māori and non-Māori (Robson & Purdie, 2007; Sharpe, 2006). Māori adults were nearly twice as likely to be diagnosed with IHD when compared with non-Māori (see Table 8), after adjusting for age and sex differences (Ministry of Health, 2013d).

Table 8   **Adjusted rate ratio of adults diagnosed with ischaemic heart disease by gender, ethnicity and socioeconomic deprivation from the 2012/2013 New Zealand Health Survey**

Comparison group	Rate-Ratio
Men vs. Women	1.7*
Māori vs. non-Māori	1.8*
Pacific vs. non-Pacific	1.4
Asian vs non-Asian	1.0
Most vs. least deprived	1.7*

* = Significant difference ($p<0.005$) between the two groups
Source: Ministry of Health, 2013d

Mortality rates for IHD have been steadily declining in New Zealand since the late 1960's largely due to reductions in three identified risk factors (Hay, 2002). The three risk factors identified were: (1) Systolic blood pressure, (2) Total blood cholesterol and (3) Cigarette smoking (Tobias, et al., 2008). High body mass, high blood glucose, high blood cholesterol and decreased physical activity have all been linked to IHD. The identified cardiovascular risk factor indicators for Māori, when compared with non-Māori were smoking (44% vs. 14%), body mass index (BMI) (29.0 vs. 26.5) and diabetes serum glucose of (5.16 vs. 4.92 millimoles per Litre (mmol/L) (Bramley, et al., 2004).

The risk factor definitions, sources of exposure data, the theoretical minimum risk exposure distribution (TMRED), linked conditions and source of relative risks in New Zealand can be seen in Table 9 (Ministry of Health, 2013e).

Although age-standardised IHD mortality rates have decreased between 1980 and 2010, IHD remains the second largest cause of death, behind cancer, accounting for nearly a

fifth of all deaths. In addition, Māori males had the highest age-standardised IHD mortality rate in 2010 (56%) when compared with non-Māori males. For Māori females, there was nearly two-fold increased IHD mortality rate when compared with non-Māori females (Ministry of Health, 2013b).

Table 9   **Summary of risk factors, exposure definitions, sources of exposure data, theoretical minimum risk exposure distributions (TMRED) and linked conditions for chronic disease in New Zealand.**

	Risk factor	**Exposure definition**	**Source of exposure data**	**TMRED**	**Linked Conditions**
1.	High body mass index	Body mass (kg/m^2)	2006/07 New Zealand Health Survey (Ministry of Health 2008b)	Mean (SD) 21–23 (1.1–1.8) kg/m^2	Ischaemic heart disease, ischaemic stroke, hypertensive heart disease, diabetes mellitus
					Cancers: oesophageal, gall bladder, pancreatic, kidney, breast, uterine, colon and rectum
					Osteoarthritis
2.	High blood pressure	Systolic blood pressure (mmHg)	2008/09 Adult Nutrition Survey (University of Otago & Ministry of Health 2011)	Mean (SD) 110–115 (4–6) mmHg	Ischaemic heart disease, ischaemic stroke, haemorrhagic stroke, hypertensive heart disease
3.	High blood glucose	Fasting plasma glucose (mmol/L) (modelled from HbA1c)	2008/09 Adult Nutrition Survey	Mean (SD) 4.9–5.3 (0.4–0.6) mmol/L	Ischaemic heart disease, stroke, diabetes mellitus
4.	High blood cholesterol	Total cholesterol (mmol/L)	2008/09 Adult Nutrition Survey	Mean (SD) 3.8–4.0 (0.50–0.65) mmol/L	Ischaemic heart disease, ischaemic stroke
5.	Physical inactivity	Physical activity categories: 0. Inactive 1. Low active 2. Moderately active 3. Highly active	2006/07 New Zealand Health Survey	All individuals highly active (level 3)	Ischaemic heart disease, ischaemic stroke, diabetes mellitus, breast cancer, colon cancer

Source: Ministry of Health, 2013e

3.3.2   Cardiovascular Disease (CVD)

Māori death rates from CVD were two times higher than for non-Māori during the 2000-2004 period (Robson & Purdie, 2007). Māori men have a particularly bad

prognosis in terms of health and are reported to be the most vulnerable group in New Zealand for developing cardiac related diseases (Brown, et al., 2010). Māori men fare poorly in terms of health status experiencing a disproportionately high burden of disease when compared with other population groups in New Zealand (Jones, Crengle, & McCreanor, 2006). Cardiac related diseases remain the most prolific contributor to the adverse health profile of indigenous people both as a cause of mortality and as a contributor to the life expectancy gap between Māori and the non-Māori population (Statistics New Zealand, 2002).

Blood serum lipids signal important risk factors for cardiovascular disease including death due to heart attack or stroke). Meta-analyses indicate that a reduction of 0.6 mmol/L in total serum cholesterol results in approximately 27% lowering of death from coronary heart disease (Law, Wald, & Thompson, 1994). Further, for every 1.0 mmol/L reduction in lower density lipoprotein (LDL) cholesterol there is about a 20% reduction in risk of heart attacks and strokes over 5 years (Baigent, et al., 2005). Either increasing high density lipoprotein (HDL) or lowering LDL cholesterol is associated with a reduction in heart disease risk. This dual effect can be captured by using the ratio of total cholesterol to HDL cholesterol. The total to HDL cholesterol ratio is seen to be a better indicator of cardiovascular events than using the individual lipids separately (Criqui & Golomb, 1998). Elevated triglyceride (TG) levels have also been confirmed as an independent risk factor for cardiovascular disease in meta-analyses (Hokanson & Austin, 1996).

Both Māori and Pacific people have higher TG levels, lower HDL cholesterol levels, and are more likely to be overweight or obese than other ethnicities (Metcalf, Scragg,

Willoughby, Finau, & Tipene-Leach, 2000). These factors are the main determinants of the various metabolic scores that have been developed. While these factors may be more common in Māori and Pacific peoples, the prevalence is high in all ethnic groups in Aotearoa New Zealand (Metcalf, et al., 2000). Pihl and Jurimae (2001) evaluated cardiovascular disease risk in former Scandinavian athletes according to their weight-change patterns during the post-competitive period. Weight gain over 10.0 kg in former athletes was associated with, increased percentage body fat, increased skinfold thickness, higher blood pressure, higher LDL higher cholesterol, and higher TG values. Lower HDL cholesterol and a lower physical working capacity were also observed with the weight gain (Pihl & Jürimäe, 2001).

In 2007, a total of 281,333 people in Aotearoa New Zealand were estimated to have CVD as defined by the Chan study (see Table 10). Māori represented 9.7 %, Pacific peoples 4.1 %, and Indians 1.4 % of people with CVD in Aotearoa New Zealand (Chan, et al., 2008).

Table 10   **Incidence of cardiovascular disease for total New Zealanders, Māori, Pacific peoples, Indian and Other ethnicities resident in New Zealand in 2008.**

Variables	New Zealand (Total)	Māori	Pacific Peoples*	Indian	'Other'
Number of people diagnosed with CVD	281,333	27,127	11,488	4,018	238,610
Population Number	4,191,388	570,356	286,282	102,267	3,232,483
Crude prevalence (%)	6.71	4.77	4.01	3.93	7.38
Age-standardised Prevalence (%) (95% CI)	4.77 (4.75-4.78)	7.41 (7.33-7.49)	5.68 (3.58-5.77)	4.96 (4.81-5.10)	4.45 (4.44-4.47)

CI = Confidence interval; *= Mostly of Samoan, Tongan, Niuean or Cook Islands origin
Source Chan, et al., 2008

The remainder (84.8 %) of people with CVD were mainly of European descent and are referred to here as 'Other' New Zealanders. Māori had the highest age-standardised prevalence of CVD, which was 67 % higher than among 'Other' New Zealanders. One of the most concerning statistics for Māori males is the early onset of CVD as opposed to other sub-populations. Consistent with the literature, it found Māori to be at the greatest risk of CVD (Bramley, et al., 2004). The findings suggest that some of the biggest gains for Māori in CVD risk reduction are smoking prevention/cessation, diabetes prevention/management and an increase in physical activity (Chan, et al., 2008).

Studies have been conducted on the beneficial effects of exercise on the prevention and treatment of coronary artery disease (CAD) (Belardinelli, Georgiou, Cianci, & Purcaro, 1999; Coats, et al., 1992; Jolliffe, et al., 2001; McKelvie, 2008). A Cochrane analysis published in 2001 concluded that an exercise-based program for cardiac rehabilitation reduced all-cause mortality by 27%. Although the information was limited by the fact that the studies reviewed contained predominantly male subjects and that ethnicity was inconsistently reported, the overall message was clear, that exercise is an effective adjunctive therapy in the treatment of CAD (Jolliffe, et al., 2001).

For the past few decades, researchers have studied the effect of exercise on left ventricular dysfunction and the accompanying metabolic and autonomic neurologic derangements present in those with heart failure (Coats, et al., 1992). A review of these studies concluded that exercise training remains a relatively safe, non-pharmacological therapy for people with heart failure, even in those with moderate to severe heart failure (Smart, 2009). More importantly, the beneficial effects on functional capacity, QOL,

and clinical outcome could be maintained during an extended period (Belardinelli, et al., 1999) as evidence has been accumulated supporting the effectiveness of exercise training to improve fitness levels and symptoms (McKelvie, 2008).

3.3.3 Diabetes Mellitus

Diabetes is a common chronic disease internationally with significant morbidity, mortality and cost, and the prevalence continues to increase rapidly worldwide (Whiting, Guariguata, Weil, & Shaw, 2011). Diabetes is a concerning health issue for Māori (Kenealy, et al., 2008) and three times more prevalent compared with non-Māori (Sundborn, et al., 2007). The mortality rate in Māori between the ages of 45 to 64 years due to diabetes are nine times higher than non-Māori New Zealanders of the same age (Joshy, Colonne, Dunn, Simmons, & Lawrenson, 2010). Compared with non-Māori, Māori are more likely to have a range of adverse risk factors for diabetes. These are (1) They are diagnosed with diabetes at a younger age, (2) Have higher BMI increasing the risk of developing diabetes, and (3) Develop more renal, foot and eye complications as a result of developing diabetes (Gentles, et al., 2007; Joshy, et al., 2010).

In a recent study, (Simmons, Rush, & Crook, 2009) the prevalence of diagnosed to undiagnosed diabetes in Māori males (10:3 for Māori and 10:1 for New Zealand European Other) was higher than in the Diabetes Heart and Health Study (Sundborn, et al., 2007). Despite these finding, the prevalence was comparable to the 'Ngāti and Healthy Project' (Tipene-Leach, et al., 2004). It has been identified that abnormal glucose tolerance, particularly undiagnosed diabetes, is high among Māori men and the very obese (Simmons, et al., 2009). However, there remains the opportunity to reduce Māori morbidity and premature mortality through the identification of type II diabetes

and appropriate interventions with suitable treatment (Simmons, et al., 2009). Another report recently highlighted the overall prevalence of diabetes in New Zealand was 7.0%, and pre-diabetes was 25.5%. The prevalence of diabetes was higher in men (8.3%) than women (5.8%), and was markedly higher among the obese group (14.2%) compared with that of normal weight (2.5%) (Whiting, et al., 2011).

3.4 Smoking

A recent review of Māori smoking and tobacco use highlighted that smoking is the leading cause of preventable death in New Zealand. Smoking is reported to be directly linked to almost 5,000 deaths each year, of which approximately 400 are attributed to second-hand smoke exposure (Gracey & King, 2009). It has been reported that non-smokers on average live 15 years longer than long-term smokers (Ministry of Health, 2008b).

The highest smoking rates persist among Māori adults and has been the case for many years (Ministry of Health, 2014). Over the 2000/04 reporting period, lung cancer was responsible for more deaths of Māori (31 % vs. 17 %) when compared with non-Māori.

Table 11   **The adjusted rate ratio of adults who are daily current smokers (at least monthly, weekly or daily) by gender, ethnicity and socioeconomic deprivation status.**

Comparison group	Rate-Ratio
Men vs. Women	1.1
Māori vs. non-Māori	2.7*
Pacific vs. non-Pacific	1.3*
Asian vs non-Asian	0.4*
Most vs. least deprived	3.1*

* = Significant difference ($p<0.05$) between the two groups
Source: Ministry of Health, 2013d

Deaths related to respiratory disease were three times more frequent in Māori than non-Māori and cerebrovascular disease death rates were two times higher for Māori than for non-Māori during the same period (Salmond, Crampton, & Atkinson, 2007). In 2012/13, Māori continued to have the highest rates of daily and current smoking (see Table 11). Around four in ten (39 %) Māori adults were current smokers, and there were significantly more Māori female smokers (42 %) than Māori male smokers (37 %) (Ministry of Health, 2014). Links have also been found between income levels and smoking rates (Ministry of Health, 2008b). These associations highlight the fact that smoking is a contributing factor to the health inequalities seen between Māori and non-Māori (Ministry of Health, 2009b). Smoking rates are also higher in low decile (most deprived) (28%) when compared with high (9%) decile areas (Ministry of Health, 2013d).

In recent years, New Zealand has witnessed a rapid decline (see Figure 8) in tobacco consumption, which has fallen more than in most other developed countries (Ministry of Health, 2008a). While the prevalence of current smokers in New Zealand has dropped, such positive trends and smoking prevalence among certain social and ethnic groups remain high (Barnett, Pearce, & Moon, 2009). Research has shown that risk factors such as smoking tobacco and how much people smoke need to be understood in relation to the life circumstances of individual smokers i.e. there is a strong link between people who experience deprivation and smoking (Salmond, et al., 2007).
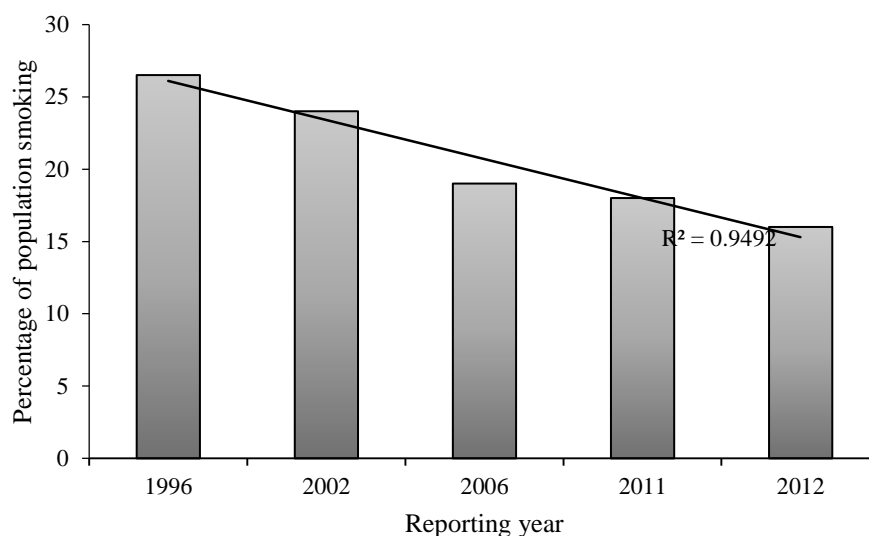
Figure 8   **Percentage of population smoking daily by age standard prevalence by reporting year for the 1996 to 2012 reporting periods.**
Source: Ministry of Health, 2013d

Evidence suggests that the percentage of people who smoke have continued to decline, although the trend is still higher in Māori when compared with non-Māori (Ministry of Health, 2013d). In 2006, 40 % of Māori were regular smokers compared to only 17 % of New Zealanders of European origin (Ministry of Health, 2008a). Māori women continue to have one of the highest smoking rates in the world in contrast to European women who smoke less than European males (Barnett, et al., 2009). Unfortunately, these actions come at a cost, with high rates of lung cancer being a primary cause of death in Māori (Blakely, et al., 2007). Links have also been found between income levels and smoking rates (Ministry of Health, 2008b). These associations highlight the fact that smoking is a contributing factor to the health inequalities seen between Māori and non-Māori (Ministry of Health, 2009b).

3.5 Alcohol

Surveys comparing alcohol drinking behaviour between Māori and non-Māori has identified that Māori (15–21 %) were more likely to be non-drinkers compared with

non-Māori (11–16 %) (Bramley, et al., 2003; Ministry of Health, 2009a). Data from the 2007/08 survey presented below indicates the prevalence and Māori drank less often - see Table 12 (Ministry of Health, 2009a).

Table 12   **Prevalence of alcohol consumption in the last 12 months among total population in New Zealand aged 16–64 years by ethnicity group.**

Ethnic group	Prevalence (%) (95% CI)	Estimated number of adults
European/Other	90.3 (89.0–91.7)	1,878,600
Māori	85.0 (83.2–86.9)	278,500
Pacific	61.2 (57.0–65.3)	94,500
Asian	54.8 (48.2–61.5)	121,600

Source: Ministry of Health, 2009a

It was also reported that Māori drank more on a typical occasion (binge drinking) at levels consistent with hazardous drinking but, non-Māori consumed alcohol more frequently (see Table 13) when compared with Māori (Ministry of Health, 2010). These differences remain after adjustment for BMI and tobacco smoking (Ministry of Health, 2009a).

The relationship between alcohol consumption and cardiovascular disease mortality has been investigated in numerous studies (Maclure, 1993a; Maclure, 1993b). Several case control studies in non-Māori New Zealanders have shown that low to moderate alcohol consumption is associated with a reduced risk of coronary disease in middle-aged and older people (Bramley, et al., 2006; Corrao, Rubbiati, Bagnardi, Zambon, & Poikolainen, 2000).

Table 13   Unadjusted prevalence of drinking alcohol daily in the last 12 months for past-year drinkers, total adults aged 16–64 years and estimated number of adults by ethnic group.

Ethnic group	Prevalence for past-year drinkers % (95% CI)	Prevalence for total adults % (95% CI)	Estimated number of adults
European/Other	7.6 (6.7–8.4)	6.8 (6.0–7.6)	141,900
Māori	4.2 (3.2–5.3)	3.6 (2.7–4.5)	11,800
Pacific	2.0 (0.9–4.0)	1.2 (0.5–2.5)	1,900
Asian	2.4 (0.5–6.7)	1.3 (0.3–3.7)	2,900

Source: Ministry of Health, 2009a

Previous studies on cardiovascular risk factors and alcohol consumption of New Zealanders had large Māori representation (Harris, 2003; Ministry of Health, 1999b; National Institute for Health Innovation, 1992, 2000; Scragg, Baker, Metcalf, & Dryson, 1991; Statistics New Zealand, 1997). The findings from these studies highlight that:

(1) **Risk factors:** Māori have higher cardiovascular risk when compared with non-Māori. For many of the risk factors, there are clear associations between one or more indicators of alcohol consumption and the risk factor of interest, which do not differ between Māori and non-Māori (National Institute for Health Innovation, 1992).

(2) **Cholesterol measures:** there were no statistically significant differences for reported diagnosis of diabetes, and serum glucose level in association with alcohol consumption between Māori and non-Māori. However, there is a highly significant ($p<0.001$) difference for systolic blood pressure in volume usually consumed and in frequency of alcohol consumption (Scragg, et al., 1991).

(3) A comparison of alcohol consumption data (see Table 14) indicates that most (83.6%) participants reported that they did consume alcohol. This

was higher than the 80.7% reported in the New Zealand Health and Nutrition Survey (Ministry of Health, 1999a) but lower than the Fletcher Challenge/University of Auckland Study (89.1%) (National Institute for Health Innovation, 1992).

Table 14   **Summary of indicators of alcohol consumption from study surveys.**

Variable	Total	Blood Donor(National Institute for Health Innovation, 2000)	FC / UoA (National Institute for Health Innovation, 1992)	NZHS (Statistics New Zealand, 1997)	Sleep(Harris, 2003)	Workforce diabetes(Scragg, et al., 1991)
No of people	44,830	17,437	7,936	6,909	9,928	5,620
Drinker	83.6	81.0	89.1	80.7	83.3	87.4
Non-drinker	16.4	19.0	10.9	19.3	16.7	12.6
Frequency of drinking						
0-9 days/year	19.4	19.2	19.6	19.7	16.8	-
10-34 days/year	21.2	17.2	10.6	25.6	39.2	-
35-74 days/year	21.0	17.9	10.6	25.6	39.2	-
75-184 days/year	21.3	23.7	28.4	19.9	8.5	-
185+ days/year	17.6	22.0	20.3	11.9	8.9	-
Volume pure alcohol drunk on typical occasion (%)						
0-<5 gm	17.3	19.4	11.4	19.6	16.9	-
5-<20 gm	24.3	21.1	14.3	44.6	23.8	-
20-<40 gm	34.2	38.0	40.7	17.1	34.2	-
46-<60 gm	9.2	8.9	8.3	9.5	10.6	-
60+ gm	14.9	12.7	25.3	9.2	14.5	-
Average daily volume per alcohol drunk (%)						
0.0-<0.2 gm	20.3	19.4	17.4	19.6	30.4	15.5
0.2-<2.0 gm	18.5	15.1	9.7	33.4	23.8	16.5
2.0-<6.0gms	18.2	19.9	18.4	21.5	11.9	16.9
6.0-<15.0 gm	23.7	28.1	29.1	15.7	15.8	22.1
15+ gm	19.3	17.5	25.5	9.9	18.1	29.0

Blood Donor = NZ Blood Donors Health Survey (1998-1999); FC / UoA = Fletcher Challenge / University of Auckland Survey (1992); NZHS = New Zealand Health Survey (1997); Sleep = Sleep Survey (1999); Workforce Diabetes = Workforce Diabetes Survey (1998-1990).
Source: Bramley et al., 2006

Considerable variations were seen in the proportions of people classified at different levels of alcohol consumption, as described by frequency of drinking and volume

consumed on a typical occasion. Regardless of the methodology used to capture the data it is evident that alcohol consumption in New Zealand is high (Bramley, et al., 2003).

In further analysis of the data from New Zealand studies (national and population specific) conducted since 1988, the data was re-analysed by Māori and non-Māori classification using multivariate modelling adjusting for sex and age (Bramley, et al., 2006). Three indicators of alcohol consumption were used:

(1) Frequency of drinking,

(2) Volume drank on a typical or usual occasion, and

(3) Average daily consumption.

Interaction terms were used to test for differences between Māori and non-Māori in the associations between alcohol consumption and cardiovascular risk factors (tobacco smoking, systolic and diastolic blood pressure, high density lipoprotein (HDL), the ratio of total cholesterol to HDL, serum glucose, reported diagnosis of diabetes, and body mass index). There was no evidence of a different association for Māori when compared with non-Māori between lipid profile and alcohol consumption. However, there were quite different associations for tobacco smoking. For Māori, low and high levels of frequency of drinking are associated with a lower proportion of current smokers. For non-Māori, there is a consistent significant increase (p=0.0001) in smoking with frequency of drinking (Bramley, et al., 2006).

The associations between blood pressure and one of the measures of alcohol intake (volume usually consumed) are different for Māori when compared to non-Māori. For non-Māori, increasing volume usually consumed is associated with higher systolic, diastolic, and adjusted systolic blood pressure. In contrast, the pattern is more variable for Māori. Although Māori have a higher proportion with a diabetes diagnosis, and

higher serum glucose levels, no differences between Māori and non-Māori were evident

in the associations with alcohol consumption (Bramley, et al., 2006).

Table 15   **Alcohol consumption by gender, frequency of drinking, volume consumed and average daily volume for Māori and Non-Māori.**

			Non-Māori	Māori
Number (%)			37,904 (84.6)	6,926 (15.4)
Sex and age group				
	Males			
		15-34 yrs.	14.2	14.6
		35-49 yrs.	23.5	22.7
		50-74 yrs.	17.6	13.8
	Females			
		15-34 yrs.	14.9	16.2
		35-49 yrs.	17.4	20.3
		50-74 yrs.	12.4	12.5
Non-drinker (%)			15.6	21.1
Drinker (%)			84.4	78.9
Frequency of drinking (%)				
	0-9 days/year		19.4	25.2
	10-34 days/year		18.3	33.9
	35-74 days/year		19.9	24.0
	75-184 days/year		22.8	11.3
	185+ days/year		19.6	5.7
Volume pure alcohol drunk on typical occasion (%)				
	0-<5 gm		16.4	22.1
	5-<20 gm		26.3	14.3
	20-<40 gm		36.3	23.6
	46-<60 gm		8.7	11.4
	60+ gm		12.2	28.5
Average daily volume per alcohol drunk (%)				
	0.0-<0.2 gm		19.0	27.6
	0.2-<2.0 gm		17.9	21.7
	2.0-<6.0gms		18.6	16.5
	6.0-<15.0 gm		25.2	15.5
	15+ gm		19.4	18.7

Source: Bramley et al., 2003

It has been reported that drinking patterns for Māori and non-Māori were different.

Overall, Māori drink less often with higher volumes per occasion, resulting in similar

average daily levels of alcohol consumption. Despite this finding, there were similar

distributions of alcohol consumption by sex and age, and there were no differences in

indicators of alcohol consumption between Māori and non-Māori participants (see Table 15). Unadjusted comparisons indicate that Māori tend to drink alcohol less often (albeit more volume per occasion) than non-Māori (Bramley, et al., 2003).

3.5.1 Alcohol in Sport

In a study covering 29 non-elite sporting codes it was reported that athletes born in Australia, United Kingdom, Ireland and New Zealand were significantly ($p=0.008$) associated with excessive drinking. Males aged 18 to 29 who played rugby league or indoor cricket, and had access to a licensed premise, were more likely to be associated with excessive drinking (Black, Lawson, & Fleishman, 1999). The finding that rugby league players were associated with excessive drinking supported a previous study that reported excessive alcohol consumption amongst non-elite rugby league sports-people (Lawson & Evans, 1992).

By incorporating the Alcohol Use Disorders Identification Test (AUDIT) questionnaire (Babor, de la Fuente, Saunders, & Grant, 1992) on a purposive sample ($n=1,279$) from various sporting codes, drinking behaviour was assessed. To ascertain drinking behaviour participants were asked if they personally, their team, or club received free and/or discounted alcohol and/or funding from an alcohol industry body (e.g. pub, brewery, wholesaler); how much they received; and whether they felt they should drink their sponsor's product and/or at the sponsor's premises. It was reported that nearly half (48%) of the participants received sponsorship and 47% reported receiving free and/or discounted alcohol products. In assessing the effects of this through multivariate models, it was reported that the individual, team and club level had AUDIT scores that

were, on average, 2.4 (0.70 to 4.09) points higher than those who received no sponsorship (O'Brien & Kypri, 2008).

In community sports clubs throughout Australia high levels of alcohol consumption and alcohol-related harm have been reported among non-elite rugby league players with reported levels of alcohol consumption between 4 and 9 times the recommended level of alcohol per drinking session (Lawson & Evans, 1992). In New Zealand non-elite sportspeople have reported higher levels of harmful alcohol consumption (51%) than non-sportspeople (31%) (O'Brien, Blackie, & Hunter, 2005), whilst in Ireland non-elite Gaelic football and hurling players have reported higher levels of alcohol consumption (32%) compared to a national representative sample of men of a similar age (15%) (O'Farrell, Allwright, Kenny, Roddy, & Eldin, 2010).

There is a drinking culture in sport with sports clubs relying on alcohol sponsorship to boost club memberships. This is more evident today with social media playing a big part in that process. Significant research has explored the public health implications associated with traditional alcohol advertising and information is emerging about how alcohol brands are interacting with consumers through various forms of digital media, shaping attitudes and consumption (Jones & Jernigan, 2010; McCreanor, et al., 2013). In Australia the alcohol-related contribution to sponsorship, based on 2007 estimates, is approximately $50 million from a total pool of $600 million. This significant level of sponsorship utilises a mix of traditional and digital media as brands seek to positively leverage their association with sport (Jones, 2010).

