Reducing lifestyle diseases using community-based sport

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Dedication

This work is dedicated to the people who have supported and inspired me. To my mother, Dr Evelyn Thompson for showing me the value of learning and work ethic. Without your example I would never have reached so high, or worked so hard, academically or professionally. Peter Colley for reminding me to laugh, and that applying knowledge to improve practice will always be my life's work. Frank Thompson, a maker of tools to fix problems, who taught me the importance of storytelling. My step sisters Jennifer and Joyous Colley for reminding me that good stories need great pictures. Merylin, Joe and Cathy for your lessons in patience, resilience and determination. Suzanne Walden for teaching me what unconditional love meant, when I had no right to expect it. I will work to 'pay forward' that gift as long as I live.

In loving memory of Jessie Sievert who respected intelligence, invested in my education, and valued learning ahead of looks or money. Your legacy continues, because knowledge pays dividends for future generations. Sr Anne, for ensuring I lived long enough to finish school, and achieve anything at all. My British family James and Sue Brooks, and in loving memory of Steve Brooks and Vera Miles. You supported my career when it seemed confusing, and I had no idea that what I was doing was innovative.

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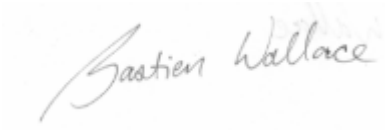
Statement of Authentication

The work presented in this thesis, is to the best of my knowledge and belief, original except where due acknowledgement is made in text. I hereby declare that I have not submitted this material, either in full or in part for a degree at this or any other institution.



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Declarations

A special thank you to Ms Rica Weller, Director Australian Software Advisors for being the first to invest in bringing my work into reality. Your investment of $25,000 will be applied to help turn the framework developed in this thesis into an application for testing, and eventually use, to help enable others to benefit from this research.

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Abstract

Lifestyle diseases are non-communicable health conditions that are responsible for the majority of global premature deaths. They also exact a huge financial cost and loss of disability adjusted life years. Physical inactivity is the largest contributor to 'lifestyle disease', which is more than a quarter of the Australian disease burden. This costs the Australian public health system over $425M each year, and is the leading cause of death. Poor nutrition, the excessive consumption of calories compared with energy expenditure, is a key contributor to lifestyle disease.

Cardiovascular disease, breast cancer, colorectal cancer, Type 2 Diabetes and obesity were the focus of this study. These diseases were selected on the basis that they are the five major non-communicable diseases attributable to a lifestyle of poor nutrition and inactivity, and the costliest financially and in terms of human health. Community sport-based interventions that target lifestyles diseases can help people improve their health.

The purpose of this study has been to identify the scope and impact of lifestyle disease, explore current practice in terms of community sport-based interventions, and to develop a framework to make it easier for community sports organisations to deliver health interventions for people with lifestyle diseases in a more methodical, evidence-based way. This study used peer reviewed academic literature, government and international sources, to identify the scope and impact of lifestyle diseases in adults, and interventions that have been delivered to address them. Grey literature sources were used to identify and describe more interventions than could be found in the academic literature.

The two outputs of the literature review were a selection of outstanding issues and questions, and a proposed framework to make it easier to design, deliver, measure, evaluate and publish results of community sport-based interventions in a more systematic, evidence-based way. The questions developed from the literature review formed the basis of semi-structured interviews conducted with seven program managers of community sport-based interventions.

A thematic analysis was developed based on the semi-structured interviews. Further refinement of the framework was undertaken based on insights from practitioners, and a discussion of the interview results followed. The research found using community sport to deliver health interventions can improve lifestyle disease, help people overcome barriers to sport participation and good health, increase the accessibility and affordability of service provision. Successful delivery can also provide community sports organisations with alternative forms of community engagement and growth opportunities.

Community sport-based interventions often have positive impacts on lifestyle disease, but may lack of evidence-based design, consistent methodology, rigorous evaluation and publication of results. This makes it difficult to secure long term funding, improve practice, increase provision, earn the trust of the health profession and government. Implementing the refined framework developed in this study to improve design, measurement and reporting will assist program managers, funders, academics and sport organisations to understand the impact and merits of using community-based sport programs to reduce lifestyle diseases.

Abbreviations

Throughout this thesis most abbreviations have been defined within the text, and a range have been set out in the table below.

Table 1 Abbreviations

Abbreviation	Meaning
AFL	Australian Football League
AIHW	Australian Institute of Health and Welfare
AUD	Australian dollar
BMI	Body mass index
CBE	Commander of the Order of the British Empire, an honorary title
DALY	Disability adjusted life year
β-cell function	A blood marker test for Type 2 Diabetes and Metabolic Syndrome that checks the function of insulin producing cells
CPAL	Changing the physical activity landscape- the name of a program that took place in the United Kingdom
GLUT4	Glucose transporter type 4, a blood marker test for Type 2 Diabetes and Metabolic Syndrome
HITT	High intensity interval training
HOMA-IR	Homeostatic model assessment for insulin resistance, a blood marker test for Type 2 Diabetes and Metabolic Syndrome
hs-CRP	High sensitivity C-reactive protein, a blood marker test for Type 2 Diabetes and Metabolic Syndrome
IGFBP-3	Insulin-like growth factor binding protein 3, a blood marker test for Type 2 Diabetes and Metabolic Syndrome
IL-1	Serum levels of interleukin, a protein that helps intercellular communication, growth regulation and immune responses including inflammation, a blood marker test for Type 2 Diabetes and Metabolic Syndrome
IL-8	Similar to (IL)-1 a blood marker used as part of testing for Type 2 Diabetes and Metabolic Syndrome
INT$	International dollar – a hypothetical currency that is equivalent to the purchasing power the U.S. dollar had at that time
IRS-1	Insulin receptor substrate-1 a blood marker used as part of testing for Type 2 Diabetes and Metabolic Syndrome
MET	One MET equals 1 kilocalorie/kilogram/hour or an oxygen uptake of 3.5 millilitre/kilogram/minute, the oxygen cost of sitting quietly
Min	Short for minute
mmol/L	Millimoles per litre, a unit of measure showing the concentration of a substance in a litre of fluid

NCD	Non-communicable disease
NPAPH	National partnership agreement on preventive health
NRL	National Rugby League
Protein kinase B	Also called PKB or AKT, the collective name for three serine/threonine-specific protein kinases that play important roles in cellular processes, measurements of its presence in tissues are used as part of testing for Type 2 Diabetes and Metabolic Syndrome
QUALY	Quality adjusted life year, used to express the loss (or preservation) of healthy life
TNF-α	Tumour necrosis factor alpha, and inflammatory protein responsible for cellular signalling leading to cell death, important protein for cancer and infection resistance
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollars
VicHealth	The Victorian health service
WHO	World Health Organisation or World Health Organization per the American spelling

1 Introduction

1.1 Background to the research

This research contributes to the field of sport and lifestyle disease management through advancing our understanding of the benefits of community sport-based interventions, beyond what is available in the academic literature. It builds on previous literature to outline the need for additional approaches to organising sport-based health interventions to reduce lifestyle disease. It argues that a more structured, measured approach to establishing, managing and reporting on these interventions will improve their impact on participants, and also allow them to be better understood and studied.

Lifestyle disease, as described in the literature in chapter two, is a global problem that cost an estimated USD$67.5 billion,[1] caused the loss of 13.4 million disability adjusted life years in 2013 (Ding et al. 2016), and caused an estimated 71% of the global deaths in 2016, some 41 million people (World Health Organization 2020c). This thesis argues that pursuing treatment models based exclusively on surgery and medication fails to realise the potential positive impact that community sport-based interventions may offer, and how they can help people improve their physical activity levels and modify their lifestyle. This could include improving patient health and mortality in breast cancer survivors (Cannioto et al. 2020; Ibrahim & Al-Homaidh 2011; Lahart et al. 2015), reversing disease in people with Type 2 Diabetes (Ades 2015; Sampson et al. 2020; Taheri et al. 2020), improving wellbeing or extending survival in colorectal cancer survivors (Kahl 2018; Van Blarigan et al. 2018), and reducing mortality

[1] $53.8 billion in health care costs and $13.7 billion in productivity losses

following a cardiovascular event (Deveza, Elkins & Saragiotto 2017). More detailed discussions of the literature related to disease impacts and interventions follows in chapter two.

Lifestyle disease, as defined at 1.6, results from physical inactivity, poor nutrition and excessive consumption of calories (Australian Institute of Health and Welfare 2017b). Therefore, interventions that assist people to change these behaviours offer the opportunity to reduce disease impact, symptoms, or in some cases to reverse it altogether. If disease outcomes could be improved through community sport-based interventions, there remains a strong need to better understand how they have reduced lifestyle disease and managed to address inactivity, nutrition, and barriers to good health. The purpose of this research is to outline the issues related to the target lifestyle diseases, discuss the current interventions and their impact, to identify whether more work has been done in the field than has made it to the academic literature, to develop a framework to make the process of establishing, measuring, evaluating and reporting on interventions easier.

1.2 Research questions and hypotheses

This research seeks to address the following questions:

1) How large a problem is lifestyle disease in Australia and globally– particularly cardiovascular disease, breast cancer, colorectal cancer, Type 2 Diabetes and obesity?
2) Are community sport-based interventions taking place?
3) Are there more community sport-based interventions being delivered in the community than those currently discussed in academic literature?
4) Can community sport-based interventions improve lifestyle disease?
5) What evidence or data is currently being collected to evaluate the effectiveness of community sport-based interventions?
6) What impact do these community sport-based interventions have on participants?

7) How have they been designed? (What methodology is used)
8) What could be done to improve them?
9) What are the barriers to widespread use of community sport-based interventions?
10) Could providing a framework to program managers make it easier to design, measure, deliver, evaluate and report on interventions?

This thesis hypothesises that there have been a considerable number of community sport-based interventions to address lifestyle diseases that have not been documented in the academic literature. It uses grey literature sources in chapter two, and semi-structured interviews in chapter four, to provide further evidence, and to contribute to an improved understanding the role of sport interventions in reducing lifestyle disease.

1.3 Justification for the research

In July of 2017 the United Nations Educational, Scientific and Cultural Organization (UNESCO) identified in the Kazan Action Plan the importance of sport and physical activity in reducing the risk of inactivity, improving community health, reducing premature mortality from lifestyle diseases, reducing healthcare costs, and contributing to the Sustainable Development Goals (United Nations Education Cultural and Scientific Organisation 2017). This is of global importance as only the 25 higher income countries in the Western Pacific and Europe are on track to achieve the United Nations Sustainable Development Goal 3.4 to reduce premature non-communicable disease by one third compared with 2015 levels (Bennett et al. 2018). The Kazan Action Plan also identified a need for greater measurement to understand the contribution of sport and physical activity to the achievement of the Sustainable Development Goals (United Nations Education Cultural and Scientific Organisation 2017).

This research seeks to identify and discuss ways in which community-based sport is being used to improve lifestyle disease in adults and reduce inactivity, a contributing factor to disease (Lee

et al. 2012). As more interventions were being carried out than could be found in the academic literature, a key objective has been to find data generated through government and sport organisation reports and make it more accessible to the academy, who are identified as key stakeholders by UNESCO, in the implementation of the Kazan Action Plan (United Nations Education Cultural and Scientific Organisation 2017).

The scale and impact of lifestyle disease on human health, as outlined in the literature in chapter two, justifies research to explore alternatives and methods that may help reduce mortality and health costs. Whilst the World Health Organisation, national governments, academics and health experts have studied and made recommendations on nutrition and physical activity levels necessary to avoid contracting lifestyle disease (World Health Organization 2018c, 2020a), community sport-based interventions are not well understood in terms of design, implementation and impact. For example, the available academic literature does not specify intervention dose rates, elements, program duration, measurements to be taken or achieved, to ensure the intervention works to reduce disease symptoms or progression. This thesis therefore seeks to identify and discuss community sport-based interventions that have been conducted, in order to better understand current practice. Using this insight, it then proposes a framework to better plan community sport-based interventions with the aim of improving the way they are designed, run and understood.

1.4 Outline of this thesis

This chapter outlines the aims and purposes of the thesis by way of an introduction. Chapter two contains a review of the literature available in peer reviewed journals, since the year 2000 which is considered the earliest known time of the first use of community sports clubs as health promotion settings (Kokko 2014). However, research related reports and grey literature sources were also sought to advance this search, and provide evidence of community sport-

based interventions not yet captured by peer review journals. This chapter aims to establish the size and scope of the problem of lifestyle disease, the contributing factors, the contribution sport and physical activity has made to addressing or preventing it. Each of the five target diseases, cardiovascular disease, breast cancer, colorectal cancer, Type 2 Diabetes and obesity, are discussed with regards to their scope, impacts, community sport-based interventions evident in the academic literature, followed by those found in the grey literature. For each disease, questions arising from the evidence of interventions described in the academic and grey literature conclude the section. A draft framework was developed at this stage of the research, at Appendix 2, to better enable practitioners to design and lead these community sport interventions in a more evidence-based way, to gather data, address the gaps in information and questions identified from the literature review, and to report results systematically. It is proposed that using the framework will make the work of program mangers easier. The eventual aim of data collection using the framework, would be to enable the questions to be studied and, in future, answered.

This third chapter describes the methodology and methods employed to conduct this research. Questions were developed from the literature review see Appendix 10, and asked of seven program mangers during semi-structured interviews. The interviews also included questions designed to test the validity and usefulness of the initial framework, and to explore what program managers thought would make their work easier. As will be expalined in the methodology section of this thesis, the interviews generated data on the community sport interventions the program managers led, their understanding of intervention impacts, and a reflection on opportunities for improvement. Following the interview, the data was transcribed and a thematic analysis was undertaken developing the four themes discussed in the findings section (chapter four) of the thesis. The inital framework was further refined to ensure it met

the needs of program managers, and based on the identified themes and findings of the semi-structured interviews.

The fourth chapter presents the findings from the thematic analysis of the research interviews which, as explained earlier, were conducted with practitioners who had led or set up community sport interventions to address one or more of the target lifestyle diseases in adults. The findings were discussed using four organising themes:

1. ***Custom Designed***: Identifying and designing programs for a target cohort
2. ***Effective Collaboration****:* Understanding funding and stakeholder engagement
3. ***Project Management and Design***: Understanding the multi-layered program mechanics
4. ***Made to Measure***: Importance of recording and effective measurement for sustainability and success

Chapter five outlines the framework elements, and the reasons for modifications to the initial framework based on the semi-structured interviews. It also discusses the ways in which the framework can be used to assist practitioners in the field to improve the way interventions are designed, managed, evaluated and publicised.

The thesis then concludes by returning to the hypotheses and research questions raised in this chapter, and it then addresses each of the target lifestyle diseases, discussing how this research has advanced our understanding of community sport-based health interventions. This is followed by the drawing of conclusions about the research problem, implications for theory, policy, practice, methodology and further research. Limitations are acknowledged and the conclusion describes the contribution that the research and development of the framework has made to the field of knowledge.

1.5 Thesis logic model

The following thesis logic model sets out the process undertaken during the research and provides the sequence of steps taken from the initial hypothesis through to the discussion and conclusions. This model also shows how the hypotheses and robust literature review informed the initial development of the framework, and how the themes that arose from the literature contributed to its refinement.

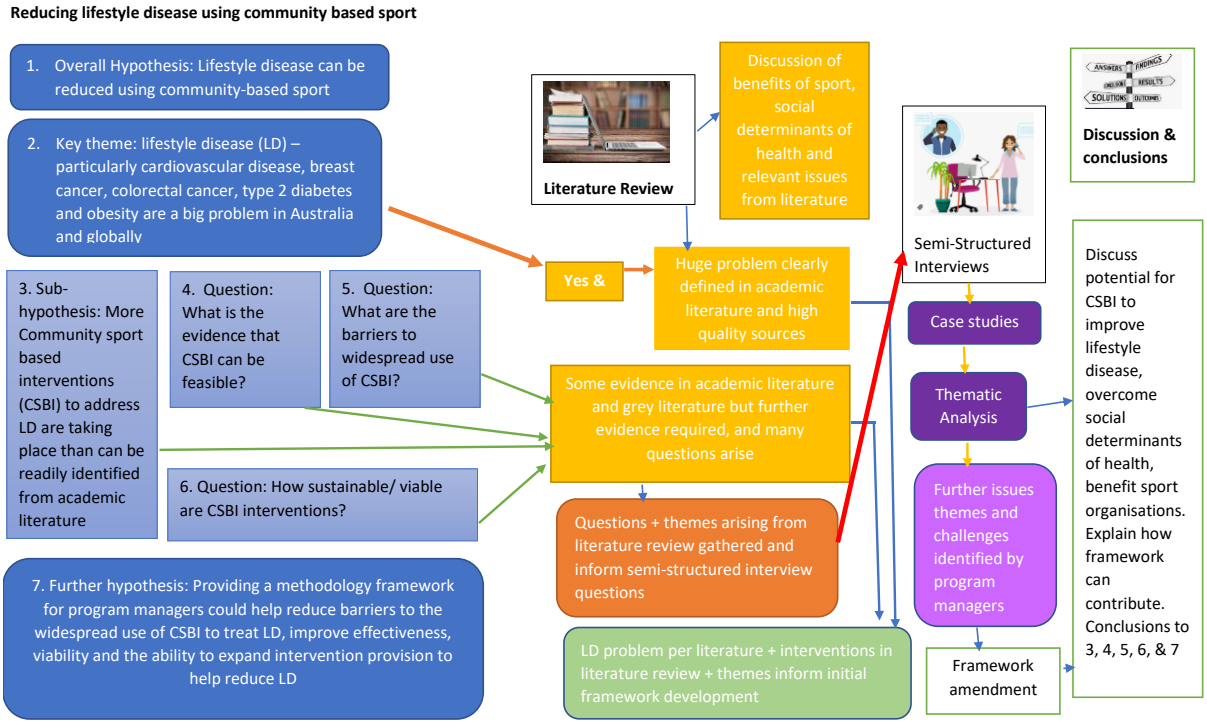

Figure 1 Thesis logic model

1.6 Definitions

A range of definitions are used within this thesis as set out below.

Adults generally refers to people aged eighteen and over. Some programs group people over 16 or mothers under 18 with adults for the purposes of participation, and this is descried within the thesis.

Breast cancer a malignant neoplasm (the uncontrolled growth of abnormal cells) in the breast, that may also spread to other parts of the body (Australian Institute of Health and Welfare 2020a).

Bowel cancer a malignant neoplasm (the uncontrolled growth of abnormal cells) of the bowel, that may also spread to other parts of the body (Australian Institute of Health and Welfare 2018b).

Cardiovascular disease refers to a collection of diseases of the heart muscle, arteries and veins that includes heart attack, stroke, hypertension, arteriosclerosis (Australian Institute of Health and Welfare 2019b).

Colorectal cancer a malignant neoplasm (the uncontrolled growth of abnormal cells) in the bowel, colon or rectum, that may also spread to other parts of the body (Australian Institute of Health and Welfare 2018b).

Community-based sport is used to distinguish between sport played by elite or professional athletes, and sport open to participation by amateur or ordinary members of the community see 'sport' definition below.

Framework in this thesis refers to a model of sequential steps developed by the researcher to assist program managers in designing, managing, measuring and reporting on community sport interventions.

Inactivity as discussed in this thesis, refers to not achieving the minimum 150-300 minutes of moderate-intensity physical activity, or 75-150 minutes per week of vigorous intensity physical activity, or a combination of both, recommended for adult health by the World Health Organization (Guthold et al. 2018; World Health Organization 2019e).

Lifestyle Disease(s) are health conditions often caused by physical inactivity, poor nutrition and excessive consumption of calories compared with energy expenditure (Australian Institute of Health and Welfare 2017b).

Metabolic Syndrome is sometimes also referred to as 'pre-diabetes' and is a set of multiple risk factors for atherosclerotic cardiovascular disease and Type 2 Diabetes. It includes atherogenic dyslipidaemia- elevated levels of triglycerides and small-dense low-density lipoprotein, low levels of high-density lipoprotein cholesterol, elevated blood pressure, insulin resistance and elevated glucose, a pro-thrombotic state, and a pro-inflammatory state (Grundy 2016).

Nutrition in this thesis refers to process of providing or obtaining the food necessary for health and growth in human beings.

Obesity Body mass index (BMI), which is weight in kilograms divided by height in meters squared, is used to identify obesity. For adults, a BMI of 30 kg/m2 or higher is defined as obese (Apovian 2016). More recently Asian and South Asian populations have been recognised as overweight and obese at lower a BMI (Coleman et al. 2008).

Overweight Body mass index (BMI), which is weight in kilograms divided by height in meters squared, is used to identify obesity. For adults, a BMI of 25.0 to 29.9 kg/m2 is defined as overweight (Apovian 2016).

Physical Activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, Powell & Christenson 1985).

Pre-diabetes see *Metabolic Syndrome* above.

Program Manager is used in this thesis to refer to people responsible for overseeing, setting up, leading or managing interventions to address lifestyle disease.

Sport for the purpose of this thesis reflects the definition adopted in the KAZAN Action Plan (United Nations Education Cultural and Scientific Organisation 2017) namely:

> "…'sport' is used as a generic term, comprising sport for all, physical play, recreation, dance, organized, casual, competitive, traditional and indigenous sports and games in their diverse forms…"

The researcher acknowledges that some jurisdictions and literature use wider definitions of sport, including participation in gym classes, group fitness, recreational weightlifting or dancing when discussing community sport, and others only include a narrower definition of sport focussed on sports that feature in international competition.

Type 2 Diabetes or Diabetes Myelitis is a progressive condition where the body becomes resistant to the normal effects of insulin and/or gradually loses the capacity to produce enough insulin in the pancreas (Diabetes Australia 2020b).

Type 2 Diabetes blood markers a range of blood tests are used in the diagnosis and treatment of Type 2 Diabetes and Metabolic Syndrome including: serum levels of interleukin (IL)-1, high sensitivity C-reactive protein (hs-CRP), tumour necrosis factor α (TNF-α), interleukin IL-8, β-cell function and insulin resistance (HOMA-IR), insulin receptor substrate-1 (IRS-1), glucose transporter type 4 (GLUT4), and protein kinase B (Akt) in the tissues. Patients with metabolic syndrome had significantly higher HOMA-IR and serum levels of IL-1, hs-CRP, TNF-α and IL-8 than the normal controls.

1.7 Target disease selection rationale

The rationale for selecting the five target diseases for this research is that they are the five major non-communicable diseases attributable to this lifestyle (Ding et al. 2016). The reasoning for their selection is set out below.

Table 2 Target diseases

Disease	**Reason for selection**
Cardiovascular disease (heart disease and Stroke)	This is 15% of the Australian Disease Burden and the second biggest killer
Breast cancer	Cancer is the biggest killer in Australia and improving lifestyle factors has been shown to have a positive impact on health
Colorectal cancer	Cancer is the biggest killer in Australia and improving lifestyle factors has been shown to have a positive impact on health
Type 2 Diabetes and Metabolic Syndrome	One million Australians have diabetes and it is one of the top 10 causes of death in Australia. It is the primary cause of death in cardiovascular disease but modifying lifestyle has been shown to improve Type 2 Diabetes symptoms or even to reverse it.
Obesity and overweight	Half of Australians are overweight or obese, and this is a risk factor for other lifestyle diseases

(Shaw et al. 2012; Welfare 2016)

1.8 Delimitations of scope and key assumptions

This research focuses on the five target lifestyle diseases in Table 2, and interventions to address them in adults. Adults were selected for two reasons. The majority of the incidence and impact of the target diseases occurs in adults (Bloom et al. 2011; Ding et al. 2016), and unlike children who depend on adult caregivers to enable participation,[2] adults have greater ability to choose to participate in available community sport-based interventions.

Diseases of addiction related to smoking, the misuse of alcohol, prescription and illicit drugs, skin cancer and melanoma related to excess sun exposure, are also lifestyle diseases, but are not specifically examined in this thesis. Some mental health conditions may be impacted by, or associated with, lifestyle factors, but mental ill health is beyond the scope of this study.

The development of this research and the framework that follows seeks to be inclusive, but it will be limited in what it can achieve in the community setting. This may not be applicable to individuals and groups who are unable to alter their sedentary behaviour.[3]

1.9 Philosophical approach

The philosophical approach taken in this thesis overall is best described as Transdisciplinary Generalism (Lynch et al. 2021), whilst an interpretivist approach was taken towards the interview process (Alharahsheh & Pius 2020).

Interpretivism distinguishes between human and physical phenomena, enabling researchers to consider the experience and behaviour of research participants as contributing to describing

[2] Either in terms of funding fees, equipment, providing permission or facilitating the child to attend

[3] People may have health conditions that require medication that shortens life, for some mental health medications (Correll et al. 2015). Others may have physical disabilities, such as spinal cord injury, that are a barrier to participating in sufficient physical activity to avoid lifestyle disease (Cragg et al. 2013). There are also a range of social, economic and cultural factors that may act as barriers to participation in physical activity.

reality, as opposed to the positivist focus on pure data (Alharahsheh & Pius 2020). By interviewing program managers of community sport-based interventions about their experiences, the researcher sought to gather information to further the understanding of these programs.

Transdisciplinary Generalism is a form of knowledge management and creation that can work for clinicians and researchers, and that addresses the differences between the perception of reality (ontology), understanding and valuing of knowledge (epistemology), reasoning and rigorous process (logic), and the contribution of values to knowledge discovery, creation, or generation (axiology) (Lynch et al. 2021). From the outset, this research was designed with the intention of providing a useable tool Appendix 8. for health and sport practitioners as well as researchers, that would help improve consistency, knowledge gathering and management in future.

The principles of Transdisciplinary Generalism as an approach to knowledge are:

> "(a) Broad Scope (integrative purpose of consultation and inclusive scope—breadth, depth, and length of reality considered);
> (b) Relational Process (collaborative understanding and shared language, and participatory co-creation with stakeholders who own the problem);
> (c) Complex Knowledge Management (complex problems addressed and coherent integration of information, perspectives and consciousness from many disparate sources);
> (d) Humble Attitude to Knowing (emergent attitude to co-created knowledge, and reflexive position of the embedded transdisciplinary researcher, generalist clinician or patient); and
> (e) Real-World Outcome Focus (translating outcomes into real-world solutions) (Lynch et al. 2021)."

An interpretivist approach informed the decision to interview program managers, to use semi-structured interviews and qualitative analysis, as the researcher recognised the invaluable nature of their experience to the further development of research and practice improvement. The researcher's encounters with interventions in the literature and program managers, has served to remind her that these interventions require the 'complex knowledge management' and 'humble attitude' to research descried above (Lynch et al. 2021).

It has been a source of despair for the researcher that to date there has been an under-appreciation and under-utilisation by the health sector of what can be delivered through the community sport sector, a similar ignorance on the part of many in the sport sector of the potential role it could play to deliver health outcomes, and insufficient engagement between either sector and academic researchers. In this light it is wholly appropriate that this research takes a transdisciplinary approach that aims to develop solutions to complex problems. It does this by examining knowledge across disciplinary boundaries (Basarab 2005), to understand what is essential to each discipline, whilst remaining open to new information and participatory approaches to knowledge formation (McGregor 2018). It goes on to develop a framework to improve data collection, knowledge gathering and sharing in ways that the health, sport and research sectors can use, understand, benefit and learn from.