3.6 Body Composition

There are several published studies on anthropometric and physiological characteristics of rugby league at the junior, amateur, semi-professional and professional levels of participation (Gabbett, 2000a; Gabbett, 2002, 2005b, 2006; King, Hume, Milburn, & Guttenbeil, 2009c). A review of the anthropometric and physiological characteristics identified the differences between participation levels highlighting the disparity between amateur, semi-professional and professional levels of participation (Johnston, Gabbett, & Jenkins, 2014). Despite the number of studies published there is a paucity of anthropometric data pertaining to amateur rugby league participants and there are no published studies on anthropometric characteristics of Māori rugby league participants.

Another review by King et al. included 26 studies and provided a detailed examination of anthropometric and physiologic aspects of rugby league players (King, et al., 2009c). Percentage Body Fat (%BF) values for forwards and backs reported as Mean (±SD) were 15.2 ±3.4 and 12.6 ±3.2 respectively for professional (Brewer, Davis, & Kear, 1994) semi-professional 17.6 ±4.4; 15.2 ±4.1 (Gabbett, 2005b) and amateur players 19.9 ±3.7; 17.5 ±5 (Gabbett, 2000a). The 2008/09 New Zealand Adult Nutrition Survey reported that Māori males had a higher mean body mass index BMI (29.9 kg/m^2 vs. 27.6 kg/m^2) when compared with non-Māori males and they were 1.5 times more likely to be obese compared to non-Māori males (Ministry of Health, 2012).

Previous research has been undertaken to evaluate body size and composition of Polynesian (Māori and Samoan) and European population groups in NZ utilising Bioelectrical Impedance Analysis (BIA) (Swinburn, Craig, Daniel, Dent, & Strauss, 1996; Swinburn, Ley, Carmichael, & Plank, 1999). The use of BIA allows body fat to

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be measured quickly and easily and is suitable for field use. Swinburn et al (1999) identified the general, and body composition characteristics of the Samoan, Māori and European males (see Table 16).

Table 16   Demographics, body mass index, body composition, bioelectrical impedance and skinfolds of male New Zealand resident Māori, and Europeans by means and standard deviation.

		Māori		European	
		Male		**Male**	
		Mean ±SD		**Mean ±SD**	
Age (year)		42.4 ±14.3[b]		36.5 ±13.1[a]	
Weight (kg)		92.1 ±15.4[b]		80.3 ±11.9[a]	
Height (m)		1.74 ±6.9[b]		1.77 ±6.4[a]	
BMI(kg/m^2)		30.5 ±5.0[b]		25.6 ±3.5[a]	
Body composition (DXA)					
	Body fat (%)	27.8 ±8.1[b]		20.7 ±8.0[a]	
	Fat mass (kg)	26.6 ±10.7[b]		17.4 ±8.9[a]	
	Fat-free soft tissue (kg)	62.6 ±7.3		60.3 ±5.8	
	Bone mineral contents (kg)	3.4 ±0.4		3.3 ±0.4	
	Bone mineral density (g/bm^2)	1.28 ±0.09[b]		1.24 ±0.09[a]	
Bioelectrical impedance					
	Resistance (Ω)	409.1 ±50.5[b]		457.2 ±44.8[a]	
	Reactance (Ω)	49.8 ±10.3[b]		55.8 ±8.8[a]	
Skinfolds*					
	Triceps (mm)	15.3 ±8.3		13.0 ±7.0	
	Biceps (mm)	9.9 ±6.1[b]		5.4 ±3.7[a]	
	Subscapular (mm)	24.5 ±10.1[b]		15.0 ±7.6[a]	
	Suprailiac (mm)	24.2 ±12.9[b]		180.1 ±9.3[a]	
	Sum of four skinfolds (mm)	73.4 ±31.1[b]		50.9 ±25.0[a]	
	Sum of two skinfolds (mm)	25.2 ±13.2[b]		18.3 ±10.1[a]	

kg = kilograms; m = metres; kg/m^2 = kilogram per square meter; DXA = Dual-energy X-ray absorptiometry; % = percentage; g/cm^2 = grams per square centimetre; Ω = ohms; mm = millimetres; Significant difference (p<0.001) than (a) = European (b) = Māori; * = some study participants removed because of large differences (>3kg) between recorded weight DXA weight outlier between BMI body fat
Adapted from Swinburn et al, 1999

These findings indicate that although the Polynesian groups had a higher mean fat mass and percentage body fat than the European group, their corresponding body fat levels at higher equivalent BMI values were significantly lower than for Europeans. The results

of this study identified that there are distinct differences in body composition between Europeans and Polynesians. Polynesians with a BMI over 25 kg/m2 have more fat-free mass (FFM) and less fat mass (FM) than Europeans at equivalent BMI levels (Swinburn, et al., 1999).

It is difficult to describe an optimal body composition that encompasses all rugby league players, because of the highly intermittent nature of the game and the inherent individual differences that exist between players, teams, and requirements for different positions (Johnston, et al., 2014).

3.7 Māori Sporting Context

Sport has a major impact on the lives of many people in New Zealand and for some Māori it is an intrinsic part of our competitive nature. Rates of sporting participation are particularly high for Māori in both rugby union (14.4%) and rugby league (4%) (Sport and Recreation New Zealand, 2008).

Sport participation and active leisure for Māori adults is high and spread across a large number of activities (Sport and Recreation New Zealand, 2008). In comparison to all New Zealander's, rugby league has four times more Māori than non-Māori adolescents participating (Richards, Reeder, & Darling, 2004).

Growth in rugby league player participation numbers reported recently were 24,000 registered in 2010 (New Zealand Rugby League, 2014) an increase of 52% from previous data collected (Sport and Recreation New Zealand, 2008). Nearly half of these

participants reported in 2008 were Māori (42%), while European (32%), Pacific Peoples (22%) and other ethnic groups (4%) had a lower representation (Sport and Recreation New Zealand, 2008). These statistics reveal that nearly half of the nation's rugby league-playing adults are of Māori descent; this is a massive over-representation of Māori compared with the number of those who play rugby union. By comparison 11% of New Zealand men play rugby union, yet only 13% of these are Māori. While only 3% of the nation's males play rugby league, close to half of them are of Māori descent. An interesting note to be made here is that rugby league in New Zealand has consistently maintained large numbers of Māori since its founding years in this country. Borell (2012) contends the influence that Māori have had on the sport of rugby league has continued from the first Māori teams of the early 20th Century through to the elite levels of contemporary rugby league in the Australian National Rugby League and the New Zealand national squad. The success of Māori at rugby league has helped to boost the sport internationally; but it appears that the paradox of Māori rugby league success is that the contributions Māori make to the sport provide more benefit to the competitions in Australia and England than to the development of the sport in New Zealand (Borell, 2012).

Participation in sport by ethnic groups has been described as being a positive experience for the players that compete. These positive experiences were identified where skills are encouraged, and rewarded, amongst their peers, and the wider community. Sports participation is also seen to foster bonding with the players whānau (family), hapū (sub-tribe), iwi (tribal region) and friends (Falcous, 2007). Sport may contribute to positive perceptions of the body through improved physical fitness and self-esteem (Blasco, Garcia-Merita, Atienza, & Balaguer, 1997). This could have a positive influence at the

end of the sport career, in terms of improved physical health and attitude towards physical activity. However, it could also work negatively if an athlete struggles with the changes in their body that accompany the end of a strict and intense training regime. Some athletes, particularly those in aesthetic-based sports, may engage in destructive habits upon ending their sports career when they are unable to deal with their lowered physical self-esteem (Ryan, 2000).

3.8 Demands of Rugby League

Rugby league and physical activity play an important role in the lives of some Māori adults (Sport New Zealand, 2015). Previous studies on rugby league (King, 2006, 2007a; King, Gissane, Clark, & Marshall, 2014; King, Hume, & Clark, 2010b; King, Hume, Milburn, & Guttenbeil, 2010c) have shown that bodily collisions or fierce physical contacts are responsible for a large proportion of the total burden of injuries suffered by athletes. This is a common occurrence in sport at all levels but when specifically looking at contact sports the long-term consequences can be devastating (Chen, Johnston, Petrides, & Ptito, 2008; Gabbett & Ryan, 2009; Gardner, et al., 2014; King, Gissane, & Clark, 2013; King, Hume, & Clark, 2012).

The effect of high intensity exercise on mortality later in life has mostly been studied among professional athletes in England, using the general population as a control group (Zwiers, et al., 2012). The outcomes from these studies differ; some did not find a survival benefit, whereas others showed lower mortality in athletes than in their non-athletic counterparts from the general population (Beaglehole & Stewart, 1983; Kujala, et al., 2003; Kujala, et al., 2001; Lee & Skerrett, 2001). It is more likely that the higher mortality risk reflects the effect of a gradual accumulation of multiple bodily injuries

during sporting activities (Zwiers, et al., 2012). Previous studies have shown that bodily collisions or fierce physical contacts are responsible for a large proportion of the total burden of injuries (Hootman, Dick, & Agel, 2007; Kujala, et al., 2003; Kujala, et al., 2001). These injuries may have long lasting detrimental effects when compared with the natural progression of ageing for the general population (Kujala, et al., 2003).

Rugby league is a collision sport played in many countries around the world and is especially popular within certain parts of Australia (New South Wales and Queensland), New Zealand, United Kingdom, Pacific Islands and France (Collins, 2006). Originating in the north of England in 1895, rugby league is a full contact sport and typically the game is played over two halves of 40 minutes duration. This may vary for junior, amateur, sub-elite or elite levels of participation (King, et al., 2010c). Players compete in a challenging contest that normally involves bouts of high-intensity activities (e.g. sprinting, running, passing, and tackling) interspersed by short bouts of low-intensity activities (standing, walking, jogging) (Gabbett, 2002).

The demands of the game of rugby league are complex and require players to have highly developed physiological capacities including speed, agility, muscular strength and power, and maximal aerobic capacity (Johnston, et al., 2014). As a result of the multiple tackles and physical collisions that occur during the course of a rugby league match, musculoskeletal injuries are frequent and common (King, et al., 2010c). Given the potential for injuries to occur it is not unexpected that many Māori players may be suffering chronic pain in one or more joints in their bodies. This would be exasperated with the cumulative effects of players continuing to play with injuries, which is common in amateur rugby league.

During the growth and development of rugby league there have been numerous changes which have had a profound effect on the way the game is now played (Eaves & Broad, 2007). A rugby league team consists of six forwards and seven backs on the field and four interchange players. The demands on the players vary according to the specific positions played with forwards (prop n=2, hooker n=1, second row n=2 and lock n=1) more predominately involved in large numbers of physical collisions and tackles. Whilst backs (half-back n=1, stand-off n=1, centre n=2, wing n=2 and fullback n=1) spent more time in free running but were also involved in tackles and collisions. There are four subgroups reflecting positional commonality, these are hit up forwards (prop, lock), adjustable (hookers and halves), wide running forwards (second-row) and outside backs (centre, wing, fullback)(King, et al., 2009c).

Perhaps the most dramatic change in the game in the last ten years is the increased fitness levels of the players. Most top level players today strive to achieve higher levels of fitness to match the demands of the modern game (Eaves & Broad, 2007). Easily recognizable examples of these physiological demands are sprint and endurance type events. In this respect, many sports involving periods of all-out sprinting interspersed with short recovery periods may be classified as multiple sprint sports (Gabbett, 2005c; Gabbett, King, & Jenkins, 2008; Johnston, et al., 2014). The fitter a player can become the more benefit he will be to his team and maintaining a high level of fitness is considered a pre-requisite to playing in the professional ranks. The greatest emphasis in this period has been placed on the application of science to sport specificity. In concise terms, this implies a complete understanding of an individual's potential and the development of this potential to meet the specific requirements of their sport (Odgers, Lannigan, & Newton, 1992). Each component of their training program must relate

directly to their specific duties on the field in order to reduce the likelihood and or severity of injuries occurring.

Rugby league is considered a multiple sprint sport because of the intermittent nature of the play (Clark, 2002). Therefore, the physiological demands need to be more fully understood if performance and training are to be optimal. Yet realistic measurement of the demands of rugby league is difficult, as play comprises repeated accelerations, decelerations, and turns, and tasks involve both the upper and lower body through tackling, running, passing and kicking (Coutts, Reaburn, Murphy, Watsford, & Spurrs, 2003; Coutts, Reaburn, Piva, & Murphy, 2007; Coutts, Reaburn, Piva, & Roswell, 2007). Players experience transient fatigue over the course of a game (Kempton, Sirotic, Cameron, & Coutts, 2013) and usually employ energy saving tactics to permit the completion of the game whilst remaining in a reasonable physical state (Waldron, Highton, & Daniels, 2013). Success in rugby league is dependent on the capacity of participants to cope with the numerous physical collisions (up to 55 per game), and the ability to gain dominance in the tackle situation (Gabbett, 2008b). This is very important for the tackler to ensure the ball carrier is always the last player to rise from the ground, thus slowing down the 'play-the-ball' to re-start play (Gabbett, Polley, Dwyer, Kearney, & Corvo, 2014). Whilst the ball-carrier must attack the line with speed and power to ensure the defence is kept moving backwards (Gabbett & Kelly, 2007).

There are many factors considered to be critical for optimal performance in rugby league. Attacking ability, as reflected by performance indicators such as line breaks, try's and tackle breaks, have been associated with greater experience, speed and better perceptual skills (Gabbett, 2005c). Defensive performance such as the number of tackle

attempts, as well as the number of completed, dominant and ineffective tackles, is linked to greater lower-body muscle power and tackling proficiency or the ability to tolerate and win a tackle (Gabbett, et al., 2008). While these fitness and skill-based attributes are extremely important, they can potentially be limited by a player's anthropometric characteristics (King, et al., 2009c). Height, body mass and muscularity are known to differ significantly between effective and ineffective tacklers (effect size $\geq$ 1.2) (Gabbett, 2009). Furthermore, skinfold thickness (body fat) has been shown to predict selection in professional rugby league and is negatively associated with performance indicators (Gabbett, et al., 2008) This means the higher the skinfold thickness, the less the number of tackles attempted, tackles completed, and how dominant the tackles may be (Gabbett, 2009). Hence, the importance of lower anthropometric characteristics for success in rugby league is well supported by existing literature (Gabbett, 2005a, 2006, 2009; King, et al., 2009c).

More recent research has shown that anthropometric (stature, body mass, skinfold thickness, somatotype) and physiological (fast acceleration and change of speed) factors are directly associated with playing and tackling ability (Johnston, et al., 2014). Fast defensive line speed reduces tackling proficiency and there is a direct relationship between physiological capacities and fatigue-induced decrements in tackling technique (Gabbett, 2008b; Gabbett & Kelly, 2007). The tackle has also been reported to be the most common cause of injury in rugby league at all levels of participation (Gabbett, 2005c; King, et al., 2012). In a recent study reporting on injuries in professional rugby league it was identified that the most common tackle-related injuries occurred to the ball carrier when contact was made with the ball carrier at shoulder height or mid torso

region, in their blind vision area (the tackler was unsighted by the ball carrier), and with two or more tacklers in total being involved (King, et al., 2012).

Physical fitness is very important for all rugby league players, and any small improvements that can be made in fitness are of considerable benefit in a match situation (Johnston, et al., 2014). Players who have low levels of fitness reportedly fatigue rapidly in the match situation (Gabbett & Herzig, 2004). This fatigue results in a decrease in work rates, as well as deterioration in skill and co-ordination (Gabbett, et al., 2014). The assessment of a player's physiological status is important for the identification of individual strengths and weaknesses, and for the monitoring and optimization of training regimes (Coutts, et al., 2003). One study revealed that defending was more physically demanding than attacking, with slightly more demanding work in defence than attack (Sykes, Twist, Hall, Nicholas, & Lamb, 2009). These differences were more pronounced in the hit-up forwards, wide running forwards and adjustable, with these positions also spending a greater proportion of time in defensive collisions than attacking collisions (Sykes, et al., 2009). Further studies confirmed that players performed a greater frequency of repeated high-intensity effort bouts when defending their own try-line than when defending the middle section of the field (between the 40m lines) and the opposition's 30m zone (try line 0-30m line). Repeated high-intensity effort frequency was moderately greater when attacking the opposition's try-line than when attacking in the middle section of the field (Whiting, et al., 2011).

3.8.1 Rugby League Injuries

Rugby league has a high incidence of injury and studies reporting on injuries in rugby league have shown that the injury incidence increases as the participation level

increases. In a recent review of match injuries in junior rugby league players 17 to 19 years it was reported that the overall incidence of injury was 56.8 per 1000 playing hours (Gabbett, 2008a). For every 1000 playing hours the majority of injuries were sustained to the shoulder 15.6 and the most common were sprains 24.7. These injuries were most commonly sustained while being tackled 19.2 and while tackling 10.1(Gabbett, 2004a, 2005d; King, et al., 2010c).

As rugby league is an intermittent collision sport, the game requires participants to compete with a combination of muscular strength, stamina, endurance, speed, acceleration, agility, flexibility and aerobic endurance (Meir, Arthur, & Forrest, 1993). There is a risk of musculoskeletal injury occurring from both match and training activities due to the number of physical collisions and tackles involved (Gabbett, 2004a, 2008a; King & Gabbett, 2009a, 2009b). As a result of these musculoskeletal injuries participants may be hospitalized, unable to participate in training and match and work related activities. Consequently there may be a loss of income to the injured player and associated financial costs for medical related care and job limitations owing to the severity and type of the injuries that have occurred (King, et al., 2010b).

The most common injury sites have varied by different participation levels. For example in professional rugby league the most common injured areas were the head and neck, the knee and the lower limb (King, et al., 2012). In semi-professional rugby league the most common injured areas were the shoulder, the thigh and the calf amateur rugby league were the head and neck, the thigh and the lower leg while junior rugby league injuries more commonly occurred in the knee and the shoulder (Gabbett, 2004a; King, Hume, Milburn, & Gianotti, 2009a, 2009b; King, et al., 2010c).

The injury type has also varied by level with haematomas and sprains more common in professional, semi-professional and amateur players (King & Gabbett, 2009a), however fractures were more frequent in junior players (Gabbett, 2004a; King, et al., 2010c).

Sports injuries are the single-most commonly reported reason why adolescents withdraw from sporting activity and participation (DuRant, Pendergast, Donner, Seymore, & Gaillard, 1991). This usually occurs where a player gets injured at the amateur level and untrained personnel treat the injured player at the side-line (Ransone & Dunn-Bennett, 1999). Often treatment and advice is via the team coach and this may be beyond their level of knowledge or training (Ransone & Dunn-Bennett, 1999). King et al (2010b) examined the effect of player perspectives on their return to play after missing a training and/or match as a direct result of an injury occurring from participation in rugby league activities. The incidence, site, nature, and cause of playing injuries was studied in 128 amateur rugby league registered players enrolled in the study over two consecutive seasons (King, et al., 2010b). A total of 178 training sessions were conducted over the study period with a training exposure of 10162 training hours. A total of 63 players recorded a missed training or match activity injury over the 24 months of the study. Nearly a quarter of the players enrolled (22%) recorded more than one missed training or match injury with 4% recording two or more missed match injuries (see Table 17). A total of 618 training hours (391 training days) and 267 match hours (201 matches) were recorded missed as a result of an injury from rugby league activities (King, et al., 2010b). Outcomes from this study highlight how vulnerable players are to injury during training let alone during competitive match play.

King et al (2010a) reported that nearly a third (29%) of injured players identified the team coach asked them to return to rugby league activities. Three quarters (75%) of

Table 17 **Missed training and match injuries by injury site, type, cause, severity and position per 1000 training player hours**

	2008						2009					
	Missed Match Injuries			**Missed Training Injuries**			**Missed Match Injuries**			**Missed Training Injuries**		
	No	Rate[1] *(95% CI)*	%	No	Rate[2] *(95% CI)*	%	No	Rate[1] *(95% CI)*	%	No	Rate[2] *(95% CI)*	%
Total	47	104.6 *(78.6 to 139.2)*	100.0	23	4.2 *(2.8 to 6.3)*	100.0	44	94.3 *(70.1 to 126.7)*	100.0	20	4.3 *(2.8 to 6.7)*	100.0
Injury Site												
Head/Neck	14^d	31.1 *(18.4 to 52.6)*	29.8	1^{bc}	0.2 *(0.0 to 1.3)*	4.3	8^b	17.1 *(8.6 to 34.3)*	18.2	1^c	0.2 *(0.0 to 1.5)*	5.0
Upper Limb	17^d	37.8 *(23.5 to 60.8)*	36.2	9^a	1.6 *(0.8 to 3.1)*	39.1	19^{ad}	40.7 *(26.0 to 63.8)*	43.2	1^c	0.2 *(0.0 to 1.5)*	5.0
Lower Limb	13^d	28.9 *(16.8 to 49.8)*	27.7	10^a	1.8 *(1.0 to 3.4)*	43.5	11	23.6 *(13.0 to 42.5)*	25.0	18^{abd}	3.9 *(2.4 to 6.2)*	90.0
Chest/Back	3^{abc}	6.7 *(2.2 to 20.7)*	6.4	3	0.5 *(0.2 to 1.7)*	13.0	6^b	12.9 *(5.8 to 28.6)*	13.6	0^c	0.0 -	0.0
Injury Type												
Sprain	4^{hi}	8.9 *(3.3 to 23.7)*	8.5	3	0.5 *(0.2 to 1.7)*	13.0	4^{fh}	8.6 *(3.2 to 22.8)*	9.1	1^f	0.2 *(0.0 to 1.5)*	5.0
Strain	7	15.6 *(7.4 to 32.7)*	14.9	10^g	1.8 *(1.0 to 3.4)*	43.5	16^{egh}	34.3 *(21.0 to 55.9)*	36.4	16^{eghi}	3.5 *(2.1 to 5.6)*	80.0
Concussion	8	17.8 *(8.9 to 35.6)*	17.0	0^{fh}	0.0 -	0.0	5^{fh}	10.7 *(4.5 to 25.7)*	11.4	1^f	0.2 *(0.0 to 1.5)*	5.0
Fract/Disloc	14^e	31.1 *(18.4 to 52.6)*	29.8	7^g	1.3 *(0.6 to 2.7)*	30.4	19^{ei}	40.7 *(26.0 to 63.8)*	43.2	2^f	0.4 *(0.1 to 1.7)*	10.0
Other	14^e	31.1 *(18.4 to 52.6)*	29.8	3	0.5 *(0.2 to 1.7)*	13.0	6^{fgh}	12.9 *(5.8 to 28.6)*	13.6	0^f	0.0 -	0.0
Injury Cause												
Tackled	28^{lm}	62.3 *(43.0 to 63.6)*	38.3	5	0.9 *(0.4 to 2.2)*	21.7	21^{lm}	45.0 *(29.3 to 69.0)*	47.7	1^m	0.2 *(0.0 to 1.5)*	5.0
Tackling	18^{lm}	62.3 *(25.2 to 90.2)*	59.6	5	0.9 *(0.4 to 2.2)*	21.7	17^{lm}	36.4 *(22.6 to 58.6)*	38.6	1^m	0.2 *(0.0 to 1.5)*	5.0
Collision	0^{jk}	0.0 -	0.0	2^m	0.4 *(0.1 to 1.4)*	8.7	1^{jk}	2.1 *(0.3 to 15.2)*	2.3	1^m	0.2 *(0.0 to 1.5)*	5.0
Other	1^{jk}	2.2 *(0.3 to 15.8)*	2.1	11^l	2.0 *(1.1 to 3.6)*	47.8	5^{jk}	10.7 *(4.5 to 25.7)*	11.4	17^{jkl}	3.7 *(2.3 to 5.9)*	85.0
Injury Severity												
Mild	23°	51.2 *(34.0 to 77.0)*	48.9	14^{op}	2.5 *(1.5 to 4.3)*	60.9	22	47.1 *(31.0 to 71.6)*	50.0	16^{op}	3.5 *(2.1 to 5.6)*	80.0
Moderate	8^n	17.8 *(8.9 to 35.6)*	17.0	4^n	0.7 *(0.3 to 1.9)*	17.4	11	23.6 *(13.0 to 42.5)*	25.0	2^n	0.4 *(0.1 to 1.7)*	10.0
Major	16	35.6 *(21.8 to 58.1)*	34.0	5^n	0.9 *(0.4 to 2.2)*	21.7	11	23.6 *(13.0 to 42.5)*	25.0	2^n	0.4 *(0.1 to 1.7)*	10.0
Injury by Position												
Forwards	26	125.3 *(85.3 to 184.0)*	55.3	13	2.4 *(1.4 to 4.1)*	56.5	24	111.4 *(74.7 to 166.2)*	54.5	10	2.2 *(1.2 to 4.0)*	50.0
Backs	21	86.8 *(56.6 to 133.1)*	44.7	10	1.8 *(1.0 to 3.4)*	43.5	20	79.6 *(51.3 to 123.3)*	45.5	10	2.2 *(1.2 to 4.0)*	50.0

Rate expressed per (**1**) 1,000 player hours; (**2**) 1,000 training hours. Significant difference (*p*<0.05) than (**a**)=Head/Neck; (**b**)=Upper Limb; (**c**)=Lower Limb; (**d**)=Chest/Back; (**e**)=Sprain; (**f**)=Strain; (**g**)=Concussion; (**h**)=Fracture / Dislocation; (**i**)=Other; (**j**)=Tackled; (**k**)=Tackling; (**l**)=Collision; (**m**)=Other; (**n**)=Mild; (**o**)=Moderate; (**p**)=Major

Source: King, Hume and Clark, 2010b and King & Gissane, 2009 - Reproduced with permission

injured players felt that the recommended times off from training or match activities were too long. Only 31% (37% training; 26% match) of injured players reported obtaining a medical clearance while nearly a third of participants (30%) reported that they felt strongly that the injury was not as bad as they were told it was. A total of 43 people recorded a missed training or match activity injury over the 24 months of the study. Although not reported in the original transcript, this study included a large proportion of Māori (>70%) players (D. King, personal correspondence, 2012).

Although historical research indicates that injuries are inevitable, studies reporting on match injuries resulting from participation in rugby league training activities have been limited (King, 2006; King & Gabbett, 2009a). It has been reported that the majority of rugby league training injuries occur in the pre-season preparation period when the training loads are higher and training injuries have been significantly correlated with training intensity (r=0.86), duration (r=0.79) and load (r=0.86) (Gabbett, 2004b). As a result of these findings it was suggested that the harder players train, the more injuries they sustain and that reductions in training loads will result in reduced training injuries.

As rugby league is a physical contact sport, the training sessions require an adequate intensity to develop the physical qualities required to compete in the match environment as reductions in training activities may result in less training injuries but may also result in more match related injuries (Gabbett, 2004c).

Studies dedicated to rugby league training injuries have reported that the injury rates are considerably lower than match injury rates. Training injuries have been reported to vary from 1.4 (Hodgson Phillips, Standen, & Batt, 1998) to 45.3 per 1,000 training hours

depending upon the participation level. This was similar for injuries that resulted in missed training sessions ranging from 1.0 to 9.0 per 1000 training hours (Gabbett, 2003).

3.8.2 Concussion

The identification, and management, of sports-related concussion is now a topical issue being faced by all sports. The risk of an acute catastrophic head injury and long-term neurological sequelae as a result of repeated sports-related concussions has been reported (Grindel, Lovell, & Collins, 2001; Wetjen, Pichelmann, & Atkinson, 2010). The identification of concussion is a diagnostic challenge even for the sports medicine professional. This is, in part, due to the fact that every sports-related concussion is unique and no two concussions present identically. To complicate things further, the signs and symptoms of a sports-related concussion may not present immediately but may evolve over several hours to days after the event has occurred (Eckner & Kutcher, 2010).