1.10 Conclusion

This chapter sets out the research themes and questions for this thesis. The limitations of scope are followed by the methodology, and a description of how the research is to be presented. The thesis logic model is provided to assist with understanding how the research phases were undertaken, and their influence on each other. A description of the philosophical approach that was taken follows.

2 Research issues

2.1 Introduction

This chapter provides an overview of the literature by discussing the five major lifestyle diseases explored in this thesis. It aims to capture the relevant modifiable behaviours that contribute to the development of these diseases, and the economic and social impact and cost of these conditions, both in Australia and globally. Given the focus of this research, community sport will be discussed as a setting for the promotion of positive health behaviours, and the individual and community benefits of health interventions delivered using community sport will be summarised. In doing so, this chapter will examine the traditional components of intervention programs to improve health that use community sport and physical activity, and it will describe their methodology and effectiveness.

Appendix 1 contains table 6 of the literature reviewed following the original search for evidence of community sport-based interventions for lifestyle disease conducted in 2018. Appendix 9 describes the search strategy for the initial literature review, ongoing alerts, and the strategy undertaken for the follow-up conducted in 2021. Table 3 below summarises the types of evidence found during those searches, as well as the sources that came from the alerts set up in 2018 that ran until the 2021 follow-up, and the additional references from the final 2021 search. Where possible, when a search alert provided a grey literature source, the researcher would then seek the original academic source.

Table 3 Literature types

Evidence Type	Peer Reviewed Sources	Grey Literature Sources
Systematic reviews	16	1
Randomised controlled trails	12	3
Cohort studies	9	1
Case controlled studies	4	
Cross sectional studies	1	
Case studies	4	7
Expert opinion	19	17
Personal opinion	1	
Total		

In addition to this, a range of literature sources were used in order to develop and support the understanding of the nature and impact of the target diseases, inactivity, nutrition, as well as to inform methodological discussions. Rather than following a pre-prepared search strategy, these sources were gathered during the writing process, with preference given to peer reviewed literature, and quality primary sources such as the World Health Organization, or official government publications.

The themes drawn from the literature review will be described, together with their relationship to the research questions. The research questions drawn from the literature, informed the semi-structured interview questions that were used to test the usefulness of the framework design with practitioners, who had designed or led health interventions using community sport.

2.2 Lifestyle disease

Lifestyle diseases are health conditions often caused by physical inactivity, poor nutrition and excessive consumption of calories compared with energy expenditure (Australian Institute of Health and Welfare 2017b). The five major non-communicable diseases attributable to this lifestyle are coronary heart disease, stroke, Type 2 Diabetes, breast cancer and colon cancer (Ding et al. 2016). As such, these form the basis of my thesis and proposed framework.

Non-communicable diseases kill 41 million people each year, account for 71% of all deaths worldwide, and over 80% of all premature deaths. Cardiovascular disease has the largest annual death rate at 17.9 million deaths, followed by cancers at 9.0 million, respiratory diseases 3.9 million, and diabetes 1.6 million (World Health Organization 2018d). Specific consideration of respiratory disease is beyond the scope of this study on the basis that health interventions designed to improve the health behaviour of individuals cannot reduce the significant risks posed by; environmental pollution- which is beyond the control of the individual[4], to genetic, allergic and dietary contributors to asthma, or the respiratory impacts of infectious disease (Ferkol & Schraufnagel 2014). Being overweight and inactive has also been identified as being associated with a range of non-communicable diseases and health conditions in the World Health Authority's *Global Action Plan for the Prevention of Non-Communicable Diseases* including renal, endocrine, and mental disorders (World Health Organization 2013b). It is estimated that the annual cost to the world of lifestyle disease was USD$67.5 billion in 2013 alone, and it cost 13.4 million disability adjusted life years (DALYs) (Ding et al. 2016). The disease burden represents the gap between a population's actual and ideal levels of health, and it includes premature death and the burden suffered by those living with disease. These two burdens are summarised together in a measure called disability-adjusted life years (DALY). One year of 'healthy life' lost due to illness and/or death is referred to as one DALY. Higher numbers are associated with a greater burden of injury or disease that could be avoided if the risk factors were removed (Australian Institute of Health and Welfare 2016a).

The financial costs of lifestyle disease were made up of $53.8 billion in health care costs and $13.7 billion in productivity losses, based on the best data available from 142 countries or

[4] Such as environmental and workplace exposure to inhaled pollutants or chemicals in countries with no/ poor controls, cooking over fires where no alternative is available, exposure to bushfire smoke for long periods

93.2% of the world's population (Ding et al. 2016). The World Health Organization estimated that 71% of the 56.9 million deaths in 2016 were due to noncommunicable diseases (NCDs), with three quarters of the deaths occurring in low- and middle-income countries. The four main culprits being cardiovascular diseases,[5] cancers,[6] chronic lung diseases[7] and diabetes[8] (World Health Organization 2020c). Poverty stems from, and is exacerbated by, NCDs and their prevention and management is critical to creating sustainable and healthy cities, and achieving global sustainable development goals (Nugent et al. 2018).

The 2016 Australian Institute of Health and Welfare report based on the Australian Burden of Disease Study, found that 50% of Australians have at least one, and 23% have two or more, of eight chronic conditions namely: cancer, cardiovascular disease, mental health conditions, arthritis, back pain and problems, chronic obstructive pulmonary disease, asthma and diabetes. Overall, these chronic conditions are responsible for 87% of deaths and 61% of the total disease burden in Australia (Welfare 2016), and demonstrate an urgent need for effective action. Therefore, health systems, societies and individuals urgently need solutions to improve outcomes, and the potential of community sport needs to be identified and harnessed. This thesis seeks to improve the ability of sport to contribute to reducing the burden of these chronic conditions on individuals, communities and health systems. This is could be achieved by developing a framework that makes it easier to design, deliver, measure, evaluate and report on community sport-based interventions to improve lifestyle disease.

The *Australian Burden of Disease Study: impact and causes of illness and death in Australia 2011* report found that 31% of the Australian disease burden in 2011 could have been prevented

[5] 44% of all NCD deaths
[6] 22% of all NCD deaths
[7] 9% of all NCD deaths
[8] 2% of all NCD deaths

by removing exposure to risk factors including tobacco use, high body mass, alcohol use, physical inactivity and high blood pressure (Australian Institute of Health and Welfare 2016b). The overall Australian disease burden increased up till the age of 85, and the three chronic conditions that contribute most to it are cancer, coronary heart disease and mental illness. Type 2 Diabetes is a key contributor to the Australian disease burden, as well as being a risk factor for heart disease, and overweight and obesity are key disease risk factors in each of the other diseases (Australian Institute of Health and Welfare 2016b).

Two modifiable behaviours, namely inactivity and poor nutrition, are key contributors to these diseases. A closer analysis of these factors follows, together with a more detailed look at each of the target lifestyle diseases in terms of global incidence, impact and cost, followed by the Australian impact, incidence and cost. For each lifestyle disease a description of community sport-based interventions found in academic and then grey literature will be discussed to provide context for the current study.

2.2.1 Inactivity

Physical activity means bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization 2020a). To be sufficiently active the World Health Organization (WHO) recommends adults complete at least 150 minutes of moderate-intensity physical activity, or 75 minutes of vigorous-intensity physical activity, or an equivalent combination of each type each week, as well as muscle strengthening activities involving major muscle groups on 2 or more days a week. Adults who fail to achieve at least 150 minutes of moderate-intensity physical activity per week are said to be inactive (Guthold et al. 2018).

A pooled analysis by the World Health Organization of 358 population-based surveys taken in 168 countries, with 1.9 million participants found that:

> "Insufficient physical activity is a leading risk factor for non-communicable diseases, and has a negative effect on mental health and quality of life."
> (Guthold et al. 2018)

Adults can gain additional health benefits by increasing their moderate-intensity physical activity to 300 minutes per week. It is recommended adults over 65 with poor mobility add physical activity to enhance balance and prevent falls, on 3 or more days per week (World Health Organization 2018e). According to the WHO around 31% of adults were insufficiently active to stay healthy based on 2008 data, and 3.2 million deaths each year can be attributed to insufficient physical activity (World Health Organization 2019e).

In 2013 it was estimated, using the best data available for 142 countries[9], that physical inactivity was responsible for the loss of 13·4 million DALYs. The estimated global cost of inactivity that year was INT$53.8 billion in healthcare,[10] and $13.7 billion in productivity losses (Ding et al. 2016). Responding to this significant issue, the WHO has called for a 10% reduction in the number of people who are insufficiently physically active, for affordable, evidence based strategies to combat the rising rates of diabetes and obesity (World Health Organization 2013b). This target has not been met globally, and is not on track to be met by 2025 (Guthold et al. 2018), however some countries have made progress. The proportion of the Australian adult population deemed insufficiently active fell from 69% to 65% between 2007–08 and 2017–18 (Australian Institute of Health and Welfare 2019e)[11], and an 0.8% increase in the number of adults getting at least 150 minutes of physical activity per week was

[9] 93.2% of the global population
[10] $31.2 billion paid by the public sector, $12.9 billion paid by the private section and $9.7 billion paid by households.
[11] This doesn't include activity undertaken at work.

measured by the Sport England Active Adult Lives Survey (Sport England 2019). Failure to meet the WHO target suggests a need for greater work on reducing inactivity, a dissemination of results, and for affordable, effective, evidence-based projects and strategies.

In a systematic review of the literature on life expectancy as it relates to physical activity Reimers, Knapp and Reimers (2012) found that regular physical activity decreased all-cause mortality by 30%, increased life expectancy by between 0.4 and 6.9 years, together with lowering risk factors including arterial hypertension, diabetes mellitus type 2, dyslipidaemia, coronary heart disease, stroke, and cancer.

This is a critical issue in Australia where people have become more sedentary, and where many combine this with poor nutrition and becoming overweight (Australian Institute of Health and Welfare 2018c; Bloom et al. 2011). Inactivity raises the risk of cardiovascular disease and all-other-causes mortality (Australian Institute of Health and Welfare 2019e). Only 60% of Australian 18-64 year old's participate in sufficient physical activity for health (Australian Bureau of Statistics 2018), meeting Australia's Physical Activity and Sedentary Behaviour Guidelines that require at least 150 minutes of physical activity per week for adults, set at 30 minutes per day on most days (Department of Health Research and Statistics 2018). This means 40% of 18–64-year-olds are considered inactive, with the Australian Government attributing 26% of the total Australian disease burden to physical inactivity. This takes into account the seven diseases most closely linked to physical inactivity (in descending order) being; diabetes, bowel and uterine cancer, dementia, breast cancer, coronary heart diseases and stroke. Sixty three percent of Australians are overweight or obese, and the population is aging, leading to increasing inactivity (Australian Bureau of Statistics 2018).

This inactivity costs Australia AUD$425M per annum in public healthcare expenditure and a further AUD$165M each year in indirect costs, such as lost work productivity due to sickness (Australian Institute of Health and Welfare, 2018; Ding, 2016). The health and economic burden of physical inactivity increases with age, so a larger aged population adds to this burden at a population level. Persistent inactivity has a physiological deconditioning effect which is cumulative over time, meaning that spending more years being inactive can contribute to poor health. In the case of cardiovascular disease, persistent inactivity contributes to functional and structural remodelling adaptations and deconditioning over time, which is likely to increase disease risk (Thijssen et al. 2010). As adults age they may also accumulate injuries, disabilities or health conditions, such as arthritis or vertigo, that reduce their ability to remain physically active.

Without a doubt, social and economic factors also contribute to the age-related burden of physical inactivity, but other factors also play a role. Australia classifies socio-economic advantage of in terms of people's access to material and social resources, and their ability to participate in society. People with high socio-economic disadvantage have lower incomes and less access to socially desirable resources (Australian Bureau of Statistics 2016). This is a barrier to being physically active as it makes childcare, transport, and fees for sport, recreation or gym facilities less affordable. If local job opportunities are poor, long commutes to find employment also reduce the available time adults have for activity. Socio-economic disadvantage also reflects barriers to participation in society that may go beyond finances. Examining the Australian Bureau of Statistics Index of Relative Socio-economic Advantage and Disadvantage Interactive Map, it shows visually the correlation between economic disadvantage, geographic remoteness, and proximity to coastline (Australian Bureau of Statistics 2016). People who live closer to coastlines are more easily able to access forms of

physical activity rated as popular amongst Australians according to the national *AusPlay Survey (SportAus 2018)* such as swimming[12], body-surfing, surfing[13] and boating[14] than those who do not. Average temperatures increase in Australia as you travel inland[15](Bureau of Meteorology 2019), which can act as a deterrent to regular physical activity and increase the risk of heat illness (Sports Medicine Australia 2007). From a study comparing United States counties, there are higher rates of obesity in counties with greater extremes of temperature (von Hippel & Benson 2014) and a systematic review of thirty seven studies across eight countries identified season and poor or extreme weather as a barrier to participation in physical activity (Tucker & Gilliland 2007). In their study of 1.9 million survey respondents in the United States between 2002 and 2012, coupled with daily meteorological data, Obradovich and Fowler (2017) showed that rain, cold and acutely hot days reduced physical activity, with the most pronounced effect seen in the elderly or obese respondents.

Small changes to one's lifestyle have been recognised to have a significant impact at a localised population level. For example, if individuals took an extra 15 minute brisk walk five days per week, this would reduce the disease burden in the population by around 13%, and increasing this to 30 minutes would reduce the inactivity disease burden by 26% (Australian Institute of Health and Welfare 2017a). This is consistent with a study of 502,611 participants between 38 and 73 years of age, conducted using the UK Biobank Resource. This study by Chudasama et al. (2019) showed that moderate physical activity was associated with longer life expectancy, even in people with multi-morbidity[16] 10 minutes of brisk walking per day is correlated with longer life expectancy but little additional benefit observed above these levels. So it may not

[12] Australia's 3rd most popular participation sport
[13] Australia's 17th most popular participation sport
[14] Canoeing, surf rowing, sailing, kayaking, outrigging, surf-ski paddling
[15] See temperature maps
[16] Defined as two or more long term health conditions

be necessary to engage in high-volume or high-intensity physical activity to achieve potential health benefits (Chudasama et al. 2019).

In a systematic review of the literature on life expectancy as it relates to physical activity, Reimers, Knapp and Reimers (2012) found that regular physical activity decreases all-cause mortality by 30% compared with being inactive, and increases life expectancy by between 0.4 and 6.9 years. Being physically inactive is associated with increased chronic disease risk

> "…arterial hypertension, diabetes mellitus type 2, dyslipidaemia, coronary heart disease, stroke, and cancer."
>
> (Reimers, Knapp & Reimers 2012).

This is an urgent global concern because chronic diseases including obesity, cancer, cardiovascular disease, diabetes, and stroke are the leading cause of death worldwide, and are expected to lower life expectancy for future generations (Anderson, E & Durstine 2019).

Worldwide, 3.2 million deaths can be attributed to insufficient activity (World Health Organization 2019e). A 25% reduction in inactivity could avert 1.3 million deaths globally each year through reducing the burden of coronary heart disease, Type 2 Diabetes, breast cancer and colon cancer (Lee et al. 2012). This does not just relate to the impact increasing physical activity can have on disease prevention. Increasing the levels of physical activity in patients who have already have colorectal cancer (Guercio, B et al. 2019; Meyerhardt et al. 2006), breast cancer (Ibrahim & Al-Homaidh 2011), cardiovascular disease (Deveza, Elkins & Saragiotto 2017), Type 2 Diabetes (Ades 2015; Miller & Dunstan 2004), or who are obese (Donnelly et al. 2009), can have health benefits post diagnosis[17]. An explanation of the potential health benefits, based on the research pertaining to each disease, follows below from 2.8.1 beginning with cardiovascular disease. This is significant to expanding the

[17] These are different for each disease, but range from reducing disease symptoms and measures to improving the effectiveness and tolerance of treatment

understanding of the nature, impact and existence of community sport-based interventions in use to help reduce lifestyle disease.

2.2.2 Poor nutrition

Worldwide in 2017 eleven million deaths and the loss of 255 million disability-adjusted life-years (DALYs) in adults aged over 25[18], were attributed to poor diet. More than half of these diet-related deaths, and two-thirds of diet-related DALYs lost, were attributable to the high intake of sodium, low intake of whole grains, and low intake of fruit (Forouhi & Unwin 2019). As discussed at 2.2 poor nutrition is the second key contributor to lifestyle disease, both in the form of excess calorie consumption, and insufficient intake of vegetables, fruit, vitamins, minerals and fibre (Australian Institute of Health and Welfare 2017b). Using a comparative risk assessment approach, Forouhi and Unwin (2019) conducted a systematic analysis of the Global Burden of Disease Study 2017 to understand the health impact of dietary risks in 195 countries. They found that consumption of nearly all healthy foods and nutrients was too low for health, and consumption of unhealthy foods like sugary beverages, sodium, processed and red meat exceeded the recommended levels (Forouhi & Unwin 2019).

The Food and Agriculture Organisation of the United Nations website shows that dietary guidelines and recommendations vary between countries (World Health Organization 2020b) Countries like Canada[19] recommend fruit and vegetables make up the largest proportion of the diet, whereas in Vietnam[20] and Japan[21] this is grains. Countries like Bolivia recommend eating

[18] 22% of all deaths and 15% of all DALYs lost
[19] http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/canada/en/
[20] http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/vietnam/en/
[21] http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/japan/en/

meat containing iron and the use of iodised salt,[22] Jamaica[23] includes the need to be physically active, and Fiji[24] warns against smoking and alcohol use. Most countries warn against the over-consumption of sugar and processed foods, and many warn against excessive consumption of fats and oils (World Health Organization 2020b). Given the confines of this thesis, a comparative discussion of the relative merits of each country's recommendations is beyond the scope of this research. However, each set of national dietary guidelines appears to broadly conform with the World Health Organization's requirements of a 'healthy diet', namely that it: protects against malnutrition and non-communicable disease, limits the consumption of saturated, trans fats, salt and sugar, and that is includes fruit, vegetables, legumes, nuts and whole grains (World Health Organization 2018c).

A large proportion of the world's population faces barriers to consuming a healthy diet. People with low incomes faced greater dietary disadvantage on average (Forouhi & Unwin 2019). This includes poor understanding of what constitutes a healthy diet and limited access to grow, purchase, transport, prepare, cook and safely store healthy food. Poverty and limited or no access to electricity and refrigeration can force people into over-reliance on processed foods, or foods with added salt or sugar to prevent food spoilage (Rosier 2011).

In Australia, unhealthy food and drinks, those high in fat, sugar, salt, chemical additives, or a combination of these, and low in vitamins, minerals and fibre account for over 30% of the diet for children and adults (Australian Bureau of Statistics 2014) Access to, and consumption of, healthy food in Australia is unequal. Australians from indigenous, culturally and linguistically diverse backgrounds, and people with low incomes, also experience food insecurity (Rosier

[22] http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/bolivia-plurinational-state-of/en/
[23] http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/jamaica/en/
[24] http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/fiji/en/

2011). It is difficult to quantify from nutritional surveys,[25] or domestic food output less exports,[26] what Australian eat, or how this has changed over time. It is possible to establish what people buy, but food purchased may not actually be eaten (Ridoutt et al. 2016), self-reported consumption may underestimate energy intake (Foster et al. 2019), or may not be sufficiently accurate to evaluate energy intake (Subar et al. 2015).

Most of the 30,000 packaged foods stocked in an average Australian supermarkets are highly processed and unhealthy (National Health and Medical Research Council 2013). The consumption of ultra-processed foods has a negative impact on the intake of health foods, such as fruit, vegetables and lean protein, and on all nutrients linked to non-communicable diseases NCDs in Australia (Machado et al. 2019). Based on 2015 data, 7.3% of the total Australian disease burden is due to poor diet (Australian Institute of Health and Welfare 2019f).

Improving nutrition is vitally important in reducing the disease burden (Australian Institute of Health and Welfare 2017b). Health intervention programs that use sport and physical activity to improve health may also seek to address nutrition (Lozano-Sufrategui et al. 2017; Western Bulldogs 2017; Wyke et al. 2015). This could take the form of educating participants to improve their understanding of healthy eating, their motivation to improve their diet, or it could explain the support services available to help address barriers to good nutrition. In a systematic review and meta-analysis of randomised controlled trials, it was found that weight reducing diets may reduce premature, all-cause mortality, including from cardiovascular disease and cancer, in obese adults (Ma et al. 2017). In adults within the healthy weight range sustained physical activity, rather than weight loss, was associated with substantial risk reduction, and

[25] Which are self-reporting
[26] Which takes no account of food waste

the prevention of weight gain was associated with reduced mortality risk (Moholdt, Lavie & Nauman 2018). There is some evidence that a healthy diet composed of a high intake of unrefined cereals, vegetables, fruit, nuts and olive oil, and a moderate/low consumption of saturated fatty acids and red meat, may improve breast cancer survival, although more clinical trials are needed (De Cicco et al. 2019). Whilst there have been no randomised controlled trials, increased coffee, vitamin D and fibre intake have been associated with improved outcomes in colorectal patients (Thanikachalam & Khan 2019). It appears that community sport-based programs may be able to assist in helping participants improve their nutrition, but further detailed study is needed to identify effective programs, and the elements they need to include to have the best impact on reducing lifestyle disease. This study seeks to identify and explore examples of work that has been done to help participants improve their nutrition in order to reduce lifestyle disease.

2.3 Social contribution of community sport

It is difficult to determine the social contribution of community sport at a global level. In a 2019 critical review of the *Methods for quantifying the social and economic value of sport and active recreation* L. Keane et. al. found that there were:

> "…few academic journal articles examining monetary valuation of the economic impact of sport and active recreation at the population level (e.g., GDP or country level)."
> (Keane et al. 2019)

Further problems arise from the wide variation between stakeholders in the methods used to assess the value of sport in terms of what is included, the outcomes measured, or the focus on specific aspects of sport such as stadia and tourism (Keane et al. 2019). This is not to downplay the significant contribution community sport makes to society.

The 2018 KPMG report evaluating Australian Sport (KPMG 2018), defines community sport infrastructure as:

> "…local regional or state level sport and recreation infrastructure which is operated and maintained primarily for the purpose of the facilitation of community sports activities…"

and it defines community sport as:

> "…any activity which is undertaken within community sport infrastructure, including participation in sport, volunteering and community activities. Importantly this study does not consider any benefits associated with sport or recreation activity which does not occur within community sport infrastructure (e.g., running)."
> (KPMG 2018)

Based on this report, community sport infrastructure was used by 8 million people and supported at least $16.2 billion worth of value in Australia. Community sport was supported by 56.5 million volunteer hours, and contributed $4.9 billion worth of value in terms of personal health benefits and health system benefits. Community sport employed 57,000 people, contributed $6.3 billion dollars to Australia in increased economic activity and productivity, and prevented the loss of 24,000 disability adjusted life years annually (KPMG 2018). The social benefit to Australia of community sport infrastructure was evaluated at $5.1 billion in the form of improved human capital and green space benefit. In addition the report acknowledges, but does not quantify, the contribution community sport makes to social inclusion and community pride (KPMG 2018).

No similar analysis of the global impact of community sport could be located, and KPMG acknowledged in their report they could not identify much similar research (KPMG 2018). However, Sport England produced the *Economic Value of Sport in England* report in 2013 that estimated the 'Gross Value Added' by sport in 2010 to be £20.3 billion or around 1.9% of the England total (Sport England 2013). The measures differed from Australia, in that they included betting, sportswear, spectating and television subscriptions, but the report did include

health, volunteering and participation benefits. In this report, sport was placed within the top 15 industry sectors in England which comparatively is larger than the sale and repair of motor vehicles, insurance, telecoms services, legal services and accounting (Sport England 2013). In spite of these reports evaluating some different elements, and a lack of global measurement to date, it is clear that community sport makes a significant contribution to society. More recently the social impact of sport in England was measured using a social return on investment model that included the funding investment in sport organisations, the Department of Culture Media and Sport, the Youth Sport Trust, and school sport, by government and the returns in terms of the reduced risk of breast cancer, colon cancer, cardiovascular disease, Type 2 Diabetes, dementia, reduced crime and improvements in reported health, wellbeing, education performance, social capital and human capital. That report determined that every £1 invested yielded a return of £1.91 (Davies et al. 2019).

In future it may be possible to more consistently determine the value of community sport from its absence. On the 11th of March 2020 the World Health Organization declared the Novel Coronavirus (COVID19) a pandemic (World Health Organization 2020d). During the 2020 COVID-19 pandemic, many countries shut down participation in community sport and access to beaches, parks, pools, skateparks, playgrounds and community sport facilities in order to control the spread of infection. The Australian Institute of Health and Welfare has acknowledged that COVID-19 shutdowns and the smoke impact of the 2019-20 bushfires in Australia, have contributed to increased inactivity (Australian Institute of Health and Welfare 2020b), and it will be for future researchers to evaluate the impact. It is clear from the literature that community sport has a significant social, health and economic value. This research offers a further way to increase that value through recognising what community sport-based

interventions can contribute to reducing lifestyle disease and potentially offers the chance for different types of sport participation.

2.4 Opportunity sport offers to promote good health

In their archival study beginning with the 1980's Richard, Gauvin and Raine (2011) found that health promotion focussed on physical activity and the consumption of fruits and vegetables, mainly took place in organizational settings like schools or worksites. However, around 2007 community settings began emerging as a preferred setting for health interventions (Richard, Gauvin & Raine 2011). Community sport draws children, families and volunteers together around a shared interest in in sport participation. As a South Australian project showed, community sport organizations can collaborate with tertiary education providers, education, community, government and charity organizations to increase physical activity among disadvantaged populations and contribute to wider community development (Rosso & McGrath 2017). What this suggests is that community sport program impacts are far reaching, offering a wide range of stakeholders the opportunity to promote health and wellness.

Sports clubs offer the potential to promote positive health messages. In his systematic review Kokko (2014) recognised Australia as leading health promotion efforts outside traditional health and workplace settings, through the replacement of tobacco advertising in community sports clubs with the promotion of health services and messages (Kokko 2014). This followed the banning of tobacco advertising and sponsorship in Australia in the mid-nineties,[27] in its place smoking and drug avoidance messages were promoted in the Rock Eisteddfod

[27]The *Tobacco Advertising Prohibition Act 1992* (the Act) phased out most forms of tobacco sponsorship by December 1995, with cricket sponsorship concluding on 30 April 1996.

Challenge,[28] a dance competition for school age children. Similar efforts were made by the Good Sports Program[29], launched in 2000 in Victoria to deliver alcohol misuse messages in sports clubs (Duff & Munro 2007). There were 9477 participating Good Sports Clubs in Australia in 2019 (Alcohol and Drug Foundation 2019), and the program has proven effective in reducing alcohol misuse (Rowland, Allen & Toumbourou 2012).