Historically concussion was viewed as a transient injury void of long term consequences and sport-related concussions were once trivialised by coaches (Broglio, Eckner, Paulson, & Kutcher, 2012). Whilst playing through the pain was regarded as a sign of an individual's toughness and commitment to the team (Broglio, et al., 2012). Even clashes to the head that were often thought of as just a ding are now receiving more attention as a potentially serious injury (McKeag & Kutcher, 2009). More recently there has been an increased awareness of the long-term effects of sport-related concussion and the possible link with the pathology termed chronic traumatic encephalopathy (CTE) (Broglio, et al., 2012). This link with CTE as well as other

neurological conditions such as depression and mild cognitive impairment have been reportedly associated with players who have a history of more than one concussive event (McCrory, et al., 2009).

Recently there has been an increase in published research on sport-related concussion relating to the identification, assessment and management in all sporting environments (Makdissi, et al., 2010a; McCrory, Johnston, Mohtadi, & Meeuwisse, 2001; McCrory, et al., 2013; McCrory, et al., 2017). Concussion has become one of the most troublesome injuries facing the sports medicine professional, especially with regard to the early identification of concussive signs and symptoms and appropriate concussive management facilitation (King, 2007b).

Major findings from a pooled analysis for studies of concussion occurring in rugby league match and training activities indicate that semi-professional participants had a threefold greater concussion injury rate than amateur league participants during match participation (King, Hume, Gissane, & Clark, 2017). The pooled analysis concussion injury incidence for match injuries was 7.7 per 1000 match hours and more concussions were recorded in amateur (2.7) than professional and semi-professional matches (1.2) (King, et al., 2017).

The incidence of concussion in rugby league varies considerably due to the lack of consensus regarding a definition of injury. The rate of injury is much higher in match play than in training and the ball carrier appears to be statistically more likely to get injured than the tackling player, and injury rates are disproportionately high for illegal play (Gardner, et al., 2014). The current rugby league concussion literature is small, and

further research is required across numerous areas and levels of competition. Research focused on studying the acute consequences and best management strategies in current players, and the potential longer-term outcomes of concussion in retired players is needed. Future research could, for example, use video analysis to determine whether certain playing styles (e.g. tackling, ball carrying or running techniques) or playing positions are associated with increased risk for injury.

Amateur sports such as rugby league in New Zealand do not have the resources available for qualified medical personnel to be at every match. As such it is often the coach or team manager, if the team has one, to make decisions with regard to player welfare and this includes concussion identification and management (King, Hume, & Clark, 2010a). The awareness of team management and concussion has been previously reported and highlights the need for concussion education for all people involved in the management level of sports participation. Players with a concussive injury returning to their sport are at a greater risk of complications (Iverson, Gaetz, Lovell, & Collins, 2004; Macciocchi, Barth, Littlefield, & Cantu, 2001). These complications are related to subsequent concussive events and may result in prolonged concussive symptoms and cumulative cognitive deterioration (Makdissi, et al., 2010b).

The National Rugby League (NRL) has implemented much tighter regulations around player concussion at the elite level with the priority on player safety at the forefront of these regulations. The responsibility is now directly placed on the club medical staff to determine whether the player is fit to continue, rather than the coach having any influence on player safety in the pursuit to win at all costs. These Guidelines were based on the Consensus Statement produced following the 4th (2012) International

Conference on Concussion in Sport (ICCS), but have been updated following the 5th ICCS held in Berlin in October 2016 (McCrory, et al., 2017) . The Guidelines should be followed at all times and any decision regarding return to play after concussive injuries should only be made by a doctor with experience in dealing with such injuries.

3.8.3 Osteoarthritis

Osteoarthritis (OA) is the most common form of a disabling joint disorder characterized by pain, stiffness and degeneration of the joints (Hunter & Eckstein, 2009). There has long been debate over the role that participation in sport may have in the development of osteoarthritis. The only agreed causative requirement is that excessive activity with high impact and torsional loading, in the presence of an abnormally aligned joint or with abnormal biomechanics, may lead to joint degeneration and osteoarthritis (Zhang, 2014)

A recent study using cross-sectional data found through analyses of rugby union participants aged 50+, osteoarthritis (4.00, 95% CI), joint replacement (6.02, 95% CI), and osteoporosis (2.69, 95% CI) were significantly higher, compared to an age-standardised general population sample on measures of morbidity and health related quality of life (Davies, et al., 2017).

Osteoarthritis (OA) is reportedly common in retired contact team sports participants, particularly in soccer, rugby league, Australian Rules and rugby union (Bennell, Hunter, & Vicenzino, 2012; Deacon, Bennell, Kiss, Crossley, & Brukner, 1997; Meir, McDonald, & Russell, 1997; Thelin, Holmberg, & Thelin, 2006). Studies of retired soccer players have shown an increased incidence of both knee and hip OA (Koea, 2008; Lloyd-Jones, et al., 2006; Steering Committee for the Review of Government

Service Provision, 2011). The development of premature osteoarthritis of weight-bearing, lower-limb joints is a common adverse effect associated with vigorous physical activity (Sundborn, et al., 2007). Osteoarthritis is a major cause of pain and disability and it is estimated that around eight out of ten people with osteoarthritis have compromised movement and one in four are unable to perform normal everyday tasks.

Meir et al (1997) looked at the incidence of later life health problems, including osteoarthritis, in retired Australian rugby league players who had suffered injuries during their playing careers. Utilizing a 23 item survey, retired professional Australian Rugby League players was asked to recall all injuries that resulted in them being unable to play for five or more consecutive games. As can be seen in Table 18 the most commonly reported medical condition in this retired cohort of rugby league players was arthritis (65%) followed by restricted joint mobility (52%) (Meir, et al., 1997)

Table 18   **Conditions resulting from major injuries (established by medical examination) from participation in professional rugby league by retired players.**

Medical condition / problem	% respondents
Arthritis	65.2
Restricted joint mobility (joint stiffness)	52.2
Chronic back pain	39.1
Chronic stiff fingers	21.7
Dental problems	17.4
Joint reconstruction	13.0
Chronic headaches	8.7
Joint replacement	4.3
Problems with hearing	4.3

Source: Adapted from Meir et al, 1997

The study reported that the longitudinal effects of the injuries the players sustained during their professional career persisted into retirement from rugby league resulting in

job limitations, reduced earning potential and increased personal medical costs. The findings of this study suggests that retired professional rugby league players may suffer at least one long-term consequence of injuries sustained during their playing career resulting in osteoarthritis and reduced physical capacity and or limited movement (Meir, et al., 1997).

The American College of Rheumatology reported strong evidence to support aerobic land-based exercise, resistance land-based exercise, and aquatic exercise for patients with OA of the hip and/or knee. They also recommended programs of weight loss for overweight patients as part of their recommendation for improving pain (Hochberg, et al., 2012). There is also evidence, although more limited, that exercise can help ameliorate the symptoms of rheumatoid arthritis. In conducting a meta-analysis of 14 random controlled trials (RCT's) it was reported that aerobic conditioning in those with stable rheumatoid arthritis was not only safe, but also improved outcome measures such as pain, function, and quality of life (Baillet, et al., 2010).

It is clear that a significant joint injury is a major factor in subsequent development of OA in former rugby league players. Presumably, once the articular surface has been damaged, further weight-bearing and shear forces will accelerate the degenerative process. Although there is no convincing evidence that exercise is associated with the development of osteoarthritis there is an association that a significant joint injury that occurs from sports participation is associated with an increased risk of subsequent development of osteoarthritis (Kuijt, Inklaar, Gouttebarge, & Frings-Dresen, 2012).

3.9 Conclusion

This chapter has described the background and relevant literature that informed the research. Included here was the demographic profile of Māori, who are a youthful population with a high growth-rate, estimated at 1.5 percent per annum (Department of Statistics, 2017). While the difference is decreasing, life- expectancy at birth for Māori was 7.3 years below that of non-Maori in 2013 (Statistics New Zealand 2013c).

The median personal income for Māori in 2013 was $6,000 less than the $28,500 national median income. This represents Māori income at 78.9 percent of the national median income (Statistics New Zealand, 2014). Contributing towards that statistic is both the lower rates of educational achievement by Māori when compared with non-Māori, in particular the European population, and the higher rates of unemployment.

Evidence shows that Māori sustain a greater burden of health loss than non-Māori for most condition groups on an absolute scale, with 26% of the excess burden experienced caused by vascular disorders, 15% by cancers, 12% by mental illness, 11% by injury, and 9% by diabetes and other endocrine disorders. One of the most damning statistics for Māori males is the early onset of cardiovascular disease as opposed to other population groups.

Māori smoking and tobacco use highlighted that smoking is the leading cause of preventable death for Māori in New Zealand. It was also reported that Māori drank

more alcohol on a typical occasion (binge drinking) at levels consistent with hazardous drinking but, non-Māori consumed alcohol more frequently.

The demands of the game of rugby league are complex and require players to have highly developed physiological capacities including speed, agility, muscular strength, power and maximal aerobic capacity. As a result of the multiple tackles and physical collisions that occur during the course of a rugby league match, musculoskeletal injuries are frequent and common.

Concussion has become one of the most troublesome injuries facing sports medicine professionals and recent findings of concussion occurring in match and training activities indicate that semi-professional participants had a threefold greater injury rate than amateur rugby league participants.

Osteoarthritis is the most common form of a disabling joint disorder characterized by pain, stiffness and degeneration of the joints. Current evidence suggests rugby union players were significantly worse off after retiring from playing with the incidence of osteoarthritis, joint replacement, hip replacement and knee replacement being more prevalent than compared to an age-standardised general population sample on measures of morbidity and health related quality of life. Retired professional rugby league players may suffer at least one long-term consequence of injuries sustained during their playing career resulting in osteoarthritis and reduced physical capacity and or limited movement. The longitudinal effects of injuries sustained persisted into retirement from

rugby league resulting in job limitations, reduced earning potential and increased personal medical costs.

3.9.1 Note on Wider Body of Knowledge

This thesis adopts a Māori-centered approach incorporating methods and guiding principles drawn from both Exercise Science and Kaupapa Māori Research. Specifically, as a trained exercise scientist, I have focused on the *physiological* aspects of the data. This focus is very much informed by the body of research knowledge which I have produced concurrently with this thesis. Since my enrolment in 2011, and during my doctoral candidacy, I have co-authored 12 peer-reviewed journal articles. If I include the period my enrolment was suspended in 2014/15 I have contributed 20 journal articles. The topics of these peer reviewed articles cover; training injuries in amateur rugby league; head impact exposure in one season of matches in women's domestic rugby league; reducing injury risks for rugby codes; measurement of head impacts in Australian Rules football using an instrument patch; concussion risks at amateur, semi-professional and professional levels of rugby league; an exploration of head impacts at junior rugby league using wireless head impact sensors; head impact acceleration in junior rugby union players; head impact thresholds for reporting data in contact and collision sports; a review of player concussion history in amateur rugby league players; using a rapid visual screening tool for assessment of concussion; injuries over 3 years in amateur representative rugby league and; the nature of impacts that result in injuries in professional rugby league. The theme of this research broadly has been on injuries and concussions, epidemiology and recovery from injury by players in rugby league settings. Three of these articles are included as full text in the appendices because these are particularly relevant to the research question.

All of the peer reviewed articles are cited in the literature above and are wholly relevant to this thesis because they resonate with the rationale for a Māori-centered, blended methods approach, drawing on knowledge and expertise from both approaches.

While we can study with increasing confidence the physiological impacts with respect to the injury and health risks to the research *subjects*, I omit any reference to the subjects as *participants*. Māori-centered research places the participant at the centre of the research, and also places the investigator as *inter*dependent rather than independent.

The next Chapter Four looks at the research findings gathered from a sample of retired Māori rugby league players on measures of health.

CHAPTER 4: RESEARCH FINDINGS - NGĀ HUA RANGAHAU

4.1 Introduction

This chapter presents the research findings gathered from a sample of Māori men, who are retired rugby league players, on various measures of health. It discusses the results of the findings under an increasing level of detail, with reference to mixed method, quantitative, qualitative and Māori methodological frameworks.

The findings are grouped into three sub-sections. First I present the findings from the physical/physiological measures, including the repeated measures taken 18 months later. Next I present the findings from the self-assessed measures, including the SF-36 Version 2, smoking and medical histories. Finally I give the findings from the qualitative interviews. I round out this chapter by discussing the findings and the conclusions reached from the evidence. Throughout this chapter, evidence from other primary and secondary sources of information is presented alongside the findings from this exploratory study to locate them within the broader context.

4.2 Section 1 Taha Tinana (Physical Side - Measured)

As discussed in chapter 3, Māori models of heath are holistic. Durie (1985) introduced the Whare Tapa Wha model, where a 4 sided house is a metaphor of Māori wellbeing. The four sections or sides (taha) of Māori Health (hauora) are whānau (family health) tinana (physical health) hinengaro (mental health) and wairua (spiritual health). This section has a focus on taha tinana (physical health) that is concerned with the capacity for physical growth and development as one aspect of health and well-being.

4.2.1 Anthropometric profiles

The participants of this study had a mean body mass of well over 100 kilograms (kg) (Part A: 108.4 ±13.4kgs; Part B 106.0 ±13.3 kg). The mean ±SD age, height and weight of the participants' for both Part A and Part B, also included a re-test 18 months later. Participants in part A were older (44.3 vs. 42.2 year; *p*=0.001) had a higher body mass (108.4 vs. 106.0 kg.; *p*=0.149) and were taller (178.0 vs. 174.9 cm; *p*=<0.001) than participants in Part B at baseline (see Table 19).

Table 19   **Anthropometric characteristics of retired Māori rugby league players at national tournaments (Part A; n=125) and from a zonal region (part B) at baseline (n=25) and at re-test (n=15).**

| | Part A | | Part B | | | |
| | Baseline | | Baseline | | Re-test | |
	Mean ±SD	95% CI	Mean ±SD	95% CI	Mean ±SD	95% CI
Age (year)	44.3 ±7.4	36.9 to 45.6	42.2 ±8.4	37.9 to 46.5	43.8 ±8.4	38.9 to 47.5
Height (cm)	178.0 ±5.9	172.1 to 179.0	174.9 ±5.8	172.6 to 177.2	174.9 ±5.8	172.6 to 177.2
Body mass (kg)	108.4 ±13.4	95.0 to 110.7	106.0 ±13.3	99.3 to 112.8	105.5 ±12.3	99.3 to 111.7
BMI (kg/m^2)	34.2 ±3.5	28.9 to 33.0	34.7 ±4.0	32.7 to 36.7	34.5 ±3.7	32.7 to 36.4
YFR (year)	8.8 ±5.1	3.7 to 9.7	8.3 ±5.1	5.7 to 10.8	9.3 ±5.1	6.7 to 11.8

SD = Standard deviation; CI: = confidence interval; year = year; cm = centimetre; kg = kilograms; kg/m^2 = kilogram per square meter; YFR = years from retirement

While this may describe a typical rugby league forward (King, Hume, Milburn, & Guttenbeil, 2009c), it is much higher (see Table 20) than the reported normal 'reference man' proportions (International Commission on Radiological Protection, 1995). These values are far removed from the average rugby league player (Gabbett, 2005).

Table 20   **Reported reference man values for age, body mass, height and body mass index in 1975 and 1995.**

Parameter	ICRP (1975)	Revised ICRP (1995)
Age (year)	20-30	35 (20-50)
Body mass (kg)	70	73
Height (cm)	170	176
Race	Caucasoid	Caucasoid
BMI (kg/m^2)	24	24

ICRP = International Commission on Radiological Protection**;** year = year; cm = centimetre; kg = kilograms; BMI = Body Mass Index; kg/m^2 = kilogram per square meter.
Source: International Commission on Radiological Protection, 1995

At the re-test of 15 participants, the mean body mass had decreased (106.0 vs. 105.5 kg *p*=0.6422) when compared with the baseline results (see Table 21) although not significant. As a result of this decrease, the calculated BMI had also decreased (34.7 vs. 34.5 kg/m²; *p*=0.2667). The average difference (bias) between the baseline and retest for participant's body mass and BMI was 0.6 ±2.7 kg (*p*=0.168) and 0.1 ±1.5 (*p*=0.494).

Table 21   **Comparison of anthropometric characteristics of retired Māori rugby league players (n=15) in a zonal region for baseline and retest.**

	Baseline		Re-test	
	Mean ±SD	95% CI	Mean ±SD	95% CI
Age (year)	42.2 ±8.4	37.9 to 46.5	43.8 ±8.4	38.9 to 47.5
Height (cm)	174.9 ±5.8	172.6 to 177.2	174.9 ±5.8	172.6 to 177.2
Body mass (kg)	106.0 ±13.3	99.3 to 112.8	105.5 ±12.3	99.3 to 111.7
BMI (kg/m^2)	34.7 ±4.0	32.7 to 36.7	34.5 ±3.7	32.7 to 36.4
YFR (year)	8.3 ±5.1	5.7 to 10.8	9.3 ±5.1	6.7 to 11.8

SD = Standard deviation; CI: = confidence interval; year = year; cm = centimetre; BMI – Body Mass Index; kg/m^2 = kilogram per square meter; YFR = years from retirement

When grouped into years' post retirement (0-5 year, 6-10 year and 11-15 year), it can be seen that retired Māori rugby league players had changes in their body mass over the duration of the study (see Table 22). There were body mass decreases in the 0-5 year (107.6 vs. 106.8 kg *p*=0.6193) and 11-15 year (102.5 vs. 101.8 kg *p*=0.2435) groups while the 6-10 year (108.1 vs. 108.4 kg *p*=0.7946) had a body mass increase.

As a result of the changes observed, the BMI also changed for the 0-5 year (35.0 vs. 34.6 kg/m^2; t_4=1.04; p=0.3553), 6-11 year (35.8 vs. 35.9 kg/m^2; t_4=-0.43; p=0.7946) and the 11-15 year (34.3 vs. 32.7 kg/m^2; t_4=1.83; p=0.1404) retired from rugby league groups. While these changes in BMI are not too significant a change and would not be considered substantive or health changing, they do signal a movement in the right direction for the players who were paying attention to their weight.

Table 22   Anthropometric characteristics comparisons of retired Māori rugby league players (n=15) in a zonal region at baseline and retest in years from retirement.

		Baseline		Re-test	
		Mean ±SD	95% CI	Mean ±SD	95% CI
0-5 year Retired					
	Age (year)	36.0 ±8.7	28.4 to 43.6	37.0 ±8.7	1.8 to 4.2
	Height (cm)	175.3 ±9.4	167.1 to 183.5	175.3 ±9.4	167.1 to 183.5
	Body mass (kg)	107.6 ±14.6	94.8 to 120.4	106.8 ±13.2	95.2 to 118.4
	BMI (kg/m^2)	35.0 ±3.3	32.1 to 37.8	34.6 ±3.8	31.2 to 37.9
	YFR (year)	1.9 ±1.3	0.8 to 3.0	3.0 ±1.4	1.8 to 4.2
6-10 year Retired					
	Age (year)	41.8 ±2.9	39.3 to 44.3	42.8 ±2.9	40.3 to 45.3
	Height (cm)	173.5 ±4.1	168.6 to 177.1	173.5 ±4.1	168.6 to 177.1
	Body mass (kg)	108.1 ±10.6	98.7 to 117.4	108.4 ±8.0	101.5 to 115.4
	BMI (kg/m^2)	35.8 ±2.2	33.9 to 37.8	35.9 ±1.6	34.5 to 37.3
	YFR (year)	8.9 ±0.8	8.2 to 9.5	10.2 ±0.8	9.5 to 10.9
11-15 year Retired					
	Age (year)	48.8 ±7.9	41.9 to 55.7	49.8 ±7.9	42.9 to 56.7
	Height (cm)	175.8 ±4.2	172.1 to 179.5	175.8 ±4.2	172.1 to 179.5
	Body mass (kg)	102.5 ±16.3	88.2 to 116.8	101.8 ±14.2	88.7 to 113.7
	BMI (kg/m^2)	34.3 ±4.4	30.4 to 38.1	32.7 ±4.5	28.8 to 36.6
	YFR (year)	13.7 ±1.4	12.5 to 14.9	14.6 ±1.5	13.3 to 15.9

SD = Standard deviation; CI: = confidence interval; year = year; cm = centimetre; BMI = Body Mass Index; kg/m^2 = kilogram per square meter; YFR = years from retirement

Previous studies highlighting anthropometric values for rugby league players indicate that height and body mass had a significant impact on playing standard (Gabbett, 2005; Gabbett, King, & Jenkins, 2008; Johnston, Gabbett, & Jenkins, 2014). Due to the physical collisions and repetitive occurrence of these during a match, body mass and in particular lean mass are important for success (Gabbett, 2009; Gabbett & Herzig, 2004;

King & Gabbett, 2009b). This indicates that whilst high body mass is important, low body fat is vital for sustained performance (Johnston, et al., 2014). Rugby league forwards are heavier and have greater skinfold thickness than other positional groups (Till, Cobley, O'Hara, Chapman, & Cooke, 2013). Other studies report no difference in body mass between elite and semi-elite players (Panz, Raal, Paiker, Immelman, & Miles, 2005), but show lower skinfold thickness as playing standard increases, indicating greater lean mass in elite players (Gabbett, Kelly, & Pezet, 2007).

The study group had much higher body mass values than all levels previously described however, they were similar in stature to senior non-elite (174-180cm) players (Gabbett, Kelly, & Pezet, 2008). Previous research suggests sport may contribute to positive perceptions of the body through improved physical fitness and self-esteem (Blasco, Garcia-Merita, Atienza, & Balaguer, 1997). This could have a positive influence at the end of the sport career, in terms of improved physical health and attitude towards physical activity. However, it could also work negatively if an athlete struggles with the changes in their body that accompany the end of a strict and intense training regime. These findings were expected given the participants were no longer training and or competing on a regular basis and therefore energy expenditure through physical activity was at a reduced level.

4.2.3 Strength and Girth Assessment

The participants waist (103.3 vs. 104.4 cm $p=0.0002$) and gluteal (110.3 vs. 111.1 cm; $p=0.0121$) measurements increased when compared with baseline results (see Table 25). Leg strength retest scores (182.1 vs. 173.5; $t_{14}=1.67$; $p=0.1193$) decreased when compared with the participants' baseline results. The average difference (bias) reported

between the baseline and retest for participant's waist (-5.7 ±4.7; *p*=0.7500), gluteal (-2.7 ±3.6; *p*=0.5320) and leg strength (7.0 ±15.7; *p*=0.1260) was not significant.

Table 23   **Girth and strength characteristics comparisons of retired Māori rugby league players (n=15) in a zonal region.**

		Baseline		Re-test	
		Mean ±SD	95% CI	Mean ±SD	95% CI
Girth (cm)					
	Waist	103.3 ±13.7	97.9 to 108.6	104.4[a] ±8.3	101.2 to 107.7
	Gluteal	110.3 ±8.7	106.9 to 113.7	111.1[a] ±6.7	108.5 to 113.8
Hand grip (kg)					
	Left	55.5 ±9.8	51.7 to 59.4	55.4 ±10.2	51.4 to 59.4
	Right	55.8 ±9.8	52.0 to 59.7	56.6 ±8.7	53.2 to 60.0
Leg Strength (kg)		182.1 ±28.7	170.9 to 28.7	173.5 ±27.4	162.8 to 184.2

SD = Standard deviation; CI = Confidence Interval; cm = centimetre; kg = kilograms; Significant difference (*p*<0.05) than (a) Baseline

When grouped into years' post retirement, there were significant differences observed in the waist measurements for the 6-10 year (103.5 vs. 109.2; *p*=0.0040) and 11-15 year (94.8 vs. 101.8 cm; *p*=0.0001) retirement groups (see Table 36). This was similar for gluteal measurements for participants in the 6-10 year (108.6 vs. 112.0 cm; *p*=0.0148) and 11-15 year (106.1 vs. 111.2 cm; *p*=0.0381) retirement groups. Further research is warranted to identify whether these changes were age related or other physiological changes that were not identified in the conducting of this study.

Strength assessments were conducted as it has been reported that upper-body and lower-body maximal strength and power have consistently been shown to increase with playing standard (Baker, 2001; Gabbett, Kelly, Ralph, & Driscoll, 2009). Muscular strength has been the most commonly assessed parameter with the back squat for the lower body, and bench press for the upper body, utilising 1-repetition maximum (RM) protocols (Baker & Newton, 2004), or 3-RM (Baker & Nance, 1999). However, the current study employed the use of dynamometers (as previously described) to measure

hand-grip and leg/back strength. This was primarily for safety reasons as the equipment was very simple to use (less risk of injury) and provided reliable objective measures. The current participants adhered to a strict protocol and test-retest time of day was consistent (morning 8am-11am) throughout the study.

 Grip Strength remained fairly consistent for the duration of the study across all stratified groups with no significant differences noted for either left or right hand. The 0-5 year group recorded the highest values (L-60.6 ±16.9 kg and R-59.8 ±15.0 kg) and the 11-15 year group the lowest values (L-51.6 ±4.4 kg and R-49.5 ±10.3 kg). Leg Strength also revealed similar patterns with the 0-5 year group recording the highest value (189.2 ±48.1 kg) and the 6-10 year the lowest value (167.4 ±29.9 kg).

There was a minimal reduction in strength noted for both hand grip and leg back indices throughout the study (see Table 24). This indicates that participants were able to retain strength levels (test-retest at 18 months) and is a positive result. Future research is warranted to ascertain at what period of time post retirement from sport decrements in performance are identified.

Table 24 **Girth and strength characteristics comparisons of retired Māori rugby league players (n=15) in a zonal region at baseline and retest periods.**

		Baseline		Re-Test	
0-5 years retired		Mean SD	95% CI	Mean SD	95% CI
Girth (cm)	Waist	99.9 ±7.4	93.4 to 106.4	102.3 ±7.6	95.7 to 108.9
Girth (cm)	Gluteal	110.6 ±4.3	106.8 to 114.4	110.2 ±5.8	105.2 to 115.2
Hand grip (kg)	Left	60.6 ±16.9	45.8 to 75.4	59.0 ±16.2	44.8 to 73.2
	Right	59.8 ±15.0	46.7 to 72.9	59.4 ±11.9	48.9 to 69.9
Leg Strength (kg)		189.2 ±48.1	147.0 to 231.4	178.8 ±34.8	148.3 to 209.3
6-10 years retired		Mean SD	95% CI	Mean SD	95% CI
Girth (cm)	Waist	103.5 ±5.7	98.5 to 108.5	109.2[a] ±2.8	106.8 to 111.6
Girth (cm)	Gluteal	108.6 ±5.2	104.0 to 113.2	112.0[a] ±4.1	108.4 to 115.6
Hand grip (kg)	Left	56.2 ±7.0	50.1 to 62.3	56.0 ±7.6	49.3 to 62.7
	Right	54.9 ±3.7	51.7 to 58.1	58.9 ±5.7	53.9 to 63.9
Leg Strength (kg)		175.8 ±26.5	152.6 to 199.0	167.4 ±29.9	141.2 to 193.6
11-15 years retired		Mean SD	95% CI	Mean SD	95% CI
Girth (cm)	Waist	94.8 ±12.2	84.1 to 105.4	101.8[a] ±11.1	92.1 to 111.5
Girth (cm)	Gluteal	106.1 ±9.0	98.2 to 114.0	111.2[a] ±9.7	102.7 to 119.7
Hand grip (kg)	Left	51.6 ±4.4	47.7 to 55.5	51.1 ±4.9	46.8 to 55.4
	Right	49.5 ±10.3	40.5 to 28.5	51.5 ±6.8	45.5 to 57.5
Leg Strength (kg)		175.5 ±32.9	146.7 to 204.3	174.5 ±24.1	153.4 to 195.6

SD = Standard deviation; CI = Confidence Interval; cm = centimetre; kg = kilogram; Significant difference ($p<0.05$) than (a) Baseline

The validity and reliability of the portable dynamometer utilised in this study has been previously reported (Coldwells, Atkinson, & Reilly, 1994). Interestingly the group mean (± SD) leg/back strength values for test (182.1 ±28.7) and retest (173.5 ±27.4) were not significant ($p>0.05$) which indicated that leg/back strength of the participants remained fairly constant throughout the study period. This is encouraging given the participants were not advised to undertake any training.

The results of this study suggest that portable dynamometry can be used for determining leg and back strength in held conditions, provided that the measurement protocol is standardized and controlled for time of day (Coldwells, et al., 1994).

Changes in girth measures can be the result of fat mass or muscle mass gains or losses. These changes are often the result of a decrease, or an increase, in physical activity. A previous study (Acree, et al., 2006) reported that healthy older adults who regularly participated in physical activity of at least a moderate intensity for more than one hour per week had higher health related quality of life (HRQL) measures in both physical and mental domains than those less physically active. Therefore, incorporating more physical activity into the lifestyles of sedentary or slightly active older individuals may improve their HRQL and reduce risk of early death (Acree, et al., 2006). New Zealand is undergoing a 'disability transition', with 50% of health loss now accounted for by non-fatal, disabling conditions such as type II diabetes mellitus, high BMI, hypertension, hyperlipidaemia, and physical inactivity, and this proportion is projected to increase (Ministry of Health, 2013c).

The findings from the current study indicated there were significant increases in body girths at the re-test session. Because of lifestyle shifts, chronic diseases are now becoming more prominent in younger adults leaving them burdened and encumbered with health care concerns for the rest of their lives (World Health Organization, 2007). One lifestyle shift that has been identified as being in part responsible for the earlier onset of chronic disease is the prevalence of physical inactivity (Blair, Cheng, & Holder, 2001). This relationship is supported by epidemiologic studies completed over the past century (Coppell, et al., 2013). Although physical inactivity is not the only

lifestyle factor associated with the development of chronic disease, this has received much interest in recent years, and is considered a principal intervention for primary and secondary disease prevention (Warburton, Nicol, & Bredin, 2006). Therefore, retired Māori rugby league players should be encouraged to maintain physical activity post retirement to offset the debilitating effects of chronic disease.

4.2.4 Blood pressure, fasting cholesterol and glucose

The players' blood pressure increased for systolic and diastolic pressure by a mean (±SD) of 4.4 ±11.3 mmHg (128.1 vs 132.5 mmHg; t_{13}=-2.15; p=0.0506) and 3.0 ±9.5 mmHg (88.3 vs. 91.3 mmHg; t_{13}=-1.60; p=0.1329) respectively, over the duration of the study (see Table 27). The fasting T-C (6.0 vs. 6.2 mmol/L; z=-0.511; p=0.6092), LDL-C (4.1 vs. 4.4 mmol/L; z=-0.824; p=0.4097) and TC/HDL ratio (5.8 vs. 5.8 mmol/L; z=-0.455; p=0.6489) of the retired zonal Māori rugby league players increased over the duration of the study, but were not significant.

Fasting glucose (5.4 vs. 6.0 mmol/L; z=-1.960; p=0.0500) also increased over the duration of the study. The average difference (bias) between the baseline and retest for participant's T-C (-0.2 ±1.6; p=0.3330), LDL-C (-0.3 ±1.5; p=0.2700) and TC/HDL ratio (-0.1 ±2.2; p=0.3620) (Bland-Altman analysis). However, the average difference (bias) between the baseline and retest for participants Glucose was significant (-0.6 ±1.3; p<0.0001).

Table 25   **Comparisons of retired Māori rugby league players (n=15) in a zonal region at baseline and retest periods for blood pressure, fasting cholesterol and fasting glucose results.**

	Baseline		Re-testing	
	Mean ±SD	95% CI	Mean ±SD	95% CI
Blood Pressure				
Systolic (mmHg)	128.1 ±13.7	121.2 to 135.1	132.5 ±14.5	125.2 to 139.9
Diastolic (mmHg)	88.3 ±10.8	82.8 to 93.7	91.3 ±9.1	87.2 to 95.4
Fasting cholesterol & Glucose				
T-C (mmol/L)	6.0 ±1.1	5.5 to 6.5	6.2 ±1.4	5.5 to 6.9
HDL-C (mmol/L)	1.1 ±0.3	1.0 to 1.3	1.1 ±0.3	1.0 to 1.2
LDL-C (mmol/L)	4.1 ±1.3	1.5 to 2.8	4.4 ±1.7	3.5 to 5.3
TG (mmol/L)	2.2 ±1.3	1.5 to 2.8	2.0 ±1.3	1.4 to 2.7
TC/HDL (mmol/L)	5.8 ±2.1	4.7 to 6.9	5.8 ±1.7	5.0 to 6.7
Glucose (mmol/L)	5.4 ±1.2	4.8 to 6.0	6.0[a] ±2.1	4.9 to 7.1

SD = standard deviation; CI = Confidence Interval; mmHg = millimetres of mercury pressure; mmol/L = millimoles per litre; T-C = Total cholesterol; TG = Triglycerides; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; TC/HDL = ratio of total cholesterol to high-density lipoprotein cholesterol; Significant difference ($p<0.05$) than (a) Baseline

When viewed by player retirement groups (see Table 26) the participants in the 0-5 year retirement group had increases in systolic (118.0 vs. 122.4 mmHg;) and diastolic (81.4 vs. 86.2 mmHg;) blood pressure; T-C (5.5 vs. 6.0 mmol/L; z=-0.67; p=0.5002); LDL-C (3.7 vs. 4.1 mmol/L; z=-0.81; p=0.4164); TG (1.7 vs. 1.9 mmol/L; z=-0.41; p=0.6858); T-C/HDL (5.2 vs. 5.8 mmol/L; z=-0.94; p=0.3452) and Glucose (5.1 vs. 6.5 mmol/L; z=-1.461; p=0.1441) over the duration of the study. There was a decrease in the TG results in the 6 to 10 year (2.9 vs. 2.5 mmol/L; z=-1.75; p=0.0796) and 11 to 15 year (1.9 to 1.7 mmol/L; z=-0.944; p=0.3452) retirement group over the duration of the study. As previously identified Māori are poorly represented in positive health and well-being statistics in New Zealand (Blakely, Ajwani, Robson, Tobias, & Bonne, 2004). Mortality rates for ischaemic heart disease (IHD) have been steadily declining in New Zealand since the late 1960's largely due to reductions in three identified risk factors (Hay, 2002). The three risk factors identified were: (1) Systolic blood pressure, (2) Total blood cholesterol and (3) Cigarette smoking (Tobias, et al., 2008).

Table 26   **Comparisons of retired Māori rugby league players in a zonal region by retirement group at baseline and retest periods**

	Baseline		Re-test	
	Mean ±SD	95% CI	Mean SD	95% CI
0-5 year Retired				
Blood Pressure				
Systolic (mmHg)	118.0 ±4.2	114.3 to 121.7	122.4 ±7.1	116.2 to 128.6
Diastolic (mmHg)	81.4 ±6.4	75.8 to 87.0	86.2 ±6.9	80.2 to 92.2
Fasting cholesterol & Glucose				
T-C (mmol/L)	5.5 ±0.4	5.1 to 5.8	6.0 ±1.3	4.8 to 7.2
HDL-C (mmol/L)	1.1 ±0.3	0.8 to 1.4	1.0 ±0.2	0.8 to 1.2
LDL-C (mmol/L)	3.7 ±0.6	3.2 to 4.3	4.1 ±1.4	2.9 to 5.4
TG (mmol/L)	1.7 ±1.0	0.9 to 2.6	1.9 ±1.2	0.9 to 3.0
T-C/HDL-C (mmol/L)	5.2 ±1.8	3.7 to 6.8	5.8 ±1.1	4.9 to 6.8
Glucose (mmol/L)	5.1 ±1.1	4.4 to 6.4	6.5 ±3.1	3.8 to 9.3
6-10 year Retired				
Blood Pressure				
Systolic (mmHg)	127.8 ±8.5	120.4 to 135.2	138.0 ±11.1	128.2 to 147.8
Diastolic (mmHg)	88.6 ±4.7	84.5 to 92.7	96.0 ±7.5	89.4 to 102.6
Fasting cholesterol & Glucose				
T-C (mmol/L)	6.5 ±1.1	5.5 to 7.5	6.4 ±1.4	5.2 to 7.6
HDL-C (mmol/L)	1.0 ±0.2	0.8 to 1.1	1.0 ±0.1	0.9 to 1.1
LDL-C (mmol/L)	5.0 ±1.5	3.7 to 6.3	5.1 ±2.0	3.3 to 6.9
TG (mmol/L)	2.9 ±1.6	1.5 to 4.4	2.5 ±2.0	0.7 to 4.2
T-C/HDL-C (mmol/L)	7.0 ±2.3	4.9 to 9.0	6.8 ±2.1	4.9 to 8.6
Glucose (mmol/L)	5.8 ±1.7	4.3 to 7.3	6.4 ±2.0	4.6 to 8.2
11-15 year Retired				
Blood Pressure				
Systolic (mmHg)	138.6 ±17.4	123.3 to 153.9	137.0 ±17.1	122.2 to 152.2
Diastolic (mmHg)	94.8 ±15.3	81.4 to 108.2	92.0 ±7.3	85.2 to 98.0
Fasting cholesterol & Glucose				
T-C (mmol/L)	6.0 ±1.3	4.8 to 7.2	6.1 ±1.5	4.8 to 7.5
HDL-C (mmol/L)	1.3 ±0.4	1.0 to 1.6	1.3 ±0.3	1.0 to 1.6
LDL-C (mmol/L)	3.7 ±1.5	2.4 to 5.0	4.0 ±1.6	2.6 to 5.5
TG (mmol/L)	1.9 ±1.0	1.0 to 2.8	1.7 ±0.5	1.3 to 2.1
T-C/HDL-C (mmol/L)	5.1 ±2.1	3.3 to 7.0	4.9 ±1.2	3.8 to 6.0
Glucose (mmol/L)	5.0 ±3.3	4.8 to 5.3	5.1 ±0.4	4.8 to 5.4

SD = standard deviation; CI = Confidence Interval; mmHg = millimetres of mercury pressure; mmol/L = millimoles per litre; T-C = Total cholesterol; TG = Triglycerides; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; TC/HDL = ratio of total cholesterol to high-density lipoprotein cholesterol

The average difference (bias) between the baseline and retest for participants' Total Cholesterol, Low Density Lipoprotien and Total Cholesterol/High Density Lipoprotien ratio were not significant.

However, the average difference (bias) between the baseline and retest for participants Glucose Concentration was significant (-0.6 ±1.3; $p<0.0001$). The increase in glucose concentration identified within this cohort is a concern. It has been reported (Whiting, Guariguata, Weil, & Shaw, 2011) that type 2 diabetes is a common chronic disease with significant morbidity, mortality and cost, and the prevalence continues to increase rapidly worldwide. Type 2 diabetes is a concerning health issue for Māori (Kenealy, et al., 2008) and is reported to be three times more prevalent when compared with non-Māori (Sundborn, et al., 2007).

The mortality rate in Māori between the ages of 45-64 years due to diabetes are nine times higher than non-Māori New Zealanders of the same age (Joshy, Colonne, Dunn, Simmons, & Lawrenson, 2010). Compared with non-Māori, Māori are more likely to have a range of adverse risk factors for diabetes. These are (1) They are diagnosed with diabetes at a younger age, (2) Have higher BMI increasing the risk of developing diabetes, and (3) Develop more renal, foot and eye complications as a result of developing diabetes (Gentles, et al., 2007; Joshy, et al., 2010).

When reviewing the results of the blood pressure, fasting cholesterol and fasting glucose, the participants in the 0-5yr retirement group had more increases in test measures than any of the other two retirement groups. This may be the result of a reduction in physical activity immediately post retirement from playing sport. The reasons for the changes identified were not explored further and this is a limitation to the current study. Future research is warranted to assist in the identification of what lifestyle changes have occurred post retirement with a specific focus on the amount and

quality of physical activity occurs during the period immediately post retirement from sporting participation.

4.2.5 Åstrand-Rhyming submaximal cycling test

The load experienced by the participants during the testing phase increased between the two testing periods (126.1 vs. 135.0; t_{14}=-2.65; p=0.0192) (see Table 36). As a result the participants estimated VO_{2max} increased (29.2 vs. 32.4 ml/kg/min; t_{14}=-1.93; p=0.0738).

Table 27 **Comparisons of retired Māori rugby league players (n=15) in a zonal region at baseline and retest periods for Åstrand-Rhyming submaximal cycling test**

	Baseline		Re-Test	
	Mean ±SD	95% CI	Mean SD	95% CI
Age (year)	42.2 ±8.4	37.9 to 46.5	43.2 ±8.4	38.9 to 47.5
Mean HR (bpm)	129.8 ±10.1	125.9 to 133.8	134.4 ±9.0	130.9 to 137.9
Loading (kp)	126.1 ±16.3	119.7 to 132.5	135.0[a] ±15.3	129.0 to 141.0
VO_{2max} (ml/kg/min)	29.2 ±6.9	26.5 to 31.9	32.4 ±5.5	30.3 to 34.6
FEV1 (L)	3.4 ±0.6	3.1 to 3.6	3.2 ±0.7	3.0 to 3.5
FVC (L)	4.0 ±0.8	3.7 to 4.3	3.8 ±0.8	3.5 to 4.1
FEV1 / FVC Ratio	0.85 ±0.08	0.81 to 0.88	0.85 ±0.08	0.82 to 0.89
PEF (L/min)	509.0 ±104.1	468.2 to 549.9	531.5 ±96.3	493.8 to 569.3
Lung age (year)	53.3 ±18.1	51.7 to 59.4	56.2 ±20.6	48.1 to 64.3

SD = standard deviation; CI = confidence interval; year = years; bpm = beats per minute; kp = kiloponds; VO_{2max} = maximal oxygen uptake; ml/kg/min = millimetres per kilogram per minute; L = litres; L/min = litres per minute; Significant difference (p<0.05) than (a) Baseline

Although the participants estimated lung age increased over the duration of the study (53.3 vs. 56.2; t_{14}=-2.12; p=0.0519) this was not quite significant. The average difference (bias) between the baseline and retest for participant's loading (-8.3 ±12.2; p=0.5772), estimated VO_{2max} (-3.3 ±6.5; p=0.6591) and estimated lung age (-7.2 ±13.1; p=0.3034) (Bland-Altman analysis). There were correlation's observed between the predicted lung age and the VO_{2max} (r=0.52; p=0.0495), Forced Expired Volume in 1 second (FEV1) (r=-0.94; p<0.0001), Forced Vital Capacity (FVC) (r=-0.82; p=0.0002)

and Peak Expiratory Flow (PEF) (r=-0.60; p=0.0186) at baseline testing of the retired

Māori rugby league players (see Table 26).

Table 28　　**Pearson correlations coefficients (r) of components of the Åstrand-Rhyming submaximal cycling test of retired Māori rugby league players (n=15) in a zonal region at baseline testing.**

VO_{2max} (ml/kg/min)	-				
FEV1 (L)	0.584^a	-			
FVC (L)	0.567^a	0.859^b	-		
PEF (L/min)	0.203	0.553^a	0.459	-	
Lung age (year)	-0.515^a	-0.942^b	-0.817^b	-0.598^a	-
	VO_{2max} (ml/kg/min)	FEV1 (L)	FVC (L)	PEF (L/min)	Lung age (year)

kp = kiloponds; VO_{2max} = maximal oxygen uptake; ml/kg/min = millimetres per kilogram per minute; L = litres; L/min = litres per minute; Significant correlation (a) = p<0.05; (b) = p<0.001

At the retest period of the study it was observed that there was a significant correlation

between PEF and FVC (r= 0.869; p<0.0001) that was not observed in the baseline

analysis of the zonal retired Māori rugby league players (see Table 27). When viewed

by player retirement groups (see Table 32) the participants in the 6-10 year retirement

group had a decrease in FEV1 (3.5 vs. 3.0 L; t_4=3.36; p=0.0283) and an increase in

predicted lung age (47.0 vs. 61.6 yrs.; t_4=-3.33; p=0.0292). Participants in the 11-15

year retirement group had an increase in their predicted VO_{2max} (25.7 vs. 32.6

ml/kg/min; t_4=-3.38; p=0.0278).

Table 29　　**Pearson correlations coefficients (r) of components of the Åstrand-Rhyming submaximal cycling test of retired Māori rugby league players (n=15) in a zonal region at retest.**

VO_{2max} (ml/kg/min)	-				
FEV1 (L)	0.703^a	-			
FVC (L)	0.5671^a	0.905^b	-		
PEF (L/min)	0.487	0.760^a	0.869^b	-	
Lung age (year)	-0.613^a	-0.951^b	-0.929^b	-0.866^b	-
	VO_{2max} (ml/kg/min)	FEV1 (L)	FVC (L)	PEF (L/min)	Lung age (year)

kp = kilopond's; VO_{2max} = maximal oxygen uptake; ml/kg/min = millimetres per kilogram per minute; L = litres; L/min = litres per minute; Significant correlation (a) = p<0.05; (b) = p<0.001

Increases in predicted lung age are a function of reduced vital capacity through the reduced flow of expired air in 1 second (Table 28).

Table 30 **Comparisons of retired Māori rugby league players in a zonal region by 0-5 year (n=5), 6-10 year (n=5) and 11-15 year (n=5) post-retirement groups at baseline and retest periods for Åstrand-Rhyming submaximal cycling test.**

	Baseline		Re-Test	
	Mean ±SD	95% CI	Mean ±SD	95% CI
0-5 year Retired				
Age (year)	36.0 ±8.7	28.4 to 43.6	37.0 ±8.7	38.9 to 47.5
Mean HR (bpm)	129.2 ±9.5	120.8 to 137.6	132.8 ±11.4	122.8 to142.8
Loading (kp)	130.0 ±20.9	111.7 to 148.3	135.0 ±13.7	123.0 to 147.0
VO_{2max} (ml/kg/min)	31.5 ±6.6	25.7 to 37.3	32.7 ±6.6	26.9 to 38.4
FEV1 (L)	3.6 ±0.8	2.9 to 4.2	3.6 ±1.1	2.7 to 4.5
FVC (L)	4.3 ±0.7	3.7 to 4.9	4.3 ±1.0	3.4 to 5.1
FEV1 / FVC Ratio	0.84 ±0.12	0.73 to 0.94	0.84 ±0.13	0.73 to 0.95
PEF (L/min)	549.2 ±75.9	482.7 to 615.7	551.2 ±96.2	466.9 to 635.5
Lung age (year)	46.0 ±16.0	32.0 to 60.0	46.6 ±24.0	25.6 to 67.6
6-10 year Retired				
Age (year)	41.8 ±2.9	39.3 to 44.3	42.8 ±2.9	40.3 to 45.3
Mean HR (bpm)	126.0 ±8.5	118.6 to 133.4	134.2 ±10.1	125.4 to 143.0
Loading (kp)	130.0 ±20.9	111.7 to 148.3	140.0 ±13.7	128.0 to 152.0
VO_{2max} (ml/kg/min)	30.2 ±5.4	25.5 to 35.0	32.1 ±3.1	29.4 to 34.7
FEV1 (L)	3.5 ±0.4	3.1 to 3.9	3.0[a] ±0.5	2.6 to 3.4
FVC (L)	3.9 ±0.5	3.4 to 4.4	3.5 ±0.7	2.8 to 4.1
FEV1 / FVC Ratio	0.90 ±0.06	0.85 to 0.95	0.88 ±0.07	0.82 to 0.95
PEF (L/min)	521.4 ±56.8	471.6 to 571.2	495.4 ±99.8	407.9 to 582.9
Lung age (year)	47.0 ±17.8	31.4 to 62.9	61.6[a] ±17.8	46.0 to 77.2
11-15 year Retired				
Age (year)	48.8 ±7.9	41.9 to 55.7	49.8 ±7.9	42.9 to 56.7
Mean HR (bpm)	134.4 ±12.2	123.7 to 145.1	136.2 ±7.9	129.3 to 143.1
Loading (kp)	120.0 ±11.2	110.2 to 129.8	130.0 ±20.9	111.7 to 148.3
VO_{2max} (ml/kg/min)	25.7 ±6.9	19.7 to 31.8	32.6[a] ±7.8	25.7 to 39.5
FEV1 (L)	3.4 ±0.8	2.6 to 4.1	3.1 ±0.7	2.5 to 3.8
FVC (L)	4.2 ±1.1	3.2 to 5.2	3.7 ±0.9	3.0 to 4.5
FEV1 / FVC Ratio	0.81 ±0.05	0.77 to 0.85	0.84 ±0.05	0.79 to 0.89
PEF (L/min)	548.4 ±150.2	416.8 to 680.0	548.0 ±114.5	447.7 to 648.3
Lung age (year)	54.0 ±22.1	34.6 to 73.4	60.4 ±23.0	40.2 to 80.6

SD = standard deviation; CI = confidence interval; year = years; bpm = beats per minute; VO_{2max} = maximal oxygen uptake; ml/kg/min = millimetres per kilogram per minute; L = litres; L/min = litres per minute; Significant difference ($p<0.05$) than (a) Baseline

Cardiorespiratory fitness is commensurate with the ability of the body to take up and use oxygen, and the internationally accepted reference standard for cardiorespiratory

fitness is the maximum oxygen uptake (VO_{2max})(Åstrand & Ryhming, 1954). The Åstrand bicycle test for estimating aerobic capacity has been previously reported and has been utilised to measure exercise capacity in both trained and untrained subjects. The standard error for prediction of VO_{2max} uptake from submaximal exercise is estimated to be 10% to 15%, and an acceptable reliability has been reported.

Healthy older adults who regularly participated in physical activity of at least moderate intensity for more than one hour per week had higher Health Related Quality of Life measures in both physical and mental domains than those less physically active. Therefore, incorporating more physical activity into the lifestyles of sedentary or slightly active older individuals may improve their HRQL and reduce risk of early death (Acree, et al., 2006). Studies have been conducted on the beneficial effects of exercise on the prevention and treatment of coronary artery disease (CAD) (Belardinelli, Georgiou, Cianci, & Purcaro, 1999; Coats, et al., 1992; McKelvie, 2008). A Cochrane analysis concluded that an exercise-based program for cardiac rehabilitation reduced all-cause mortality by 27%. Although the information was limited by the fact that the studies reviewed contained predominantly male subjects and that ethnicity was inconsistently reported, the overall message was clear; exercise is an effective adjunctive therapy in the treatment of CAD (Jolliffe, et al., 2001).

Despite the finding that the results for the Åstrand-Rhyming and lung function spirometry were non-significant, there were minor performance increases as repeated measures estimated VO_{2max} increased (p=0.0738) and estimated lung age (p=0.0519) over the duration of the study. This was unexpected, but encouraging, as subjects were not instructed to participate in any training intervention, however mean increases were

noted. Perhaps more importantly there was no significant decline in performance measures and therefore participants were able to maintain their aerobic capacity without any advice or direction.

Researchers have studied the effect of exercise on left ventricular dysfunction and the accompanying metabolic and autonomic neurologic derangements present in those with heart failure (Belardinelli, et al., 1999; Godfrey, Ingham, Pedlar, & Whyte, 2005; Piepoli, Davos, Francis, & Coats, 2004); (Coats, et al., 1992). A review of these studies concluded that exercise training remains a relatively safe, non-pharmacological therapy for people with heart failure, even in cases of moderate to severe heart failure (Smart, 2009). Lung Function assessment is important for adults suffering from respiratory related diseases as deaths were three times more frequent in Māori than non-Māori (Salmond, Crampton, & Atkinson, 2007). These associations highlight the fact that smoking is a contributing factor to the health inequalities seen between Māori and non-Māori (Ministry of Health, 2009). Unfortunately, these actions come at a cost, with high rates of lung cancer being a primary cause of death in Māori (Blakely, Tobias, & Atkinson, 2007).

4.2.6 InBody230 Bio-impedance assessment (BIA)

In the current study the InBody230 assessment identified that the participants had a body-fat mass (32.3 vs. 31.3; t_{14}=1.63; p=0.1248) and percent-body-fat (30.2 vs. 29.6; t_{14}=1.25; p=0.2334) decrease over the duration of the study (see Table 40). The average difference (bias) between the baseline and retest for participant's Skeletal muscle mass

(-0.1 ±1.1; *p*=0.1023), Total body water (-0.2 ±1.1; *p*=0.1164), Percent body fat (0.6 ±1.9; *p*=0.9732) and BMR (-8.2 ±2.7; *p*=0.1802) (Bland-Altman analysis).

Table 31   **Comparison of baseline and retest results for the InBody230 of retired Māori rugby league players (n=15) from a zonal region**

	Baseline		Re-test	
	Mean ±SD	95% CI	Mean ±SD	95% CI
Skeletal muscle Mass (kg)	42.5 ±5.6	39.7 to 45.3	42.6 ±6.1	39.6 to 45.7
Body-fat mass (kg)	32.3 ±8.9	27.8 to 36.8	31.3 ±8.0	27.2 to 35.3
Total body water (kg)	54.0 ±6.7	50.6 to 57.4	54.2 ±7.2	50.5 to 57.8
Free-fat mass (kg)	73.7 ±9.2	69.0 to 78.3	73.8 ±9.7	68.9 to 78.7
Percent body fat (%)	30.2 ±6.3	27.0 to 33.4	29.6 ±6.3	26.4 to 32.8
Waist-Hip Ratio	1.00 ±0.03	0.98 to 1.02	1.00 ±0.03	0.98 to 1.02
BMR (kcal)	1,960.9 ±199.2	1,860.1 to 2,061.8	1,969.2 ±211.9	1,862.0 to 2,076.4

SD = standard deviation; CI = confidence interval; kg = kilograms; % = percentage; kcal = kilocalories;

When viewed by player retirement groups, the participants in the 6-10 year retirement group had a decrease in the percent body fat (29.6 vs. 28.2%; *p*=0.1311) over the duration of the study (see Table 34).

The BMR decreased for the 11-15 year retirement group (2,032.2 vs. 2,015.6 kcal; *p*=0.7535) but increased for the 0-5 year (1,828.0 vs. 1,844.6 kcal; *p*=0.1663) and the 6-10 year (2,031.6 vs. 2,047.4 kcal; *p*=0.2507) but these were not significant.