Community sport can be a powerful tool to target people at risk of social exclusion, who tend to have more health-related problems (Van der Veken, Lauwerier & Willems 2020). Community sport settings have also been used to promote healthy eating, healthy catering, the responsible service of alcohol, sun protection, and sports injury prevention (Dobbinson, Hayman & Livingston 2006). This includes through partnerships between VicHealth[30] and community sport to promote health messages (Casey et al. 2009), and through cross-sector partnerships between non-profit community sport and public health to increase physical activity through strategic marketing campaigns (Misener & Misener 2016). In their study of stakeholders and participants in sport and social partnership organisations, Van der Veken, Lauwerier and Willems (2020) developed a program theory that identified the importance of experiential learning amongst peers, incremental responsibility-taking, reflexivity, group connectivity and skilled guidance by community sport coaches to the successful use of community sport for health promotion. This process helps participants feel safe, build self-esteem, self-efficacy and motivation to set and pursue their own health goals (Van der Veken, Lauwerier & Willems 2020).

[28] An Australian dance and drama challenge for government-funded high schools that was active between 1980 and 2012 with the aim of promoting healthy lifestyle choices, particularly abstinence from drugs, alcohol and cigarettes

[29] A program for community sports clubs to prevent and minimise the harm caused by alcohol and other drugs.

[30] The name given to the Victorian Health Organisation in Australia

In 2011 Basketball Australia launched the Illicit Drugs in Sport program (IDiS) (Basketball Australia 2011), an initiative of the Department of Prime Minister and Cabinet to educate athletes to avoid taking recreational and image enhancing drugs. The program was rolled out across major Australian sports including Rugby, NRL[31], AFL[32], Cricket, Tennis, Rowing, Surf Life Saving and Athletics. Part of the justification for the IDiS program in the common resources provided to all sports, was that athletes were perceived as role models in Australia. Drug taking damaged their sports performance, and athletes caught and sanctioned damaged their careers and reputations.[33]

Over the following three years IDiS program delivery evolved to address the challenges basketball athletes and sports organisations were facing including the use of performance and image enhancing drugs in sport, supplements, binge drinking, sports betting and integrity issues. Funding, education and program reporting requirements focussed on professional athletes and those on performance pathways towards representing Australia.[34] The program could be considered a qualified success for Australian Basketball in that Australian Sports Anti-Doping Authority sanction list shows no record of an adverse analytical finding during or for the four years following the program in an Australian representative basketball player.[35] The first recorded adverse analytical finding since the program was in 2018 for a wheelchair basketball player (Australian Sports Anti-Doping Authority 2020).

[31] National Rugby League
[32] Australian Football League
[33] I led this work for Basketball Australia
[34] Archived digital remnants of the program can be found, but funding ceased in 2014 https://www1.health.gov.au/internet/main/publishing.nsf/Content/illicit-drugs-in-sport-IDIS-online-education-programme
[35] Governing bodies and ASADA are required to publish sanctions. Samples are retained and retested for at least a decade after collection, so results from the program period that ended in 2014 may be retested up till 2024

The initial hope for the program was that athletes would act as positive role models, and this would reduce drug taking in the population. Unfortunately, IDiS had limited funding and resources[36] that were insufficient to run wider community engagement campaigns and it required no measurement of community impact or influence. During its rollout period,[37] and ever since, illicit drug use in Australia continued to increase according to wastewater analysis (Australian Criminal Intelligence Commission 2019). This larger program aspiration failed, and during the IDiS program doping scandals occurred in the AFL and NRL (Hughes 2013), which led to their program funding being cut.

Sports clubs attract children, families, volunteers and spectators, providing an audience for messages. However, for health promotion to work in a sport setting or club, it must recognise the core-business of sport is to develop athletes, coaches and opportunities to train and play. Health behaviours and sports performance, or athlete development need to be clearly linked, and messages must be given in the common language of that sport context (Kokko 2014). Participating in team sport is associated with improvements in social and psychological health regardless of the type of team sport, the age, physical or mental health problems of participants, and it may be more efficient in promoting continued physical activity than individual sport (Andersen, Ottesen & Thing 2019). Behaviour change theories suggest that the social aspects of community sport-based interventions, and enjoyment of the activity, are important to the development of intrinsic motivation, and group-based physical activity interventions can be more effective to support long term adherence than participation alone or at home (Corepal et al. 2020). The use of sport settings for health promotion offers relevant lessons for community sport-based interventions, especially those that include health or behaviour change education

[36] Only funding for 1 staff member, their travel and collateral budget – usually with each sport having to contribute 30-50% from its own budget.
[37] 2011 – 2014 for Basketball Australia, it was cut earlier in some sports due to poor delivery and doping scandals in AFL & NRL

as well as sport and physical activity. This thesis will develop a framework to enable methodological improvements to help measure the effectiveness of health promotion interventions that use community-based sport.

2.5 Program theory

Community sport-based interventions to reduce lifestyle disease usually involve a program that is more than just playing ordinary sport. Program theory is the study of the elements that go into a program, its outcomes of interest, effectiveness or impact (Weiss 1998). Program theory evaluation then goes on from looking at what the elements of a program and its outcomes are, to also examine how they are delivered, and why they are there (Weiss 2000).

As Brousselle and Champagne (2011) explain, the reason for evaluating programs is that stakeholders want to know if what is being done works, and how the intervention could be improved. However programs, and the decisions that go into their design, are complex and a combination of experience and professional lore (Weiss 1998). Modelling program logic, using evidence to understand causal mechanisms and appreciate the intervention's potential impact can assist, but more needs to be done to test the validity of the intervention's elements and the scientific basis for the program's theory (Brousselle & Champagne 2011). Evaluations need to interrogate how the intervention delivery is actually achieving the intended outcome, rather than reflecting the stakeholders' perceptions and beliefs, which may be incomplete or wrong.

Analysing program logic can help understand a program's strengths and weaknesses, by identifying whether it has been designed in a way that is capable of producing the desired results. This can also help show how strong the causal link is between the resources and

processes used in the intervention, and the intended effects. The logic model of a program is built to represent the program theory and basis on which the intervention is supposed to achieve the desired outcomes. An evaluation of the logic model should draw on literature and scientific knowledge to see whether the optimal conditions have been created to achieve them, and how the model compares with those described in the literature or described by experts (Brousselle & Champagne 2011).

Program theory evaluation includes the elements and outcomes but also how they work and why (Weiss 2000). This type of evaluation can help identify what is working or what could be improved by examining factors like the choice of success measures, the study design, the process of learning during the evaluation process, and the ideas and insights gained during the evaluation (Weiss 1998). The literature included in this research from 2.8.1 to 2.8.5, and the programs described from 3.4 to 3.4.8 included descriptions of the outcomes, but not an analysis or discussion of which elements contributed to success and how. Program theory evaluation can provide the kind of detailed information about what aspects of a program lead to success, that is needed to replicate programs in new and varied settings (Hacsi 2000).

This research is not an analysis of program theory itself, but rather aims through the framework proposed at Appendix 2 and refined in Appendix 8, to help practitioners more methodically design, document and report on community sport-based interventions such that if adopted future research could more easily examine program theory, replicate and improve on intervention design.

2.6 Workplace health interventions

One of the strategies used in Australia to improve adult physical activity rates and health, has been to conduct workplace-based physical activity and health interventions. Following the 2008 Council of Australian Governments agreement the National Partnership Agreement on Preventive Health was funded to reform the health system. This included $294.4 million of commonwealth funding for the Healthy Workers program, to be implemented by state governments (Council of Australian Governments 2008). As the New South Wales Government points out 60% of the Australian adult population is employed, and absenteeism costs Australian business about $2,100 per worker. It is in the interests of business to target chronic disease risk factors like smoking, physical inactivity and poor diet, as chronic disease is the most common cause of absenteeism (New South Wales Health 2014). Accessing interventions via work can help overcome the disadvantage people may face based on where they live, as well as issues related to securing afterhours childcare. In a study comparing the stock performance of companies over a six year period, those with higher performance also had the highest scores in a health and wellness self-assessment (Grossmeier et al. 2016). It appears investing in staff health and wellbeing is something that high-performing, well managed companies do, and workplace health interventions may be worth considering for organisations wishing to improve performance.

Workplace-based health interventions may include a range of activities, from providing individuals with opportunities to have their health assessed, to resources to assist in developing workplace health plans tailored to address team concerns. Opportunities may be provided to participate in lunchtime sport, physical activity or active transport, workers may be offered dietary advice, smoking cessation or mental health support (New South Wales Government 2020). In their systematic review Grimani, Aboagye and Kwak (2019) found workplace based interventions addressing diet and physical activity were most successful at improving rates of

absenteeism, and to a lesser extent workplace performance and productivity. A systematic review and meta-analysis of the impact of workplace physical activity interventions on the cardio-metabolic health of working adults, found that workplace interventions significantly reduced body weight, BMI and waist circumference (Mulchandani et al. 2019). Whilst these interventions were carried out in workplaces, their behaviour change impact and use of community sport demonstrates that health improvement can be achieved in non-clinical settings. This thesis will provide a schema to enable better measurement of community sport-based interventions, that could equally be applied to workplace health interventions that use sport and physical activity.

2.7 Parkrun a free inactivity antidote for the community

Parkrun was started in Busy Park, Teddington in the United Kingdom on the 2nd October 2004 by Paul Sinton-Hewitt CBE,[38] with thirteen runners and four volunteers. Over the past seventeen years it has spread to twenty-two countries, including Australia in 2011, and volunteers hold free timed events each week to run or walk in local parks and open spaces. For adults 5km runs are usually held on Saturdays, and 2km runs are held for juniors on Sundays. Participants register, print a barcode, and can then participate in any event, at any location they choose. They can then access the recorded time they achieved online (Parkrun Global 2021). There have now been over 209,794 Parkrun events, over 2.86 million participants, over 33 million individual runs, approximately 160 participants per event (Cleland et al. 2019). Australia has over 417,000 registered participants, around 289 weekly events that attract an average of 127 people per event each week (Cleland et al. 2019).

[38] CBE is a post-nominal that stands for Commander of the Order of the British Empire

Parkrun started as a time-trial (Reece et al. 2019), and was not established as a lifestyle disease intervention. It aimed to promote participating in physical activity and volunteering, in a safe and supportive environment (Cleland et al. 2019), and it mission is

> "to create a healthier, happier planet."(Parkrun Global 2021)

However, Parkrun has been effective in attracting people who did not previously walk or run from population groups who have historically been hard to engage in physical activity (Cleland et al. 2019). In the United Kingdom average parkrun completion times have increased each year indicating more walkers and people who may have previously been considered inactive are participating. In 2017 an 88% increase was recorded in the instances of runners taking more than 50 min to complete a 5 km parkrun compared with 2016.

Regardless of the initial aims, Parkrun has excellent potential to improve public heath through reducing inactivity. Parkrun has been endorsed by the World Health Organisation as an initiative engaging whole communities in regular mass participation in physical activity in public space that is accessible, enjoyable, affordable, socially and culturally appropriate (Reece et al. 2019). The Royal College of General Practitioners in the United Kingdom has recognised Parkrun as a viable option for patients as an alternative to medication (Reece et al. 2019; World Health Organization 2019d).

Parkrun does not follow a typical community sports club format. It does not limit participants to one local club, charge costly membership fees, or require special clothing. It takes place in the same place each week, and participants do not have to pre-register to attend. This helps address barriers associated with traditional sports club membership (Cleland et al. 2019). As well as reporting finishing times online to provide feedback on progress, participation milestones are also acknowledged for attending 10, 50, 100, or 250 Parkruns, which encourages

participation (Parkrun Global 2021; Reece et al. 2019). People of all backgrounds and abilities are welcome to participate, including parents with prams, children and people with dogs. A volunteer 'tail walker' is responsible to be the final finisher and ensures everyone, no matter what their speed, is supported (Reece et al. 2019). Parkrun also works to facilitate social interaction and help develop mutual support and encouragement (Reece et al. 2019). In a study of Tasmanian Parkrun, participants identified appealing characteristics including strong social support, performance gain opportunities, socialising, inclusivity, sense of community, positive atmosphere and accessibility, with some saying parkrun had stimulated gains in their total physical activity. Most reported that they first attended parkrun because of encouragement people they knew and they went on to encourage others to attend (Sharman, Nash & Cleland 2019).

Unlike annual mass community sport or physical activity events such as fun-runs or ocean swims, Parkrun's weekly format can contribute 30-40% of an individual's 150 minutes of moderate-intensity physical activity, or 75 minutes of vigorous-intensity physical activity per week (Cleland et al. 2019; World Health Organization 2018e). People who are only able to meet physical activity recommendations in one or two sessions per week, still have a substantially lower risk (30%-40%) of all-cause and cardiovascular disease mortality, compared with people who are not sufficiently active (Cleland et al. 2019; World Health Organization 2018e). For people whose work, family and other commitments make weekday exercise difficult, Parkrun offers a format that encourages weekly participation, on weekend days, which may be more accessible.

Parkrun is not a lifestyle disease intervention, so does not seek to recruit people based on measures of health, disease or inactivity, or to evaluate its success relative to participant health measures. However, a scoping review of parkrun literature showed evidence that participants

improved their fitness, physical activity levels, and body mass index, and this had a dose–response effect related to participation frequency (Grunseit et al. 2020). This research had limitations including the failure to include people who participate but do not register for parkrun, those who participate in parkrun but do not sustain it, and a greater number of studies outside the United Kingdom and Australia (Grunseit et al. 2020). The scale of participation and research to date suggests that, regardless of intention, design, and measurement gaps, Parkrun offers a model worth studying for anyone with an interest in using community sport-based interventions to improve lifestyle disease. This research could also offer measurement opportunities to better understand the impact of Parkrun on the health of participants.

2.8 Target lifestyle diseases

Non-communicable disease (NCD) caused 71% of the global death in 2016 and this study focuses on five chronic diseases that contribute significantly to global mortality, and whose outcomes and incidence can be modified through changes in behaviour. Cardiovascular disease (44% of all NCD deaths), breast and colorectal cancers (cancers account for 22% of all NCD deaths), Type 2 Diabetes (3% of all NCS deaths) and obesity which is a risk factor for each of these diseases as well as for other health conditions (World Health Organization 2020c). Each of these diseases will each be described in turn. The global disease and financial burden of each disease will be explained based on available data, followed by the Australian data on the health and economic burden of disease. Evidence of sport interventions for the disease found in academic literature for each disease will be described. This will be followed by evidence of interventions found in grey literature sources.

Whilst respiratory diseases, including asthma and chronic obstructive pulmonary disease caused 9% of death from non-communicable disease, they have been excluded from this study

on the basis that environmental pollution is a significant contributor to their severity and impact of disease (Soriano et al. 2017). Also, participation in community sport-based interventions is unlikely to change the laws, policy, working or living conditions that exposes them to this risk.

2.8.1 Cardiovascular disease

Cardiovascular disease describes a collection of diseases of the heart and blood vessels that include: coronary heart disease, stroke, cardiomyopathy, hypertension, rheumatic heart disease, congenital heart disease and heart failure (World Health Organization 2019b). It is the leading cause of death globally at 31% or 17.9 million deaths in 2016, with 85% of these attributed to heart attack and stroke. Over 75% of these fatalities occurred in low and middle-income countries, and most cardiovascular disease could be prevented by changing behaviour such as tobacco use, unhealthy diet, obesity, physical inactivity and harmful use of alcohol (World Health Organization 2017a). The World Heart Federation (2020) estimated the global economic cost of cardiovascular disease at approximately US$863 billion in 2010, and predicts it will rise to US$1,044 billion by 2030. This figure is a combination of productivity losses and direct healthcare costs (Bloom et al. 2011). The burden of cardiovascular disease is higher in low and middle-income countries, where 80% of the fatalities occur, and more of the people impacted are of working age, than in higher income countries. The total economic loss due to cardiovascular disease in lower and middle income countries between 2011 and 2015 was approximately 2% of Gross Domestic Product of these countries (Gheorghe et al. 2018).

Progress has been made. There has been a global reduction in age standardised death from cardiovascular disease, with a 14.5% reduction measured between 2006 and 2016. The reasons vary between countries because diet, smoking rates, access to medications and health services

are all different. However smoking cessation, dietary improvement, reductions in salt consumption, and improvements in medication have all contributed to reducing death from cardiovascular disease at younger ages. Lifestyle modification was shown, in a longitudinal American study of 59,727 middle aged women, to reduce the 26-year risk of total stroke by 23%. These modifications included: smoking cessation, exercising for 30 minutes or more per day, reducing BMI if overweight or maintaining a healthy weight, reducing red meat consumption to 3 serves per week or less, eliminating processed meat, eating one or more serves of nuts per day, 3 or more serves of fish per week, increasing fruit and vegetable consumption, and reducing alcohol consumption (Jain et al. 2020).

Over 1.2 million (6%) Australian adults were affected by cardiovascular disease in 2017-18, and more that 3% of the adult population reported having Coronary Heart Disease at some point in their lives (Australian Institute of Health and Welfare 2019b). Rates increase rapidly with age, and people living in the most disadvantaged areas reported having heart, stroke and vascular disease at slightly higher rates (6.4%) compared to those in the least disadvantaged areas (4.8%) (Australian Institute of Health and Welfare 2019b). Cardiovascular disease is the second leading cause of death in Australia (Shaw et al. 2012; Welfare 2016), and second highest contributor to the Australian disease burden accounting for 15% of all DALYs (Australian Institute of Health and Welfare 2016b). It was the leading cause of death for males in 2018 accounting for 10,870 or 13% of male deaths, and it was the second most common cause of death in Australian women at 8,207 or 11% of female deaths (Australian Institute of Health and Welfare 2018a). Cardiovascular disease is also the most expensive disease group in Australia and based on 2015-16 data it cost the Australian health system estimated $10.4 billion dollars that year, or 8.9% of direct healthcare expenditure (Australian Institute of Health and Welfare 2019b).

Fatalities attributed to cardiovascular disease in high income countries have fallen over the past fifty years, but rates of decline have slowed (Lopez, AD & Adair, T 2019). Reductions in rates of cigarette smoking have had a strong positive impact on cardiovascular disease in English speaking countries (Lopez, AD & Adair, T 2019). In 1995 23.8% of adults smoked, by 2017-18 this had declined to 13.8% (Australian Bureau of Statistics 2019). In 2015, 11.5% of the burden of cardiovascular disease in Australia was attributed by the Australian Institute of Health and Welfare to tobacco use (Australian Institute of Health and Welfare 2019a). Smoking was also estimated to triple the risk of mortality from cardiovascular disease and to be responsible for 16% of deaths from it (Banks et al. 2019). English-speaking countries like Australia have successfully reduced smoking to relatively low rates through a combination of warnings and health education, raising purchaser age requirements, taxation, public health campaigning, media campaigns, plain packaging laws, restricting product sales and advertising.

These sustained efforts have required significant investment. Plain packaging alone is estimated to have contributed to a 7.5% reduction in monthly cigarette consumption (Bonfrer et al. 2020), but the resulting legal battle with Philip Morris Asia was reported to have cost Australian taxpayers AUD$38.9 million (Hutchens & Knaus 2018). However the economic impact of lost productivity if the current 2.5 million Australian adult smokers,[39] continued to smoke is estimate at $A388 billion (Owen et al. 2019). Investing in reducing smoking rates, yields more health and life expectancy benefits to the individual. On average each smoker loses 1.2 years of life, 2.5 quality adjusted life years, or 1 productivity adjusted life year (Owen et al. 2019).

[39] aged between 20 and 69 years

Lowered overall smoking rates reduces the ability to continue to achieving significant improvement in reduced cardiovascular disease mortality (Luo, Q et al. 2019). Lopez and Adair partially attribute the slowdown in improvement in cardiovascular disease rates to the reduced scope for improvement in countries whose smoking rates are already low, as well as to the rising rates of obesity (Lopez, AD & Adair, T 2019).

Based on data gathered by the Public Health Information Development Unit from Population Health Areas, Local Health Organisations and the Australian Bureau of Statistics, the Australian Health Policy Collaboration found that in 2017 23.0% of Australian adults had high blood pressure and 32.8% had high cholesterol (Australian Health Policy Collaboration 2017). High blood pressure (Wu et al. 2015) and high levels of cholesterol in the blood, or hyperlipidaemia (Nelson 2013), are both risk markers for cardiovascular disease. Rising rates of overweight, high blood pressure and hyperlipidaemia in the population are well above the current incidence of cardiovascular disease, and a large proportion of the population have been exposed to these risks for decades (Lopez, A & Adair, T 2019). This may mean that cardiovascular disease rates will rise as these risk factors are maintained or increased in the population. A study published in the Lancet in 2009 equated the reduced survival associated with morbid obesity to the 10 year reduction in survival caused by persistent cigarette smoking in male British doctors (Prospective Studies Collaboration 2009).

Unfortunately searches of peer reviewed journals in English using terms such as sport, or named sports, in combination with the terms ‘heart disease’, ‘cardiovascular disease’ or ‘hypertension’ only yielded results of one study into a swimming-based intervention. The other examples identified in peer reviewed literature focussed more broadly on the impact of physical activity interventions, or the risk-reduction potential of sport, rather than interventions

delivered to treat lifestyle disease. These are described below, followed by sport-based interventions described in grey literature, to illustrate the potential for the positive impact of sport interventions on the health of people post-diagnosis with cardiovascular disease.

2.8.1.1 Swimming

A randomised controlled trial of 62 sedentary women found that high-intensity intermittent swimming is an effective training strategy to improve cardiovascular health and physical performance in sedentary women with mild hypertension. Similar adaptations were achieved by both groups in spite of the high intensity training group training for 15 to 25 minutes where the moderate intensity group who swam continuously for an hour. Both groups lost body fat and improved cardiovascular health and physical performance (Mohr et al. 2014).

2.8.1.2 Reducing cardiovascular mortality risk

Participation in community sport has been shown to lower the risk of death even in people who have cardiovascular disease. A cross-sectional study that combined Scottish Health Surveys and hospital admissions data for people with confirmed cardiovascular disease, found that participating in at least 20 minutes of vigorous sport per week,[40] such as cycling, swimming, running, football or tennis, lowered the risk of all-cause and cardiovascular mortality (Hamer & Stamatakis 2009).

A follow-up survey of 13,204 participants in American Atherosclerosis Risk in Communities Study cohort (1987–2015) found that, based on self-reported sport and exercise activities, participation in racquet sports, aerobics, running and walking was associated with a lower risk

[40] Greater than 6 metabolic equivalents (METS)

of cardiovascular disease. However participation in bicycling, softball/baseball, gymnastics, swimming, basketball, calisthenics exercises, golfing with cart, golfing with walking, bowling, or weight training had no significant association with reduced cardiovascular disease risk (Porter et al. 2019).

By contrast, a cohort study of 80,306 British adults found reductions in mortality from cardiovascular disease were associated with cycling, swimming, racquet sports and aerobics but not with cycling, running and football (Oja et al. 2017). It appears that participation in sport has the potential to reduce the risk of cardiovascular disease but further study of the comparative efficacy of each sport is needed.

2.8.1.3 Physical activity interventions

A review of 27 randomly controlled trials found that regular physical activity reduces the blood pressure of people with hypertension, a risk factor for cardiovascular disease (Börjesson et al. 2016). This was followed by a systematic review of 63 randomised controlled trials showed that exercise-based cardiac rehabilitation, after a cardiac event, is effective at reducing cardiovascular mortality when compared with usual care. It was not shown to be effective at reducing total mortality, but the authors admit many trials were small an included only short term follow-up (Deveza, Elkins & Saragiotto 2017). In spite of being safe and effective, exercise based cardiovascular rehabilitation is underutilised (Bethell et al. 2008).

Interventions for people with current cardiovascular disease, or identified risk factors such as hypertension, offer opportunities to help people increase their understanding of cardiovascular disease, the behaviour changes they can make to lower their risk, the available medical, nutrition and community support services, how to access them, how participating in regular sport and physical can improve their health.

2.8.1.4 Grey literature

Grey literature searches showed that community sport interventions for cardiovascular disease are taking place, even if they have not yet been written about on academic journals. These are described below.

2.8.1.5 A health intervention for male football fans

The 2013 Football Fans in Training Randomised Controlled Trial, worked with male fans 35-65 years of age with a BMI of 28-30 who attended Scottish Premier League Football Clubs, and who were classed as being at high risk of ill health including Type 2 Diabetes, hypertension and cardiovascular disease. The intervention group received dietary guidance, and an exercise program of pedometer-based walking with goal-setting and diary records, and pitch-side physical activity sessions. The intervention group achieved clinically significant weight-loss, reductions in waist circumference, percentage body fat, systolic and diastolic blood pressure compared with the control group. The intervention was also considered good value in the United Kingdom at an estimated intervention cost of £2535 per life-year gained, compared with no intervention, and £2810 per quality adjusted life year (QALY)[41], when the threshold value attributed to a QALY was £20,000/ QALY (Wyke et al. 2015).

2.8.1.6 Tennis, cardiovascular health and Type 2 Diabetes

Tennis Australia developed a modified program called Cardio Tennis for beginners to learn elements of tennis as part of a fitness program. Professor Gary Jennings, a cardiologist and director of the Baker IDI Heart and Diabetes Institute in Melbourne, said this type of program

[41] This measure of both quality and quantity of life was used in the study. One QALY is a year in perfect health.

could lead to an increase in life expectancy due to the benefits exercise for cardiovascular health, lowering blood pressure, reducing the likelihood of developing diabetes, and lowering blood glucose (Tennis Australia 2012). Cardio Tennis has not yet been used in a health intervention, but could be used by tennis clubs as part a program to improve the health of people with cardiovascular disease.

2.8.1.7 Changing the Physical Activity Landscape in County Durham Program

Changing the Physical Activity Landscape in County Durham (CPAL) was a three year £4.5m investment into physical activity delivery, funded by National Health Service (NHS) County Durham and Darlington and managed by County Durham Sport (County Durham Sport 2012). This was one of 49 County Sport Partnerships in England, part of the national delivery system for sport and until recent changes at national level, also for physical activity.

The investment was secured as non-recurrent funding in June 2009 following agreement with the local Health & Well-Being Partnership on its focus across the County. During the detailed research using the national NHS Health Check programme, a significant proportion of the adults in County Durham aged 40–74 years of age with an estimated or actual risk of cardiovascular disease greater than 20%, it also included their families. The CPAL intervention aimed to increase physical activity participation and used a wide variety of sports to deliver the intervention including tennis, rugby, running and cycling.

The program set recruitment targets of 5,800 people with cardiovascular disease risk and 1000 others, and a goal of 3,364 (or 58%) of those at risk demonstrating an increase in physical activity within six months. Recruitment targets were met by the end of September 2011 (6,710) and whilst more time was required for current participants to work through the system and

reach the six-month mark, 68% of those recruited increased their physical activity levels compared with the previous 6 months. Over one-third of CPAL projects met their targets for recruitment well ahead of the end of the programme and over 50% are already exceeded the 58% benchmark for increased physical activity performance by the time the 2012 report was prepared (County Durham Sport 2012).

Twenty-eight different projects were commissioned and physical activity levels of participants were tracked using the Stanford 7-day recall. CPAL recruited 13,000 participants, more than double the target and over 8,000 met the physical activity target. 62% of participants met increased physical activity targets after 6 months, including 63% in the CVD group. On average 62% of participants undertook an average of 2 extra hours of physical activity per week (County Durham Sport 2013), achieving the recommended levels of physical activity according to the Joint Chief Medical Officer. Return on investment modelling showed a return of between £2.10-£3.20 for every £1 invested (County Durham Sport 2013).