Table 32 **Comparison of baseline and retest results for the In-Body230 of Māori rugby league players by 0-5 year (n=5), 6-10 year (n=5) and 11-15 year (n=5) post-retirement groups.**

	Baseline		Re-Test	
	Mean ±SD	95% CI	Mean ±SD	95% CI
0-5 year Retired				
Skeletal muscle Mass (kg)	38.8 ±3.2	35.9 to 41.6	39.0 ±3.4	36.1 to 42.0
Body-fat mass (kg)	30.7 ±6.2	25.3 to 36.1	30.8 ±6.0	25.5 to 36.0
Total body water (kg)	49.4 ±4.1	45.9 to 53.0	49.7 ±4.2	46.0 to 53.3
Free-fat mass (kg)	67.5 ±5.6	62.6 to 72.4	68.4 ±6.3	62.9 to 73.9
Percent body fat (%)	31.1 ±4.7	27.0 to 35.2	31.2 ±5.3	26.6 to 35.8
Waist-Hip Ratio	0.98 ±0.01	0.98 to 0.99	0.99 ±0.01	0.98 to 1.00
BMR (kcal)	1,828.0 ±121.3	1,721.7 to 1,934.3	1,844.6 ±131.8	1,729.1 to 1,960.1
6-10 year Retired				
Skeletal muscle Mass (kg)	44.6 ±6.3	39.1 to 50.0	44.8 ±6.5	39.1 to 50.5
Body-fat mass (kg)	33.1 ±11.0	23.5 to 42.8	31.2 ±10.5	22.0 to 40.5
Total body water (kg)	56.4 ±7.3	50.0 to 62.8	56.9 ±7.6	50.2 to 63.6
Free-fat mass (kg)	76.9 ±10.1	68.1 to 85.8	77.2 ±10.9	67.7 to 86.8
Percent body fat (%)	29.6 ±7.7	22.8 to 36.3	28.2 ±7.8	21.4 to 35.0
Waist-Hip Ratio	1.02 ±0.04	0.99 to 1.05	1.02 ±0.04	0.99 to 1.05
BMR (kcal)	2,031.6 ±218.0	1,840.5 to 2,222.7	2,047.4 ±221.4	1,853.3 to 2,241.5
11-15 year Retired				
Skeletal muscle Mass (kg)	44.2 ±5.8	39.1 to 49.3	44.1 ±7.1	37.8 to 50.3
Body-fat mass (kg)	33.2 ±10.6	23.9 to 42.5	31.8 ±8.8	24.1 to 39.5
Total body water (kg)	56.2 ±6.9	50.1 to 62.2	55.9 ±8.3	48.7 to 63.2
Free-fat mass (kg)	76.5 ±9.7	68.1 to 85.0	75.8 ±10.8	66.4 to 85.2
Percent body fat (%)	30.0 ±7.6	23.4 to 36.6	29.5 ±6.8	23.6 to 35.4
Waist-Hip Ratio	1.01 ±0.05	0.96 to 1.06	1.00 ±0.04	0.96 to 1.04
BMR (kcal)	2,032.2 ±208.6	1,840.3 to 2,206.1	2,015.6 ±246.9	1,799.2 to 2,232.0

SD = standard deviation; CI = confidence interval; kg = kilograms; % = percentage; kcal = kilocalories

Bio-impedance assessment provided the participants with first-hand knowledge of their body composition at the time of analysis. Some were pleasantly surprised with the results, while others were disappointed with the results when compared to their previous high levels of athletic fitness. For example:

> I'm probably 20kgs above my playing weight when I retired, but I still feel fine. I just want to be able to play with my moko (grandchildren) when they're with me. Participant H. (6 to 10 year retired group)

Previous research utilising bio-impedance analysis to evaluate body size and body composition of Polynesian (Māori and Samoan) and European population groups in New Zealand indicated that; although the Polynesian groups had a higher mean fat mass and percentage body fat than the European group their corresponding body fat levels at higher equivalent BMI values were significantly lower than for Europeans (Swinburn, Craig, Daniel, Dent, & Strauss, 1996; Swinburn, Ley, Carmichael, & Plank, 1999). The results of these studies identified that there are distinct differences in body composition between Europeans and Polynesians. Polynesians with a BMI over 25 kg/m2 have more fat-free mass (FFM) and less fat mass (FM) than Europeans at equivalent BMI levels.

4.3 Taha Tinana (Physical – Self-report)

The following sets of measures are all self-reported, without verification.

4.3.1 Medical history

The zonal participants all completed a previous medical history questionnaire (see Appendix 1). Nearly half (48%) of the participants reported they had received a concussion and/or suffered a head injury as a result of rugby league match and training activities (see Table 42). More than half (54%) of the participants reported they had on-going neck and back problems as a result of participating in rugby league match and training activities. Two percent of players reported that they had developed epilepsy from participating in rugby league activities.

Table 33 **Summary of neurological, physical, medical and musculoskeletal medical concerns reported for retired Māori rugby league players (n=25) from a zonal region.**

Condition	%	Condition	%	Condition	%
Neurological		**Medical**		**Musculoskeletal**	
Concussion	48	Asthma	10	Neck / back issues	54
Head injury	48	Bronchitis	10	Sprains / strains	36
Epilepsy	2	Diabetes	8	Fractures	18
Physical		Chest pains	4		
Nose bleeding	34	Heart Problems	4		
Dental	34	Bowel Problems	4		
Glasses	28	Kidney problems	2		
Operations	24	Thyroid	2		
Deafness	18	Hepatitis	2		
Eye problems	16				

4.3.2 Tobacco intake

All participants were asked to identify whether they were active daily smokers as part of the baseline questionnaire. Of the total participants (n=179) initially enrolled (154 Tournament; 25 Zonal), nearly a quarter (24.6%) of retired Māori rugby league players reported that they smoked (see Table 23). The highest percentage (15.3%) of smokers belonged in the 40-49 year age group.

Table 34 **Current smoking status (%)**

Age group	Tournament %	Zonal %	Total %
30-39	5.6	16.0	7.3
40-49	14.4	20.0	15.3
50-59	4.0	0.0	2.0
total	24.0	36.0	24.6

% = percentage of total number of participants

These results are comparable with the normal distribution of smokers for non-Māori of the relative age (34-75yrs) (Ministry of Health, 2013b). The smoking prevalence for

non-Māori aged 15 years or older in New Zealand is in decline and reflects both decreasing smoking initiation, and increasing successful quitting (from 8% in 2006 to 11% in 2012) (Ministry of Health, 2014). However, this does not appear to be the case for Māori (see Table33).

Table 35   **Changes in daily smoking prevalence by ethnicity between 2006 and 2012 as reported by the New Zealand Health Survey (NZHS)**

Ethnicity	2006 (% population)	2012 (% population)	Relative Change (%)
Māori	42	39	-7
Pacific	27	25	-9
Asian	11	10	-10
European/Other	19	15	-18*

% = percentage; *Source: Ministry of Health, 2013 p 21*

This table presents unadjusted prevalence results in 2006 and 2012. There is a statistically significant difference ($p<0.05$)* between 2006 and 2012. The p-values have been adjusted for differences in the age structures of the underlying populations over time. The results of the NZHS surveys identify that the relative percentage change for Māori (-7%) is far less than that for non-Māori (18%). The largest relative declines in current smoking prevalence between 2006 and 2012 occurred among 15- to 19-year-olds (-36%) and those aged 65–74 years (-27%) (Ministry of Health, 2014). This is in direct contrast to Māori, in 2012/13, Māori continued to have the highest rates of daily and current smoking with around four in ten (39%) Māori adults current smokers, and there were more Māori female smokers (42%) than Māori male smokers (37%) (Ministry of Health, 2014). As seen by the results of the baseline assessments of the retired Māori rugby league players, there were fewer participants (24.6% vs. 39%) who reported they were daily smokers than reported nationally. Further research is warranted

to see if the incidence of smoking amongst active Māori rugby league players is any different, or if there is a decline when compared to the national percentages reported.

4.3.3 Injuries

Rugby league has a high incidence of injury and studies in rugby league have shown that the injury incidence increases as the participation level increases (Gabbett, 2003; King & Gabbett, 2009b). A recent pooled analysis of studies identified the tackler recorded more injuries than the ball carrier at the professional (RR: 2.2; 95% CI 1.9 to 2.6; $p<0.0001$), semi-professional (RR: 1.3; 95% CI: 0.9 to 1.9; $p=0.2393$), amateur (RR: 1.4; 95% CI: 1.2 to 1.6; $p=0.0003$) and junior (RR: 4.3; 95% CI: 2.3 to 8.1; $p<0.0001$) levels of participation (King, Gissane, Clark, & Marshall, 2014). The lower limb (69; 95% CI: 67 to 72 per 1,000 match hours) was the most common total injury region recorded. Total lower limb injuries were recorded more commonly in amateur than semi-professional (RR: 1.9; 95% CI: 1.7 to 2.0; $p<0.0001$), professional (RR: 3.2; 95% CI: 2.8 to 3.8; $p<0.0001$) and junior (RR: 4.7; 95% CI: 3.5 to 6.3; $p<0.0001$) rugby league. More injuries were recorded in the first than the second half (RR: 1.1; 95% CI: 1.0 to 1.2; $p=0.0246$) of pooled matches. Amateur studies reported more injuries in the second half of matches (RR: 1.5; 95% CI: 1.4 to 1.7; $p<0.0001$) than semi-professional studies (King, et al., 2014).

In another review of match injuries in junior rugby league players 17-19 years (mean ±S.D. age, 18.1 ±0.8 year) it was reported that the overall incidence of injury was 56.8 (95% CI: 42.6 to 70.9) per 1,000 playing hours (Gabbett, 2008). There is a risk of musculoskeletal injury occurring from both match and training activities due to the number of physical collisions and tackles involved (Gabbett, 2004a, 2008; King &

Gabbett, 2009a, 2009b). As a result of these musculoskeletal injuries participants may be hospitalized, unable to participate in training and match and work related activities (King, Hume, & Clark, 2010b). Consequently there may be a loss of income to the injured player and associated financial costs for medical related care and job limitations owing to the severity and type of the injuries that have occurred (King, et al., 2010b).

In a previous study reporting on rugby league injuries in New Zealand it was identified that the knee was the most commonly recorded injury site followed by the shoulder; ankle and hand/wrist (King, Hume, Milburn, & Gianotti, 2009a). The lower limb recorded 42.4% of the injury entitlement claims and 31.5% of the total injury claim costs ($13,490,695). Soft tissue injuries were the most common rugby league injury entitlement claims (17,324,214) lodged while fractures/dislocations were slightly less ($16,935,094) (King, et al., 2009a). While only 1.8% of total injury entitlement claims were the result of concussion/brain injuries they accounted for 6.3% of injury entitlement costs ($2,712,139) with the highest mean cost per claim ($25,347) (King, et al., 2009a).

Previous studies have shown that bodily collisions are responsible for a large proportion of the total burden of injuries (Blair, et al., 2001; Hootman, Dick, & Agel, 2007; King, 2006; King & Gissane, 2009). These injuries may have long lasting detrimental effects, in line with the generalised theory of ageing (Zwiers, et al., 2012). For instance, repetitive blows to the head, especially in boxers, are associated with cognitive impairment, early onset dementia, and reduced life expectancy (Xie, Brayne, & Matthews, 2008). Rugby league has numerous studies highlighting incidence, site, type

and severity of injury sustained whilst playing the game and in training (Gabbett, 2004b; Gabbett, Minbashian, & Finch, 2007; King, 2006; King & Gabbett, 2009a; King, et al., 2014; King, Hume, Milburn, & Gianotti, 2009b). While the short term effects from broken bones or strains eventually heal, less is known about the long term consequences of these injuries, especially concussive injuries in rugby league (King, 2000; King, Gissane, & Clark, 2013; King, Hume, & Clark, 2010a).

In a recent study a total of 213 (mean ± SD: age, 19.2 ± 4.4 year) amateur rugby league player concussion questionnaires were reviewed. There was an average of 4.0 ± 2.6 concussive injuries per participant in the previous two years and an average of 5.0 ± 4.6 concussive injuries per participant the period preceding this (King, et al., 2013). A total of 7.5% participants saw a medical doctor for their concussion; 5.2% completed the required three week return-to-play; and 2.8% reported seeing a medical doctor for medical clearance. No Under 15yr old player reported seeing a medical doctor or having a stand down period for return to play.

Recently it was reported that Māori had the highest mean Accident Compensation Corporation (ACC) cost per Moderate to Severe Claim (MSC) for a concussion injury (King, et al., 2013). These findings were similar to a previous study reporting ethnicity variations of injury costs in rugby league (King, et al., 2009a). It must be noted that although the previous costs per Māori rugby league participant had increased ($38,118 vs. $43,604) this may be related to the increasing costs of medical care due to the different reporting periods between these studies (King, et al., 2009a).

Although the financial costs of injuries from participation in rugby league can be identified, what has not been previously reported are the non-financial, in-direct effects of these type of injuries on retired Māori rugby league players and their whānau (King, et al., 2009a, 2009b). The longitudinal effects of these injuries are often not recorded unless identified through medical presentations and captured as part of a national recording system such as the ACC reporting system. The effects of these injuries may have encroached into other areas of the retired player's lives and these may have resulted in changes to the player's relationships with their whānau, work and social interactions. There were a number of participants interviewed who suffered injuries during their careers and this was a concern highlighted during the interview process. For example:

> I've had lots of injuries....knees, ankles, concussions;
> spine injury (spinal shock), chest, and shoulder....played 8
> weeks after broken back.....poor advice. Participant H. (6
> to 10 year retired).

<div align="center">and</div>

> I was advised to retire relatively young (29yrs) because of
> injury but wouldn't have changed anything in my career
> and I would love to do it all again. The injuries were part
> and parcel of playing the game….you were taught to be
> tough on the field by making tackles or being tackled
> Participant E. (11 to 15 year retired group)

The sites of the injuries varied in this cohort and this may have been as a result of some of the participants being retired professional rugby league players while others were amateur players. Analysis of the differences in the participation levels were not taken as there were only two ex-professional players in the group. It has been previously reported that the most common injury sites have varied by different participation levels

and this was similar for the current cohort (Gabbett, 2004a; King, Hume, & Clark, 2012; King, et al., 2009a, 2009b; King, Hume, Milburn, & Guttenbeil, 2010c). Further research is warranted to explore the effects of injuries longitudinally to ascertain what these may be for retired Māori rugby league players.

With neck and back injury rating the highest (54%) incidence followed closely by concussion/head (48%) injury the evidence gathered from the current cohort (see Table 41) confirms that many of the same injuries had occurred throughout their careers. While this is a positive finding in terms of exploratory evidence, it is unfortunate and contributes to the state of poor health experienced by the cohort in retirement from sport.

These findings of the current study are consistent with previous studies reporting on medical history and injuries suffered during a rugby league playing career (Gabbett, 2000b, 2001, 2003; Meir, et al., 1997). By exploring the injury history of the zonal retired Māori rugby players' further analysis was able to be undertaken. The fact that players were injured did not stop them participating and for some, if it were not for injuries they would still be participating fully. For example:

> I've learnt to deal with my injury (dislocated hip). I'd still
> be playing today if I could (40year old). I miss the team
> environment and mates on and off the field
> Participant E. (10 to 15- year retired group)

Rugby league is a brutal sport that requires dedication to training to offset the likelihood of injury, although injury is inevitable. The evidence points to fatigue as a major contributing factor to injuries occurring in games, and the most common injuries

reported in rugby league are hematoma's, strains and sprains with lower limbs being the most frequently injured site on the body. Concussion is a cause for concern in light of recent trauma experienced within the elite level (NRL) of the game. However, it is accepted as part of the game and players are managed as best they can within the confines of the sport.

Lastly, osteoarthritis is reportedly the main cause of debilitation for players retired from the game, with joints being subjected to minor and/or major trauma throughout their playing careers leading to bone on bone scenario's in knees with the removal of menisci and poor hip mobility causing gait problems when walking and or running (Elleuch, et al., 2008; Kuijt, Inklaar, Gouttebarge, & Frings-Dresen, 2012; Vignon, et al., 2006).

A study based in the United Kingdom assessed morbidity and health-related quality of life (HrQoL) amongst former rugby players, compared to an age-standardised general population sample. Using cross-sectional data they found through analyses of participants aged 50+, diabetes was significantly lower amongst former players, (0.28, 95% CI), whereas osteoarthritis (4.00, 95% CI), joint replacement (6.02, 95% CI), and osteoporosis (2.69, 95% CI) were significantly higher (Davies, et al., 2017). Osteoarthritis (OA) is reportedly more common in retired contact team sports participants, particularly in soccer, rugby league, Australian Rules and rugby union (Bennell, Hunter, & Vicenzino, 2012; Deacon, et al., 1997; Meir, McDonald, & Russell, 1997; Thelin, et al., 2006).

4.4 Section 2 Short Form 36 version 2 questionnaire (SF-36v2)

The SF-36v2 is scored by the variance of the mean, with scores above 50 being positive and scores below 50 rating negative. A full explanation of the scoring mechanism can be found in Appendix 10. The scores for the majority of the scales were above (50) but these ranged from 18.2 to 100. As a result of these scores it can be seen that some of the retired Māori rugby league players rate their quality of health as very low through to extremely high. The results of this questionnaire are explored in more detail for each of the participant groups.

4.4.1 Part A Tournament participants (SF-36v2)

In respect of the physical component summary (PCS) scales of the SF-36v2 participants rated their physical function (86.1 ±18.0) and role physical (83.7 ±19.3) as high (see Table 36). Whilst for the mental component summary (MCS) scales, participants rated their role emotional (85.5 ±19.2) and mental health (68.6 ±9.3) as being high. As a result, the physical component summary (71.8 ±8.8) and mental health summary (66.2 ±7.0) were also high.

Table 36   Summary of the SF-36v2 Results (Part A)

Scales		Mean ±SD	95% CI	Range
PCS scales	PF	86.0 ±17.5	83.2 to 88.8	33.3 to 100
	RP	83.6 ±19.0	80.6 to 86.6	20.0 to 100
	BP	39.1 ±19.2	36.1 to 42.2	18.2 to 90.9
	GH	59.7 ±10.0	58.1 to 61.3	32.0 to 88.0
MCS scales	VT	54.6 ±9.0	53.2 to 56.1	24.0 to 76.0
	SF	60.1 ±7.7	58.8 to 61.3	20.0 to 80.0
	RE	84.9 ±18.9	81.9 to 88.0	26.7 to 100
	MH	68.4 ±9.4	66.9 to 69.9	28.0 to 88.0
	PCS	71.8 ±8.5	70.4 to 73.2	36.0 to 89.5
	MCS	64.9 ±7.1	63.8 to 67.1	30.7 to 81.3

SD = standard deviation; CI = confidence interval; PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary

4.4.2 Part B (Zonal) participants (SF-36v2)

The participants in Part B completed a baseline SF-36v2 and a re-test 18 months later. This was undertaken to identify if changes had occurred when compared with participants' baseline data. As previously identified, not all the participants (15/25; 60%) returned for the re-testing phase of this study. The results are therefore limited in this section as comparisons were only undertaken on those participants who presented for both the baseline and re-test evaluations. The returning retired Māori rugby league players (n=15) initially reported a low score (which means high pain) on bodily pain (BP) but this increased at the retest (40.0 vs. 50.7) (see Table 37). The Role Physical (RP) (83.0 vs. 85.7), General Health (GH) (60.8 vs. 62.7) and Mental health (MH) (67.0 vs. 71.5) scales all improved at the retest when compared with their baseline results.

Table 37   **Comparison of baseline and retest SF-36V2 scale and component summary results (Part B)**

Scales		Baseline		Retest	
		Mean ±SD	95% CI	Mean ±SD	95% CI
PCS scales	PF	85.6 ±15.4	79.6 to 91.6	84.9 ±18.3	75.6 to 94.1
	RP	83.0 ±17.8	76.0 to 90.0	85.7 ±18.9	76.1 to 95.2
	BP	40.0 ±23.0	31.0 to 49.0	52.7 ±27.1	39.0 to 66.4
	GH	60.8 ±9.7	57.0 to 64.6	62.7 ±9.4	57.9 to 67.4
MCS scales	VT	54.9 ±11.9	50.2 to 59.6	60.5 ±7.4	56.8 to 64.3
	SF	60.8 ±8.6	57.4 to 64.2	63.3 ±4.9	60.9 to 65.8
	RE	82.1 ±17.2	75.4 to 88.9	88.9 ±13.3	82.2 to 95.6
	MH	67.0 ±10.2	63.0 to 71.0	71.5 ±9.4	66.7 to 76.2
	PCS	72.0 ±7.2	69.1 to 74.8	74.5[a] ±7.7	70.6 to 78.4
	MCS	65.2 ±7.8	62.1 to 68.2	70.2 ±5.7	67.3 to 73.1

PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary; Significant difference ($p<0.05$) than (a) Baseline

As a result of these changes, there was a significant difference observed in the PCS (72.0 vs. 74.5p=0.0408) when compared with the baseline (see Table 30).

Table 38   **Comparison of baseline and retest SF-36V2 scale and component summary results of retired Māori rugby league players.**

			Baseline		Retest	
	Scales		Mean ±SD	95% CI	Mean ±SD	95% CI
0-5 year Retired						
	PCS Scales	PF	92.7 ±8.0	85.7 to 99.6	84.0 ±21.3	65.4 to 102.6
		RP	100.0 ±0.0	-	84.0 ±16.7	69.3 to 98.7
		BP	27.3 ±9.1	19.3 to 35.2	45.5 ±23.2	25.1 to 65.8
		GH	59.2 ±5.9	54.0 to 64.4	59.2 ±11.1	49.5 to 68.9
	MCS scales	VT	54.4 ±6.1	49.1 to 59.7	60.0 ±9.4	51.8 to 68.2
		SF	64.0 ±5.5	59.2 to 68.8	62.0 ±4.5	58.1 to 65.9
		RE	94.7 ±8.7	87.0 to 102.3	89.3 ±16.7	74.7 to 104.0
		MH	68.8 ±15.1	55.6 to 82.0	75.2 ±13.1	63.7 to 86.7
		PCS	76.3 ±3.7	73.0 to 79.6	71.9 ±10.5	62.7 to 81.0
		MCS	68.5 ±7.9	61.6 to 75.5	71.2 ±9.1	63.2 to 79.2
6-10 year Retired						
	PCS Scales	PF	96.0 ±4.3	92.2 to 99.8	83.3 ±18.1	67.5 to 99.2
		RP	82.0 ±20.5	64.0 to 100.0	88.0 ±16.8	73.3 to 102.7
		BP	45.5 ±27.3	21.5 to 69.4	63.6 ±33.4	34.4 to 92.6
		GH	62.4 ±6.1	57.1 to 67.7	63.2 ±9.5	54.8 to 71.6
	MCS scales	VT	57.6 ±11.5	47.5 to 67.7	57.6 ±4.6	53.8 to 66.2
		SF	60.0 ±7.1	53.8 to 66.2	62.0 ±4.5	58.1 to 65.9
		RE	81.3 ±20.8	63.1 to 99.5	90.7 ±11.2	80.9 to 100.4
		MH	68.8 ±5.2	64.2 to 73.4	67.2 8.7	59.6 to 74.8
		PCS	76.5 ±7.7	69.8 to 83.2	76.0 ±3.3	73.1 to 79.0
		MCS	66.4 ±5.0	62.0 to 70.8	68.0 ±3.9	64.6 to 71.4
11-15 year Retired						
	PCS Scales	PF	79.3 ±13.8	67.2 to 91.5	87.3 ±19.5	70.2 to 104.4
		RP	68.0 ±18.2	52.0 to 84.0	85.0 ±26.0	62.2 to 107.8
		BP	41.8 ±20.9	23.5 to 60.2	49.1 ±26.2	26.1 to 72.0
		GH	64.8 ±13.7	52.8 to 76.8	65.6 ±8.3	58.3 to 72.9
	MCS scales	VT	60.0 ±14.7	47.1 to 72.9	64.0 ±7.5	57.4 to 70.6
		SF	64.0 ±8.9	56.2 to 71.8	66.0 ±5.5	61.2 to 70.8
		RE	74.7 ±16.6	60.1 to 89.2	86.7 ±14.1	74.3 to 99.1
		MH	68.8 ±14.8	55.8 to 81.8	72.0 ±4.9	67.7 to 76.3
		PCS	67.7 ±5.6	62.8 to 72.6	75.6 ±8.6	68.1 to 83.1
		MCS	66.4 ±10.6	57.1 to 75.7	71.5 ±2.9	68.9 to 74.0

PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary;

The average difference (bias) between the baseline and retest for Physical Function (PF) (4.4 $\pm$21.1; p=0.1102), Bodily Pain (BP) (-14.5 $\pm$27.8; p=0.3122), Vitality (VT) (-3.2 $\pm$13.3; p=0.1882) and Mental Component Summary (MCS) (-3.1 $\pm$8.5; p=0.3094) (Bland-Altman analysis) were not significant. When viewed by player retirement groups, the participants in the 0-5 year from retirement group had a decrease in the PCS (76.3 vs. 71.9p=0.5421) while participants in the 11-15 year retirement group had an increase in the PCS (67.7 vs. 75.6p=0.3642). Participants in the 0-5 year group (68.8 vs. 75.2; $F_{(3,1)}$=3.62; p=0.3642) and 11-15 year (68.8 vs. 72.0; $F_{(2,2)}$=1.74; p=0.3650) mental health (MH) scale increased over the duration of the study while players in the 6-10 year group (68.8 vs. 67.2 p=0.3648) had a decrease (see Table 38).

The participants who completed the SF-36v2 were stratified into age groups for further analyses (i.e. 25 to 34 yrs., 35 to 44 yrs., 45 to 54 yrs., 55 to 64 yrs. and 65 to 74 yrs.) (see Table 39). The stratification of the age groups were identical to those utilised in the 2006/07 New Zealand Health Survey (Ministry of Health, 2008). The groups were in 10 year blocks from age 15 through to 75+ yrs.

4.4.3 SF-36v2 and New Zealand Health Survey

The 2006/07 New Zealand Health Survey (NZHS) (Ministry of Health, 2008) was the first time the SF-36v2 was used. There were more than 17,000 New Zealanders interviewed from the usually resident population living in private dwellings about their health status, risk and protective behaviours for health outcomes and use of health care services. This survey provided the first normative values specific to the New Zealand population (Frieling, Davis, & Chiang, 2013). Further comparative analysis using the SF-36v2 with other countries, including the United States of America (Ware, 2000) and

Australia (Hawthorne, Osborne, Taylor, & Sansoni, 2007), generally indicate that New Zealanders report better health status. However, it is unclear to what extent the observed differences between countries reflect genuine health differences (Frieling, et al., 2013).

The New Zealand Health Survey has utilised the Medical Outcomes Study Short Form 36 questionnaire (SF-36) since 1996/97 as a measure of health-related quality of life in adults (Ministry of Health, 2008; Ware & Sherbourne, 1992). This version is identical to the version utilised in the current study (Appendix 9) and was chosen because the questionnaire had improved wording and layout, and reduced the number of responses in some questions, minimising ambiguity and bias and allowing for greater comparability between cultural adaptations and translations (Ministry of Health, 2008).

When stratifying the participants' data into the age groups, bodily pain (BP) was more than two standard deviations below the average (50) for all the age groups reported. When compared to the New Zealand Health Survey results the participants BP results were between three to four deviations lower than the national results. This finding indicates that the participants are experiencing increased pain and discomfort since retiring from competitive rugby league (see Tables 39 and 40).

Table 39   Comparison of SF-36v2 scale and results of retired Māori rugby league players at tournaments and the New Zealand Health Survey 2006/07 for age group comparisons of 25-34 yrs., 35-44 yrs. and 45-54 yrs.