Swimming, football and physical activity interventions have been shown in the literature to be effective in reducing the symptoms, risk factors for disease and in helping people recover. Regular participation in certain sports can reduce disease risk, and a modified tennis-based program has potential to reduce disease. The CPAL program used a range of community sport providers to deliver successful outcomes, but this population-scale health intervention using community sport does not appear in the academic literature, and a systematic review published in 2019 concluded that no evidence was available on the effectiveness of non-occupational interventions on reducing sedentary time in older adults (Shrestha et al. 2019). The specific details of each intervention and comparative success of each sport have not been reported on

in the available grey literature, and a request for further information by the researcher was declined by Sport England.

2.8.1.8 Limitations of literature and future directions

Now questions need to be asked, based on gaps in the literature, and barriers identified to reducing disease.[42] The swimming based intervention examined effectiveness of longer less intense doses, versus shorter more intense doses (Mohr et al. 2014). Further study should examine dose impact and effectiveness in terms of frequency of sessions, the number of months or years of treatment needed for effective treatment. The choice of sport participation for leisure appears significant in reducing cardiovascular disease risk, though some disagreement remains as to the best sports to choose. Will some sports be more effective than others when used in intervention programs? Will they require different doses, and will some sports be more or less effective at promoting adherence? If these types of interventions are effective, why are they not widespread, well researched and discussed? If successful interventions are being carried out, but remain unknown, are important opportunities being lost? As more interventions are studied, other elements such dietary control, and behaviour changes that may positively contribute such as smoking cessation, also need to be factored into any comparison of overall effectiveness and impact. This research will contribute to improving the understanding, collection and publication of data to enable more of these questions to be answered in future.

2.8.2 Breast cancer

The term cancer refers to diseases that involve the rapid creation of abnormal cells that grow beyond their usual boundaries, which can then spread to other parts of the body impairing regular function, and causing death in a process called metastases. Cancer is a leading cause of

[42] See Figure 2

death globally with an estimated 18 million new cases diagnosed and 9.6 million deaths in 2018 (World Health Organization 2018a).

Breast cancer is considered a lifestyle disease on the basis that around 40% of deaths from the disease are attributable to alcohol use, overweight and obesity, and physical inactivity (Danaei et al. 2005). In 2018 there were 2.08 million new cases of breast cancer diagnosed (11.6% of new cancer diagnosis), and 626,679 deaths from breast cancer (6.6% of the total cancer deaths) (International Agency for Research on Cancer 2019a). It is the most common cancer in women, both in the developed and the developing world. The incidence ranges from 19.3 per 100,000 women in Eastern Africa to 89.7 per 100,000 women in Western Europe, with most developing countries having incidence rates below 40 per 100,000 (Anderson, B et al. 2008; Global Burden of Disease Cancer Collaboration 2015; Mathers et al. 2008; World Health Organization 2019a). Whilst the incidence of breast cancer is higher in the developed world, almost half deaths occur in less developed countries. This is largely due to limited access to, screening, diagnosis and medical care. Survival rates ranging from 80% in North America, Sweden and Japan, to around 60% in middle-income countries, and below 40% in low-income countries (Coleman et al. 2008).

Some of the risk factors for breast cancer that cannot be altered through changes in lifestyle. These include a family history of breast cancer, prolonged exposure to estrogens either through early menarche, late menopause, through contraceptive or hormone replacement medication, some genetic mutations, particularly in the BRCA1 and BRCA2 genes[43] which pose a high risk for breast cancer but account for a small proportion of the total breast cancer burden (Boyle & Levin 2008; Lacey et al. 2009).

[43] Stands for 'Breast cancer gene 1' and Breast cancer gene 2'

Danaei et al. (2005) calculated that of the modifiable breast cancer risk factors, excluding reproductive factors,[44] 21% of all breast cancer deaths worldwide are attributable to alcohol use, overweight and obesity, and physical inactivity. In high-income countries this equates to 27% and 18% in low and middle-income countries. Overweight and obesity are the biggest contributors to breast cancer in high income countries, and physical inactivity was the most important determinant in low and middle-income countries (10%) (Danaei et al. 2005). The total annual economic cost of cancer globally was estimated in 2010 at approximately US$ 1.16 trillion (World Health Organization 2018a).

Cancer accounts for 19% of the Australian disease burden, with breast cancer being responsible for 8.5% of the Australian disease burden (Australian Institute of Health and Welfare 2016b)[45]. Based on 2013 data, breast cancer cost Australia AUD$0.8 billion per year in health costs (Goldsbury DE et al. 2018). Patients may also pay thousands of dollars on top of this for tests, treatment, medications, care services and they may lose income due to illness. A 2007 study conducted by Access Economics for Cancer Council NSW found that the average lifetime financial cost faced by a household of a person with breast cancer was $28,500, and on average individuals pay around 40% of the total financial cost of cancer in NSW (Access Economics & The Cancer Council NSW 2007).

2.8.2.1 Physical activity and breast cancer

Sport and exercise-based interventions offer the opportunity to lower risk factors and they can also be used to assist with treatment and recovery. A 2011 meta-analysis of breast cancer

[44] Such as the age of the onset of menarche, whether a person has children or breastfeeds
[45] p109

studies found that pre-diagnosis physical activity reduced all causes mortality by 18% but had no effect on breast cancer deaths. However post-diagnosis physical activity was shown to reduce breast cancer deaths by 34%, all causes mortality by 41%, and disease recurrence by 24% (Ibrahim & Al-Homaidh 2011). However, a systematic review and meta-analysis of epidemiological studies published in 2015 found an inverse relationship between physical activity and all-cause, breast cancer-related death and breast cancer events. There was a significant risk reduction in all-cause and breast cancer-related death amongst participants who reported high lifetime recreational pre-diagnosis physical activity levels as well as for those reporting more recent pre- and post-diagnosis recreational physical activity (Lahart et al. 2015).

The Clinical Oncology Society of Australia in their 2018 *Position statement on exercise in cancer care* recommended that exercise be embedded as an adjunct therapy as part of standard practice in cancer care, to help patients overcome the adverse effects of cancer and its treatment (Cormie et al. 2018). A prospective study of diet, exercise lifestyle and cancer prognosis of 1,340 patients ancillary to a clinical trial, found an association between those who met the minimum American Guidelines for Physical Activity (Piercy et al. 2018) both before diagnosis and after treatment, and a statistically significantly reduction in recurrence and mortality among breast cancer patients (Cannioto et al. 2020). At one year after diagnosis there was a 41% reduction in recurrence for those who met the Guidelines before and after treatment and a 49% reduction in mortality, rising to 45% and 68% at the two-year follow-up (Cannioto et al. 2020).

A Canadian randomized trial allocated 301 breast cancer patients starting chemotherapy to either supervised exercise consisting of a standard dose of 25–30 minutes (min) of aerobic exercise three times a week, a higher dose of 50–60 min of aerobic exercise, or a combined dose of 50–60 min of aerobic and resistance exercise. Patients participated for the duration of

their chemotherapy, on average 17 weeks. Patients reports indicated that performing combined exercise during and after breast cancer chemotherapy seemed to give better results for sleep quality and upper body muscular endurance, compared with standard dose and higher dose aerobic exercise. The combined exercise also may result in better longer-term patient-reported outcomes and health-related fitness compared to performing aerobic exercise alone (An et al. 2020). In a study of women taking adjuvant endocrine therapy, those who had at least moderate levels of physical reported fewer medication-related symptoms and better overall quality-of-life. However overall physical activity levels observed in the study sample were low, particularly for Black women, and it was identified that successful strategies to greater physical activity were needed (Sheppard et al. 2020).

2.8.2.2 Sport participation and breast cancer

A systematic review found that regular sport participation is associated with lower risk of cancer and cancer-related death and that individual and team-based sports (including triathlon, wall climbing, dragon boat racing, and soccer) can be an effective prevention tool or therapy for people diagnosed with cancer (Luo, H et al. 2019). This review noted the need for greater study and more randomised controlled trials to understand the efficacy of sport participation in cancer management the relative effectiveness of different sports compared with each other, comparing individual and team sports and evaluating the impact of different sports activities at different stages of cancer treatment (Luo, H et al. 2019).

2.8.2.3 Sport based interventions for breast cancer

A search of the literature for sport-based interventions for breast cancer yielded no results published in peer reviewed journals of sport interventions to address disease. Searches yielded

a 2011 qualitative study of the social relationships and social support amongst 17 breast cancer survivors participating in dragon boating over their first two seasons of participation. It found that dragon boating may work to promote social connection and provide survivors with a positive and productive challenge to move on and grow (McDonough, Sabiston & Ullrich-French 2011). The search also yielded a study by Weisenbach and McDonough of 15 breast cancer survivors and their decision-making when considering joining group physical activity programs, such as dragon boating (Weisenbach & McDonough 2014). These small qualitative studies did not seek to analyse or discuss the effectiveness of dragon boating as a health intervention.

This search also yielded a three-month randomised controlled trial of post-primary treatment breast cancer survivors. Participants were randomised to receive either usual care of a physical activity behaviour change intervention. Based on self-report those receiving the intervention reported improved sleep quality at 3 and 6 months compared with the control group. However, improvements were not detected via accelerometer measures (Rogers et al. 2017).

2.8.2.4 Grey literature

A search of grey literature sources uncovered a description of the 1996 program run by Dr Don McKenzie, a Professor in the Department of Sports Medicine at the University of British Columbia in Vancouver and an exercise physiologist. He designed and led a program to assist women in recovering from breast cancer through training for and paddling dragon boats. The program went against the contemporary medical thinking that women who had been treated for breast cancer should avoid rigorous upper body exercise so as not to develop lymphedema, a debilitating and chronic side effect of treatment.[46] Following participation in his three-month

[46] This can include swelling related to the pooling of lymphatic fluid, following the removal of lymph nodes

program of strenuous, repetitive upper body exercise in the gym, and to learning and paddle dragon boats, none of the twenty-four volunteer breast-cancer survivors had lymphedema and they were healthier, fitter and happier. Since then a modified version of dragon boating called 'Dragons Abreast' has spread throughout Canada, Australia and across the world (Dragons Abreast Australia 2015). Dragon boating, and breast cancer survivors benefited from having someone with the relevant health and exercise physiology qualifications to design and conduct the study. The medical profession also benefited from a practitioner with the knowledge, credentials and experience to challenge the status quo.

However, this modified version of the sport, focussed on participation by survivors, no longer includes study, other physical training elements or a behaviour change intervention. The modified version of the spot could potentially be used this way in future. Further study is also needed into the impact of dragon-boat paddling on health, wellbeing, rates of remission and long-term survival of participants compared with those undertaking standard treatment or other forms of exercise.

2.8.2.5 Questions

The literature raises the need for greater study of the effectiveness of community sport-based interventions for breast cancer.[47] It points to the need for sports to be evaluated for impact and effectiveness in symptom management, for an exploration of the suitability of particular sports and activities at different stages of treatment, a study of effective dose rate in terms of session frequency, dose duration, intervention duration, dose intensity. Do sport interventions reduce the loss of DALYs? Do they impact survival rates at five years post diagnosis, or longer?

[47] See Figure 2

Eventually a comparative analysis of the effectiveness of sports needs to be conducted, and research carried out on the barriers, facilitators and critical success factors for interventions. This research will enable improved data collection consistency and measurement, in order to make such an analysis possible.

2.8.3 Colorectal cancer

Cancer, the rapid proliferation of abnormal cells that impairs the function of the body, is one of the leading causes of death worldwide. Based on the Global Burden of Disease 2013, it is estimated that there were 14.9 million incident cancer cases, causing 8.2 million annual deaths, and the loss of 196.3 million disability-adjusted life-years (DALYs) (Global Burden of Disease Cancer Collaboration 2015).

According to the World Health Organization global cancer database, bowel and colon cancer, or colorectal disease, is the second most commonly diagnosed cancer in females and the third most commonly diagnosed in males. In 2018 1.8 million new cases were diagnosed and it killed 861,000 people (World Health Organization 2018b).

Australia, New Zealand, Europe, and North America have the highest rates, and the lowest rates can be found in Africa and south-central Asia (Fitzmaurice et al. 2017). Whilst there are genetic risk factors, physical inactivity, poor diet[48], low socio-economic status, obesity and smoking all increase the chance of developing colorectal cancer (Chan & Giovannucci 2010). It is not yet possible to accurately measure the global financial cost of colorectal cancer as there is so much international variation in: the availability and cost or medical screening and treatment programs, average earnings of patients and caregivers, private and

[48] For example, one with too much red meat and too little fibre

insurance-recovered health costs (Yabroff, Borowski & Lipscomb 2013). Nationally we know bowel cancer accounts for 11% of the Australian disease burden (Australian Institute of Health and Welfare 2016b)[49]. Based on 2013 data, colorectal cancer cost Australia the most at AUD$1.1 billion per year in health costs (Goldsbury DE et al. 2018). These human and financial costs could be prevented through being more physically active, avoiding smoking, weight gain and heavy alcohol use (Chan & Giovannucci 2010). A follow-up of the *National Institutes of Health-American Association of Retired Persons Diet and Health Study*, using a multivariable Cox regression to estimate hazard ratios, found that participants who engaged in weekly weight lifting had 22-25% lower risk of colon cancer compared with participants who did not lift weights (Mazzili et al. 2019).

[49] p109

2.8.3.1 Physical activity and colorectal cancer

The human and financial costs of colorectal cancer can also be reduced by increasing the levels of physical activity in patients with colorectal cancer post diagnoses. Whilst research in this area is ongoing, being physically active is thought to mediate the regulation of insulin and the IGF axis, which have been linked to the formation and prognosis of colorectal cancer (DeTroye et al. 2018). An observational study of 573 women with stage 1 to 3 colorectal cancer, found that increasing levels of exercise after diagnosis of nonmetastatic colorectal cancer reduced colorectal cancer-specific mortality and overall mortality (Meyerhardt et al. 2006). In a small randomised pilot study, post treatment physical activity has been proven to lower mortality and improve the functional well-being of patients with colorectal cancer (Kahl 2018). A prospective cohort study of 992 patients with stage 3 colon cancer who were enrolled in a randomized chemotherapy trial found that having a healthy body weight, being physically active, and eating a diet rich in vegetables, fruits, and whole grains was associated with a longer survival (Van Blarigan et al. 2018).

A larger American study of 1,218 patients with either colorectal cancer or leukemia who started chemotherapy in the prior month, found that low intensity workouts and walking for four or more hours a week can help to extend the survival time of people with advanced colorectal cancer. It could provide almost 20% reduction in cancer progression or death. Patients who engaged in 18 or more MET hours[50] per week had a 15% higher chance of survival from any cause compared with patients who exercise for less than 3 MET hours per week (Guercio, B et al. 2019).

[50] One MET = 1 kcal/kg/hour or approximately the energy it takes to sit quietly

In their review on the *Impact of physical exercise in cancer survivors during and after antineoplastic treatments,* Ferioli et al. (2018) describe how physical activity and sport can reduce the physical, psychological and psycho-physical cancer symptoms and cancer treatment side effects. Rather than discussing exercise impact based on a breakdown by cancer type, they organise around cancer symptoms. For example, the physical symptom of bone loss is identified as both related to cancer metastases, and to hormonal therapies used for treating breast and prostate cancer. They examine muscle loss and weight imbalance, cachexia,[51] peripheral neuropathy, lymphedema, pain, fatigue, sleep disorders, depression and anxiety, quality of life and self-esteem. Ferioli et al. (2018) then explain the causes of the issues in each domain, the best types of sport or physical activity treatment, and where possible, the dose rate. They explain the best available understanding of the how the recommended activity helps address the issue, and they reference the available evidence for these recommendations (Ferioli et al. 2018). They explain the impact of exercise on pre-pubertal accumulation of bone mass, the benefits of Judo, weight training, and impact activities like running and jumping on bone health. From there they outline the evidence for the use of programs combining impact, resistance and aerobic training in cancer patients who may lose bone mass due to treatment[52] (Ferioli et al. 2018).

Ferioli et al. (2018) discuss the barriers patients and survivors face to participating in physical activity treatment. The most common are the fear of pain and fatigue, and a belief that cancer treatment requires rest, rather than exercise.[53] Other barriers include socio-economic, childcare, transport and, decreased motivation (Ferioli et al. 2018). Early encouragement to exercise from the time of diagnosis and supervision were found to be significant to addressing

[51] Loss of skeletal muscle mass
[52] P14006-7
[53] P14021-22

motivation and social contact and support from family, friends and community were found to predict engagement in healthy behaviour (Barber 2012; Ferioli et al. 2018; Koll et al. 2017). Group exercise or exercise with a partner that is supervised, individually tailored and gradually progressed can help overcome barriers to exercise (Blaney et al. 2010).

In an American study of survivors of colorectal cancer, a home-based exercise intervention succeeded in getting participants to increase total minutes spent exercising at 3 months compared with the control group. However, rates progressively decreased at 6 and 12 months. Patients who participated in sporting events reported having improved physical fitness, better weight control, improved strength, energy levels, enjoyment social interaction, and decreased stress levels. But the survivors most likely to participate were male, married, in very good or excellent health at 5 or more years postdiagnosis, and had less than four comorbidities (DeTroye et al. 2018)

A systematic literature review by Dutch researchers critically analysed the types of exercise training during treatment, before and after surgery as well as during chemoradiation therapy, in colorectal cancer patients. They sought to identify an optimal exercise prescription to improve patient functional capacity, as poor functional capacity contributes to complications of colorectal cancer surgery. Of the seven relevant studies they identified that investigated the effects of regular exercise during adjuvant chemotherapy for patients with colorectal or gastrointestinal cancer, two studies found that endurance or interval training combined with strength training and a small positive effect in five studies of a mixed population of cancer patients, interval training resulted in a large improvement in functional capacity compared with the control groups (van Rooijen et al. 2018).

2.8.3.2 Sport intervention and colorectal cancer

The EuroFIT program targeted male football fans with the aim of improving their physical activity rates and reducing their risk of, or the severity of impact of, five chronic health conditions: colorectal cancer, Type 2 Diabetes, coronary heart disease, stroke and depression. In a study investigating the 5-year cost-effectiveness of EuroFIT in England, Netherlands, Portugal and Norway the average cost over 5 years per participant was €14,663 to achieve an average QUALY gain of 0.01, compared with health costs per person receiving no intervention €14,598. The intervention was not cost-effective compared to no intervention over a period of 5 years, however it was more effective and less expensive than no intervention over 10 years (Kolovos et al. 2020). This sport-based intervention can be effective in improving public health in a cost-effective way, but only when evaluated in the long term.

2.8.3.3 Questions

It appears being physically active is important to successful prevention, treatment and management of colorectal cancer, but more randomised controlled trials of different sports and sport-based interventions are needed. Community sport may offer opportunities to sustain physical activity longer term, but greater examination of the barriers to participation are needed (Guercio, BJ et al. 2019). Did non-participants have more co-morbidities and therefore find physical activity harder to sustain? Does the underrepresentation of women reflect income, childcare accessibility, or leisure time barriers to participation, a shortage of activity options that meet the needs and preferences of women, lower motivation to remain physically active long term, or are there other issues at play? Findings in the EuroFIT program appear to suggest that measurements of value and potentially impact may need to be conducted over timeframes of 10 years or longer (Kolovos et al. 2020). Are there ways to design interventions and measurement to enable cost-effective, longer-term delivery and follow-up? This research will

contribute to improving intervention methodology so that these and other questions arising from the literature[54] can be answered in future.

2.8.4 Type 2 Diabetes

The term diabetes describes metabolic disorders that are characterized and identified by the presence of hyperglycaemia in the absence of treatment. They are diagnosed using a fasting plasma glucose test. A diagnosis is confirmed if the result is ≥ 7.0 mmol/L or 2-hour post-load plasma glucose ≥ 11.1 mmol/L or Hba1c ≥ 48 mmol/mol. The common characteristic underlying all forms of diabetes is the dysfunction or destruction of pancreatic β-cells (World Health Organization 2019c).

Broadly stated diabetes is a serious, chronic, endocrine disease related to insulin, the hormone that regulates blood sugar or glucose. In the case of Type 1 Diabetes the pancreas does not produce enough insulin because the insulin producing β-cells have been destroyed (Diabetes Australia 2020a), and in the case of Type 2 Diabetes the body cannot use the insulin it produces properly to regulate blood sugar (Diabetes Australia 2020b; World Health Organization 2019c). The 2019 update to the World Health Organizations' 2009 classification (World Health Organization 2013a), recognises more subtypes of diabetes and provides more detailed descriptions of the types and the known risk factors (World Health Organization 2019c).

2.8.4.1 Global impact

The World Health Organisation estimates that 422 million adults were living with diabetes in 2014, up from 108 million adults in 1980. The global prevalence has doubled since then increasing from 4.7% to 8.5% in the adult population. This reflects global increases in

[54] See Figure 2

overweight and obesity, a key risk factor for disease (World Health Organization 2016). Without interventions to halt the increase in diabetes, there will be at least 629 million people living with diabetes by 2045 (World Health Organization 2019c). In 2012 1.5 million deaths were caused by diabetes, and elevated blood glucose levels caused an additional 2.2 million deaths through increasing the risk of cardiovascular and other diseases such as stroke, kidney failure, blindness and complications due to amputation. 43% of these 7.7 million deaths occurred in adults under the age of 70 (World Health Organization 2016). By 2017 4 million deaths were attributed to the impact of high blood sugar (World Health Organization 2019c). The long-term impact of diabetes and high blood sugar includes neuropathy, an increased risk of cardiovascular disease, obesity, cataracts, erectile dysfunction, nonalcoholic fatty liver disease and some infectious diseases, such as tuberculosis (World Health Organization 2019c).

This thesis focuses on Type 2 Diabetes which accounts for between 90% and 95% of diabetes. Most people with the condition are overweight or obese, which either causes or aggravates insulin resistance, and even those who are not obese by BMI criteria have a higher proportion of body fat distributed predominantly in the abdominal region compared to people without diabetes (World Health Organization 2019c). Whilst there are genetic risk factors for Type 2 Diabetes, it is associated with modifiable lifestyle factors such as being overweight, having low levels of physical activity and an unhealthy diet but lifestyle modifications have been shown to improve Type 2 Diabetes symptoms or even to reverse the disease (Shaw et al. 2012; Welfare 2016). This research aims to contribute to helping more people reverse the disease.

The global annual healthcare and national income cost of Type 2 Diabetes, was estimated at USD$142.5 billion in 1997, rising to USD$171 billion in 2002 and USD$195 billion in 2007

(Muka et al. 2015). By 2017 annual global health care spending on diabetes among adults had risen to USD$ 850 billion (World Health Organization 2019c). In addition to rising incidence of disease, greater access to healthcare, increased standards of living and wages contribute to this cost. However access to insulin and other medicines essential to controlling diabetes depends on the national capacity to provide health care and to the individual's ability to afford treatment (World Health Organization 2016).

2.8.4.2 Australian impact

Diabetes was the underlying or associated cause of 11% of Australian deaths in 2017,[55] and over half of these deaths were cases of Type 2 Diabetes. According self-reported data in the Australian Health Survey, a further 5% of Australian adults[56] were living with Type 2 Diabetes in 2017–18, though it is likely this figure underreports due to people not being aware they have the disease (Australian Institute of Health and Welfare 2019c). Whilst the incidence of self-reported disease is 5% of adults in major cities, 4% in inner regional and 6% in outer regional and remote areas, rates of disease are twice as high in the lowest socioeconomic group at 7% compared with the highest socioeconomic group at 3% (Australian Institute of Health and Welfare 2019c). Socioeconomic disadvantage was associated with higher incidence of diabetes, and higher rates of hospitalisation and death (Australian Institute of Health and Welfare 2019c).

Type 2 Diabetes, and its precursor Metabolic Syndrome[57](Grundy 2016), affects one million Australians and is one of the top 10 causes of death in Australia (Welfare 2016). In 2015 Type 2 Diabetes was the 12th largest contributor to Australia's disease burden at 2.2% of total burden. There was an increase in the burden from Type 2 Diabetes from 1.8% in 2003 to 2.2% in 2011, but no increase between 2011 and 2015 (Australian Institute of Health and Welfare 2019c). Type 2 Diabetes is also the primary cause of death in cardiovascular disease (Shaw et al. 2012). In 2015–16 Type 2 Diabetes was estimated to have cost the Australian health system AUD$2.7 billion, or 2.3% of total expenditure (Australian Institute of Health and Welfare 2019d).

[55] 17,000 deaths
[56] 1 million people
[57] A risk for Type 2 Diabetes where blood lipids, blood pressure and blood glucose are raised, there is insulin resistance, a pro inflammatory state and a pro-thrombotic state as well as elevated risk of stroke and cardiovascular disease

2.8.4.3 Disease management

People can reduce their risk of contracting Type 2 Diabetes through regular physical activity,[58] maintaining a healthy weight, and diet low in saturated fats, added sugar, and high in fibre, vegetables and fruit (World Health Organization 2016). The good news is that even once people have Type 2 Diabetes, modifying lifestyle has been shown to improve symptoms or even to reverse the disease (Shaw et al. 2012; Taheri et al. 2020; Welfare 2016). Increasing exercise can reduce mortality and improve glycaemic control, even when weight loss has not been achieved (Miller & Dunstan 2004). A meta-analysis and systematic review of the effectiveness of High Intensity Interval Training (HIIT) found that clinical markers[59] for people with Metabolic Syndrome improved compared with control groups who did not participate in exercise (Serrablo-Torrejon et al. 2020). In their systematic review Acosta-Manzano et al. (2020) showed that resistance training, namely muscle Hypertrophy Training[60] and Muscular Endurance Training produced comparable beneficial effects to aerobic training for participants with Type 2 Diabetes. Both types of training helped participants improve their HbA1c,[61] insulin levels and sensitivity, muscle strength, body mass index, waist circumference, and fat mass. Hypertrophy Training also helped participants improve glucose, cardiorespiratory fitness, fat percentage, lean body mass, lipid profile, systolic blood pressure, and C-reactive protein, whilst Muscular Endurance Training helped participants reduce their weight(Acosta-Manzano et al. 2020). In their study Savikj and Zierath (2020) found greater improvements in

[58] combining low intensity and vigorous aerobic activity and resistance exercise for older adults
[59] These included Blood Glucose (- 0.11 mmol/L), Systolic Blood Pressure (- 4.44 mmHg), Diastolic Blood Pressure (- 3.60 mmHg), and Waist Circumference (- 2.26 cm). Otherwise, a slight increase was observed in HDL Cholesterol (+ 0.02 mmol/L).
[60] Aims to increase the size of the muscle
[61] A diagnostic blood test of glycated haemoglobin that is used to help diagnose and monitor people with diabetes

glycaemic control can be achieved through combined aerobic and resistance training programs compared with either training type alone. Increased training frequency and intensity, as well as training with low carbohydrate availability, could also improve cardiorespiratory function and skeletal muscle oxidative capacity, more than conventional training for people with Type 2 Diabetes, just as it does with healthy untrained individuals (Savikj & Zierath 2020).