Scales		25-34 yrs.				35-44 yrs.				45-54 yrs.			
		Retired Māori		NZHS 2006/07		Retired Māori		NZHS 2006/07		Retired Māori		NZHS 2006/07	
		Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
PCS scales	PF	90.3	80.3to 100.0	92.3	91.4 to 93.1	85.5	80.7 to 90.3	90.7	89.9 to 91.5	85.4	79.5 to 91.3	87.4	86.3 to 88.5
	RP	89.6	82.7 to 96.5	89.9	88.9 to 90.9	81.9	76.9 to 87.0	88.8	87.8 to 89.8	85.7	79.7 to 91.8	87.1	85.8 to 88.4
	BP	35.6	24.8 to 46.5	77.9	76.5 to 79.3	39.8	34.9 to 44.6	76.1	74.9 to 77.2	39.2	33.8 to 44.7	75.2	73.6 to 76.7
	GH	59.3	54.8 to 63.8	76.1	75.0 to 77.2	61.2	58.8 to 63.5	76.5	75.6 to 77.4	57.9	54.3 to 61.4	75.4	74.2 to 76.6
MCS scales	VT	54.3	49.1 to 59.6	63.1	62.2 to 63.9	55.7	53.6 to 57.9	63.5	62.5 to 64.5	52.4	50.1 to 54.7	65.3	64.2 to 66.3
	SF	60.0	56.6 to 63.4	88.8	87.6 to 89.9	59.7	57.4 to 61.9	88.1	87.2 to 89.0	59.8	57.8 to 61.8	89.6	88.5 to 90.6
	RE	92.2	83.9 to 100	93.3	92.5 to 94.1	85.2	80.3 to 90.1	93.2	92.6 to 93.8	84.1	77.8 to 90.3	94.0	93.0 to 94.9
	MH	69.3	63.4 to 75.2	80.7	80.0 to 81.5	69.6	68.0 to 71.1	81.4	80.7 to 82.0	67.4	63.9 to 70.9	82.8	81.9 to 93.7

CI = confidence interval; PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary

Table 40 **Comparison of SF-36v2 scale and results of retired Māori rugby league players at tournaments and the New Zealand Health Survey 2007/07 for age group comparisons of 55-64 yrs. and 65-74 yrs.**

Scales		55-64 yrs.				65-74 yrs.			
		Retired Māori		NZHS 2006/07		Retired Māori		NZHS 2006/07	
		Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
PCS scales	PF	88.6	84.2 to 93.0	81.3	80.1 to 82.6	76.7	57.1 to 96.3	73.6	710.9 to 75.2
	RP	82.1	69.8 to 94.4	83.2	81.9 to 84.5	70.0	50.4 to 89.6	76.5	74.6 to 78.5
	BP	36.4	25.6 to 47.1	73.0	71.6 to 74.5	45.5	9.8 to 81.1	70.1	68.2 to 71.9
	GH	54.3	50.4 to 58.2	73.6	72.5 to 74.6	74.0	46.6 to 100.0	71.0	69.5 to 72.4
MCS scales	VT	55.7	49.8 to 61.5	65.0	64.1 to 66.0	62.0	58.1 to 65.9	64.3	63.0 to 65.6
	SF	61.7	57.6 to 65.7	89.0	88.0 to 90.1	65.0	55.2 to 74.8	88.1	86.7 to 89.5
	RE	87.8	76.9 to 98.7	94.6	93.9 to 95.4	70.0	50.4 to 89.6	94.2	93.3 to 95.1
	MH	67.7	60.4 to 74.9	84.6	83.9 to 85.2	68.0	52.3 to 83.7	85.2	84.5 to 86.0

CI = confidence interval; PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary

In the case of retired Māori players across all age groups body pain (highlighted) appears to be of greatest concern to the participants. A possible reason for the finding that retired players may be experiencing increased pain and discomfort may be related to degenerative diseases such as osteoarthritis. There has long been debate over the role that participation in sport may have in the development of osteoarthritis (Zhang, 2014). Osteoarthritis is reportedly common in retired contact team sports participants, particularly in soccer, (Thelin, Holmberg, & Thelin, 2006) rugby league, (Meir, McDonald, & Russell, 1997) and Australian Football Rules (Deacon, Bennell, Kiss, Crossley, & Brukner, 1997). The only agreed causative requirement is that excessive activity with high impact and torsional loading, in the presence of an abnormally aligned joint or with abnormal biomechanics, may lead to joint degeneration and OA (Stewart & White, 2007).

The SF36v2 results of the current study were compared with the results of New Zealand Health Survey (NZHS) in 2006-2007 (Ministry of Health, 2008) and South Australian norms in 2004 (Sport and Recreation New Zealand, 2008) (see Table 39). Comparing the 95% CI of these different studies can assist to identify where the means of the current cohort are in relation with other reported norms from New Zealand and South Australia. When comparing the findings of the retired Māori rugby league participants with the 2006/07 NZHS some, but not all of the scales were similar (see Table 40). The summary scale of BP rated positively (75.3 ±23.2) in the NZHS, yet it rated negatively for retired Māori rugby league participants for combined data (39.1 ±19.2), Part A (39.0 ±15.9), Part B baseline (40.0 ±23.0) and Part B re-testing (52 ±27.1) of all the component scales.

Table 41 **Comparison of SF-36V2 data for the combined data of retired Māori rugby league players in a zonal region at baseline and retesting with New Zealand (2006-2007 survey results) and South Australia (2004 survey results) by mean and standard deviation.**

		Baseline		Re-test		New Zealand 2006-7		South Australia (2004)	
		Mean SD	95% CI	Mean SD	95% CI	Mean SD	95% CI	Mean SD	95% CI
PCS Scales	PF	85.6 ±15.4	79.6 to 91.6	84.9 ±18.3	75.6 to 94.1	85.9 ±21.8	85.3 to 86.5	84.6 ±21.9	83.5 to 85.7
	RP	83.0 ±17.8	76.0 to 90.0	85.7 ±18.9	76.1 to 95.2	85.7 ±23.2	85.1 to 86.3	84.4 ±25.1	93.1 to 85.7
	BP	40.0 ±23.0	31.0 to 49.0	52.7 ±27.1	39.0 to 66.4	75.3 ±24.2	74.7 to 75.9	76.5 ±21.2	75.4 to 77.6
	GH	60.8 ±9.7	57.0 to 64.6	62.7 ±9.4	57.9 to 67.4	74.5 ±19.7	74.1 to 74.9	71.9 ±21.9	70.8 to 73.0
MCS scales	VT	54.9 ±11.9	50.2 to 59.6	60.5 ±7.4	56.8 to 64.3	64.0 ±18.4	63.6 to 64.4	61.1 ±20.8	60.1 to 62.1
	SF	60.8 ±8.6	57.4 to 64.2	63.3 ±4.9	60.9 to 65.8	88.4 ±20.5	88.0 to 88.8	86.2 ±22.3	85.1 to 87.3
	RE	82.1 ±17.2	75.4 to 88.9	88.9 ±13.3	82.2 to 95.6	93.7 ±15.0	93.3 to 94.1	91.6 ±17.5	90.7 to 92.5
	MH	67.0 ±10.2	63.0 to 71.0	71.5 ±9.4	66.7 to 76.2	82.3 ±13.2	81.9 to 82.7	80.6 ±17.0	79.8 to 81.4

PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary;

Table 42 **Comparison of SF-36v2 scale baseline and retesting results of retired Māori rugby league players at a zonal region with the New Zealand Health Survey 2006/07 by mean with 95% confidence interval**

Scales		Baseline		Retest		NZHS 2006/07	
		Mean	95% CI	Mean	95% CI	Mean	95% CI
PCS scales	PF	96.7	92.9 to 100.4	84.4	57.2 to 111.7	92.3	91.4 to 93.1
	RP	86.7	60.5 to 112.8	99.9	99.8 to 100.1	89.9	88.9 to 90.9
	BP	48.5	5.7 to 91.3	60.6	14.2 to 107.0	77.9	76.5 to 79.3
	GH	64.0	56.2 to 71.8	58.7	49.2 to 68.1	76.1	75.0 to 77.2
MCS scales	VT	52.0	40.0 to 64.0	56.0	51.5 to 60.5	63.1	62.2 to 63.9
	SF	60.0	48.7 to 71.3	60.7	59.4 to 62.0	88.8	87.6 to 89.9
	RE	84.4	65.5 to 103.4	95.6	86.8 to 104.3	93.3	92.5 to 94.1
	MH	69.3	62.4 to 76.2	68.0	56.0 to 80.0	80.7	80.0 to 81.5

PF = Physical function; RP = Role physical; BP = Bodily pain; GH = General health; VT = Vitality; SF = Social functioning; RE = Role emotional; MH = Mental Health. PCS = Physical component summary; MCS = Mental component summary

This major variance (52%) in Bodily Pain from the NZHS to the current study was unexpected, and requires further longitudinal study to determine the significance of this divergence. The remaining summary scales also produced differing results with mostly negative findings for retired Māori rugby league participants. This indicated a negative trend toward poorer health status. The 95% CI suggests that the means of the cohort in this study are lower than the New Zealand and South Australian norms.

Another interesting finding of the SF-36v2 results were that, although all the participant groups were 1 to 2 standard deviations (10-20) above the average (50) in mental health (MH), this was still below the mean (82.3 ±13.2) of the NZHS population. Māori experience higher rates of psychological distress than other adults: overall, 6% of adults had experienced high or very high levels of psychological distress in the last four weeks, indicating a high probability of an anxiety or depressive disorder. Māori are 1.6 times as likely to have experienced high levels of psychological distress as non-Māori (Ministry of Health, 2013b).

The burden of anxiety and depressive disorders increased from 5.3% to 6.9% of total disability-adjusted life year calculations (DALY) over the 2006-2010 reporting period when the indirect impact of these disorders as a risk factor for suicide, self-harm and coronary heart disease is included (Ministry of Health, 2013a). Suicide was the fourth leading cause of death for Māori males and the second leading cause of death for non-Māori males (Ministry of Health, 2010). The Mental Health, Role-Emotional, and Social Functioning scales and the MCS summary measure have been shown to be the most valid of the SF-36v2 scales as mental health measures.

During the 2006/07 NZHS, Māori had lower mean scores than the total population on all SF-36v2 domains except vitality, where there were no differences for either gender and mental health, where Māori showed no difference compared to all others (Ministry of Health, 2008). These findings were adjusted for age and found Māori, were less likely to report excellent or very good self-rated health, whereas European/Others were more likely to report excellent or very good self-rated health, in the total population (Ministry of Health, 2008).

Factor-analytic studies have been shown to be most responsive in comparisons of patients before and after recovery from depression, change in the severity of depression and as well as drug treatment and interpersonal therapy for depression (McHorney, Ware & Raczek, 1993). This pattern of results has been replicated in both cross-cultural and longitudinal tests using the method of known-groups validity (Ware, 2000). However, not recorded in the New Zealand Health Survey was the physical and mental component scale (PCS, MCS) summaries and therefore inter-study comparisons were not able to be achieved. Further studies utilising the SF-36v2 should include the PCS and MCS to enable a summary analysis to be recorded and this will assist with providing another two parameters to the analysis.

A further limitation to only completing baseline SF-36v2 (Part A) was that there was no capacity to revisit the participants to enable a review of the results of the SF-36v2 and for kanohi ki te kanohi (face to face) interviews. According to Ware (2000) the PF, RP, and BP scales and the PCS summary have been shown to be the most valid SF-36v2 scales for measuring physical health. These scale scores tend to be most responsive to the effects of, and benefits from, knee replacement and hip replacement and heart valve

surgery (Mathews, 1973). Future studies utilising a similar methodology should consider this an important part of the review process.

Whilst Māori health has improved over the past 25 years on many indices (reduced smoking rates, improved quality of life, and reduction in mortality) as evidenced by the research being produced through the Health Research Council, there are still key fundamental issues where inequality still exists in the 21st century. Māori rates of smoking are still nearly double that of non-Māori. It is widely acknowledged that smoking has a severe impact on global health at a macro-level, but perhaps more importantly the impact it is having within whānau, iwi and hapū. To their credit many iwi are incorporating quit smoking initiatives (aukati kai paipa) as part of their overall strategy to improve health outcomes for all.

Criteria utilised in the validation of the SF-36v2, which include accepted clinical indicators of diagnosis and severity of depression, heart disease, and other conditions, are well documented (McHorney, Ware, & Raczek, 1993). The reliability of the eight scales, and two summary measures, of the SF-36v2 have been estimated using both internal consistency and test–retest methods (Ware, 2000). Extensive psychometric testing has also been conducted on SF-36v2 all over the world. By using the same tests of scaling and scoring assumptions that were used in developing the SF-36v2, investigators have compared results across general population studies in 10 countries.

While it was unclear what contributed to changes during the subsequent re-testing period some of the participants indicated to the researcher through kanohi ki te kanohi

at the follow up assessment that they were embarrassed with their results during baseline testing. For example:

> I was embarrassed by my test results and wanted to make sure I could perform better during re-testing….so I started training again and I'm probably 15kg overweight at the moment, but I can manage that by simply training more often….and trying to cut out fried food Participant J. (6-10 year retired group)

Further analysis from the participants kanohi ki te kanohi responses revealed that not only an increase in body mass (kg) was concerning, but the effect on health was a common theme amongst these retired Māori rugby league players. For example, the change in health status was a concern and was discussed:

> I've had a few health problems with liver and stomach....all to do with poor eating and drinking alcohol...I've never smoked cigarettes...my main problem is alcohol...takeaway foods Participant J. (6 to 10 year retired group)

4.5   Section 3 Kanohi ki te Kanohi Interviews (Part B)

All players enrolled in Part B of the research were invited to participate in kanohi ki te kanohi interviews. Only 40% (10/25) of participants agreed to be part of this and these interviews took place at a venue of the participant's choice.

4.5.1 Test-Re-test evaluations

With only 15 (60.0%) of the original 25 participants returning for re-testing, I contacted the participants who did not return. Although participants were encouraged to return, those who were able to be contacted advised that due to various reasons they were unable to commit to the project and were unable to return for re-assessment. Of the 15 participants who returned for repeat physiological testing only 10 agreed to participate in the kanohi ke te kanohi discussions. This was mainly due to time constraints and availability during the timeline for this process. Whilst I was disappointed that not all participants could share their stories, I was happy for those who did provide some personal context:

> It's difficult to return as I have a new job in Christchurch (Participant 2H).
>
> I'm moving to Australia in November (Participant 2D).
>
> I've injured my leg and unable to return (Participant 3B).
>
> The doctor has advised me my diabetes isn't stable enough to continue (Participant 2E). Participant 2F, decided he wanted to start playing competitive level footy again so became ineligible under the criteria of the research.

None of these participants' baseline data was included in any comparisons.

There were no observable differences ($p>0.05$) in the participants body mass and resultant BMI when compared with the baseline assessment. The amount of body mass loss and resultant BMI score was more evident when stratified into years from retirement with the 0-5 year and 11-15 year groups all showing a decrease. The changes in these groups may have been related to an indirect result of the players being assessed as no incentive was provided for these participants to undertake any form of activity.

Bandura's (1977) Social cognitive theory may provide a possible reason for the physiological changes observed at the re-testing of retired Māori rugby league players an insight into why this may have occurred. Social cognitive theory is formulated around triadic reciprocal determinism, or the view that behaviour (efficacy), cognitive thoughts (perceived self-efficacy) and environmental stimuli influence each other in a bi-directional, reciprocal direction. Perceived self-efficacy is the belief that a person has about their personal capabilities to accomplish a task and is commonly thought of as a person's confidence (Bandura, 1977).

Efficacy beliefs are what people will try, motivating them to achieve what they believe they will be successful at achieving. According to Bandura (1977) self-efficacy beliefs are influenced by four main sources: (1) Enactive attainment; (2) Vicarious experience; (3) Social persuasion; and (4) physiological / emotional states. Enactive attainment is based on the individuals actual past performance giving them an authentic measure of their capability Vicarious experience is obtained by the individuals' confidence gained by seeing other people, judged to be similar to themselves, perform the same behaviour. Social persuasion encourages action through verbal reinforcement (Bandura, 1977).

In the case of the retired Māori rugby league players this may have been the results of the baseline assessment, and these were not seen in a positive manner. This would have been their enactive attainment. The vicarious experience may have been the psychological effect on the individual's confidence in seeing the testing results of the other, in some cases older, participants. The social persuasion of this situation may have encouraged the participants to address the issue of their physical health and the social persuasion may have been the testing group. For the participants who returned for their

re-test, this effect was evident in the changes that occurred through the assessment process.

Further research is warranted to identify if a routine assessment would assist in motivating retired Māori rugby league players to undertake more health promoting activities. Further research is recommended to explore the effects of injury suffered and especially the long term effects from concussive injury for retired rugby league players.

4.5.2 Body Anthropometrics

Similar to changes in the SF-36v2 results, those retired Māori rugby league players in the 6-10 year retirement group had changes in conflict with the 0-5 and 11-15 year groups. The increase in body mass, and subsequently in their BMI, may be related to the findings in the SF-36v2 where there was more bodily pain than the other retirement groups. This may have resulted in a decreased capacity to undertake any physical activity resulting in possible psychological changes such as feeling depressed leading to an increase in body mass. Further research is warranted to identify the possible causes in the changes and whether it is sport-related or age-related changes that are occurring.

While it was unclear what contributed to these changes during the subsequent re-testing period some of the participants indicated to the researcher that they were embarrassed with their results during baseline testing through discussions at the follow up assessment. For example:

I was embarrassed by my test results and wanted to make sure I could perform better during re-testing….so I started training again" and "I'm probably 15kg overweight at the moment, but I can manage that by simply training more often….and trying to cut out fried food Participant J. (6-10 year retired group)

This was similar for some of the other participants whose results were not what they expected. As a result of the assessments, some participants identified that they were motivated to undertake their own physical activities in an endeavour to improve upon their assessment results. For example:

I'm healthy most of the time, but probably 10-20kg overweight at the moment…I run and walk every 2nd or 3rd day...swim occasionally, but I've gained 6-8kgs in the last year since retirement…but I've never smoked cigarettes (Participant B, 0-5 years retired group).

Further analysis from the participants responses revealed that not only an increase in body mass (kg) was concerning, but the effect on health was a common theme amongst these retired Māori rugby league players. For example, the change in health status was a concern and was discussed:

I've had a few health problems with liver and stomach....all to do with poor eating and drinking alcohol...I've never smoked cigarettes...my main problem is alcohol...takeaway foods (Participant J, 6 to 10 years retired group).

There were other reasons identified for player's retiring. For example:

> I retired because of family reasons (partners urgings)…my body was
> still in good working order. Not as active currently and need to increase
> my activity levels (Participant H, 6 to 10 years retired group).

4.5.3 Health evaluation

Sport has the capacity to elicit physical, psychological and social benefits as previous research on high school students highlighted that sports participation had the strongest, most consistent inverse relationship with elevated weight status (Drake, et al., 2012). Drake et al (2012) highlighted that sports team participation was inversely related to overweight/obesity and obesity. Obesity prevalence would decrease by 26.1% if all adolescents played on 2 sports teams per year and by 22.1% if all adolescents walked/biked to school at least 4 days per week.

However, given the evidence suggested thus far, male Māori are somewhat susceptible to ill health because of their ethnicity, high rate of smoking, and hazardous drinking tendency (Bramley, et al., 2004; Jones, Crengle, & McCreanor, 2006; Salmond, et al., 2007; Sharpe, 2006). As well, male Māori may also be more susceptible with links to some familial history of cardiovascular disease, diabetes mellitus, lung cancer, obesity, and the consequences of previous injuries (Blakely, Fawcett, Hunt, & Wilson, 2006; Brown, et al., 2010; Kritharides, et al., 2010; Robson & Harris, 2007). It is hardly surprising that for nearly every health status indicator utilised, disparities (both absolute and relative) were more pronounced for Māori than those of non-Māori in New Zealand (Bramley, Hebert, Tuzzio, & Chassin, 2005). The evidence is overwhelming in terms of poorer health outcomes for Māori (especially males) post career, particularly if they have not continued to participate in some form of physical activity.

Rugby league has made me the person I am today. I have made many lifelong friends in the game…and perhaps just as many enemies (laughing)…but it taught me discipline, dedication and determination…you only get out what you put in…if you're prepared to work hard...and keep giving when the going gets really tough…you will succeed…I look back now and wonder where it all went (the years)…but I've had a wonderful career thus far and I'm looking forward to the next 50 years in the game (Participant A, 11 to 15 years retired group).

The results from the current study would indicate that many of the players had gained weight since retirement (between 3-30kg). In fact, this was the most acknowledged component by all players who took part in the study (both quantitative and qualitative data). There were various explanations put forth (osteoarthritis, injury, CVD and other forms of poor health) that are all contributing factors toward morbidity. However, it did not diminish the players' enthusiasm for the game and the pleasure it brought them throughout their lives, even though it contributes to their ill health post career.

Rugby league has had a positive effect on my life....being active and healthy....it's in my blood. However my current health is relatively poor – pneumonia recently took some 3-4 months to recover (Participant B, 0 to 5 years retired group).

and;

Current health is pretty good...a lot heavier now (121kgs) peak playing weight was 105kg, still quite physically active (Participant G, 0 to 5 years retired group).

Previous evidence suggests that early and regular physical activity is associated with a number of positive effects on the respiratory, heart and circulatory systems,

psychological and cognitive effects, as well as an active lifestyle (Holfelder & Schott, 2014; Lees & Hopkins, 2013; Siegrist, Lammel, Haller, Christle, & Halle, 2013; Stodden, et al., 2008). Furthermore, the negative health effects associated with physical inactivity and obesity may result in insulin resistance and cardio-vascular disease (Froberg & Andersen, 2005).

The results of this study indicate that, although these players had undertaken regular physical activity when they were playing, they may have stopped as a result of no longer playing or from the effects of the injuries they had incurred. As no activity history was recorded in the conducting of this study this is seen as a limitation. Future research should incorporate the activity history past and current to identify if it is age related changes or as a direct result from the change in activity participation levels.

As discussed previously concussion is one of the most troublesome injuries facing the sports medicine professional, especially with regard to the early identification of concussive signs and symptoms and appropriate concussive management facilitation (King, 2007). Players with a concussive injury returning to their sport are at a greater risk of complications (Iverson, Gaetz, Lovell, & Collins, 2004; Macciocchi, Barth, Littlefield, & Cantu, 2001). These complications are related to subsequent concussive events and may result in prolonged concussive symptoms and cumulative cognitive deterioration (Makdissi, et al., 2010). The result of concussive injuries was an issue for the zonal Māori rugby league players and was discussed:

> Concussion was a major issue....I suffered 14 during my career
> (Participant K, 11 to 15 years retired group).
> and;

> I retired at 27 because of concussion (multiple) headaches and
> advised medically (7-8 Concussions). I was working as a
> plasterer....but could not continue (worked on stilts) dizzy spells
> and migraines....had to change vocations....went back to school at
> 29 (Participant D, 11 to 15 years retired group).

While it appears that concussion may have severe long term effects, there is, to date, no direct causal link established (King, et al., 2013). Although there is an increasing body of knowledge about concussive injuries, the evidence in rugby league is relatively sparse. Some participants indicated their health was either average or below what they thought was ideal;

> My current health is 'average' ...mentally harder than
> physically…really enjoy the involvement….don't like taking
> medication....been prescribed, but don't take it. Haven't had
> medical for ages....went for an operation, which is still not right.
> Bone scrape to fix hip joint....hasn't worked (cortisone injection)
> (Participant C, 11 to 15 year retired group).

4.5.4 Influences and skill development

A number of players indicated that rugby league had given them direction in life and equipped them with skills (discipline, dedication and commitment) to implement into their daily lives. This was discussed further and some responses supported this, for example;

> Rugby league has had a positive influence on my life....love the
> competitive nature of the game and the discipline required in
> training (Participant E, 11 to 15 years retired group).

and;

> My position (front row) demanded a huge physical commitment. I met so many good people through footy who helped me optimistically and psychologically to deal with the demands of the game (Participant F, 0 to 5 years retired group).

There were also some who credited rugby league with far more than health and life skills, for example:

> Rugby league taught me good habits....I could of gone in the wrong direction....the game has done well for me and my personal health (Participant A, 11 to 15 years retired group).

> and;

> League provides a lot of life skills.....job opportunity (professional).....a lot of youth went to jail, instead of following sport (Participant F, 0-5 years retired group).

The opportunities afforded these players were in direct contrast to a potential life of crime and the detrimental consequences a life of crime can bring. The club culture in the rugby league community provided a place to socialise and meet with whānau and friends. Often this would mean the whole family unit would spend time watching the juniors play in the mornings before the seniors participated in the afternoons. Sometimes the responsibilities would mean volunteering on committees to ensure the clubs were building strong networks in the community.

4.6 Taha Whānau (Health of the family)

Whānau was a strong theme throughout the analysis as many participants expressed their reliance and devotion toward significant others as a major driving force for both the participation and enjoyment of the sport. Further to that the study group under investigation became a rugby league whānau with close knit bonds being formed during the data collection process. As highlighted by some of the kanohi ki te kanohi responses from the participants whānau means everything:

> Family support is paramount in my life and rugby league has taught me many life-skills (Participant B, 0 to 5 years retired group).

> and;

> My son played for Wellington and was top points scorer at 17yrs. I support him now I've retired (Participant G, 0 to 5 years retired group)

> and;

> My son now gives me an incentive to follow the sport more (Participant H, 6 to 10 years retired group).

As previously identified, Māori have a strong connection to whānau (Metge, 1995). In 2013, 435,000 (84%) Māori adults had face-to-face contact with whānau they didn't live with at least once in the previous four weeks. The frequency varied, but 55 percent had contact with whānau at least once in the previous week, while non-face-to-face contact was even more common. There were 489,500 (94%) Māori who had this contact with whānau who didn't live with them at least once in the previous four weeks and this included 72% who had non-face-to-face contact at least once in the previous week

(Dobbs & Eruera, 2014). This connection to whānau for Māori is crucial to working together to achieve common goals. For example:

> Rugby league means everything.....I'd still be playing today to keep active and be involved in team environment, camaraderie and fun getting out of the house. (Participant C, 11 to 15 year retired group).

Māori feature highly in terms of participation in physical activity and sport (Sport and Recreation New Zealand, 2008). In the early 1990s, Dr Papaarangi Reid compared the findings for Māori against those for the non-Māori population (McConnell, 2000). Contrary to the stereotypical image of Māori people not being physically active, they were indeed active and in some cases were even more physically active than non-Māori. Māori prominence in sport is evident in many team sports that receive media attention in New Zealand and Australia, such as rugby union, rugby league, basketball, netball and field hockey (Erueti & Palmer, 2014). In a study undertaken on Māori athletes who participated at elite-level sport, it was identified that this group are a very diverse social group, many of whom function adaptively in the high echelons of sport in New Zealand society and on the world stage. The narrative contained within the study highlighted that some Māori elite athletes carry a public burden that is somewhat predicated by the situational influences of public opinion. This public opinion extended to their level of cultural competency and interaction being judged by both Māori and non-Māori. Regardless, Māori athletes are still capable of highlighting the significance of personal mauri (life force) even though they may not be familiar with traditional tikanga (customs) and Mātauranga Māori (knowledge) (Erueti & Palmer, 2014). For example:

> Rugby league has been a positive influence; I still train regularly in the gym and lead the youth of today in my vocation (Participant D, 11 to 15 years retired group).

The cohort involved in the current study was at different stages of retirement but the overall summation was similar; rugby league had a positive effect on their lives. For one participant:

> My teammates and playing rugby league had a positive effect on my life on and off the field…kept me in training to keep fit (Participant B, 0 to 5 years retired group).

The combined effect of training and playing rugby league on a regular basis forms a habit that can provide stability in one's life. When this habit is interrupted, either through injury or retirement, the effects can be devastating. Previous evidence (King, et al., 2010b) found that injured players returning to match and training activities indicated that team involvement was very important to them. In particular areas of motivation reported in the current study were:

(1)   The desire to retain their spot in the team;

(2)   They did not like watching from the sideline;

(3)   The game was important to them and;

(4)   They felt they were needed by the team.

Team affiliation and sense of belonging have been reported to be key motivators for players wanting to return from injury (Podlog, 2006). The findings of this study are similar to a previous study where team sports participants reported that they wanted to

regain a spot in the team and to "have an impact" on their team's performance. As well they reported a love of the sport, wanting to keep fitness up, bonding and socialising with team mates and to retain their athletic identity as key motivators to return to sport (Podlog & Eklund, 2006). These findings were all similar to the current study where players reported the influences for returning to sport were more team related than being told they could return to sport.

Every participant involved in this study expressed their deep love for the game of rugby league. Regardless of their current health status (good or poor) as a direct result of injury (acute or chronic) from playing or training for the game, every single player confirmed their willingness to do it all again regardless of the consequences of injury. Playing rugby league had afforded them some of the best times of their lives through deep and meaningful friendships built on shared experience (winning and losing). This was also taking place for the next generation with many players now following their own children and grandchildren in sport.

4.6.1 Retirement from playing rugby league

The findings from this study will assist athletes and ex-players to understand the importance of maintaining a healthy and active lifestyle upon retirement from the rigors of playing. It could also identify common issues amongst the targeted study groups, assist further activities for positive healthy lifestyles and allow health agencies to take into account the issues to be faced by this group of our ageing communities.

Outcomes from this exploratory study indicate that Māori males retired from rugby league participation have gained weight and suffered injury, but they still maintain a

positive outlook on life with few regrets from playing the game. So, engagement in high performance sport has contributed to a decrease in mobility for some retired players in later life. It is, however, apparent from key informant interviews that for some of those players, this has not diminished their appreciation of life

The club culture in the rugby league community provided a place to socialise and meet with whānau and friends. Often this would mean the whole family unit would spend time watching the juniors play in the mornings before the seniors participated in the afternoons. Sometimes the responsibilities would mean volunteering on committees to ensure the clubs were building strong networks in the community.

> I miss the team camaraderie and being physically active...my health is not the best these days mainly from injury and poor food choices…but I still enjoy getting down to the club to support the boys'….that will never change (Participant D, 11 to 15 years retired group).

The evidence presented from the current findings was positive, where the players described their involvement in the game as being some of the happiest times of their lives.

> I feel I owe my life to rugby league including my current health….I'm 50 but I still feel like I can foot it with some of these young blokes….the mind is willing, but the body is just a bit slower to react these days….but I've been very lucky having not had any major injuries, so I feel fine and to a certain extent very healthy. (Participant A, 11 to 15-year retired group).

The main themes of this research have highlighted how important whānau are to the players and the role they play within the game of rugby league. Their support is critical

to the players' success and enjoyment derived from playing the game. As highlighted previously by utilizing the holistic interpretation model of Te Whare Tapa Whā for Māori, Taha whānau (the health of family) is the capacity to belong, to care and to share where individuals are part of wider social systems. Whānau provides us with the strength to be who we are. This is the link to our ancestors, our ties with the past, the present and the future. This is what makes us Māori (Durie, 1985).

4.7 Discussion of the Findings

This chapter presents the findings from the research in the context of a broader body of knowledge. Retired Māori, male rugby league players have been studied at an increasing level of detail in terms of physical/physiological parameters, self-assessed measures and the insights from qualitative semi-structured interviews held kanohi ki te kanohi (face to face) between the interviewer and individual players in a zonal region.

Most of the participants of this study were well over 100 kilograms (kg) and while this may be typical for a rugby league forward it is well above the normal reference values for males (73kg). At the 18 month re-test of these participants, the mean body mass had decreased when compared with the baseline results although the decreases were not significant. A summary of indicative, not all, test and interview findings is presented in Table 43.

Table 43　　　Summary of indicative Findings

Measures Physical/Self report	Result	Positive or Negative health factor
BMI	Most increase	Negative
	One group decreased	Positive
Girth	Increased	Negative
Strength	Maintained	Positive
Blood Pressure	Increased	Negative
Cholesterol	Small Increase	Negative
Blood glucose level	Increased	Negative
Oxygen uptake	Increased	Positive
Self-reported		
Smoking	Above all other ethnicities	Negative
	Less than the national Māori average	Positive
Bodily Pain Score	Increased scores over time	Negative
Mental health	Above average	Positive
	Lower than mean of NZ population	Negative

The participants' waist and gluteal measurements increased when compared with baseline results. Leg strength retest scores decreased when compared with the participants' baseline results. Grip Strength remained fairly consistent for the duration of the study. The players' systolic and diastolic blood pressure increased over the duration of the study. The fasting Total-Cholesterol; Low Density Lipoprotein-Cholesterol and Total-Cholesterol/High Density Lipoprotein Ratio of the retired Māori rugby league players also increased over the duration of the study.

The results from the current study indicate that many of the players had gained weight since retirement. In fact, this was the most acknowledged component by all players that

took part in the study (both quantitative and qualitative data). There were various explanations put forth (osteoarthritis, injury, CVD and other forms of poor health) that are all contributing factors toward morbidity.

A quarter of retired Māori rugby league players reported that they smoked. While this rate is lower than the rate of all Māori in the population, it is at a higher rate than the total population of New Zealand.

Retired Māori rugby league players reported low score (which means high pain) on bodily pain (BP). This finding indicates that the participants are experiencing increased pain and discomfort since retiring from competitive rugby league and this appears to be of greatest concern to the participants.

Outcomes from this exploratory study indicate that Māori males retired from rugby league participation have gained weight and suffered injury, but they still maintain a positive outlook on life with few regrets from playing the game. So in effect sport has contributed to a decrease in mobility in later life, but an increase in appreciation of life.

During kanohi ki te kanohi discussions a number of players indicated that rugby league had given them direction in life and equipped them with skills (discipline, dedication and commitment) to implement into their daily lives. A number of positive impacts were observed as a result of participation in the study, in particular the high level of expression of *whanaungatanga* (positive and meaningful relationships) which emerged

over the duration of participant involvement with the study. As highlighted by some of the kanohi ki te kanohi responses from the participants whānau means everything.

4.7.1 Limitations of the Research

Some limitations of the exploratory nature of the study were a lack of comparative analyses of Māori ex-players retired from other collision (i.e. rugby union) and multiple sprint (i.e. touch) sports where there are high Māori participation numbers. This also applies to a comparative analyses of Māori and non-Māori retired from other collision (i.e. rugby union) and multiple sprint (i.e. touch) sports.

This should be the focus for future study as Māori need to be supported through evidence based research. This may lead to the implementation of strategies to combat the deleterious effects of sporting injury resulting in better health outcomes for future generations.

Other limitations to this study include the use of just the participants in kanohi ki te kanohi sessions limiting this to just their story, and not the stories of their whānau. The inclusion of the players' whānau may assist in broadening and deepening the knowledge likely to be obtained. The main areas to consider for future research, based on the limitations identified in this study are:

> 1. More data could have been collected from the tournament based players who consented to participate in this research. Areas such as

bio-impedance assessments would enable other comparable analysis to be undertaken;

2. The use of an open ended questionnaire for all participants to complete with questions relating to the current health, participation in other sporting activities and leisure activities. This data would enable a broader analysis to be completed;

3. Inclusion of participant whānau in the kanohi ki te kanohi sessions. The inclusion of these people would enable a wider body of knowledge enhancing the richness of the data in the qualitative analysis.

4. Include comparative analyses of Māori and non-Māori sport and non-playing sport participants

There is also potential to implement similar studies on other indigenous cohorts around the globe to support healthy ageing once retired from competitive sporting environments.

4.8 Conclusion

Some limitations of the exploratory nature of the study were a lack of comparative analyses of Māori ex-players retired from other collision (i.e. rugby union) and multiple sprint (i.e. touch) sports where there are high Māori participation numbers. This should be the focus for future study as Māori need to be supported through evidence based research. This may lead to the implementation of strategies to combat the deleterious effects of sporting injury resulting in better health outcomes for future generations. There is potential to implement similar studies on other indigenous cohorts around the

globe to support healthy ageing once retired from competitive sporting environments. The next chapter presents the conclusions of this research and makes recommendations for further research and the potentials of a full scale intervention study.

Chapter 5: Discussion and Conclusions - Nga Whakatau Me Nga Tohutohu

5.1 Introduction

This chapter concludes the study and provides brief recommendations for future research. The overarching theme has been one of discovery and potential. With the caveat that the numbers engaged in this exploratory study are small, the findings do provide a base of evidence that is supported by current literature. This research offers the opportunity for new beginnings, by creating new pathways for health improvement for Māori men. These are my conclusions.

There were four key areas that were identified as a result of this research:

(1)   The health disadvantage for male Māori is also seen in retired Rugby league players;

(2)   Positive changes in repeated measures are possible with intervention;

(3)   Telling of personal stories contributed significantly to the research by providing insight into the thinking and experiences of the participants, and;

(4)   The presence of a Māori researcher can positively influence engagement with Māori-centered research.

5.2 Health disadvantage for male Māori

Whilst the Treaty of Waitangi serves as a reminder to New Zealanders that Māori are the original custodians of the land and waterways it is clear that Māori have undergone tremendous upheaval during colonisation. Māori suffer from poorer health and Māori

men have a particularly bad prognosis in terms of health outcomes when compared to non-Māori men. In particular Māori men are reported to be the most vulnerable group in New Zealand for developing cardiac related diseases. Māori sustain a greater burden of health loss than non-Māori in most condition groups and one of the most damning statistics for Māori males is the early onset of cardiovascular disease contributing to Māori life expectancy being at least eight years less than for non-Māori.

The finding of a decline in the health status of Māori players, who had ceased playing competitive rugby league, whilst not entirely unexpected, ought to remain a cause of significant concern. Given that rugby league is a physical repetitive collision sport where injuries are common, the potential health of players who have previously played may not be in line with similar aged males who have not played any contact sports. When the participants in this study were compared with the general population on the Quality of Life Questionnaire (SF 36v2) there was a significant negative trend toward a poorer health status compared with data from the New Zealand Health Survey for 2006/7.

Retired Māori rugby league players reported low scores (which equates to high pain) on Bodily Pain (BP) which indicates that the participants were experiencing increased pain and discomfort since retiring from competitive rugby league and this appears to be of greatest concern to the participants. Further evidence points to the incidence of hip and knee replacement being more prevalent than compared to an age-standardised general population sample on measures of morbidity and health related quality of life.

Recent findings show that the incidence of concussion is increasing in rugby league which could have detrimental long-term effects for some participants. The current cohort revealed a problem with nearly half having suffered at least one concussion whilst they were still playing.

5.3 Changes in repeated measures

As a result of the narratives recorded from kanohi ki te kanohi interviews, some changes observed from the repeated measures study may have been influenced just because they were part of the research project. Most of the study participants weighed well over 100 kilograms and during the study some participant's mean body mass decreased when compared with their baseline results. The findings that some of the participant's results improved were unexpected and further exploration of this finding was required.

In regards to other participants, where their assessment results continued to decline, this was not unexpected considering that a time period of 18 months had occurred between the two testing events. These findings did show that decline with the ageing process was occurring but of concern was that the participants' health status still remained lower than the general population. Waist and gluteal measurements increased when compared with baseline results. Leg strength scores decreased and hand grip strength remained fairly consistent for the duration of the study. Systolic and diastolic blood pressure increased over the duration of the study and fasting Total-Cholesterol; Low Density Lipoprotein-Cholesterol and Total-Cholesterol/High Density Lipoprotein Ratio of the retired Māori rugby league players also increased over the duration of the study.

Further research is warranted to identify if the changes that were observed were specific to this cohort of participants or whether this occurs with players across other sporting codes when they cease active competitive participation.

5.4 Telling of personal stories

The interviews conducted kanohi ki te kanohi provided a wealth of information that added data and also helped to explain some of the findings. Some participants improved on specific indices of physical performance during the repeated measures. At first this was unexpected, as results were thought to decline through the normal ageing process. While it was unclear what contributed to changes during the subsequent re-testing period some of the participants indicated to the researcher that they were embarrassed with their results during baseline testing. Whilst this was not part of the study process it was encouraging that players chose to implement change themselves and this leads into the fourth key point.

5.5 Presence of a Māori researcher

It was identified that the presence of a Māori researcher observing the participants could have had an influence on them to be mindful of their health status. Whilst Māori health has improved over the past 25 years on many indices (reduced smoking rates, improved quality of life, and reduction in mortality) as evidenced by the research being produced through the Health Research Council, there are still key fundamental issues where poor choices are made which affect the health of Māori males. Further analysis from the participants responses revealed that not only an increase in body mass was concerning,

but the negative effect on health was a common theme amongst these retired Māori rugby league players. Personal choices need to be better and the intention of any future program should consider the wider ramifications of behaviour management.

This research provided strong evidence for the willingness and feasibility of undertaking such research with Māori. Recruitment, physical measurement, qualitative interviews and longitudinal assessments have all been tested. Importantly, the involvement of a Māori rugby league researcher has been critical to optimising engagement, participation, and the success of the project.

This study reaches the following conclusions:

- This small group of Māori men who have retired from playing rugby league experienced high levels of injury and disability contributing to on-going morbidity;

- Concussion and head injuries are a major concern to participants, and potentially a major cause of morbidity;

- Retired players were enthusiastic and willing participants in research, especially where interventions can be of benefit to other rugby league players;

- Participants were willing and competent at engaging with the research methods, including undertaking physical measures, with longitudinal assessments over time, and completing qualitative interviews kanohi ki te kanohi.

- The presence of a researcher as a peer retired Māori league player was a critical component in successfully engaging with the rugby league organising bodies and the Māori men who are themselves retired rugby league players;

- There was some evidence of declining health status for some over the time scale of the research, yet there was some evidence that participation in the research process may have yielded some health benefits for participants, for example motivations for weight loss, possibly due to the Hawthorne/observer effect;

- This exploratory research has shown strong potential for undertaking intervention research with retired Māori rugby league players and potentially players from other high contact sports.

5.6 Future Research

Further research is critical in order to better gauge the effectiveness of anti-smoking policies and Māori health promotion messages in relation to the focus group of this study.

- The higher smoking rate found in Māori men is of concern. The rate of smoking incidence among Maori who are currently active rugby league players is unknown. How that ranks in relation to national smoking rates, and why that may be the case requires further research. The potential to intervene and positively influence quit smoking decisions and lowering smoking rates for Māori and others in rugby league are another arena of research that could have significant impact on the health status of the players, including those who have retired from the game.

The major variance (52%) in Bodily Pain from the NZHS to the current study was unexpected, and requires further longitudinal study to determine the significance of this divergence.

- The increase in body mass, and subsequently in their body mass index, may be related to the findings in the SF-36v2 where there was more bodily pain than the other retirement groups. This may have resulted in a decreased capacity to undertake any physical activity resulting in possible psychological changes such as feeling depressed leading to an increase in body mass.

Waist and girth measurements increasing

- Further research is required to identify whether these changes were age related or other physiological changes that were not identified in the conducting of this study.

Hand grip and leg back indices

- Future research is warranted to ascertain at what period of time, post retirement from sport, decrements in performance for these indices are identified?

Physical activity in retirement

- Future research may assist in the identification of what lifestyle changes have occurred post retirement with a specific focus on the amount and quality of physical activity that occurs during the period immediately post retirement from sporting participation.

Injury management support and monitoring

- Further research is needed to explore the effects of injuries longitudinally to ascertain what these may be for retired Māori rugby league players, and to identify if a routine assessment would assist in motivating retired Māori rugby league players to undertake more health promoting activities. It is also

recommended to explore the effects of injury suffered and especially the long term effects from concussive injury for retired rugby league players.

The results of this study indicate that, although these players had undertaken regular physical activity when they were playing, they may have stopped as a result of no longer playing or from the effects of the injuries they had incurred. As no activity history was recorded in the conducting of this study this is seen as a limitation. Future research should incorporate the activity history past and current to identify if any changes in function are simply age related changes or as a direct result from the change in activity participation levels.

Post Script - Tuhinga O Mua

Having completed the study – and in acknowledging its exploratory nature – it is appropriate to evaluate and reflect on what has happened and where we go to from here.

Whakapapa

For Māori, whakapapa serves to acknowledge where people come from and to whom their whānau is related either directly or indirectly. These strong family connections come from a sense of belonging somewhere and to somebody. Many of the participants in this study originated in the Waikato-Tainui region and have strong generational ties with the sport of rugby league. This made it very easy for me to relate to their stories. Many indicated that when they retired they missed the team environment most of all. The main themes of this research have highlighted how important whānau are to the players and the role they play within the game of rugby league. Whānau support is critical to the players' success and enjoyment derived from playing the game. The study group under investigation became a close knit group which equated to a rugby league whānau with strong bonds being formed during the process. As highlighted by some of the kanohi ki te kanohi responses from the participants, whānau means everything and this was a key theme throughout the journey.

Whānau

My son Mitch completed another milestone in October, by featuring for the New Zealand Māori Rugby League Team in a victory over the New Zealand Residents Team winning 22-16 and being the first team to do so. I fear for my son's future and likely consequences of injury, but that is just part of the game and from the evidence found

thus far it appears there is some hope for him with added support and possible intervention models.

Rugby League

The rationale behind this research was based on the fact that very little was known about the health of retired rugby league players, and even less known about Māori players. This project has added new knowledge to the field of Māori health research with specific reference to improving health outcomes for retired male Māori rugby league players. The findings can contribute to a strategy to promote long term health in retired Māori players.

Research

Further to this, some components of my research on sport concussion has also contributed new knowledge to the Global - Rugby Codes Research Group (RCRG), of which I am a member, as part of a worldwide study on retired rugby union and rugby league players.

The focus for future research should be aimed at further developing an intervention model to improve male Māori health for retired sports participants. The development of an intervention framework that could be implemented to make a positive change in the lives of retired male/female and other indigenous participants should be the focus of future projects.

Where to from here?

A further observation emerging from the study has been the comparatively high level of willingness of key informants to participate. The broader kaupapa of this study, the health of Māori men, appears to have been a particularly strong catalyst for meaningful participation and involvement. This bodes well for future studies and research. The search for knowledge and the importance of maintaining good health is a shared responsibility, with the individual, the research team and their whānau, which could mean much more than just their immediate household whānau. The Māori centred research design together with the Kaupapa Māori methodological framework employed for this study have offered a firm foundation upon which to engage in further research around the health of Māori rugby league players. An informed health intervention may be one possible pathway. A ground-up Māori Health promotion initiative may also be possible as a result of this undertaking. Regardless of what else may emerge, it is important that further research in this field continues to give authentic and meaningful expression to the core principles of Kaupapa Māori Research.

Lastly, this study has sought to better understand the critical determinants of the health of Māori men who have retired from playing Rugby League. Whilst the findings reveal some significant challenges both for the administrators of the game of Rugby League and for the players themselves, the study has also revealed new opportunities for further research. This may comprise an investigation into determinants of health that does not focus so emphatically on Māori players as individuals, but upon Māori players as part of a greater collective, and as contributors to and leaders of their whānau and communities.

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Appendix 1: Example of kanohi ki te kanohi interview questions

Interview Subject (A) 27July 2012

Introduction:

TC: Kia ora kei te pehea koe

A: Kei te pai, kei te pai

TC: No hea koe

A: KoTainui te waka, no Kirikiriroa ahau

TC: Pai rawe e hoa

Formal interview:

TC: Can you start by giving me a brief outline of your rugby league sporting career?

A: I started playing in….

TC: Why was that?

A: Rugby….

TC: How did you progress?

A: I was fortunate….

TC: What was the reason for your success?

A: That's a tough question…..

TC: How are you feeling these days?

A: Yeah I'm….

TC: You mentioned earlier the number of teams you played with…did any of the clubs you had played for have any input to your health post career?

A: There's…..

TC: What effect do you think being involved in rugby league has had on your health?

A: I honestly think….

TC: You say the mind is willing….can you expand on that?

A: Well I reckon….

TC: Have you had any issues with your physical health in the last 5 or so years?

A: I had….

TC: Do you have any drive to keep in shape and stay healthy?

A: I wouldn't…

TC: What aspect of sport (rugby league) do you think contributed to your life?

A: As I said…..

Appendix 2: Example of participant Information Sheet

Massey University

COLLEGE OF SCIENCES
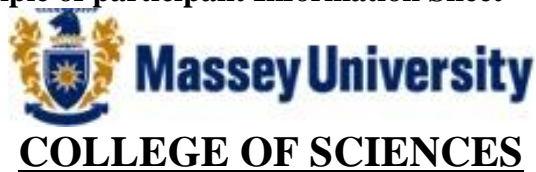
Participant information sheet

What has Sport got to do with Health?

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Take time to decide whether or not you wish to take part. If you would like more information please contact the person listed at the end of this sheet.

Thank you in advance.

What is the purpose of the study?
This proposed research is to determine how retiring from rugby union or rugby league impacts upon the health and well-being of both elite and non-elite Māori players. The prevalence of cardiovascular disease, diabetes mellitus and obesity are significantly higher in Māori than Pākehā, and Māori suffer a reduced life expectancy of around 7 years (WHO, 2005). Māori men have a particularly bad prognosis in terms of health and are arguably the most vulnerable group in New Zealand for developing CVD. It is surprising therefore, that given the high rates of participation of Māori men in sport and particularly rugby union and rugby league, that lifestyle-related diseases are so prevalent. The outcomes of the study will help us better understand the impact on Māori men's health, in the transition to and during retirement from rugby sporting codes

Why have I been asked?
You fit the criteria to be eligible to participate in this specific research project. These being – you are Māori and you have previously played either rugby union or rugby league at elite or non-elite level and you are in the process of retiring (end of season), or recently retired (within the last year), or long-term retired (within the last 15 years).

Do I have to take part?

It is entirely up to you to decide whether or not to take part. If you agree to take part, this information sheet is for you to keep. You will also be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect the study in any way.

What will happen to me if I take part?
The study only requires you to fill in questionnaires. Therefore there are minimal risks involved.

What are the possible disadvantages and risks of taking part?
There are no disadvantages or risks foreseen in taking part in the study.

What are the possible benefits of taking part?
By taking part, you will be contributing to Māori research workforce career development which will help us better understand the impact on Māori men's health, in the transition to and during retirement from sport

What if something goes wrong?
If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Professor Chris Cunningham Research Centre for Māori Health & Development, Massey University, PO Box 756, Wellington, +64 4 380 0627.

Will my taking part in the study be kept confidential?
All information which is collected about you during the course of the research will be kept strictly confidential so that only the researcher carrying out the research will have access to such information.

What will happen to the results of the research study?
The results will be written up into a report for the completion of the researcher's PhD degree.

Who is organising and funding the research?

The lead researcher will organise and conduct the proposed study in conjunction with the Research Centre for Māori Health & Development, Massey University, and PO Box 756, Wellington.

Who may I contact for further information?

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact:

Trevor Clark
Email: t.clark1@massey.ac.nz

Phone Number: 04 801 5799 ext. 6144

Thank you for your interest in this research.

Appendix 3: Example of Participant consent form

Massey University
COLLEGE OF SCIENCES

Title of Project:

What has Sport got to do with Health?

Name of Researcher: Trevor Clark, email: t.clark1@massey.ac.nz

Please initial box

1 I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.

2 I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my legal rights being affected.

3 I agree to take part in the above study.

Name of Participant   Date   Signature

_____   _____   _____

Researcher
              Date   Signature

_____   _____   _____

Appendix 4: Copy of letter of support from Masters of Rugby League New Zealand

MASTERS OF RUGBY LEAGUE NEW ZEALAND

PO Box 18 136
Auckland 1072
New Zealand

Fax: 09 633 0266
Email: peter.clark@mastersrugbyleague.com

Mr Trevor Clark MSc, BA (Hons)
Programme Exercise Science
Massey University
Institute of Food, Nutrition and Human Science
Private Bag, 756
Wellington 6140

Dear Sir

I refer to your recent request to carry out a survey of players participating iin the Masters of Rugby League International Tournament to be held in Auckland in October 2009. We understand this survey is to assist you in your studies into sport and health issues.

The Masters of Rugby League endorse your survey and support you in your studies.

Please contact me if you require any further assistance concerning this matter.

Yours faithfully
Masters of Rugby League New Zealand

Peter Clark
Secretary

Masters of Rugby League International
(Copyright 2005)

Appendix 5: Copy of letter of support from New Zealand Māori Rugby League

01 October 2009

Trevor Clark,

To whom it may concern,

I am writing in my capacity as the Chairman of the New Zealand Maori Rugby League. This letter is to support Trevor Clark in his current academic studies in which he is pursuing his PhD qualification. His thesis is based on determining how retiring from Rugby League and Rugby Union impacts upon the health and wellbeing of both elite and non-elite Maori players. There are significant health issues for Maori in many areas of this kaupapa. The study will be important in identifying further trends and issues in this particular area.

I am a former international Rugby league player having played for New Zealand for seven years. I have suffered the effects of injuries sustained during those playing years for many years.

I believe there will be positive benefits that will accrue through this thesis as there would be very few studies done in this particular area. The findings should be used as a background to assist athletes and ex-players to understand the importance of maintaining a healthy and active life style upon retirement from the rigors of playing. It could also identify common issues amongst the targeted study groups, assist further activities for positive healthy lifestyles and allow health agencies to take into account the issues to be faced by this group of our aging communities.

I support Trevor Clark's work in this field I look forward to reviewing his work upon its completion.

Naku noa

Na

Howe Tamati MBE

Appendix 6: Copy of letter of endorsement from New Zealand Rugby League

Rugby League House
7 Beasley Avenue, Penrose
Auckland 1061, New Zealand
PO Box 12712, Penrose
Auckland 1642, New Zealand
Phone: +64-09 525 5592
Fax: +64-09 525 5596
Email: info@nzrl.co.nz
Website: www.nzrl.co.nz
www.leaguenet.co.nz

Trevor Clark MSc, BA (Hons)
Programme Manager
Diploma Exercise Science
Massey University
Institute of Food, Nutrition and Human Health
Private Box 756
Wellington 6140

Endorsement of PhD Research Project

Dear Trevor,

The New Zealand Rugby League are happy to support and provide ethical endorsement of your PhD research project.

I have read through your proposal and the information sheet associated with your proposed study. I am confident that this area of research will provide valuable information for both the sports and health sectors.

The New Zealand Rugby League will provide assistance to you in this endeavor as we are able to, and as required by you.

Yours Sincerely,

Dain Guttenbeil
Community Programmes Manager
New Zealand Rugby League
Phone: 09 571 3873
Email: dain@nzrl.co.nz

Appendix 7: Copy of letter of support from Wellington Rugby League

WELLINGTON RUGBY LEAGUE
Pelorus Trust Sports House
Hutt Park Road
Hutt City
Ph: 04 560 0361
Fax: 04 560 0400
Web: www.wrl.org.nz

10 October 2009

Trevor Clark MSc, BA (Hons)
Programme Manager
Diploma Exercise Science
Massey University
Institute of Food, Nutrition and Human Health
Private Box 756
Wellington 6140

Dear Trevor,

I am writing to extend my support and that of Wellington Rugby League to you for your upcoming project as part of your PhD studies.

I have read the information provided by you and can see great value in the project and I am more than comfortable with the process to be undertaken.

If there is anything I can do to assist you in your endeavors please feel free to ask.

Sincerely,

Jason Hemson
General Manager
Wellington Rugby League
Direct:04-5600363
Mobile:0277 253535
Email: jason@wrl.org.nz
web: www.wrl.org.nz

Proudly Sponsored By

Appendix 8: Medical History Questionnaire

MEDICAL HISTORY QUESTIONNAIRE

All questions contained in this questionnaire are strictly confidential and will become part of the PhD study on rugby league and health status.

Name: _____

ID Code: ____ ____ ____
Club   Yr   No.