A meta-analysis demonstrated that a lifestyle program of weight loss and regular exercise could prevent the onset of Type 2 Diabetes in at risk individuals, and cause remission in those with the disease, to the point where they no longer require glucose lowering medication (Ades 2015). In their systematic review and meta-analysis of mobile-based health interventions aimed at reducing cardiometabolic risk through promoting physical activity and healthy lifestyle changes, Sequi-Dominguez et al. (2020) showed overall a strong positive effect on cardiometabolic risk indicators among individuals with metabolic syndrome, including significant average reductions in BMI, waist circumference, systolic blood pressure, diastolic blood pressure and HDL Cholesterol (Sequi-Dominguez et al. 2020). This is significant not only in terms of the impact of interventions on the symptoms and risk factors for people with metabolic syndrome, but it also reflects the interplay between lifestyle diseases such as metabolic syndrome and cardiovascular disease.

The Norfolk Diabetes Prevention Study, a clinical trial that ran for 8 years and involved more than 1,000 people with prediabetes and a high risk of developing Type 2 Diabetes, found that losing 2-3kg of weight and increasing physical activity over two years, reduced the risk of Type 2 Diabetes by 40 - 47%. This trial supported participants to lose weight thorough small changes to their lifestyle, diet and physical activity (Sampson et al. 2020).

The challenge is the availability and accessibility of such programs to those who most need them. Type 2 Diabetes prevalence has been identified globally as higher in populations with a low socio-economic position, whether people live in high-, middle- or low-income countries (Agardh et al. 2011). This is unsurprising as low socio-economic position contributes to the barriers people face, relative to the population, in accessing: primary healthcare, relevant programs to address disease, education about disease risk factors, affordable transport to program activities and healthy food sources, the internet and devices necessary to access to on-line resources, suitable exercise facilities such as gyms, parks, beaches, and shaded open space. This phenomenon is referred to as the social determinants of health, a theory that describes how peoples circumstances can have a causal role in fostering illness and disability or in improving a disease prevention and the maintenance of health (Cockerham, Hamby & Oates 2017).

2.8.4.4 Literature

Searching peer reviewed journals for sport-based interventions and diabetes yielded two studies using football (soccer) as part of an intervention, and one study that used swimming in a research, rather than a community, setting. A prospective longitudinal study of 208 patients randomly assigned to either sports therapy and recreational sport intervention, or to a control, appeared to demonstrate that community sport interventions can be used successfully to improve blood glucose concentrations, weight, body mass index, body fat percentage and visceral fat in people with Type 2 Diabetes (Szilágyi et al. 2018). However, this could not be discussed in detail as only a limited abstract and a news report in English was discoverable for this Hungarian study, which did not include detail of the sports used or intervention design.

2.8.4.5 Community soccer training and diet intervention in France

The first was a 12-week study in France 2017 where 51 patients were randomised in an intervention using calorie-restricted diets, or a combined calorie restricted diet and community soccer training sessions of 40 minutes each, 3 times a week. Those receiving the soccer and diet showed higher levels of growth hormone, free fatty acids and ammonia and lower blood glucose levels than the diet only group. The study concluded that:

> "Recreational soccer training was popular and safe, and was associated with decreased plasma glucose and insulin-like growth factor binding protein 3 levels, decreased ammonia genesis, and increased lipolytic activity and IGF-1/IGFBP-3 ratio, all indicative of attenuated catabolism [loss of muscle mass due to dieting](Vieira de Sousa et al. 2017)."

2.8.4.6 Community soccer training and diet intervention in Brazil

The second example was a 12-week Brazilian study of the impact of soccer training and diet on protein catabolism (muscle breakdown) and cardiovascular risk markers in people with Type 2 Diabetes. 51 patients (29 female, 22 male) with Type 2 Diabetes were recruited and placed on moderate calorie restricted diets and half the group were randomised to also participate in recreational soccer training sessions of 40 minutes duration, 3 times per week. Nineteen participants attended all of the scheduled soccer sessions, sustained no injuries and showed higher levels of growth hormone, free fatty acids and ammonia compared with diet only group. They also had lower levels of glucose and insulin-like growth factor binding protein. Recreational soccer training was associated with decreased plasma glucose and IGFBP-3 levels, decreased ammonia-genesis, and increased lipolytic activity and IGF-1/IGFBP-3 ratio, all indicative of reduced muscle breakdown (Vieira de Sousa et al. 2017).

2.8.4.7 A Randomized Controlled Trial using swimming for Type 2 Diabetes and Metabolic Syndrome

At the University Hospital of Chuzhou University, in Chuzhou, China a randomised controlled trial of 100 patients with metabolic syndrome and 100 healthy individuals was carried out using swimming (Tan & Guo 2019). All participants had blood tests for the serum levels of interleukin (IL)-1, high sensitivity C-reactive protein (hs-CRP), tumour necrosis factor α (TNF-α) and IL-8.[62] The patients were randomly divided into five groups. Patients in group A received conventional drug treatment, those in groups B-E received conventional treatment plus a swimming intervention four times per week for three months. The session duration for group B was 15 minutes each time, for group C it ran for 30 minutes, for group D it ran for 45 minutes and for group E it ran for 60 minutes.

Changes in the homeostatic model assessment of β-cell function and insulin resistance (HOMA-IR) score, and in the serum levels of IL-1, hs-CRP, TNF-α and IL-8 were recorded. Patient muscle tissue was collected and western blot assay was used to detect the expression levels of insulin receptor substrate-1 (IRS-1), glucose transporter type 4 (GLUT4) and protein kinase B (Akt) in the tissues. Patients with metabolic syndrome had significantly higher HOMA-IR and serum levels of IL-1, hs-CRP, TNF-α and IL-8 than the normal controls. The swimming intervention reduced HOMA-IR and these serum levels, with greater reductions noted for longer swimming duration groups. It also promoted IRS-1 and Akt phosphorylation, and increased GLUT4 expression level, with greater reductions the longer the intervention dose duration.

[62] Please see table 1 in Abbreviations for a full explanation of these tests

This study found that a swimming intervention reduced the HOMA-IR score and serum levels of IL-1, hs-CRP, TNF-α and IL-8, which was used to reflect the degree of insulin resistance. It also promoted IRS-1 and Akt phosphorylation, and GLUT4 translocation, meaning it improved the metabolic syndrome through multiple pathways (Tan & Guo 2019). Whilst this was a small research study, not a study of a community sport-based intervention, the implications are that swimming could also be used to help improve Type 2 Diabetes and Metabolic Syndrome and in community sport-based interventions in the future. The correlation between reductions in insulin resistance and increased duration of swimming, is also significant for future program plans.

2.8.4.8 The 'Football is Medicine' model

In a 2018 editorial for the British Journal of Sports Medicine, Birgitte and Krustrup discuss the merits of using football training in patient groups with hypertension, Type 2 Diabetes, osteopenia, and prostate and breast cancer. They recommend twice weekly football fitness training sessions of 60 minutes duration each[63] for positive effects on cardiovascular, metabolic and musculoskeletal fitness, fat loss and increased muscle mass. Birgitte and Peter Krustrup propose the *Football is Medicine* model for the prevention, treatment and Rehabilitation of lifestyle disease (Krustrup & Krustrup 2018). The format they refer to is community-based 'Football Fitness' training, rather than match play, and includes a warm-up, pair-based football exercises and 2 vs 2 to 5 vs 5 football drills. It builds social relationships, teamwork, and can be enjoyed by participants of all ages and skill levels. They also note that football as medicine is low cost and relatively accessible with an estimated 500 million players worldwide and 300 registered clubs (Krustrup & Krustrup 2018).

[63] with proper warm-up, pair-based football exercises and 2 vs 2 to 5 vs 5 football drills with rules adjusted to the participant group

2.8.4.9 Discussion

Football and swimming training on their own are not the same as a lifestyle intervention that provides patients with education to assist them in reducing disease risk or improving symptoms. But as with the Cardio Tennis format that could be used to work with people with cardiovascular disease or Type 2 Diabetes (Tennis Australia 2012),[64]or Dragons Abreast where dragon boating is used to work with breast cancer survivors[65], sport participation can induce measurable positive effects even if further intervention elements are not included. It also appears that exercise improves cardiac structure and function to the point where Verboven et al. (2019) recommend it as a cornerstone of treatment for Type 2 Diabetes. It was acknowledged in the final CPAL report that although the program targeted people at risk of or with Cardiovascular Disease, Return on Investment calculations could be expanded to include the impact of increased physical activity achieved under the program on Type 2 Diabetes and other health outcomes (County Durham Sport 2013).

The good news is that Type 2 Diabetes is a reversible lifestyle disease. A prospective cohort study found that weight loss equal to or greater than 10% was sufficient to achieve remission (Dambha-Miller et al. 2019). This relatively modest weight loss is achievable without intensive lifestyle interventions or extreme calorie restrictions and opens the way for community-sport based interventions to contribute to reducing disease.

[64] Described above under Cardiovascular Disease and Breast Cancer respectively
[65] Discussed at 2.7.2.3 and 2.7.2.4

2.8.4.10 Questions

A range of questions arise from the literature,[66] including; if the modifiable risk factors for Type 2 Diabetes are obesity and poor diet, what is the most effective treatment for short, medium, and long-term improvement? Are some sports better than others for running interventions? Football may be more commonly written about, but what about other sports? What is the most effective dose duration, frequency and intensity? How many months or years do people need to participate in intervention to manage or reverse disease or to reduce the loss of DALY's? Which sport best promotes adherence? Which sport is most effective? What are the barriers/ facilitators/ critical success factors for interventions? Are there any other intervention design factors that are important? This research will contribute to greater understanding, data collection and measurement, in order to enable these questions to be answered in future.

2.8.5 Obesity and Overweight

The World Health Organisation (WHO) defines overweight and obesity as 'abnormal or excessive fat accumulation that may impair health.' (World Health Organization 2017b) Being overweight or obese is a modifiable risk factor for other conditions including cardiovascular disease, breast cancer, colorectal cancer and Type 2 Diabetes (Blüher 2019). The WHO uses Body Mass Index (BMI) measures[67] to measure adults as overweight if they are above a BMI of 25 an Obese above a BMI of 30. However the WHO admits this is a rough guide as BMI may not correspond with fatness in different individuals (World Health Organization 2017b). Obesity, or excessive fat accumulation, is caused by an energy imbalance between calories

[66] See also Figure 2

[67] defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2)

consumed and calories expended. At a global level this is caused by increased consumption of energy-dense foods, high in fat and sugars, and physical inactivity as work and transport become more sedentary (World Health Organization 2017b). Increased levels of urbanisation, changes in diet and physical activity patterns often result from societal change associated with development, and a failure to plan for the health, agriculture, transport, urban planning, environment, food processing, distribution, marketing, and education that would support better human health (Blüher 2019; World Health Organization 2017b). Whilst these factors raise the risk of obesity, they are not the sole cause. Heredity, the hormonal regulation of appetite, and the interplay of genetic, epigenetic and environmental factors are all contributors (Rohde et al. 2019). Historically women have been blamed for the intergenerational transmission of obesity, but a structured review of studies exploring epigenetic and social mechanisms of obesity risk transmission, reveals a failure to appreciate the role of paternal actions, in inducing epigenetic changes and influencing the metabolic functioning of the child. It appears there is shared parental responsibility for the intergenerational transmission of obesity (Milliken-Smith & Potter 2018).

The prevalence of obesity has tripled since 1975 according to the NCD Risk Factor Collaboration (2016), and this is attributed to an increased intake of energy dense foods and a reduction in calories expended due to people leading increasingly sedentary lives. In 2016 over 1.9 billion adults, or 39% of the global adult population, were overweight. 650 million of these adults, or 13% of the world's adult population were obese. Obesity now kills more people worldwide than underweight (World Health Organization 2016). Attempts at qualifying the global cost of obesity through systematic reviews have failed due to the variability of methodological approaches between countries (Dee et al. 2014; Tremmel et al. 2017). However being overweight and inactive is associated with a range of non-communicable diseases and

health conditions including cardiovascular, renal, endocrine, and mental disorders (World Health Organization 2013b). The International Agency for Research on Cancer also attributes 23.6% cases of breast cancer in post-menopausal women, and 17.7% of colon cancer to obesity based on 2012 body mass index data (International Agency for Research on Cancer 2019b). Being overweight or obese is also a risk factor for other lifestyle diseases (Shaw et al. 2012; Welfare 2016), including cardiovascular disease, Type 2 Diabetes and metabolic diseases, osteoarthritis, dementia, depression and some types of cancers (Blüher 2019). Rates of overweight and obesity have risen significantly worldwide over the past 50 years, reaching pandemic proportions (Blüher 2019). In 2007 for the first time global rates of overweight people exceeded the underweight population (Soekatri & Widyahening 2016). By 2016 global obesity has increased by 167% since 1975, compared with a 35% fall in the proportion of underweight people, leaving almost 13% of the global population obese, compared with just over 9% who are underweight (Soekatri & Widyahening 2016).

At a national level obesity contributed 5.5% of the Australian disease and injury burden in 2011. It was held to be responsible for 52% of diabetes burden, 23% of coronary heart disease burden and 17% of stroke burden, and ranked as the second risk factor with the most attributable burden for disease (Australian Institute of Health and Welfare 2016b). Two thirds of Australia's adult population were overweight or obese in 2014-15. According to the Council of Australian Governments overweight and obesity cost Australia $11.8 billion dollars in 2018 in direct health costs and indirect community costs (Council of Australian Governments Health Council 2019). In addition to the social determinants of health theory that describes the causal role people's circumstances play in fostering or preventing illness (Cockerham, Hamby & Oates 2017), in high income countries like Australia the inequality in power, money, and resources, are linked to healthy life expectancy with non-communicable diseases like obesity

having higher incidence amongst people of lower socioeconomic position (Marmot & Bell 2019).

In Australia people from indigenous and low socio-economic backgrounds are more likely to be affected (Australian Institute of Health and Welfare 2018c). Indigenous people and people in lower than average socio-economic position are more likely to have reduced access to affordable healthcare, allied health services to address obesity, and racism has been shown to negatively affect the quality of health care provision (Bastos, Harnois & Paradies 2018). These people are also less likely to have access to education to better inform their choices, high quality nutritious food, gyms and suitable safe attractive spaces for physical activity such as beaches, parks and waterways, and affordable transport. Low income reduces the ability of people to pay for goods, services and activities that contribute to maintaining a healthy lifestyle. Experimental work by Claassen, Klein and Corneille showed that poverty may also influence people to eat more calories and more impulsively (Claassen, Klein & Corneille 2016). Poverty and health are also interdependent, as poor health may lead to a reduced income if a person is unable to participate fully in the workforce, and people from lower income households are more likely to spend 10% or more of household income on healthcare (Callander, Fox & Lindsay 2019).

As entertainment and labour-saving technology improves, Australians are becoming more sedentary and less physically active, which is a risk factor for cardio-vascular disease and all-other-causes mortality risk in adults (Alicia et al. 2011). When combined with poor nutrition, sedentary behaviour increases the risk of becoming overweight, two of the key modifiable risk factors for lifestyle diseases (Bloom et al. 2011). Obesity and lifestyle-related chronic conditions place considerable burden upon individuals and these conditions are complex, long-

term public health problems. The World Obesity Federation estimates that the annual cost of treating obesity-related diseases in Australia will rise from $12 billion in 2014 to $21 billion by 2025. This is based on the rising rates of obesity, rising healthcare costs, and the continuation of current approaches (Huffington Post 2017).

The good news is that obesity and overweight are can be prevented, managed and reversed by maintaining a healthy diet and being physically active (Donnelly et al. 2009). Genetic factors can predispose individuals to obesity and the FTO gene has the strongest known association with obesity susceptibility. A meta-analysis of 45 studies of adults and 9 studies of children[68] found that physical activity may attenuate the effect of the FTO gene on obesity risk (Kilpeläinen et al. 2011). The *EPIC-Norfolk Prospective Population Study* of 20,430 adults found that regular physical activity can lessen a genetic predisposition to obesity by about 40% (Li et al. 2010).

An American Study examined data from four US public health surveillance surveys from 2011 to 2017, covering almost 1.7 million American adults. It found that adults who complied with the recommendation for 150 minutes or more of aerobic physical activity and 2 or more sessions of muscle-strengthening exercise per week were less likely to be obese (Bennie et al. 2019). A study of 1302 adults found an association between being in the normal BMI range and having lower body fat, with having high self-reported rates of leisure time physical activity for women, whereas there was little association for men. No association for either men or women was found between measures of occupational/domestic activity and BMI or body fat (Ball et al. 2001). A meta-analysis of interventions found that diet and exercise interventions

[68] Total 218,166 adults and 19,268 children

can work to reduce overweight and Type 2 Diabetes symptoms, but that interventions my need to be long term to sustain behaviour change (Miller & Dunstan 2004).

2.8.5.1 Football Fans in Training

The first was the 2013 Football Fans in Training Randomised Controlled Trial which worked with 374 male fans 35-65 years of age with a BMI of 28-30 who attended Scottish Premier League Football Clubs. They were classed as being at high risk of ill health including Type 2 Diabetes, hypertension and cardiovascular disease. This was a lifestyle modification program designed to promote weight loss through healthy eating and increased physical activity. The intervention group received dietary guidance, and an exercise program of pedometer-based walking with goal-setting and diary records, and vigorous pitch-side physical activity sessions. The control group were randomised to a 12 month wait-list.

After 12 months the intervention group achieved clinically significant weight-loss, reduction in waist circumference, percentage body fat, systolic and diastolic blood pressure compared with the control group. The intervention was considered cost effective, at an estimated £2810 per QALY gained, and good value in the United Kingdom. It was also attractive and enjoyable for men at high risk of future ill health (Wyke et al. 2015).

2.8.5.2 Grey literature sources

Grey literature searches showed that community sport interventions for obesity are taking place, even if they have not yet been written about on academic journals. These are described below.

2.8.5.3 Canterbury Bankstown Bulldogs Active Breed Program

The Canterbury Bankstown Bulldogs National Rugby League (NRL) Club runs the Active Breed program targeting men aged 35-64 in the South West of Sydney with a BMI of 25-43kg/m2. This 12-week program encourages men to lose weight and improve their physical and mental health through a series of weekly education and exercise sessions. Each session runs for around 90 minutes and focuses on topics including physical activity, weight loss, diet and mental health and the physical activity component includes football skills and drills, supervised gym sessions and small-sided social games (Canterbury Bankstown Bulldogs 2020). Over the 12 week 2018 course, the 24 participants lost an average of 3kgs per participant, and achieved average waist circumference reductions of 6.6cm each (Canterbury Bankstown Bulldogs 2018).

2.8.5.4 Australian Football League programs

In addition to the sport interventions described above that targeted obesity and overweight together with cardiovascular disease or Type 2 Diabetes, some sport organisations already run projects and programs to help people 'get fit', 'get healthy' or to improve specific health conditions. The Australian Football League (AFL) runs the AFL Active in partnership with Vic Health to help people exercise and stay active (Australian Football League 2018). The Western Bulldogs AFL club have run the Daughters of the West[69](Western Bulldogs 2017), and Sons of the West[70] (Western Bulldogs 2019) programs to help local people improve their health. The AFL has received ethics approval to test a feasibility and randomised controlled trial of intervention based on the Football Fans In Training (Wyke et al. 2015) model, to target

[69] Focusses on mental health, nutrition, physical activity, respectful relationships, parenting and financial literacy

[70] Aims to combat common health inequalities related to nutrition, exercise, diversity and gender equity

male obesity in Australia (Quested et al. 2018). The Aussie-Fit pilot trial ran for 6 months in Perth and targeted overweight middle-aged men[71](Kwasnicka et al. 2020). The 306 eligible participants were randomised to either receive the intervention immediately or to start three months later. The intervention ran for 12 weeks and included a 90-min weekly face-to-face session of physical activity, nutrition, and behaviour change information and practical activities delivered by coaches at 2 AFL clubs. Baseline, post-intervention and 6 month follow-up data were collected including weight, self-reported measures, device-measured physical activity, waist size, and blood pressure and at 3 months the intervention group had lost 3.3 kg[72] more an had higher moderate-to-vigorous physical activity than the control group (Kwasnicka et al. 2020).

2.8.5.5 Discussion

It appears that sport-based interventions for obesity can help participants achieve measurable results. Whilst the examples outlined are from football codes, it is possible that participants in other sport based interventions, such as the multi-sport CPAL program (County Durham Sport 2013), achieved weight or fat loss, but this was not a target of the program, and therefore not reported on. When sport based health interventions are conducted measurements of weight, BMI and body-fat need to be taken, because obesity is a risk factor for other conditions including cardiovascular disease, breast cancer, colorectal cancer and Type 2 Diabetes (Blüher 2019). A small study conducted with men who had participated in the UK based MAN v FAT Football as players or coaches, also suggested that weight loss programs may be more successful for men if their program content worked with masculine identities, used organised sport and competition to drive healthy behaviour change (Budden et al. 2020).

[71] With a BMI of ≥ 28 kg/m^2 aged 35–65 years old
[72] A mean measure compared with baseline weight

2.8.5.6 Questions

Based on the literature a range of questions arise[73] including: if the modifiable risk factors for obesity are insufficient exercise and poor diet, what is the effective dose of activity or dietary alteration required to achieve immediate and lasting change? Or to reduce the risk of loss of DALY's? Are some sports better than others at achieving this? What is the optimal session duration and frequency physical activity? How many days per week, and how many months or years should interventions run for? What best promotes adherence? What are the barriers/ facilitators/ critical success factors for interventions? Are there any other intervention design factors that are important? Again, the importance of this research is to identify these important questions that merit further research, to offer a way to improve intervention methodology so that in future they may be able to be answered, and to help make the case for their expanded use.

2.9 The merits of running interventions using sport

Participating in community sport has a wide range of health benefits (Castagna et al. 2018), and millions of people enjoy it enough to participate worldwide (Hulteen et al. 2017). It is estimated that globally 500 million people play soccer, 100 million play basketball, and 70 million play team handball (Castagna et al. 2018). Running community health interventions through sport organisations and facilities, rather than hospitals and health services, may help reduce barriers to participation. Most local government areas will have only one or two hospitals, but will usually have larger numbers of sports facilities and clubs, potentially improving accessibility. Some of the most popular community sports, such as running, soccer and swimming (Hulteen et al. 2017), do not require clubs or complex equipment or facilities to

[73] See Figure 2

participate. Where sports facilities and leisure centres exist, they often have areas or facilities suitable for children to receive care or participate in activity, enabling families to play and be active. Sport sector staff also receive lower average pay than health sector workers.[74] This means interventions conducted in community sport settings may be able to run at a lower overall cost to participants, making them more accessible.

Sports organisations also have coaches, teams, officials, volunteers and players who all provide opportunities for participants to have social contact and enjoy themselves whilst getting the health benefits of physical activity (Castagna et al. 2018). The process of teaching, coaching or playing sport involves a degree of supervision, even if only by peers, gradual progression and the instructions can be tailored to meet the needs of the individual. Community sport activities can generate huge engagement for a very low investment. Parkrun, discussed at 2.7 operates a weekly, is free to participate in, is mostly run by its 375,000 volunteers, has continued for 14 years, spans 20 countries, includes 3 million participants and the increasing completion times suggest that more walkers and previously inactive people are joining in (Reece et al. 2019). This is an example of mass participation community sport that is general practitioners refer patients to in the UK (Reece et al. 2019). It is not an intervention program but it appears to be helping people increase their levels of physical activity.

A 2019 systematic mapping review of how the settings-based approach is applied through health promotion interventions in sports clubs, identified no controlled studies assessing health promotion interventions in sports clubs, and interventions focused only on study participants rather than the club overall (Geidne et al. 2019). Almost 60% of the interventions targeted men

[74] Sport Instructors receive an average hourly rate of $20 https://www.payscale.com/research/AU/Job=Sports_Instructor/Hourly_Rate whereas the average hourly rate for healthcare staff is $30 https://www.payscale.com/research/AU/Employer=Healthcare_Australia/Hourly_Rate though qualified doctors, nurses and exercise physiologists may cost more.

in team sport settings such as rugby, soccer, multiple team sports, but this gender bias relates to the type of sport settings in which the interventions were conducted. Using sport settings to promote health can enhance sport clubs' performance,[75] as well as the participant's health outcomes sd the setting itself may also positively influence participants in the health intervention (Geidne et al. 2019). Most interventions only focused on one health behaviour, two thirds of the studies were descriptive, and the majority did not use validated measurements, limiting the ability to evaluate their effectiveness (Geidne et al. 2019). This confirms the lack of controlled designs noted in previous literature reviews (Priest et al. 2008b). Most studies included in the mapping failed to capture health and behaviour change, or identify the facilitators and barriers of the setting or intervention (Geidne et al. 2019). This highlights the need for a more systematic, rigorous process for setting up, measuring and evaluating health promotion interventions in community sport settings.

The structure and nature of sport can also provide extrinsic motivation for participants in the sense that a team requires a certain number of participants to function, or the activity occurs at a set time. Participants may find team sport increases their levels of motivation (Pedersen et al. 2017), or they may not want to miss out on enjoyable social interaction involved in team or group sport participation (Reece et al. 2019). There is some evidence that interventions for Type 2 Diabetes could lead to sustained increases in physical activity (Booth et al. 2020), but more study is required to identify if this is true of interventions for other lifestyle diseases. Deploying health interventions in sport settings can provide a pathway for participants to join in club sport, or volunteering activities, to help sustain physical activity once the intervention has concluded.

[75] For example, by providing opportunities to recruit new players or volunteers

Research based on the Household Income and Labour Dynamics in Australia survey published in the British Journal of Health Psychology, found that people with higher social support were involved in more physical activity. Social support affected peoples' physical activity indirectly by reducing their pain, which was true of the general population and a subsample with a chronic pain condition (Stevens, Cruwys & Murray 2020). Conducting interventions in sport settings, offers the opportunity for participants to form social connections and gain support. This may assist in reducing the participant experience of pain, whether soreness from being previously inactive and becoming more active, or to surgery related pain, disease or treatment effects. Using community sport to run interventions to reduce lifestyle disease may offer a range of facilitators and benefits in addition to achieving identified program aims. These merit further study, and this research seeks to assist in improving methodological practices to make it easier in future to identify them.

2.10 Discussion of themes

This research is focussed on reducing lifestyle disease using community-based sport. The significant burden of lifestyle disease, globally and in Australia, has been described, as has the social contribution of sport and the opportunity it offers to promote good health. The target diseases: cardiovascular disease, breast cancer, colorectal cancer, Type 2 Diabetes and obesity have been examined in terms of their contribution to the burden of disease, the opportunity presented to date by sport-based lifestyle interventions and programs.

A range of questions were identified for each disease, based on the literature. These are summarised in a table of questions at table 4 at 2.11 and Appendix 10 together with suggested program elements that may help address them and themes. The themes identified became the seven topics requiring further investigation to understand more about the questions that had

arisen, and they were: method, measurement, money, participants, publication, partners, disease. Gaps in the literature highlighted a need for a greater understanding of, and improved practice in, these areas.