[ ] M   [ ] F   DOB: ____ / ____ / ____
DD   MM   YY

Dominant hand: Left [ ]   Right [ ]   Dominant leg: Left [ ] Right [ ]

Player Position: _____

Ethnic Background:

[ ] NZ European/Pakeha	[ ] Tongan	[ ] South East Asian	[ ] Tokelauan
[ ] Other European	[ ] Niuean	[ ] Indian	[ ] Other (please specify)
[ ] NZ Māori	[ ] Fijian	[ ] Other Asian	_____
[ ] Cook Island Māori	[ ] Other Pacific	[ ] Samoan	

PERSONAL WORK HISTORY	

Occupation _____   ANZSCO Code No.   [ ] [ ] [ ]

[ ] In paid employment
Part time or full time
[ ] I own/part own the company   [ ] I am self employed   [ ] I am not in paid employment   [9] [1] [1]

Work Type   [ ] Sedentary   [ ] Light   [ ] Medium   [ ] Heavy   [ ] Very heavy

Brief standing and walking   *Mainly standing and walking*   *Often lift 5 kg plus*   *Often lift 9kg plus*   *Often lift 22kg plus*

MEDICAL HISTORY

Height: _____m   Weight: _____ kg   BSI: Waist Girth_____cm

Previous medical / injury history. Please indicate where necessary if you have had, or now have, any of the following

Head Injury	Yes: [ ] No: [ ]	Ulcers	Yes: [ ] No: [ ]	Thyroid disorder	Yes: [ ] No: [ ]
Concussion	Yes: [ ] No: [ ]	Bowel Problems	Yes: [ ] No: [ ]	Sprains	Yes: [ ] No: [ ]
Epilepsy/Seizures	Yes: [ ] No: [ ]	Urinary Infections	Yes: [ ] No: [ ]	Specify	
Neck/Back Problems	Yes: [ ] No: [ ]	Kidney Problems	Yes: [ ] No: [ ]		
Eye Problems	Yes: [ ] No: [ ]	Diabetes	Yes: [ ] No: [ ]	Operations	Yes: [ ] No: [ ]
Glasses/Contacts	Yes: [ ] No: [ ]	Blood transfusions	Yes: [ ] No: [ ]	Specify	
Nose Bleeds	Yes: [ ] No: [ ]	Hepatitis	Yes: [ ] No: [ ]		
Dental Problems	Yes: [ ] No: [ ]	Allergies	Yes: [ ] No: [ ]	Do you smoke cigarettes Yes: [ ] No: [ ]	
Deafness/Ear Problems	Yes: [ ] No: [ ]	Specify		Please list any other health issues not described:	
Asthma	Yes: [ ] No: [ ]				
Bronchitis	Yes: [ ] No: [ ]	Fractures:	Yes: [ ] No: [ ]		
Chest Pains	Yes: [ ] No: [ ]	Specify			
Heart Problems	Yes: [ ] No: [ ]				

Medications

Please list any medications you are currently taking:

_____

Appendix 9: Copy of SF-36v2 Short Form Health Survey Your Health and Well-Being

This questionnaire asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. *Thank you for completing this questionnaire!*

For each of the following questions, please mark an ⊠ in the one box that best describes your answer.

1. **In general, would you say your health is:**

Excellent	Very good	Good	Fair	Poor
▼	▼	▼	▼	▼
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2. <u>**Compared to one year ago**</u>**, how would you rate your health in general** <u>**now**</u>**?**

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse now than one year ago	Much worse now than one year ago
▼	▼	▼	▼	▼
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

3. **The following questions are about activities you might do during a typical day. Does** <u>**your health now limit you**</u> **in these activities? If so, how much?**

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a <u>Vigorous activities</u>, such as running, lifting heavy objects, participating in strenuous sports	☐ 1	☐ 2	☐ 3
b <u>Moderate activities</u>, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	▼ ☐ 1	▼ ☐ 2	▼ ☐ 3
c Lifting or carrying groceries	☐ 1	☐ 2	☐ 3
d Climbing <u>several</u> flights of stairs	☐ 1	☐ 2	☐ 3

255

e Climbing <u>one</u> flight of stairs ....□ 1 ....□ 2 ....□ 3

f Bending, kneeling, or stooping ....□ 1 ....□ 2 ....□ 3

g Walking <u>more than a kilometre</u> ....□ 1 ....□ 2 ....□ 3

h Walking <u>several hundred metres</u> ....□ 1 ....□ 2 ....□ 3

i Walking <u>one hundred metres</u> ....□ 1 ....□ 2 ....□ 3

j Bathing or dressing yourself ....□ 1 ....□ 2 ....□ 3

4. **During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?**

		Yes, limited a lot	Yes, limited a little	No, not limited at all
a	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	□ 1	□ 2	□ 3
b	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	▼ □ 1	▼ □ 2	▼ □ 3
c	Lifting or carrying groceries	□ 1	□ 2	□ 3
d	Climbing several flights of stairs	□ 1	□ 2	□ 3
e	Climbing one flight of stairs	□ 1	□ 2	□ 3
f	Bending, kneeling, or stooping	□ 1	□ 2	□ 3
g	Walking more than a kilometre	□ 1	□ 2	□ 3
h	Walking several hundred metres	□ 1	□ 2	□ 3
i	Walking one hundred metres	□ 1	□ 2	□ 3
j	Bathing or dressing yourself	□ 1	□ 2	□ 3

		All of the time ▼	Most of the time ▼	Some of the time ▼	A little of the time ▼	None of the time ▼
a	Cut down on the amount of time you spent on work or other activities	□ 1	□ 2	□ 3	□ 4	□ 5
b	Accomplished less than you would like	□ 1	□ 2	□ 3	□ 4	□ 5
c	Were limited in the kind of work or other activities	□ 1	□ 2	□ 3	□ 4	□ 5
d	Had difficulty performing the the work or other activities (for example, it took extra effort)	□ 1	□ 2	□ 3	□ 4	□ 5

5. **During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)?**

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a Cut down on the <u>amount of time</u> you spent on work or other activities	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
b <u>Accomplished less</u> than you would like	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
c Did work or other activities <u>less carefully than usual</u>	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

6. **During the <u>past 4 weeks</u>, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?**

Not at all	Slightly	Moderately	Quite a bit	Extremely
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

7. How much <u>bodily</u> pain have you had during the <u>past 4 weeks</u>?

None	Very mild	Mild	Moderate	Severe	Very severe
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

8. **During the <u>past 4 weeks</u>, how much did <u>pain</u> interfere with your normal work (including both work outside the home and housework)?**

Not at all	A little bit	Moderately	Quite a bit	Extremely
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

9. **These questions are about how you feel and how things have been with you <u>during the past 4 weeks</u>. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the <u>past 4 weeks</u>…**

	All of the time	Most of the time	Some of the time	A little of the time	None of the time

		▼	▼	▼	▼	▼
a	Did you feel full of life?	□ 1	□ 2	□ 3	□ 4	□ 5
b	Have you been very nervous?	□ 1	□ 2	□ 3	□ 4	□ 5
c	Have you felt so down in the dumps that nothing could cheer you up?	□ 1	□ 2	□ 3	□ 4	□ 5
d	Have you felt calm and peaceful?	□ 1	□ 2	□ 3	□ 4	□ 5
e	Did you have a lot of energy?	□ 1	□ 2	□ 3	□ 4	□ 5
f	Have you felt downhearted and depressed?	□ 1	□ 2	□ 3	□ 4	□ 5
g	Did you feel worn out?	□ 1	□ 2	□ 3	□ 4	□ 5
h	Have you been happy?	□ 1	□ 2	□ 3	□ 4	□ 5
i	Did you feel tired?	□ 1	□ 2	□ 3	□ 4	□ 5

10. During the <u>past 4 weeks</u>, how much of the time has your <u>physical health or emotional problems</u> interfered with your social activities (like visiting with friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
▼	▼	▼	▼	▼
□ 1	□ 2	□ 3	□ 4	□ 5

11. **How TRUE or FALSE is <u>each</u> of the following statements for you?**

		Definitely true	Mostly true	Don't know	Mostly false	Definitely False
a	I seem to get sick a little easier than other people	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
b	I am as healthy as anybody I know	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
c	I expect my health to get worse	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
d	My health is excellent	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Thank you for completing these questions!

Detailed Explanation of the Quality of Life Questionnaire – SF-36v2

The SF-36v2 (Quality Metric, http://www.sf-36.org) is one of the most well recognised measures in survey and clinical research designed to measure health-related quality of life. It has been used internationally both in national surveys to measure population health status and in numerous clinical studies.(McHorney, et al., 1993) Although the measure has its critics and limitations, an advantage of its widespread use is the ability to compare results internationally and within local populations. The SF-36v2 consists of 36 items, grouped into eight scales (see Table 1), each 0±100 scale measuring a different aspect of health, and with higher scale scores representing better self-reported health.

Table 1: Overview of the eight dimensions in the SF-36 instrument(Frieling, et al., 2013).

Dimension	Description	No. of items
Physical Functioning (PF)	Respondents' reported level of difficulty in carrying out a range of physical tasks from low exertion to high exertion.	10 items
Role-Physical (RP)	Limitations in performance of regular daily activities due to physical problems.	4 items
Bodily Pain (BP)	Respondents' experience of bodily pain and the extent to which pain interferes with their normal work.	2 items
General Health (GH)	Respondents' perception of their current overall health status, how their health compares to others and expectations of future health.	5 items
Vitality (VT)	Respondents' perceived levels of energy.	4 items
Social Functioning (SF)	The extent to which physical or emotional problems impact on respondents' participation in social activities.	2 items
Role Emotional (RE)	Limitations in performance of regular daily activities due to emotional problems.	3 items
Mental Health (MH)	The amount of time over the last four weeks a respondent felt happy, calm, down, depressed and nervous, respectively.	5 items

Table 2: Abbreviated Item Content for the SF-36v2® Health Survey Health Domain Scales(Ware et al., 2000)

Scale Item	Abbreviated Item	Content
Physical Functioning (PF)	3a	Vigorous activities, such as running, lifting heavy objects, or participating in strenuous sports
	3b	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf
	3c	Lifting or carrying groceries
	3d	Climbing several flights of stairs
	3e	Climbing one flight of stairs
	3f	Bending, kneeling, or stooping
	3g	Walking more than a mile
	3h	Walking several hundred yards
	3i	Walking one hundred yards
	3j	Bathing or dressing oneself
Role-Physical (RP)	4a	Cut down the amount of time one spent on work or other activities
	4b	Accomplished less than you would like
	4c	Limited in kind of work or other activities
	4d	Had difficulty performing work or other activities (e.g., it took extra effort)
Bodily Pain (BP)	7	Extent pain interfered with normal work
	8	Intensity of bodily pain
General Health (GH)	1	Is your health: excellent, very good, good, fair, poor
	11a	Seem to get sick a little easier than other people
	11b	As healthy as anybody I know
	11c	Expect my health to get worse
	11d	Health is excellent
Vitality (VT)	9a	Feel full of life
	9e	Have a lot of energy
	9g	Feel worn out
	9i	Feel tired
Social Functioning (SF)	6	Extent health problems interfered with normal social activities
	10	Frequency health problems interfered with social activities
Role-Emotional (RE)	5a	Cut down the amount of time spent on work or other activities
	5b	Accomplished less than you would like
	5c	Did work or other activities less carefully than usual
Mental Health (MH)	9b	Been very nervous
	9c	Felt so down in the dumps that nothing could cheer you up
	9d	Felt calm and peaceful
	9f	Felt downhearted and depressed
	9h	Been happy
Reported Health Transition (HT)	2	How health is now compared to 1 year ago

The scales are: Physical Functioning (PF), Role Physical (RP) (the impact of physical health on performance of everyday role); Bodily Pain (BP); General Health (GH); Vitality (VT); Social Functioning (SF); Role Emotional (RE) (the impact of emotional health on role performance); and Mental Health (MH) (see table 2). The SF-36v2 was

constructed to represent two dimensions of health: physical health and mental health.(Ware, 2000)

The SF-36v2 is a self-administered 36-item questionnaire that takes approximately 7 to 10 minutes to complete. The scale consists of eight separate subscales measuring physical health, physical and emotional role function, bodily pain, social functioning, mental health, vitality, and general health perceptions. Response possibilities range from six-point scores to yes/no ratings. The instrument includes a score for each of the eight subscales as well as summary mental health and physical scales.

The reliability of the SF-36V2 has been estimated using internal consistency, test-retest, and alternative forms (mental health scale only) methods. Coefficients have exceeded 0.70 with some items measuring 0.80. Coefficients for the mental health and physical summary scores exceed 0.90.(Ware, 2000) Reliability, validity, and feasibility of the SF-36v2 for general hospital psychiatric patients have been established,(Elleuch, et al., 2008) and when used with schizophrenic patients, the SF-36v2 has also been found valid and reliable.(Johnston, Watsford, Austin, Pine, & Spurrs, 2000) The SF-36v2 has been found to be valid for use with Spanish-speaking patients,(Vignon, et al., 2006) and a recent study demonstrated validity in assessing health-related quality of life in a sample of older Mexican Americans.(Kuijt, Inklaar, Gouttebarge, & Frings-Dresen, 2012a) This instrument is widely used in the assessment of functional health status and is referenced to a U.S. normative group to facilitate comparisons.(Till, Jones, Darrall-Jones, Emmonds, & Cooke, 2000)

The SF-36v2 consists of 36 items, grouped into eight scales. Version 2.0 scoring uses norm-based scoring algorithms for all eight scales (T-score transformation with mean,

50±10 [SD]) that has made the SF-36v2 summary measures much easier to interpret.(Gandek, et al., 1998; Ware, et al., 1998)
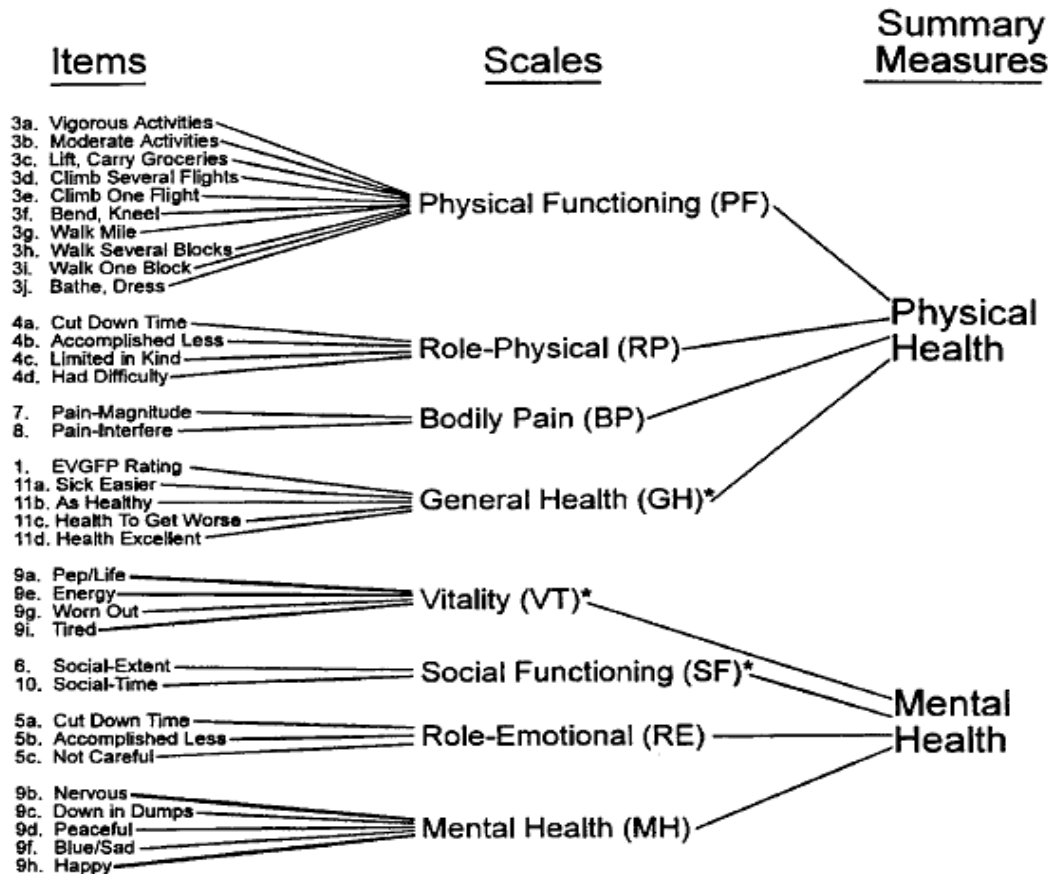

Figure 7: Taxonomy of items and concepts underlying the construction of the SF-36 scales and summary measures. *Source: Ware et al.(Ware & Kosinski, 1997)*

Each scale measures a different aspect of health, and with higher scale scores representing better self-reported health. The scales are: Physical Functioning (PF), Role Physical (RP) (the impact of physical health on performance of everyday role); Bodily Pain (BP); General Health (GH); Vitality (VT); Social Functioning (SF); Role Emotional (RE) (the impact of emotional health on role performance); and Mental Health (MH). Figure 7 represents a breakdown of these subscales and the relationships that co-exist between the two summary measures. The taxonomy has three levels: (1) items, (2) eight scales that aggregate 2–10 items each, and (3) two summary measures

that aggregate scales. All but one of the 36 items (self-reported health transition) is used to score the eight SF-36v2 scales. Each item is used in scoring only one scale. The eight scales are hypothesized to form two distinct higher ordered clusters according to the physical and mental health variance that they have in common.(Ware, 2000)

Three scales (Physical Functioning, Role-Physical and Bodily Pain) correlate most highly with the physical component and contribute most to the scoring of the Physical Component Summary (PCS) measure. The mental component correlates most highly with the Mental Health, Role-Emotional, and Social Functioning scales, which also contribute most to the scoring of the Mental Component Summary (MCS) measure. Three of the scales (Vitality, General Health, and Social Functioning) have noteworthy correlations with both components.
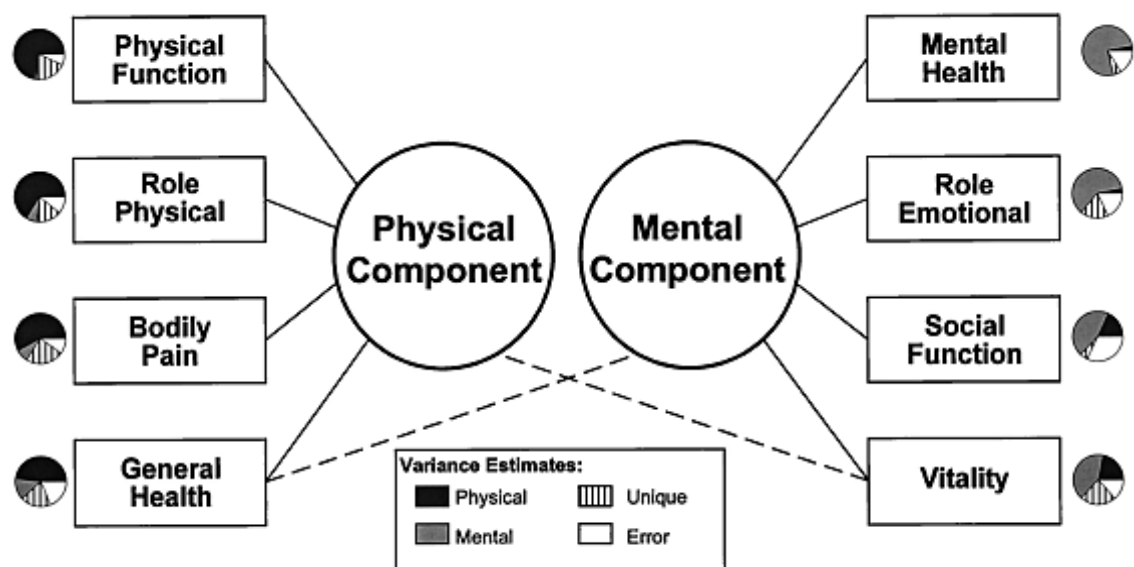

Figure 8:   SF-36v2® Health Survey Measurement Model *Source: Ware et al. 2000(Ware & Kosinski, 1997)*

The reliability of the eight scales and two summary measures has been estimated using both internal consistency and test–retest methods.(Ware, 2000) Extensive psychometric testing has

been conducted on SF-36v2 all over the world (Aaronson NK, Acquadro C, & Alonso J, 1992; Gandek, et al., 1998; McHorney, et al., 1993; Ware JE, Gandek B, & Group, 1994a) by using the same tests of scaling and scoring assumptions that were used in developing the SF-36v2. Investigators have compared results across general population studies in 10 countries.(Gandek, et al., 1998; Ware JE, et al., 1994a) On the strength of favourable results from tests to date, nearly all studies have used the method of summated ratings and standardized SF-36v2 scoring algorithms documented elsewhere.(Ware JE, Kosinski M, & SK, 1994b)

Appendix 11: Health and Disability Ethics Committees Ethics Approval CEN/09/09/067

Health and Disability Ethics Committees

2 October 2009
Amended 23 January 2015

Mr Trevor Clark
Massey University
Wallace Street
Mt Cook
Private Bag 756
Wellington 6140

Dear Mr Trevor Clark

CEN/09/09/067 - What has Sport got to do with Health

The above study has been given ethical approval by the Central Regional Ethics Committee.

Approved Documents:

- Appendix A.1 – SF-36 Health Survey
- Appendix B: NZPAQ – Short Form (Instrument, Showcards, Instructions)
- Appendix C : Medical History Questionnaire
- Appendix D : Information Sheet : What has Sport got to do with Health?
- Appendix E: Informed Consent: What has Sport got to do with Health?
- Interview Instructions : NZPAQ-SF (Version 1)
- New Zealand Physical Activity Questionnaire – Short Form (Version 1)
- NZPAQ –Showcard 1: Moderate Physical Activity
- NZPAQ – Showcard 2: Vigorous Physical Activity

Accreditation
The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, April 2006.

Progress Reports
The study is approved until **1 December 2012**. The Committee will review the approved application annually and notify the Principal Investigator if it withdraws approval. It is the Principal Investigator's responsibility to forward a progress report covering all sites prior to ethical review of the project in **2 October 2010**. The report form is available on http://www.ethicscommittees.health.govt.nz. Please note that failure to provide a progress report may result in the withdrawal of ethical approval. A final report is also required at the conclusion of the study.
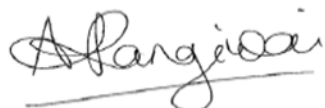
Amendments
It is a condition of approval that the Committee is advised if the study does not commence, or is altered in any way, including all documentation eg advertisements, letters to prospective participants.

Please quote the above ethics committee reference number in all correspondence.

The Principal Investigator is responsible for advising any other study sites of approvals and all other correspondence with the Ethics Committee.

It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.

Yours sincerely

Awhina Rangiwai
HDEC Secretariat

Appendix 12: Health and Disability Ethics Committees Ethics approval CEN/09/12/104

Health and Disability Ethics Committees
1 the Terrace
PO Box 5013
Wellington
0800 4 ETHICS
hdecs@moh.govt.nz

22 March 2010
Amended 23 January 2015

Trevor Clark
Massey University
Wallace Street
Mt Cook
Private Bag 756
Wellington 6140

Dear Trevor Clark

Ethics ref: **CEN/09/12/104**
Study title: What has Sport got to do with Health: Part B
Investigators: Mr Trevor Clark

The above study has been given ethical approval by the Central Regional Ethics Committee.

Approved Documents

- Appendix A: Informed Consent. Version 3, dated 01/02/2010
- Appendix B: Information Sheet. Version 3, dated 01/02/2010

Accreditation

The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, April 2006.

Progress Reports

The study is approved until **1 November 2012**. The Committee will review the approved application annually and notify the Principal Investigator if it withdraws approval. It is the Principal Investigator's responsibility to forward a progress report covering all sites prior to ethical review of the project in **31 March 2011**. The report form is available on http://www.ethicscommittees.health.govt.nz. Please note that failure to provide a progress report may result in the withdrawal of ethical approval. A final report is also required at the conclusion of the study.

Requirements for SAE Reporting

The Principal Investigator will inform the Committee as soon as possible of the following:
- Any related study in another country that has stopped due to serious or unexpected adverse events
- withdrawal from the market for any reason
- all serious adverse events occurring during the study in New Zealand which result in the investigator breaking the blinding code at the time of the SAE or which result in hospitalisation or death.

- all serious adverse events occurring during the study worldwide which are considered related to the study medicine. Where there is a data safety monitoring board in place, serious adverse events occurring outside New Zealand may be reported quarterly.

All SAE reports must be signed by the Principal Investigator and include a comment on whether he/she considers there are any ethical issues relating to this study continuing due to this adverse event. It is assumed by signing the report, the Principal Investigator has undertaken to ensure that all New Zealand investigators are made aware of the event.

Amendments
All amendments to the study must be advised to the Committee prior to their implementation, except in the case where immediate implementation is required for reasons of safety. In such cases the Committee must be notified as soon as possible of the change.

Please quote the above ethics committee reference number in all correspondence.

The Principal Investigator is responsible for advising any other study sites of approvals and all other correspondence with the Ethics Committee.

It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.

We wish you well with your study.

Yours sincerely

Awhina Rangiwai
HDEC Secretariat

12 publications. * Indicates full texts of articles are appended.

1) **Clark, TN.,** & King, D. (2017). Incidence of training injuries in a New Zealand amateur rugby league team over three consecutive years. *Australian Journal Strength Conditioning*. In Press.

2) King, D., Hume, P., Gissane, C., Kieser, D., **Clark, T.** (2017). Head impact exposure from match participation in women's rugby league over one season of domestic competition. *Journal of Science and Medicine in Sport*. In Press

3) Hume, P., Quarrie, K., Carlson L., King, D., Bradshaw, E., Le Flao, E., Alderson, J., Theadom, A., Lopez, V., Lewis, G., Hind, K., Entwistle, L., Brughelli, M., Gissane, C., **Clark, T.** (2017). Can we reduce injury risk in rugby codes? *Journal of Science and Medicine in Sport.* 20S (2017) 1. doi.org/10.1016/j.jsams.2017.09.370

4) King, DA., Hecimovich, M., **Clark, TN.,** & Gissane, C**.** (2017). Measurement of the head impacts in a sub-elite Australian Rules football team with an instrumented patch: An exploratory analysis. *International Journal of Sports Science & Coaching,* May 1–12. DOI: 10.1177/1747954117710512

5)* King, D., Hume, P., Gissane, C. & **Clark, TN**. (2017). Semi-Professional Rugby League Players have Higher Concussion Risk than Professional or Amateur Participants: A Pooled Analysis. *Sports Medicine* 47: 197. doi:10.1007/s40279-016-0576-z

6) King, D**.,** Hume, P., Gissane, C. & **Clark, TN**. (2017). Head impacts in a junior rugby league team measured with a wireless head impact sensor: An exploratory analysis. *Journal Neurosurgery: Paediatrics*. doi: 10.3171/2016.7.PEDS1684

7) King, D., & Hume, P., Gissane, C., & **Clark, TN**. (2016). Similar head impact acceleration measured using instrumented ear patches in a junior rugby union team during matches in comparison with other sports. *Journal Neurosurgery: Paediatrics* **18**(1):65-72

8) King, DA., Hume, PA., Gissane, C., Brughelli, M., & **Clark, TN.** (2016). The influence of head impact threshold for reporting data in contact and collision sports: Consensus needed. *Sports Medicine* 6:151-16

9) * King, D., Gissane, C., & **Clark, T.** (2013). Concussion in amateur rugby league players in New Zealand: A review of player concussion history. New Zealand Journal of Sports Medicine, 40(2), 64-69.

10) King, DA., **Clark, TN.,** & Gissane, C. (2012). Use of a rapid visual screening tool for the assessment of concussion in amateur rugby league: a pilot study *Journal Neurological Science* 320(1-2); 16-21.

11)   King DA., & **Clark TN.** (2012). Injuries in amateur representative rugby league over three years. *New Zealand Journal Sports Medicine* 39(2):48-51.

12) *   King, DA., Hume, PA. & **Clark, TN.** (2012). Nature of impacts that result in injury in professional rugby league. *Research Sports Medicine* 20(2): 87-105.