Following the preliminary literature review an initial draft framework at Appendix 2 was designed, providing a sequence of steps for a project or program manager to complete in order to plan and manage a lifestyle disease intervention program.[76] A simplified version appears below at Figure 2. The model is designed for the program manager to follow a sequence of steps, addressing the questions in turn following down the page within each phase before beginning the next phase. Each of the questions has been developed from an understanding of the contributors to lifestyle disease generally as described at 2.2, the specifics of each of the target diseases described at 2.8.1 Cardiovascular disease, 2.8.2 Breast cancer, 2.8.3 Colorectal cancer, 2.8.4 Type 2 Diabetes and 2.8.5 Obesity and Overweight. The questions draw on an understanding of participant activity screening discussed at 4.4.1 and the need to match participants to activity that is suitable for their health status. For example, a person experiencing vertigo as a side effect of cancer treatment is unlikely to be suitable to participate in a climbing-based intervention. The sequence of steps also draws on the researcher's understanding of the logical pre-requisites required for participation. For example, if there is no pool or body of water, the program manager will not be able to plan an aquatics-based intervention, and if a participant cannot ride a bicycle a cycling-based intervention will be unsuitable for them until the can learn. Questions in phases 3 and 4 draw on program elements described in academic and grey literature about community sport-based interventions, behaviour change, and the questions in phase 5 draw on both the disease and intervention literature described in chapter 2.

[76]See Figure 1

Phase 1 questions	Phase 2	Phase 3	Phase 4	Phase 5
About the Illness & suitability to participate	**About the Person**	**About the Sport**	**Other Program Elements**	**Measurement**
Lifestyle disease for improvement	Participant history of sport participation? (Preferences? Aversions?)	Locally available & accessible sports?	What other behaviour needs to change to achieve outcomes?	Progress measurement selection. Use medical model for the disease, evidence-based measures and partner expertise.
Does the person have any other injuries, illness, risk factors to exercise? E.g., occasional vertigo	What is accessible to the person? (Geographically? Logistically? Financially? Culturally?)	Of the available sports, which ones are likely to be able to offer a positive impact?	What would be good measures of these other behaviours changing?	Measure at baseline, progress intervals, and post-program to see whether behaviour has changed
What outcome, if measured, would indicate an improvement in the condition?	Does the person have skills gaps or other barriers to participating in certain sports? (e.g., never learned to swim, can't participate in mixed gender group for religious reasons)	What resources are available? Anything else needed? How intense/ risky/ complex/ is the sport? (Use scales at 2.2 to grade it) Can it be modified?	Which local organisations, have the expertise to partner to deliver activities/ education that might change these other behaviours?	Measure the costs and other inputs required. Are there any other inputs or outputs you need to measure? E.g., to satisfy a sponsor or partner?
Does physical activity have the potential to improve disease symptoms or outcomes?	What does the person find most motivating? • Team v individual activities, novelty & high-risk v routine • Complexity v simplicity • High intensity vs low intensity • Short v long duration	How individual/ team focussed is the sport? (grade it)	How should these other elements be delivered? Frequency? Dose amount? Group work or one-to-one?	Identify how and when you will report on the program, who to and what other evidence you need to gather along the way [photos, measures, testimonials]
Outcome: Person identified as having	**Outcome:** Characteristics of the person, their skills, history,	**Outcome**: Helps match the sport to the person and identify	**Outcome**: Design of non-sport elements of the program	**Outcome**: Measures selected for progress, success

potential to be helped by a sport intervention, any program modification needs recorded OR person identified as unsuitable	barriers to participation revealed to assist program selection, design and modification.	necessary modifications	completed and/or partner sourced to deliver these. Potentially great source of referrals to program	and reporting, evidence gathering and report planned for

Figure 2 Proposed framework - simplified

The intended output of this research is framework to make it easier to design and deliver community sport-based interventions to address lifestyle disease. In order to test the usefulness of the framework, and the accuracy of the researcher's understanding of the issues, ethics approval was obtained at Appendix 6 to conduct semi-structured interviews with program leaders who had led or managed community sport-based interventions to reduce lifestyle diseases. The interviews were conducted in 2019 between the 17th of May 2019 and the 28th of December via Zoom, WhatsApp audio, Google Meetings and telephone, depending on the platform preference of the interviewee. Audio recordings were made of each interview and these were professionally transcribed. The transcripts were coded manually based on the seven themes identified from the literature[77], and any additional themes that arose were coded individually.

The semi-structured interview questions were developed in order to ask about the themes arising from the literature, and to test the usefulness of the framework design with practitioners who had designed or led health interventions using community sport. Semi-structured interview questions were used in order to provide the opportunity for practitioners to raise issues and themes that had not occurred to the researcher or arisen from the available literature. The CPAL program (County Durham Sport 2013), other interventions described in grey

[77] Method, measurement, money, participants, publication, partners, disease

literature but not in journals, raised the likelihood that practitioners would have encountered issues not described in the literature. The outcome of interview data collection and analysis will then be used to revise the framework.

2.11 Questions

During the literature review the candidate noted questions for each of the interventions described that had not, or could not, be answered. The following table captures these questions. Where the same question applies to multiple diseases, it is not repeated, the initials of the other disease have been added in the disease column. These questions, and the inability to answer them from the literature, further informed the design of the framework.

Table 4 Questions arising

Disease	**Question Arising**	**Program Element**	**Theme**
CVD, BC, CRC, T2D, O.*	What's more effective longer duration, less intense activity? Or more intense shorter duration?	Dose	Method
CVD, BC, CRC, T2D, O	How frequently should doses occur	Dose	Method
CVD, BC, CRC, T2D, O	Are some sports more effective than others to use in intervention programs?	Sport selection	Method
CVD, BC, CRC, T2D, O	If interventions are effective, why are they not widespread, well researched and discussed?	Publication & Measurement	Publication & Measurement
CVD, BC, CRC, T2D, O	What is the opportunity cost of not conducting health interventions using sport?	Measurement	Measurement
CVD	What contribution do dietary control, smoking cessation and behaviour change make to the intervention?	Measurement	Measurement, Partners, Participants
BC	Which sport-based interventions are effective in symptom management for breast cancer?	Sport selection, sport suitability, equipment suitability	Method, Measurement
BC, CVD, CRC, T2D, O	Are different sports more suitable at different stages of treatment?	Sport selection, sport suitability, equipment suitability	Method, measurement
BC, CVD, CRC, T2D, O	What's the optimal dose duration? Session frequency? Dose intensity?	Dose	Method, Participants, Measurement

BC, CVD, CRC, T2D, O	Do sport interventions reduce the loss of DALYs?	Measurement	Measurement
BC, CVD, CRC, T2D, O	Do they impact survival rates at five years post diagnosis, or longer?	Measurement	Measurement,
BC, CRC, CVD, CRC, T2D, O	What are the barriers, facilitators and critical success factors for interventions?	Sport selection, sport suitability, equipment suitability, participant skill, participant preference, participant barriers, partner capabilities, financial (money	Method, Money, Partners
CRC, CVD, BC, T2D, O	What's the impact of co-morbidities on successful participation in sport-based interventions?	Measurement	Measurement, Participant
CRC	Why are women underrepresented in sport-based interventions?	Participant preference, participant barriers,	Participant, Partners, Method
CRC, CVD, BC, T2D, O	What's the mortality impact at 10 years or longer?	Measurement	Measurement, Evaluation
CRC, CVD, BC, T2D, O	How can interventions and measurement be designed to enable cost-effective, longer-term delivery and follow-up?	Measurement, Money	Measurement, Evaluation, Money
T2D, CVD, BC, CRC, O	What is the most effective treatment for short, medium, and long-term improvement?	Sport selection, measurement	Method, measurement
T2D, O	How many months or years do people need to participate in intervention to manage or reverse disease or to reduce the loss of DALY's?	Dose	Method, measurement
T2D, CVD, BC, CRC, O	Which sport best promotes adherence?	Sport selection	Method, evaluation
T2D, CVD, BC, CRC, O	Are there any other intervention design factors that are important?		
O	All questions arising have been covered above		

*Cardiovascular Disease (CVD), Breast Cancer (BC), Colorectal Cancer (CRC), Type 2 Diabetes (T2D), Obesity (O)

It is important to note that, as set out at 1.7 this study is limited to interventions for adults, not children and mental health is beyond the scope of this research, although it may have important impacts on and from lifestyle disease. There may also be important impacts on lifestyle disease risk and outcomes related to factors such as culture, access to health services, religion, income, sexuality and gender. The next step for this research is to develop the framework into a useable

application, and gather data that may enable to some of the above questions to be addressed. Future researchers may also wish to study interventions to improve mental health, or that were designed for children and young people, and may wish to adapt the framework if it proves useful to these areas of study.

3 Methodology

This chapter presents the methodology for this research project, analysing the semi-structured interviews that were conducted with practitioners who had led or 'auspiced' seven community sport interventions to address one or more of the target lifestyle diseases in adults. The sample size was small due to the recruitment challenges explained below beginning at 3.2. The questions for the interviews were generated from reflecting on the questions, issues and themes that arose from the literature review and were designed to test the validity and usefulness of the framework to make the work of practitioners more effective in delivering lifestyle disease programs. These interviews were coded thematically and analysed to refine the initial framework. This thesis utilised semi structured interviews as the main method to generate data for this thesis, which will be justified later in this chapter. This method enabled this research to develop a framework that can be applied to make it easier to assess the impact and measure the outcomes of community sport-based, non-clinical interventions to improve lifestyle disease.

The semi-structured interview questions were designed to test the framework elements with interview participants. The initial framework that was developed from the literature review was then amended based on the identified themes and findings of the semi-structured interviews. The modifications made to the initial framework will be discussed in the findings and discussion section of this thesis. The results section also discusses the ways in which the framework can be used to assist practitioners in the field to improve the way interventions are designed, managed, evaluated and publicised. The thesis then addresses the hypotheses raised, how the subsequent framework was designed to address them and to better equip practitioners in their running of programs, if deployed. This is followed by the drawing of conclusions about the research problem, implications for theory, policy, practice, methodology and further

research. Limitations are acknowledged and this conclusion describes the contribution that the research and development of the framework has made to the field of knowledge.

3.1 Semi-structured interviews

As previously discussed, the underdeveloped scholarly area of sport intervention program evaluation and implementation practices, meant further research was required to understand the work that was being undertaken, and the effectiveness of the programs by way of outreach and execution. Therefore semi-structured interviews were conducted with practitioners responsible for establishing or managing these interventions in order to gather evidence of this work, to better understand it, test the validity and usefulness of the proposed framework, and to learn more about the issues arising for people leading and managing community sport interventions to address lifestyle disease.

Theoretically, semi-structured interviewing sits in phenomenology, described as a form of qualitative research that focuses on studying an individual's lived experience (Neubauer, Witkop & Varpio 2019). It can also a form of participant 'action research' (Alston & Bowles 2019 198-210) in that the target participants are required to reflect on what they have done, and program managers would be targeted to take action as a result of the research in order to improve practice (Alston & Bowles 2019). Semi-structured interviewing is a technique where the interviewer plans an interview schedule which includes open-ended questions and allows the discussion to diverge from the questions if needed (Stuckey 2013). It was considered necessary for this research project given its exploratory nature, providing the opportunity for the interviewees to express their views in their own terms (Cohen & Crabtree 2006). This method also had the advantage of flexibility (Miles & Gilbert 2005 p.66), as it enabled the researcher to refine their understanding of the challenges faced in developing and managing

sport interventions to address lifestyle disease, as interviewees had the opportunity for raise additional issues and the researcher the opportunity to probe the participants for clarification (Miles & Gilbert 2005 p67).

Semi-structured interviews provided the opportunity to test the validity of the framework with people who had experience planning and delivering interventions. At the same time, they allowed for the development of a richer data-set that included new issues that advanced the scope of the planned questions (Miles & Gilbert 2005). In response to the questions, program managers were able to identify issues that had arisen during their work, explain problems they would like solved in future, talk about the cultural and technological context of their projects and identify priorities for future solutions that the researcher had been previously unaware of.

Whilst the advantages of this approach have been discussed, this thesis recognises the disadvantages of conducting semi-structured interviews, in that responses are more subjective to code than if a structured set of questions were used via either structured interviewing or surveys. Surveys were not employed because of the difficulty in finding program managers to interview in sufficient volume to carry out the research meaningfully in a survey format, as these workers are often employed on contracts that end when project funding is exhausted. Selecting surveys or a fixed set of questions may have led to the researcher ignoring important issues, and risked failing to capture the depth of experience or problems program managers encountered.

Additionally, whilst it is recognised that qualitative research is not value-free, researchers can mitigate this issue by disclosing their own values, bias and position in relation to the research in order to be transparent (Alston & Bowles 2019 p211.228). This reflexivity is how qualitative

researchers can improve the rigor and quality in their work, through describing transparently to readers the contextual intersecting relationships between the participants and themselves (Dodgson 2019). The researcher engaged with reflexivity, values improving human health and wellbeing, and seeks to reduce the incidence and impact of lifestyle disease. At the time of the data collection, the researcher was self-described as a cis-gender, white, Australian/British dual national, in her early-forties. She was a physically fit, middle class, non-beer drinking, non-smoking, tertiary-qualified, atheist, bisexual, single female with no disabilities. These characteristics could lead to preconceptions, unconscious biases or to significant issues being overlooked if the research format failed to provide the opportunity to include issues generated by the subjects. She has led, seen and heard of a range of successful interventions using sport to treat lifestyle disease and seeks, via the research, to make it easier for more of these interventions to be conducted.

3.2 Recruitment strategy

The semi-structured interviews were conducted with program managers who had 'auspiced' or led interventions using sport to address lifestyle disease. Program managers were chosen on the basis that they had the best chance of providing evidence of practice, testing the framework and disclosing issues, barriers and challenges that needed addressing. These were the individuals who had to make decisions about how interventions were designed and conducted. They were selected as a sample on the basis that they were most likely to be able to answer the research objectives as outlined earlier in this thesis (Alston & Bowles 2019 p87). The recruitment process for this research was based on contacting program leaders. The original design was to recruit at least ten project or program managers from either Australia or the United Kingdom, the two contexts in which the researcher had worked. The recruitment strategy therefore aimed to utilise what is called the 'snowball technique' (Atkinson & Flint

2001), to identify project or program managers who had led health interventions to address lifestyle disease, and asking people contacted to refer others if they were aware of relevant projects. Even if the nominated minimum ten interviews were achieved, interviewing would continue until the research reached data saturation point.

To begin, the researcher identified key stakeholders in sport and health in Australia and the United Kingdom and contacted them via email, telephone, LinkedIn and Facebook Messenger. This yielded referrals in Australia, but none in the United Kingdom. An advertisement was also placed on The Clearinghouse for Sport electronic newsletter (SportAus 2019b) which is subscription service circulated by the Australian Sports Commission, now known as SportAus, on weekdays to national and international subscribers, predominantly from the sport sector. This did not lead to any responses, and therefore the recruitment strategy required changes. To this end, the research placed on information about partaking in the research via her personal LinkedIn, Twitter and Facebook pages, as well as, the NSW Sport monthly newsletter for State Sports Organisations. The researcher also made contact with sport leaders, academics and professionals within her networks seeking information about relevant programs and managers to interview. Whenever an initial contact resulted in a referral, the researcher also contacted the nominated referral and followed up on further suggested contacts. By the end of September 2019, the researcher had also contacted almost all sports organisations recognised by SportAus. Interviews ceased after the 2nd of February 2020, and no further recruitment could take place due to the impact of the COVID-19 Pandemic, as declared by the World Health 31st Organization on the 11th of March 2020.[78] This was because community and professional sport

[78] https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

activities were cancelled or postponed, and staff working on these programs in the sport sector were being stood down globally, something that will fundamentally change this sector.

In total, seven semi-structured interviews conducted, three of the intervention programs were based in Australia, two in the United Kingdom, one in New Zealand and one program was conducted in Pacifica nations, but was managed from, and funded by, Australia. Four of the interviewees were female and five were male, with three leaders participating in a group interview for one of the programs. Seven interviewees identified as white, one identified as of mixed European and New Zealander background and one participant chose not to disclose how they identified. Participant average age was in the mid-forties, with most having professional backgrounds in sport and health. These participants and the programs will be explained further in the later stages of this chapter.

The managers that were recruited had the best chance of generating research data with 'thick description'(Geertz 1973), meaning an explanation of what they were doing, the context of their actions, their intentions when they performed particular actions and the meaning behind their actions (Kostova 2017). They were best able to identify the actions they took, what they intended and why, the context in which the work was carried out, the issues, barriers and challenges that needed addressing. It is important to note that the research targeted program managers for interview, rather than participants, on the basis that the framework has been designed to make their work more efficient and systematic. Participants interviews were not sought as the focus was not on the experience of being in a sport intervention, but rather, on the mechanics of its organisation. This aligns back to the original thesis aims and purposes that sought to understand and provide recommendations to program managers to select the activities, set the duration, frequency and location of activities, evaluate the suitability of

candidates to participate, measure progress and results, seek funding and program support and to gather results data. The following section will describe and discuss the participants and their programs. What follows is a discussion of the interview schedule that was developed and finally qualification of the thematic coding scheme applied to this research.

3.3 Demographic profile of the participants and programs

This section will begin with a brief description of the demographic of participants, a description of each of the programs, followed by the thematic discussion. At the time the interviews were conducted, only the [F] program described at 3.4.8 was not operating, all the other programs described beginning with [N] at 3.4.2, [X], [T], [D], [E] and [H], were all running. The nine interview participants were representatives from community sport programs (55.5% male, 77.7% white) with a mean (s.d.) age of 42 ± 18 years. Five had spent their professional careers in community sport, two in a combination of health and community sport and two in unrelated fields. These participants represented seven community sport programs delivered in Australia (n=3), the United Kingdom (n=2), New Zealand (n=1) and Pacifica Nations (n=1).

3.4 Characteristics of the programs included in this study

3.4.1 Coding table

In order to protect the privacy and confidentiality of participants in this research, each of the programs has been given a letter code, and each of the interviewees has been given a pseudonym. Anyone wishing to learn more about the programs may contact the researcher.

Table 5 Coding table

Program Code	**Interviewee Code name(s)**	**Interview month and year**	**Quote attribution**
[N]	Edward	May 2019	(Edward: [N] – May 2019)

[X]	Angela, Helen, Zac	June 2019	(Angela/ Helen/ Zac: [X] June 2019)
[T]	Adam	June 2019	(Adam: [T] – June 2019)
[D]	Mike	December 2019	(Mike: [D] – Dec. 2019)
[E]	Beth	May 2019	(Beth: [E] – May 2019)
[H]	Sarah	June 2019	(Sarah: [H] – June 2019)
[F]	Nick	August 2019	(Nick: [F] – Aug. 2019)

3.4.2 [N]

[N] is a modified basketball program developed in 2017 and run by Edward the program manager from the Oceania office in Australia, but delivered in community basketball facilities in six Pacifica Nations at the time of interview. The program targeted inactive women, teenage girls and mothers, in countries and communities where women faced poverty, domestic violence, sexual assault, poor access to healthcare and reproductive services with the aim of improving women's health and empowerment. Edward explained that it did this through helping participants become more physically active using basketball drills and games, and providing education about nutrition, self-esteem, general and reproductive health services, and domestic violence support services available to them. The program worked with local non-profits, and recruitment was via social media and word of mouth. Following an expression of interest by a country within the Oceania region, one member of the FIBA Oceania staff travelled to the community with some female players from the national team to meet with interested women to gather the group together and explain to them what is happening. The initial program rollout runs for six to eight weeks, once a week, beginning with a combination of basketball related physical activity and conversations related to the health and education needs of women and the local services available. During this period local people are trained and they are paid to continue to leading the ongoing intervention once the initial team has left. The format is designed to be sustained and grow locally. It does not currently include tournaments, but participants may choose to progress to mainstream club basketball.

Participant recruitment was via word of mouth, community leaders and Facebook. [N] was a fully funded with half the costs met by FIBA Oceania and the remainder by the Australian Government. Participants were not required to contribute.

3.4.3 [X]

[X] is a modified basketball program developed in 2016 which targets older adults (over 60 years of age) with an aim at reducing inactivity and social isolation. Particular health conditions were not specifically targeted, but a range were noted by the three program managers, Angela, Helen and Zac, at interview. Delivery took the form of modified basketball drills and games which took place in community basketball facilities in Victoria, Australia. The principal modification, compared with ordinary basketball, is that running was not allowed. Participants were also allowed to use mobility aids if needed, and lower height hoops were used where required. All other aspects of play and rules used in [X] were the same or similar to those used in ordinary basketball. The three program managers had worked to set [X] up in local some basketball associations in Victoria, but it was up to Basketball Associations to run and sustain programs. The only other program element was that participants were invited to share cups of tea and biscuits afterwards to help reduce social isolation. Recruitment was via targeted approaches to local councils, engagement with activity groups and clubs for senior citizens, and via social media. At the time of interview [X] had been piloted in Victoria, but aspired to expand Nationally and was waiting to receive confirmation of the funding required to do so. Basketball Victoria had funded the program managers, court and Association staff costs were met through users paying $6-$8 each per session, and where Councils covered transport costs for participants where this was provided.

3.4.4 [T]

[T] was first began in Australia 2007 and is an ongoing, modified soccer program that now runs in every state in Australia in 18 community sport facilities at the time of interview. It targeted people aged 16 and older experiencing marginalisation due to issues such as homelessness, disability, mental ill-health and poverty. Adam explained that the aim of the program is to promote social inclusion, personal change, to help participants get fit, socialise and seek support if they need it but are unaware of, or have disengaged with, relevant services. [T] did not target specific health conditions, but participants had a range of issues including obesity, Type 2 Diabetes, breast cancer, colon cancer, cardiovascular disease and mental health issues. Some [T] participants were drawn from a mental health facility, and others were identified as having mental health conditions. Having a mental health condition is known to increase the risk of lifestyle disease, but it may be unrelated in the individual (Scott & Happell 2011). The program consists of weekly two-hour sessions, that combine soccer (football) in community settings usually run by two [T] staff, an activity or talk to promote health awareness such as a talk about a mental health or nutrition, often delivered by service providers or non-profits. [T] works with organisations like OzHarvest to deliver nutritional outcomes, and they bring food to some sessions for participants. Soccer games focussed on inclusion and fair play. [T] also held a national competition where players from all 18 community locations were brought together for a weekend competition that focussed on behaviour change as well as soccer competition. Regular attendance and fair play at weekly sessions formed the nomination criteria to attend the national tournament. At the time of interview [T] had officially engaged with 8000 people. Participant recruitment was via word of mouth, The Big Issue Magazine, referrals from services for people experiencing homelessness, poor mental health and from migrant and refugee service providers.

3.4.5 [D]

[D] was an early-stage pilot program that had commenced in March 2019, in the United Kingdom targeting stroke survivors aged 52-78 that used physical activity, group exercise, walking football and Pilates to help participants rehabilitate. Mike explained that current occupational therapy, physiotherapy, speech and language therapy services funded and provided through the National Health Service (NHS) end around eight weeks after a person has had a stroke. The aim of the pilot was to test whether [D] worked to provide effective, affordable, accessible rehabilitation following the conclusion of NHS care. Three hour-long activity-based sessions were offered each week, and participants who were well enough could attend all three and walking football if they were able. A local stroke association partnered with [T] to lead a social support group and provide speech and language therapy classes for participants, and the local University provided volunteers to help participants who required support. Twenty participants began in the first group undertaking the program and recruitment was via hospital and health sector referral. Activity delivery was in community halls and facilities and the cost of delivery was funded through charging participants £5 per session per patient. Mike was the program lead and a researcher at the University Stroke Clinic, and it was this clinic that funded his position and the testing and measurement involved in the pilot program that was designed to establish whether or not it worked. The focus of this program was to develop a format for eventual widespread use in community settings, and to establish through the pilot and measurement that it worked in order to secure NHS support and funding.

3.4.6 [E]

[E] was a modified version of dragon boating targeting anyone who had survived breast cancer. It began in Canada in 1996, has spread across the world, run in Australia since 1999 and at the time of interview there were 30 groups Australia-wide. Beth explained that [E] aims to help survivors get fit, stay well active and healthy, and to raise community awareness of breast

cancer. [E] only involves dragon boat paddling, not other education sessions or program elements. Paddling sessions usually run for between 45 and 60 minutes each week, although each group may vary the frequency or duration of the sessions. Groups paddle on rivers, lakes and inland waterways, and boats either fit 10 or 22 paddlers, with a sweep who steers. Each boat has an accredited coach who will either sweep or paddle. The sport could only be said to be modified in the sense that the emphasis is on participation and inclusion rather than competition. [E] can hold regattas, but groups and paddlers can choose whether they join in, and they are not precluded from joining in mainstream competition. At the time of interview there were around 1100 people paddling in [E] groups Australia-wide. Recruitment was via word of mouth, oncologists, nurses or the [E] website.[79] Sponsorship funded the two part time staff in the national office, and each group needed to fundraise to afford the costs associates with renting or purchasing, storage and maintenance of boats, which Beth explained at interview is expensive.

3.4.7 [H]

[H] is a national, ongoing holistic behavioural support program aimed at getting people to improve their physical activity, health and nutrition. It has run since 1999 and reached over 50,000 New Zealanders across all 82 regions, and it takes place in neutral community settings like recreation facilities. [H] uses multiple sports and partnerships with community organisations to deliver 'activity tasters' (beginner or introductory sessions) and education sessions on health, wellness and nutrition topics. Sarah explained that [H] is about participants setting their own goals for behaviour change and it includes one-on-one sessions at the start and as monthly follow-up with the program manager, to set goals and discuss progress and issues. [H] targets people who identify as Māori or Pacifica, or who have a low income, and

[79] www.dragonsabreast.com.au

who have or are at risk of developing, chronic disease. This includes Type 2 Diabetes, obesity, mental health issues, high cholesterol and hypertension. [H] participants were more likely than average to have poor housing, experience poverty and domestic violence. [H] works with other organizations who are delivering programs,[80] and will support, share resources, partner with and access referrals into these programs for their participants, rather than duplicate existing activities. [H] is funded by the Ministry of Health but finding is devolved to each region, enabling the program to be delivered differently in order to respond to the needs of each community. [H] also includes incentives in the form of vouchers for local fruit and vegetable cooperatives, supermarkets and Rebel Sport offered to families with children. They receive vouchers to the value of NZ$50 when participants signed up, NZ$100 if they make it to six months and another NZ$100 if they make it to 12 months.

3.4.8 [F]

[F] was a multi-sport program targeting adults aged 40-74 identified as at risk of cardiovascular disease, although later the program criteria expanded to also include those at risk of Type 2 Diabetes. Nick explained that the objective of [F] objective was to help participants increase their levels of physical activity to at least the recommended 150 minutes (United Kingdom Government 2019) during the intervention, and to have them continue being active after they had completed participating. It began in 2009 and ran until 2015, reaching over 22,000 people. This was a multi-sport program that included cycling, cricket, rowing, tennis, bowls, rugby, cricket, football, touch rugby and dancing. It was run on a commissioning model, where program managers worked with each of the 23 providers who designed programs, and were paid to deliver them. Each provider had a lot of flexibility, in designing programs but most

[80] Such as the Heart Foundation, Arthritis New Zealand, diabetes educators who all talk about these health issues, St. John's who talk about First Aid in the Home, non-profits who talk about health, mindfulness, stress management, how to heat your own well during winter.

offered participants the [F] sessions for three to six months and used a range of different incentives to encourage them to continue with mainstream sport, including learner training on modified equipment to enable full participation, pricing structures to encourage attendance, training people providing uniforms and offering paid work as officials afterwards. [F] only provided activity-based programs, and did not include an education component. Recruitment was via general practitioners and health checks carried out in community settings. The program was funded the National Health Service (NHS) England,[81] then Public Health England,[82] then Sport England.[83]

3.5 Interview Schedule

The semi-structured interviews were carried out over the telephone, Skype, Zoom Meeting and the WhatsApp telephone calling function. This was necessary as participants were located hundreds, if not thousands of kilometres from the researcher. The researcher offered participants a choice of platform and the participants chose what worked best for them, as most needed to participate in ways that worked within their workplace. Audio recordings were made of the interviews and they were transcribed, de-identified and coded to protect participant confidentiality. Each of the questions asked during the semi-structured interview related to one or more of the themes identified at 2.10. Wherever additional themes were identified during interviews, these were also recorded. A wide range of additional themes arouse including: communication, success measures, transport, misunderstanding of the program, recruitment, facilities, reporting, innovation, flexibility, visibility time poverty of participants readiness to change, deprivation and inter-sport competition.

[81] £4.5 million
[82] £1.5 million
[83] £780,000

3.6 Thematic analysis

Verbatim transcripts were professionally prepared from audio recordings of the interviews with program managers. Transcripts were colour-coded by hand into themes based on the 7 themes arising from the literature described at 2.10[84], as well as any additional themes arising during the interview process. As mentioned in the methodology chapter this study employed thematic analysis (Braun & Clarke 2006) a qualitative research technique where themes, data domains or organising 'buckets' are developed from data collection questions, once the researcher has familiarised themselves with the data (Braun & Clarke 2019). This is a multi-stage approach where interviews are transcribed, read and re-read to identify these themes, develop initial codes for the transcripts, identify over-arching elements and sub-themes (Braun & Clarke 2006). This process involved transcripts being re-written by the researcher into case-studies, coded, and thematic analysis being undertaken comparing each of the case studies. Sub-themes and a definition were identified in the case study and example quotes selected from the transcript. An example of this process is provided at Appendix 5. This process formed part preparing the thematic analysis. The case study and thematic analysis examples linked in Appendix 5 demonstrate the process, and it helped with the identification of barriers and facilitators to program success, and provided ways to identify where the framework could assist in improving processes.

Thematic analysis is a qualitative research technique where organising themes are developed inductively from data that has been collected, transcribed, coded, prepared as case studies, and analysed. In this case the small number of interviews meant that colour-coding transcripts by hand was used instead of analytical software. The coding process and thematic analysis

[84] Method, measurement, money, participants, publication, partners, disease

followed the six phases described by Braun and Clarke (2006), including the transcription, generation of themes from the literature and interview which were used as codes. Preparation and consideration of the case studies and transcripts together then enabled the generation of the 4 overall themes, their naming and defining.

1. ***Custom Designed***: Identifying and designing programs for a target cohort
2. ***Effective Collaboration****:* Understanding funding and stakeholder engagement
3. ***Project Management and Design***: Understanding the multi-layered program mechanics
4. ***Made to Measure***: Importance of recording and effective measurement for sustainability and success

These 4 themes were then used as to structure the overall analysis and presentation of the interview data (Braun & Clarke 2006).

The results chapter was organised by these key themes common to each interview, and the case studies were treated together thematically in the sequence: intervention method, disease, participants, measurement, partners, money and publication. Following this, answers and discussion themes that arose during the interview were described.

3.7 Framework Development

Interview questions were designed to test the validity and usefulness of the proposed framework design against the experience of practitioners leading and 'auspicing' projects. They covered themes identified in the literature review; participants, disease, method, money, measurement, publication and partners. The interview questions, located in Appendix 4., had key themes they sought to explore which included;

- the basic demographics of the interviewee including age, gender, ethnicity and background

- intervention design including sport selected, facilities used, equipment used, participant selection, target lifestyle disease(s), participant demographics
- the target disease(s)
- the method or design chosen for the intervention
- any project partners, whether individuals or organisations
- funding sources and issues
- measurement used, and
- reporting or publication.

Questions also encouraged program managers to describe the problems they faced and identify any additional functionality that could help them address these issues.

This research describes the elements that were altered based on the interviews, the modifications made to the initial proposed design, and the interview findings that led to the changes. The amended framework is found at Appendix 8, with the added elements within phase 6 reflecting the additional issues and themes that arose at interview. The overall process flow for this research is captured in the thesis logic model diagram at 1.5. The research now moves to a discussion of issues and themes arising during the semi-structured interviews, that have informed framework design and any alterations. It will also discuss the ways in which the framework can be used to assist practitioners in the field to improve the way interventions are designed, managed, evaluated and publicised. This amended framework is the key output of this research, specifically designed to help practitioners in future and to improve data gathering for future researchers.

3.8 Conclusions

The literature review makes a compelling case for the need to do more to reduce lifestyle disease, and for the potential community-based sport interventions offer to help people improve their activity levels, change behaviour and overcome barriers to health improvement. It also provided a range of questions that that informed the semi-structured interviews and the development of the initial framework. Thematic analysis of the interview data helped refine the framework, identify additional barriers and facilitators for community sport-based interventions, and highlighted the impact that has been achieved but remains under-recognised. The thesis concludes by addresses the overarching questions posed that relate to: the evidence found of more community sport-based interventions taking place than could be found in peer reviewed academic literature; evidence of effectiveness; how improving intervention methodology could help; how using the framework could help improve process consistency, data collection and the ability to answer more questions to help reduce lifestyle disease using community-based sport. It sets out the contribution that the research makes to the field of knowledge and implications for future research.

4 Introduction to Results

As mentioned in the methodology chapter this study employed thematic analysis (Braun & Clarke 2006) a qualitative research technique where themes, data domains or organising 'buckets' are developed from data collection questions, once the researcher has familiarised themselves with the data (Braun & Clarke 2019). This is a multi-stage approach where interviews are transcribed, read and re-read to identify these themes, develop initial codes for the transcripts, identify over-arching elements and sub-themes (Braun & Clarke 2006). This process involved transcripts being coded, prepared as case studies, and thematic analysis being undertaken comparing each of the case studies.

The themes are identified from the researcher immersing themselves in the data, and taking a rigorous and systematic approach to coding and theme development. They provide this thesis with interpretive stories about the data based on the theoretical assumptions, analytic resources and they build from relationships with participants, where the researcher was able to develop shared meaning united by a core concept (Braun & Clarke 2019). A coding frame was developed as a process to identify and sort into the relevant 'bucket' or theme (Braun & Clarke 2006). For thematic analysis to be valid, a researcher must explain the assumptions that informed their approach and how they were enacted (Braun & Clarke 2019). In this case the coding framework for this research was developed using inductive and deductive reasoning(Goswami 2011). The researcher used inductive reasoning to develop an understanding about which elements of programs may act as barriers or facilitators, or be significant to the improvement of lifestyle disease, based on the data. This reasoning was informed by academic scholarship and sport reports discussed in the literature review. The interview process was deductive in that it enabled the researcher to explore and test their

understanding of program barriers and facilitators by asking questions that related to the overall aims of the project. In order to discuss the findings, four key themes were identified:

5. ***Custom Designed***: Identifying and designing programs for a target cohort
6. ***Effective Collaboration****:* Understanding funding and stakeholder engagement
7. ***Project Management and Design***: Understanding the multi-layered program mechanics
8. ***Made to Measure***: Importance of recording and effective measurement for sustainability and success

The first theme is about 'who' programs are designed for and to some degree 'why' they have been developed. It discusses the specificity of program design for populations, or diseases, compared with those that have a more general design. The second theme is about 'who' does the work, the resources they need to do it, and how they work together. The third theme is about 'what' the programs do, 'when' in terms of activity timings, the organisational mechanics of how they function. The fourth theme focuses on 'how much' and the impact that good measurement can offer in terms of understanding impact, communicating results or the 'why' when it comes to arguing for more program resources that can lead to program sustainability and expansion. Support and justification for these themes was found in quotes by the participants. The researcher reviewed themes prior to defining and naming them, and finalised them to write the thesis, engage with the data, and the analytic process (Braun & Clarke 2006, 2019).

This chapter will present the findings of the semi-structured interviews conducted with practitioners responsible for establishing or managing community sport interventions to address lifestyle disease. The demographic, coding and program information can be found at 3.3.

4.1 *Custom Designed*: Identifying and designing programs for a target cohort

The first theme identified in this research was "Custom Designed" and reflects the importance of programs having the right organisational structure from their inception to accommodate a particular social group or community. Substantial challenges remain in accurately measuring how sports programs can lead to better outcomes for individual communities. What this research suggests is that a well organised, more targeted programs designed to help individuals and communities overcome barriers to health, are more effective than those delivered to the community more broadly. As will be shown in the following section of this thesis, programs were either designed to accommodate those with a particular disease, or target a particular community. Both approaches worked, and it is not possible from the available evidence and measurement to say which approach was more effective. Each of the programs explored in the current study had different target participants and program objectives that shaped their design requirements. Their success in improving lifestyle disease depended on creating a program that understood, and accounted for, the needs and challenges faced by the target group. Program design for each of the groups this study explored demonstrates a range of ways to help address barriers participants faced to being physically active and healthy, with mixed success.

4.1.1 Targeting disease

Three of the programs, [E], [D] and [F], targeted people based on the lifestyle disease impacting them. [E] targeted breast cancer survivors, [D] targeted stroke survivors and [F] targeted adults aged 40-74 with or at risk of cardiovascular disease, though after around two years this expanded to also include people at risk of Type 2 Diabetes. By targeting lifestyle disease, these programs aimed to address specific symptoms or risk factors associated with that disease. In the case of breast cancer survivors, a common side effect of treatment is lymphedema, poor circulation of lymphatic fluid and swelling of the arm that can be uncomfortable or painful

(Breast Cancer Network Australia 2021). The program for breast cancer survivors from the beginning was customised to meet the needs of individuals who had undergone breast cancer, as the following quote illustrates:

> "…was started by a Canadian [Dr Don Mackenzie] back in 1996 who realised that after breast cancer surgery that current wisdom was don't do anything. And he realised that was limiting…so he put them [survivors] in the gym first of all, but then he put them in a boat and that changed everything, particularly with lymphedema..."
>
> **(Beth: [E] – May 2019)**

Participants in the program reported improved health, according to the interviewee:

> "…they believed they're fitter…their lymphedema is more manageable…and that they're more confident about their abilities to do a sport…"
>
> **(Beth: [E] – May 2019)**

This program helped participants reduce lymphedema, a common symptom of treatment. Beth referred to research by Toohey (2018) that used a randomized controlled trial to show that High Intensity Interval Training (HITT), like that utilised in [E] could be useful in helping breast cancer survivors reduce their elevated risk of cardiovascular disease (Cespedes Feliciano et al. 2019). Similarly, the [F] program targeted adults aged 40-74 with, or at risk of, cardiovascular disease. It focussed on helping previously inactive participants achieve at least the recommended 150 minutes of physical activity per week (United Kingdom Government 2019) through providing activities and pathways into mainstream sport and community activity.

> "…we were trying to … reduce the … heart risk, so we wanted people to participate … a number of times…and try to get their 150 minutes [of activity] a week … and [once they had learned] start participating with the mainstream club…"
>
> **(Nick: [F] – Aug. 2019)**

This is also reflected in the design of [D] program for stroke survivors, which sought to address specific stroke symptoms including, difficulties with movement, strength, balance and speech, using a combination of group exercise classes, Pilates, walking football, and speech therapy.

Whilst the program was in a pilot stage at the time of interview, a range of detailed measurements of each participant were conducted upon entry and at regular intervals to establish the effectiveness of the program in assisting with the symptoms and impact of stroke.

> "…we get that sort of background data, … cholesterol and glucose…walking three meters around… sitting back down…four 10-meter walks, three at self-selected pace, one at a maximum velocity… also where they'll monitor the G Walk that…allows us to look at walking symmetry. So, we can…start to monitor whether our intervention is having a benefit on that walking gait…and we do a six-minute walk test for an indication of aerobic capacity, walking endurance, we'll probably start to incorporate 30 seconds sit to stand type activity to give an indication of low muscle strength…. We then go through a series of psychosocial questionnaires, looking at things such as anxiety, depression, self-confidence, social isolation, loneliness, etcetera. …it's quite a lot of measures …when they come in, which is basically a baseline assessment, we then implement the program for 12 weeks... reassess [at] 12 weeks. And then our long-term plan of action is we will then do a reassessment somewhere between six- and 12-months post screening…"
>
> **(Mike: [D] – Dec 2019)**

4.1.2 Reducing inactivity

However, the remaining four programs aimed to reduce inactivity, one of the key contributors to lifestyle disease, but targeted a participant cohort rather than a specific disease. For example, [N] targeted women and girls of childbearing age in Pacifica nations, [X] targeted people over 60 years of age, [T] targeted people over 16 who were homeless or disengaged with health and community services and finally, [H] targeted adults and families with or at risk of a range of lifestyle diseases, who had low incomes and it particularly targeted Māori and Pacifica people.

> …from pregnant women [and their families] right through to older adults, what we're really targeting is those who identify as Māori or Pacifica...or … in the low socio-economic income bracket…and they may be at risk of, or have are developing chronic disease…especially Type 2 Diabetes or mental concerns, weight concerns, high cholesterol, hypertension.
>
> **(Sarah: [H] – June 2019)**

4.1.3 Addressing barriers

Targeting cohorts of people effectively entailed designing interventions that recognised the barriers people faced to being physically active and participating in mainstream sport. These could include financial, transport, accessibility, cultural barriers or a mindset that certain forms of sport were unsuitable for a particular group. Helen from [X] also highlighted that for programs that focused on older participants program design needs to include a transport plan, as many are unable to drive or access suitable transport:

> "…the other really good thing with the connection with the local council is that they usually bus [participants] in... that certainly if you're working with elders, that can be a pretty difficult thing for people to manage…"
>
> **(Helen: [X] June 2019)**

This was further discussed by Edward who reflected that not all barriers to regular activity are economic, logistic or physical, and he explained from his understanding of the lives of women in the target communities how:

> "Cultural expectations of the role of women in the Pacific Islands is one of stay-at-home mum who doesn't do anything. The mindset is that women sit, it's depressing, and changing this is one of the key objectives of the program".
>
> **(Edward: [N] – May 2019)**

Equally, as Adam pointed out, participants may have additional needs that require a different choice of settings than may normally happen in community sport:

> "…indoor settings or those with lots of noise can be claustrophobic for participants.."
>
> **(Adam: [T] – June 2019)**

Each of the programs identified barriers that people faced to being physically active enough for good health, to reducing their disease symptoms or risk. It was clear that this understanding underpinned program design in each case and efforts to address barriers took many forms

including bringing programs to where people needed them,[85] reducing or removing costs for participation,[86]and providing education[87].

4.1.4 Accessibility

In designing a program, one of the important factors remains ease of local access for participants. Accessibility for participants was aided by each of the programs being conducted in community facilities or community sport settings. The nature of the activity constrained location for example when a waterway was needed to paddle, or a court was needed for basketball, but program design reflected a thoughtful approach to helping address barriers, and responsiveness to participant feedback. The [D] program used community halls and facilities based on their disability accessibility for participants, accessible bathrooms, transport access, and cost control, recognising the challenges stroke survivors faced. Whilst [T] could use indoor or outdoor spaces, program designers prioritised outdoor settings because these were preferred by participants, to avoid excessive noise and reduce feelings of claustrophobia associated with indoor settings.

4.1.5 Program design; frequency, session duration and longevity

A sub-theme that emerged when discussing the delivery and targeting of individuals related to the frequency and session duration, which varied between programs. Five programs [E], [H], [T], [N], [H] ran only one session per week, although one [E] had the option for more sessions depending on the availability of participants and equipment another [H] included additional monthly one-to-one sessions with participants.

[85] [N] and [T]
[86] [N], [X], [T], [D], [E], [H], [F]
[87] [N], [T], [H],

> …the one-on-one interventions or the personal goal setting is really lead by participant in terms of what it is that they wanted to get involved with, whether it's walking, or something more structured, like regular swimming…or joining a local group or [sports]club…"
>
> **(Sarah: [H] – June 2019)**

Two programs, [F] and CR, provided multiple weekly sessions. The [F] program encouraged the community sport organisations they contracted to deliver the program to offer multiple sessions, so participants would accrue at least 150 minutes of activity per week and [D] offered two one-hour sessions per week suitable for all who chose to attend and a further higher intensity session for those had been screened as suitable to the attend. Session durations were variable, but usually 1 to 2 hours, ranging from 45-60 minutes [X] to as long as three hours for [N]. [F] took a flexible approach to session duration provided participants accumulated 150 minutes of activity in order to provide all of the weekly minimum activity recommended by the United Kingdom's Chief Medical Officer (United Kingdom Government 2019). [D] offered sufficient programming for participants who were well enough to do the same. However participants in the remaining programs would need to engage in other weekly physical activity to meet the minimum rates of physical activity set for adults by the World Health Organization (World Health Organization 2020a), that align with those used in the UK (United Kingdom Government 2019). [H] specifically encouraged participants to increase their levels of physical activity based on individual goal setting, but no targets were set in the other five programs.

Some programs were sustained over the long term, and others were less enduring or only designed for participants to engage with for a prescribed period. [E], [T], [X] and [N] were ongoing programs where participants had agency and choice about how long they wish to attend. In the case of [N], the intervention is initially led by intervention staff for 6-8 weeks,

but during that process the [N] team trains local people who are then recruited and paid to deliver the program and make it sustainable in each country:

> "…through developing good quality facilitators and good partnerships with local organisations…"

(Edward: [N] – May 2019)

Local coaches are also paid by the international sport federation for their work on the program as it continues in the community. The [D] program is designed to run for 12 weeks, but participants are welcome to continue attending, and according to the project manager over half had done so. [F] programs ran for 3-6 months, and [H] ran for 3-6 months for adults and 12 months for families. In both cases the objective is to create a pathway for participants into mainstream community sport and activity. The aim of each of the programs is to change behaviour, but where [F] and [H] act as a discreet intervention in people's lives that provides a pathway to mainstream activity but has a finite end as an intervention, [E], [T], [X], [N] and [D] are designed to continue and offer enduring support to those who choose to continue participating.

4.1.6 Program staffing

Facilitation of the programs and ratios of participants to facilitators varied but for [E], the many sports involved in [F] and [X] where the sport alone was the intervention, these ratios conformed with the traditional format for each sport. For example, in the case of [E], a boat holds either 10 or 22 participants plus a boat coach or sweep and a single coach would either sweep or paddle with the group. The [D] program offered sessions run by a Neuro Physiotherapist, a Pilates teacher and a coach if attendees chose to participate in walking football, and supplied volunteers for those fewer mobile participants who needed help. [T], [N] and [H] use coach facilitators for the activity sessions and a range of community partners

for the accompanying health and behaviour change education components. Topics include nutrition, mental health, family planning, healthcare, personal safety and information about local services. [H] also provided a monthly one to one session with program staff, to help with individual goals.

> "…It's important to offer practical, accessible opportunities not just the talking. It's, 'Okay, let's do this together,' whether it's cooking, or some kind of activity, or sport…"
>
> **(Sarah: [H] – June 2019)**

4.1.7 Price

The structure of each of these programs with one paid leader for a group of participants, made delivery far more affordable than for an individual to pay for one-on-one service:

> "...with stroke patients…after those six to eight weeks, you're pretty much, you're done with the NHS… independent physiotherapy…costs about £100 an hour. So, unless you've got really good insurance or you've got a lot of money behind you, that's not, that's not feasible...We cover our costs and patients make a small contribution…it costs us about £70 a session to run one of our classes…it costs £ a session for a patient [and]…we need about 13, 14 people to turn up …to cover our costs…"
>
> **(Mike: [D] – Dec. 2019)**

Again, the understanding of the barriers encountered in accessing services, led to program design that addressed affordability as well as transport and physical accessibility issues, which will be discussed later in this chapter.

4.1.8 Sport offerings for beginners

In some of the programs a range of sports were used, with [F] and [H] being multi-sport programs. For example, [F] commissioned sports clubs including cycling, rowing, tennis, rugby, cricket, football, touch rugby and dancing to run programs.

> "…the allocation of funding was to community organizations… all sorts of different community sports clubs…we went from three predominant [leisure service] providers to…23 different provider organizations who were all funded…to deliver stuff in community settings…"
>
> **(Nick: [F] – August 2019)**

[H] invited local community sport and activity providers to run taster sessions.

> "...the personal goal setting is really lead by participant in terms of what it is that they wanted to get involved with, whether it's walking, or something more structured, like, regular swimming, joining a local group or club … or…community recreation events like a fun run…So it's around their aspirations, and then health and well-being and how they want to enjoyably achieve it …we…facilitate their access to a sustainable option…"
>
> **(Sarah: [H] – June 2019)**

In both cases this enabled program participants to choose which activities they wished to participate in, which programs managers reflected worked well.

A range of modifications were made to the sports to better accommodate the needs of participants in [X], [D], [N], [F] and [T] as follows. For example, in [X] basketball is played but no running is allowed. Other than offering lower hoops and allowing participants to use mobility aids if required, the program included traditional basketball drills and game play. Walking Football used in [D] also provided a game format that prohibits running, but otherwise it conformed to the traditional soccer format. [N] begin with an introduction to movement not normally used in basketball, because many participants had not participated in any form of structured physical activity which then developed over time, as the program manager reflected on in the interview.

> "…Skilled program facilitators then gradually progress participants into more rigorous activity [and eventually] to learning and playing basketball..."
>
> **(Edward: [N] – May 2019)**

[D] also worked to help participants build their skills, fitness and confidence and they could progress over time to walking football. This required first however a program that was focused

on chair-based aerobics or Pilates until their recovery and fitness progressed to a point where they could partake in the other activities.

> "…in March 2019 it started off with a motor skills development session, that included walking football and hand eye coordination."
>
> **(Mike: [D] – December 2019)**

At times modifications were made to the sports used within programs. Each of the sports involved in [F] used beginner versions of the sport, or modified equipment, to teach program participants. Some sports clubs involved in [F] also used other more social activities to attract participants. For example, the tennis club used Zumba classes and the cricket club ran 'Bums and Tums' and Yoga classes for adults whose children were attending cricket coaching. Both clubs used these classes to entice adults to participate in their respective sports.

[T] modified the sport by emphasising inclusion, not just competition. The coordinator for [T] reflected on this as an important consideration to the design of their program.

> "We find soccer is really inclusive, it's played in different cultures, and we include everyone regardless of ability. It's an easier game than Rugby League or Union and a higher intensity workout from constant running and sprinting."
>
> **(Adam: [T] – June 2019)**

[H] included the delivery of 'taster sessions', introductions to the sport or activity designed for beginners, to enable participants to try a range of different sports and activities and choose what they liked best.

> "…group programs, they are based in the community and we would bring other sport or rec providers in, as a part of a taster or to break down those barriers to joining something a bit more sustainable…"
>
> **(Sarah: [H] – June 2019)**

The most successful community sport or activity providers were those who delivered:

> "…programs tailored towards the non-participant, and that focus on activity rather than competition…"

(Sarah: [H] – June 2019)

This reflected a change in the emphasis or focus of how the sport was played, rather than necessarily a change of the rules or equipment. [E] did not modify the sport other than emphasising participation and inclusion over competition. [E] crews may choose to conduct more social paddles, for example to hold a picnic, instead of training to race. Whilst they may choose to compete, [E] paddlers may remain social rather than competitive participants. A range of sports and approaches were used in the interventions described. Nick reported of [F] but it appeared true of the others too:

> "The majority of projects exceeded expectations, and very few failed."

(Nick: [F] – Aug. 2019)

4.1.9 Equipment

In most cases equipment selection was activity based, chosen to enable the sport or activity to be performed. However, some changes were made that reflected an understanding of the barriers participants may have, and suitable ways to overcome them. [X] used temporary lower hoops for participants who were unable to shoot the full height. One of the tennis projects involved in [F] began using softer balls, gradually moving to ordinary balls over time. A rowing club delivering the [F] program,

> "…identified that people were scared of sitting on the narrow boats because they are quite unstable in the water. Their bid, initially, was part capital to buy stability boats…which [are] the same kind of boat but with outrigger-type stabilisers the side. This was to assist adults to learn to row as the ordinary craft were unstable..."

(Nick: [F] – Aug. 2019)

Planning and implementing these changes required an understanding of the health conditions, capabilities and limitations of the participants, the ways in which each sport could be modified

to adjust for participant needs, and of ways participants could be progressed over time as their skills and fitness increased.

4.1.10 Non-sport elements of programs

Of the seven programs discussed, five [D], [N], [H], [T], [X], used measures other than sport to help address lifestyle disease. [E] and [F] were sport only programs, with no other elements. The only non-sport element offered by [X] was a social catch-up over cups of tea after the activity to address social isolation, but not inactivity or any risk factor for disease. The [D] program partnered with the Stroke Association who ran a monthly social support group and provided speech and language therapy classes for participants. This helped with disease symptoms as well as social isolation.

Three of the programs, [N], [H] and [T], also aimed to reduce lifestyle disease through providing education to help participants improve other health behaviours such as nutrition, mental health, personal safety or engagement with service providers relevant to the individual. The [N] program promoted behaviour change through education sessions covering nutrition, hydration, what to wear when exercising, how to look after your body and keep yourself safe. The program partnered with non-profits who help women with contraception and reproductive health issues, and who support women and children impacted by domestic violence and sexual assault. The program manager was considering adding martial arts training to the program to help women keep themselves safe, due to the high rates of domestic and family violence they faced. [H] provided education in nutrition, cooking, health and wellbeing and patient centred support. [T] sessions always included an activity to promote health awareness, which may be a guest speaker from another organisation, or a discussion. OzHarvest also brought healthy food to sessions to promote good nutrition.

Three of the programs also used forms of incentives to help with behaviour change. [T] offered selection to attend the annual national competition, where players from all 18 locations attend to compete for one weekend and focus on behaviour change.

> "…we try and get participants from each program who have…participated in the program on a regular basis and like with a sense of fair play…"
>
> **(Adam: [T] – June 2019)**

[F] program activities included a wide range of incentives, and the program had a goal of seeing what would work to keep people active following the intervention. The rugby program trained participants to become referees and offered £50-60 worth of official kit to those who completed three months of training. Trained referees could also then go on to be paid for refereeing games. Other sports offered different pricing models to incentivise continued participation. Touch rugby session fees reduced based on continued attendance from £3 for the first three months to £2 for the next three months and £1.50 after six months continued attendance. Other [F] sport providers used different sport-appropriate incentives. [H] offered the highest level of incentives of any program for participants in the child and partner programs and this took the form of:

> "…vouchers...[for] a local fruit and veggie co-operative…[and] 50 bucks [NZ$50 voucher for Rebel sport] when they signed up, and the $100 dollars if they made it to six months and then another $100 dollars if they make it to 12 months.
>
> **(Sarah: [H] – June 2019)**

It was unclear what contribution education, incentives or other features of these programs made to overall success, and further work is needed to evaluate which model is more effective at changing behaviour and sustaining participation. However, [E] and [H] have both run for 20 years and are the longest running programs as, but they are at the opposite ends of the spectrum for incentives and additional program elements. [T] has run for 12 years in Australia, [N] for 4 years, [X] for 3 years, and each program planned for continued delivery or expansion. Only [D] could be described as short duration at 9 months by the time of interview, as it was running as a trial to test efficacy. [F] was the only program to have been stopped, but it ran for 6 years but reached over 22,000 participants.

The design of each of the programs reflected an understanding of the potential barriers to physical activity and health faced by the targeted cohorts, and a range of creative solutions to help overcome them. Programs also enabled some opportunities for customisation to meet the needs of individuals in the form of empowering [H] and [F] participants to choose their own sport and activity, and education on a range of topics for the [H], [N] and [T]programs that enabled participants to engage with what was most relevant to them.

4.2 *Effective Collaboration:* Understanding funding and stakeholder engagement

Effective collaboration is needed in order to secure the resources to deliver interventions. This topic covers the funding sources and constraints of the different programs, and the way stakeholders within and beyond sport were engaged to assist with program delivery. It also discusses the technology used to engage stakeholders, and the approach to recruiting participants. For programs to work, each of these different elements, and the people involved, needed to work together.

4.2.1 Funding

Each of the programs explored in this thesis operated in varied contexts, with some having participants that struggled to afford sufficient healthcare to overcome, avoid, and/or manage lifestyle disease. The challenge for those organising community sport-based programs to improve health, when participants are unable to pay the ordinary cost of health services or club sport participation, is to secure funding and deliver programs in a way that is affordable for participants. Interview participants reflected how funding sources can come from a variety of sources including governments and sport governing bodies. Securing government funding often requires grant writing skills, can entail meeting challenging conditions which can be subject to change or annual renewal, and requires the preparation of progress and acquittal reports. However, securing this funding has become increasingly challenging. Nick described with [F]

that £500,000 of the original £5 million grant secured to run the program starting in 2009 had to be returned due to austerity measures in the United Kingdom following the global financial crisis. [F] did receive a further £2.28 million as the program continued and demonstrated success:

> "…we had an additional £1.5 million after…two and half years of that project...from Public Health [England]…and then Sport England provided £780,000 …for the last phase of the project…"

(Nick: [F] – August 2019)

[D] did not fit within grant funding criteria, which also took place in the United Kingdom, and so Mike piloted a user-pay model using lots of measurement in the hope that demonstrating the program worked would help secure future funding and expansion.

> "…What I'm trying to do is to demonstrate that what we, what we do at the moment works well so we can get, buy in from the NHS, from the stroke association, from our local clinical commissioning group…we're really trying to…show that we can run this community…scheme…that you can pick this up and you could move it somewhere…what we're trying to show is that it could be sustainable…it costs us about £70 pounds a session to run one of our classes…So we need about 13, 14 people to turn up…to cover our costs…."

(Mike: [D] – December 2019)

Mike's efforts to show [D] works, and the further investment in [F] once it had been shown to work also highlight the need to demonstrate impact to secure funding. [X] had been running in Victoria and at the time of interview was awaiting a decision on whether the program would receive government funding to expand nationally.

> "…[we used] innovation funding…to actually start the program. And part of that was collecting the data about whether the program heading influence people to become more active. [we have applied for] funding through the Australian Participation Grant, but…we're waiting [for a decision before we can]...put a resource in every state to drive the program…"

(Angela: [X] June 2019)

In order to secure, retain funding or acquit against funding the program managers of [N], [X], [T], [D], [H] and [F] all had to produce reports, but measuring and demonstrating impact requires skill, and understanding of what to measure. Each of the programs used different funding models. These included fully funded by programs, partially funded programs and programs that required sourcing their own funding through donations and fundraisers, as they received no financial support. The following section of this thesis will explore the stakeholder involvement and how that impacted on the capacity for the program to be sustainable.

4.2.2 The funding dilemma for community sport

Community sport-based programs to improve lifestyle disease face the challenge of covering the cost associated with delivery. The programs discussed were either fully, partially or un-funded. In fully funded programs, no financial charge was levied on participants. All costs associated with program delivery were met by government or other organisations. Partially funded programs required that participants contribute towards program costs, and un-funded programs required participants to meet the cost of participating.

4.2.2.1 Fully Funded

[H], [T], [N] and [F] were fully funded but there were some differences in how they operated. [H] and [T] were completely funded by government and required no financial contribution from participants. [H] was funded by the New Zealand Government's Ministry of Health on an annual basis. Sarah reflected that this created a level of uncertainty with partnerships and staffing:

> "…when we get to the end of the year it can feel a bit uncertain…in terms of that sustainability to really build those partnerships and relationships…We've been really lucky over the last couple of years…all of our team are on permanent contracts now. They used to be on fixed year-on-year…that wasn't a good fit because…[staff] would be like, "Is my contract ending yet?" So all of the team are on permanent... I think [that's] the biggest thing in terms of retaining skills..."
>
> **(Sarah: [H] – June 2019)**

Sarah explained that [H] also had detailed reporting requirements back to the Government, although she noted benefits to this.

> "…there is a lot of reporting…we report quarterly on how many [participants] and where they come from, the ethnicities, their…demographics... and then we were report [using]…Results Based Accountability, so, you know, challenges and successes. We do a lot of storytelling through case studies, which is quite powerful and in we've started to do more around our rubric and qualitative information as well."
>
> **(Sarah: [H] – June 2019)**

[T] was funded by the Australia's Federal Department of Health and Adam was the only program manager in this research who said that they had no difficulty in securing funding for their program. They did however explain in the interview that running a government funded program involved report writing that was time consuming.

> "…each month, each program…reports on the health outcomes of the activities that they performed... So that might relate to a discussion that was had about health or raising awareness or a game that they played that then they related back to looking after somebody's health. We have to report back on the attendances and make sure that we're getting the participants there…as well as the outcomes. Whether it's dealing with services and what connections we're making with local services. But also those individual outcomes that suppliers might share with us...the impacts of eating healthier or getting more activity or getting a job…Those are the predominant basis of our…reporting…"
>
> **(Adam: [T] – June 2019)**

[N] was fully funded but funding provision was split between the Australian Government and the International Basketball Foundation and Edward reflected similar reporting responsibilities:

> "…we've obviously got to report back as the program is funded partially by the Australian Government and by International Basketball foundation. So we have to obviously prepare reports and I've got a board that want to know what I'm doing with my time sort of thing. So we report back to them, but it's really a summary report of those activities…"
>
> **(Edward: [N] – May 2019)**

[F] received a total of £6.78 million worth of funding to establish, run, measure, promote, resource and report on the project, but this was not without difficulty. Program changes to satisfy funders began prior to any activity commencing. Initially this began with a funding reduction:

> "…The original [planned] funding was £5 million but in 2009 austerity measures came in and …business analysts came…looking for their money back… The procurement and commissioning process had been completed, contracts had been signed but nothing had been delivered yet... £500,000 had to be returned but we still had £4.5 million…."
>
> **(Nick: [F] – Aug. 2019)**

As the above quote reflects, the program manager had to advocate strongly with the original government funder in the face of austerity measures to prevent cancellation of the program. Later funding top-ups came from two different parts of government, but these government-funding bodies required that the original aim of the program change to meet new requirements. This included expanding program eligibility to include people at risk of Type 2 Diabetes, and then a greater emphasis on club sport, as opposed to active recreation like walking or leisure cycling.

[F] commissioned sports clubs to deliver an initial fully funded program to participants for three to six months, but clubs could then use different pricing models to encourage ongoing participation in sport.

> "….most projects would probably be delivering…the intervention for at least three months, but we experimented…there was a project that said they would keep people engaged for six months... a three month or a six month discounted period, and then after that period the person would move to…a different pricing model or a different activity…that would feed in to more mainstream activities further down the line…there was touch rugby… and what they did was they'd start off, it started off at a kind of higher pricing point…three pound a session… then...if somebody continued for three months, it would reduce to two pound a session…if they were still going in six months, it would reduce down to one pound fifty a session. So that the incentive to continue was…increased all the time."
>
> **(Nick: [F] – August 2019)**

4.2.2.2 Partially Funded

[X] and [D] were partially funded to cover the costs of program management, and required a small financial contribution from participants[88] to cover the delivery costs of the program. The costs entailed in program development and management for [X] were met by the sport's state governing body, and the wages of the program manager for [D] were met through the non-profit Stroke Clinic he established which was attached to the University. These funding constraints were described by the program managers as preventing the expansion of the [X] program. At the time the time of interview, the management team were awaiting news of whether they would receive government funding to expand nationally, providing more coordinators for each state to enable the establishment of similar programs.

> "…At the moment it's funded … through our [State Sport] organization... Australia has the funding through the Aus Participation Grant...but they're yet to move on that, so we're, waiting…to put a resource in every state to drive the program…till the end of next year…"
>
> **(Angela: [X] June 2019)**

Despite [D] applying for government funding, they were unsuccessful in their application to cover the program delivery costs from a sporting affiliated government department or organisation. However, fortunately for the program, they were able to secure funding for the program's establishment, equipment and management costs through establishing a non-profit attached to the University. Covering program costs required a cost recovery model recouped over time by participant contributions.

> "…[D] is all about trying to provide accessible low cost, a local service where …[stroke] patients make a small contribution…it costs us about £70 a session to run one of our classes, which is basically £50 for a practitioner, £10 to hire [the hall] eight pounds of VAT. So for us to do that, it costs £5 a session for a patient. So we need about 13, 14 people to turn up each [session] to cover our costs."
>
> **(Mike: [D] – Dec. 2019)**

[88] [X] $6-8 [D] £5 per session

[D] intended to seek government funding to expand, depending on the outcome of the pilot.

4.2.2.3 Funding Constraints

Funding was identified as a constraint in every program except [T].

For example, funding constraints and lack of stakeholder engagement limited the ability of [N] to make the program sustainable long term in terms of paying coaches, securing appropriate facilities and recruiting partners to deliver the non-sport education to participants.

> "…not having enough bodies to help deliver the program… enough partners to come on board with that other expertise than sports …of course if you had more money you could probably do more work with these groups…"
>
> **(Edward: [N] – May 2019)**

What the above quote reflects is the frustration of program managers in running program with limited or unreliable funding streams. [N] further reported in the interview that they had increased participation in basketball which led to greater demand for facilities, coaches and referees, but some locations were unable to take place as they did not have the funding or club structure to meet this need. Whilst [H] was funded by government, staff retention remained an ongoing issue as funding was received on an annual basis. This meant that for many years the program could only offer one-year employment contracts, which made it difficult to retain staff over the long term. More recently, due to the continuation of the program staff have been able to be employed permanently. The funding for [H] is tied to specific referral targets, and there is a constrained budget to spend per referral. This limits the resource affordability and the flexibility to deliver a patient-centred approach. The current funding model for [H] is also limited to delivering to 6-month adult intervention or 12-month intervention for families. The program manager reflected that she would like to add a low needs category funded for 3 months, a program for adults with high needs that is highly intensive, and includes more monthly home visits, especially those who are socially isolated and vulnerable. She would also like the flexibility not to have to cut people off after six months.

> "…we're funded in a way that we give x-amount of dollars per referral... and the referral targets define how many start or how many resources we can afford…it doesn't allow the flexibility that we would like in terms of a patient-centred approach. So ideally, it would be great if we could have…one tier that don't get a huge amount of support, a couple of ideas and links in the community and are they doing a wonderful job with the family. They may be graduated after three months. And then the second cohort, a little bit more intensive um...sort of our structure at the moment…And in the third tier…highly intensive…maybe more monthly home visits and home visits to adults, especially those who are socially isolated and vulnerable… and longer engagement

> time, depending on the need, rather than one size fits all, or you know, "Okay you're at six months. We need to cut you off now."
>
> **(Sarah: [H] – June 2019)**

The most profound funding constraint came in the form of the ending of [F]. In spite of the success of the program in terms of transforming inactivity in the target cohort, reaching over 22,000 people, and the program manager reporting that funders deemed it had been successful, it only ran for 6 years and has not been repeated. Final reports for the project could not be found, but a summary report from 2013 prepared for the original funder found that [F] recruited more than twice its original funding target – over 13,000 people against a target of 5,800. More than twice the original target of 3,364, some 8,000 people had increased physical activity levels after 6 months and 62% of participants achieved this against a target of 58%. [F] modelling showed a return on investment of between £2.10 - £3.20 per £1 spent. The evaluation report is descried as making a clear case for [F]'s success as a cost effective model for achieving large scale robustly tracked changes in the physical activity levels of individuals and contributing to health outcomes (County Durham Sport 2013).

[F] also offered the opportunity for further study of financial facilitators and barriers to sport participation. Sports clubs in the [F] program tested different user contributions and incentives to encourage ongoing participation in sport. These ranged from price reductions for participants to incentivise consistent attendance, to gradually moving from free or discounted fees to a normal rate, to free equipment and providing training and opportunities to work for pay as a referee. Further study comparing the effectiveness of different incentives used by each sport could have helped identify the most effective at the time, and a follow-up study of participants in the years post-intervention could also have helped to better understand the ongoing impact of participation cost and incentives. The program manager attributed initial funding cuts to austerity measures in the United Kingdom following the global financial crisis.

Given the success described at interview, in the interim report (County Durham Sport 2013), and the additional funding granted to continue the program, it is regrettable that the program was not sustained or replicated in other parts of the United Kingdom.

As discussed, funding constraints for programs meant they were unable to meet participant needs, and had the subsequent impact of slowing program expansion and the ability to recruit staff and partners. Overall, of the 6 programs still running, [D] still remains in its infancy as a pilot program, but is pursuing a user pays model to make activities sustainable. It remains to be seen whether this will be successful, but the program manager intended evaluating at the end of the pilot and publishing the results.

Whilst [N], [T] and [H] have been funded and continue to be sustainable, they remain vulnerable to cancellation if government funding priorities shift or the International Sports Federation become unable or unwilling to provide support. [T] has run in Australia since 1993 and in Sydney for the past 12 years.

> "…since starting in 2007 [in Sydney], we've, you know, engaged with, uh, 8000 people…"
>
> **(Adam: [T] – June 2019)**

> "…[H] has been around for 20 years…I know that over 50,000 New Zealanders have been a part of this program…"
>
> **(Sarah: [H] – June 2019)**

Whilst [N] only began as a pilot in 2015, and exact participant numbers were not available at interview, it takes place now in the twenty-two member nations in the Pacific area. All three programs depend entirely on funding, reducing their resilience when circumstances change.

4.2.2.4 Not Funded

[E] clubs were not funded by government grants, but the program has been sustained long term. The national office was had successfully secured sponsorship to cover its operational expenses, and clubs undertook fundraising in their community to cover their costs. Beth said it was up to each club how they raised the money to fund the cost of renting, storing and transporting boats. This is expensive, as the boats are large and funding these programs were described as challenging, especially as participants already faced many additional costs related to breast cancer.

> "…each group has its own arrangements, we as a national organisation, don't own any boats. And other [clubs] in Sydney they rent boats. So it's up to the individual group. They did their own fundraising. They're all incorporated…have the ABN, they work under terms and conditions…But they all self-fund…there's 30 groups around the country and they all paddle in different places… [lakes, rivers, inland waterways] … we are 20 years old now…"
>
> **(Beth: [E] – May 2019)**

In spite of the difficulties cited, [E] has been sustained for 20 years. It does not need to answer to government or funders, to prepare complex reports, or change how it operates to align with the changing priorities of a funding body. Neither does it face cancellation by a third party. [E] does not have any non-sport program elements, reducing cost, complexity and the need for broader stakeholder engagement beyond the sport, potential participants and referral pathways.

Participation in these programs measurably reduces inactivity, the burden of lifestyle disease on the health of individual, and the depletion of the resources of healthcare systems, so it makes sense to invest in sustaining them. These programs also appear to offer opportunities to increase sports participation and volunteering. If it was easier to measure and communicate these benefits to governments and sports organisations, it should be easier to advocate for and secure investment. This will be further discussed in chapter 5.

4.2.2.5 Stakeholder Engagement

In order to deliver these programs, this research found that broad range of stakeholders were required to be engaged. Stakeholder in this context refers to parties involved in program delivery, whether as partners delivering elements of the program, volunteers, or on a 'commissioning model' where they were paid to deliver the program. In the case of two of the programs, [E] and [X], stakeholder engagement involved liaising with community sports clubs whose boats and facilities were rented, medical professionals who referred people to participate in the program and local government councils. Specifically, for [X] the program organisers liaise with the local government to organise transportation for elderly participants, who may no longer be able to drive or reach the basketball facilities otherwise.

> "…the other really good thing with the connection with the local council is that they usually bus them [the participants] in. So transport is being easy…"
>
> **(Helen: [X] June 2019)**

[X] depends on engaging basketball associations as stakeholders to run the program once it is established. Staff from the sport state governing body, Angela, Helen and Zac, help set the program up but the association has to run it long term. It can be difficult if there is local demand for [X] but the association is not keen to run the program.

> "…the best programs are the ones where the association comes to us and says that they, they came to do it…" [X]
>
> **(Zac: [X] June 2019)**

The biggest challenge is participant numbers, when at least ten are needed to make the program viable financially. Associations are not keen to take on programs that run at a cost to them.

> "…[if] we only get eight to ten …that's been the ones that have struggled …as…those people drop off … the number of participants is being the key challenge for the associations to be able to offer [the program] ongoing, I guess." [X]
>
> **(Zac: [X] June 2019)**

Overall, each of the other organisations used a range of community sport clubs, non-profit organisations, volunteers and business to deliver programs. In the case of [N], the intervention

also involved staff from the regional office in Australia recruiting local people to deliver the program and sustain it long term. Outreach and recruitment for this took place via national sports organisations in each of the six countries in the pacific that the program had been delivered in at the point of interview. Local non-profits who provide reproductive services[89], support for women and girls, support for mothers and children impacted by domestic violence and sexual assault were then engaged as partners to deliver education about their services and to help participants. The work of the program manager and his team was to identify and engage appropriate partners in each country to help deliver the non-sport elements of the program, which may include:

> "…aid groups local government, local council, advocacy groups, health groups…the local Police and so on…it's hard to, engage those groups, in your activities [that] is probably the most challenging part. You know, as I said, money aside, that would be the part we've got to get right…"
>
> **(Edward: [N] – May 2019)**

What the above reflects is a 'partnership structure' where stakeholders join the program to deliver education that helps participants understand issues, learn about services, access support or change their behaviour in ways that can help. This research revealed that program delivery can benefit greatly from engaging stakeholders in partnership whose goals or interests are shared with the program aims to improve the health of the target group. Non-profit or community partners may have specialist knowledge of domestic and family violence services per [N], first aid, mental health, nutrition per [T] and [H] rehabilitation and language therapy per [D]. Each of the stakeholders engaged to provide participant education had expertise relevant to assisting participants in understanding and engaging with services to improve their health and wellbeing. This complimented the sport-based activity to provide a greater program depth, and the non-sport partners benefited from a program that drew the target cohort together in one place as a group, making them easier to reach.

[89] Family planning, contraception and sexual health

[T] used the same type of partnership structure for services relevant to homeless people:

> "…during that session we will also maybe start or finish, or in the middle there, we'll either run, uh, an activity to sort of promote health awareness …or have a guest speaker to come and sort of educate our group on key …health issues…Whether it be heart disease...mental health research… programs that are based on trying to improve our participant's nutrition…educating them on healthy…choices …when you're going for food. And then also working with organizations like OzHarvest as well to deliver that nutritional outcome…"
>
> **(Adam: [T] – June 2019)**

Both [T] and [N] also delivered sessions that included a sport component, and education in the form of a presentation by the non-profit or community organisation about relevant health topics or services available to help participants. They aimed to provide a more holistic approach to improve health and wellness through combing sport activity with the targeted education. In spite of the complexity and variety of [T] participant needs, the program manager recalled that they could not identify any issues that related to working with their partners. However, the [D] manager recalled that it had taken some time to build trust with the Stroke Association.

> "…the stroke association…are sort of charity. They have funding rounds once a year, but it's purely for research and…this is…£250,000 for a specific research question, which could be qualitative, might be quantitative, but this type of community initiative…doesn't really fit within that sort of bracket. The stroke association …didn't really want to get engaged with us or trust us because we're this separate group trying to maybe try to do what they're doing. But then I think they've had a change of stakeholder and then suddenly the local…stroke association workers came to us saying, it'd be great if we can work together, we can do this and do that. I was like well, I did approach you guys a couple of years ago. You weren't really all that interested…"
>
> **(Mike: [D] – Dec. 2019)**

However, despite these challenges, the [D] program worked collaboratively with the Stroke Association to deliver some of the activity-based sessions.

> "The stroke association now drives the social support group and they also provide some sort of communications speech and language therapy classes for patients."
>
> **(Mike: [D] – Dec. 2019)**

Mike, the [D] manger, described how the Stroke Association provided a monthly social support session, and the local University partnership provided a source of volunteers to assist participants during the activity sessions. Once the pilot was complete the program manager was positive about its succuss and as the below quote reflects envisioned it being run in sport and community settings.

> "…[D] could act as a transition between post-hospital care and participation in modified sport, it could incorporate modified sport or provide a pathway to sport participation or volunteering but at present it is in a development and measurement phase."
>
> **(Mike: [D] – Dec. 2019)**

[H] and [F] worked on a commissioning model for the session delivery, paying existing sports clubs and service providers instead of duplicating or replacing services that existed or could be provided by others. [F] commissioned and paid sports clubs to deliver on sporting activity sessions. [H] however partnered with community sport organisations to provide a more holistic approach to health and wellbeing by creating sessions for sport participation, coupled with community based non-profit organisations to deliver education. The project manager reflected that these included the Heart Foundation, Arthritis New Zealand, diabetes educators, St. John's for First Aid in the Home, non-profits focused on health mindfulness, stress management, how to heat your home well during winter.

> "... it's really important we work with similar organizations who are delivering similar programs, so that we're not reinventing the wheel, supporting each other... and sharing resources in that way…we would…try …to make sure that it's not a lot of cross-duplication going on and [ensure]…information sharing and sometimes partnering on delivery for those organizations delivering similar projects…just trying to aim for…collective impact…"
>
> **(Sarah: [H] – June 2019)**

Of the organisations that used delivery partners, building trust and developing open communication was considered important to the ongoing sustainability of the partnership. It was also important that activity taster sessions provided by partners were delivered at a beginner level, as those which were not proved less engaging for program participants, and this was emphasised by the [H] program manager.

4.2.3 Broader Stakeholder Involvement: Introducing Technology

Some of the challenges with having multiple stakeholders is the ongoing administration involved in program delivery. This included establishing and maintaining communication with stakeholders, coordinating their activities, record-keeping, reporting requirements, and issues related to digital connectivity especially in countries or regions with poor internet coverage. Improving the technology and tools involved offered opportunities to improve stakeholder engagement.

The manager of [N] identified the need to better engage with and recruit non-sport stakeholders, and suggested in the interview that a communication tool that links activity providers with potential partners would be useful for them. [F]'s manger found that computerising and centralising records helped, and the advent of Facebook during the project also assisted greatly with communication about the program, as well as with participants. All participants reflected in the interviews that in order to deliver programs, program managers, sports clubs, health, government, community and funding organisations have to collaborate and have a plan achieve this. Insufficient funding can see programs with the potential to reduce lifestyle disease, fail to reach their full potential, or even stop. Local sports clubs and non-sport partners have expertise, services and referral networks that can help enhance programs for participants, but two-way

communication, resourcing, and relationship management are necessary to maximise collaboration and program impact.

The manager of [D] could see the potential for the application of technology to enhance communication and recording of baseline measurements for programs, participant education and the support for those caring for participants.

> "…it would make sense [if]…someone could log into an app and [report]… some measures of quality of life or social isolation…before they enrolled in a program…[and] get information on what could be suitable exercise...with our program, an educational component, something whereby our patients would get…something …similar to a cardiac rehab model…phase one…information on medication adherence, diets, smoking cessation, alcohol consumption, physical activity goals, whatever it might be. That type of sort of bight-sized evidence education would also be I think very beneficial not just to the patient but also for carers support network as well…"
>
> **(Mike: [D] – December 2019)**

The program manager of [F] raised the issue of the management and retention of program resources once a program is completed. In the absence of a repository for program resources, or a tool for recording what was done, the risk is that all resources created will be discarded.

> "…there was quite a bit of front ended training needed for…the new [community sport] organizations that were being employed by the project... that training was never formalized… if you wanted to replicate it now, you'd probably have to ask me…That's not ideal because if it's not documented, or it hasn't been recorded or standardized, or developed into a package of training for future use, then obviously that can't be replicated…we trained them on…business case development…marketing and promotion, on data collection evaluation, physical activity screening…once the project [concluded]…our training was no longer needed… and so kind of just ended up probably being archived somewhere on the PowerPoint presentation and eventually maybe even deleted…and if we had to replicate it…that would be a barrier…to be able to skill up community projects…
>
> **(Nick: [F] – August 2019)**

Nick identified this record keeping as an obstacle to replicating a program in future, but it is also a barrier to anyone wishing to study program outcomes and identify the impact different elements had on the outcome. He expanded on the need for robust data collection and evaluation to be structured into program design from the outset, for project planning, some flexibility, the application of standards to the way things are done, and that core components

need to be identified for inclusion in interventions. He felt an app or technology support should help do this.

> "…what I would see as being really important for any intervention would be around robust data collection and what … kind of tools you would need to use to make sure that your data collection was robust….In this day and age…you've got to demonstrate…the right outcomes…and that needs to be governed in a standardized way and in a robust way with validated tools…if you don't use the right tools, then somebody will just look at your intervention and say, "Well it's not valid data because you didn't use the right tool to measure."…from my point of view [the priority] is making sure that right from the outset…evaluation's built in, not bolted on at the end. It's a core component in design…I think there are some components that have to be kind of…built in and standard… there are some components where we ... designed how the…activity is going to be delivered and how long it's going to be delivered for and… if that's too defined, and, and too rigid…some of the stuff that was delivered on our project wouldn't … have worked…because they wouldn't have been allowed, allowed to be flexible enough…[but] some stuff that has to be done as standard…things like physical activity screening for instance… there's a correct way and a wrong way to screen people, and if you do it, if you don't do it the right way, then you get yourself in trouble… there'll be core components of intervention that absolutely have to be included to get it right …I guess it's coming up with what those core components are and then making sure that any app or support kind of covers those core components…"
>
> **(Nick: [F] – August 2019)**

With [T] Adam saw the need for technology support to help participants and service providers better understand program objectives, to access resources, raise the profile of relevant services that participants may be unaware of, or find hard to access because they are homeless or have challenging personal circumstances.

> "…so makes it easier for either service providers or participants themselves to see what the program is trying to achieve or … what the model is, we're not trying to have a competition. We're trying to have inclusive space… also…so…both service providers and participants go to find things that they're looking for…and also just general awareness of [T]…[like] an app called…Ask Izzy…helping to raise awareness of a whole lot of different community outcomes for work that's done in the local services…"
>
> **(Adam: [T] – June 2019)**

The program managers for [X] shared the desire for technology support to better enable their target participants and partners to find the program, but they also wanted ways to help show that this form of basketball was inclusive.

> "…I think it's really how we can personify basketball as not just a fast, running, game [it] can cater for everybody…through walking…but that's still a struggle... I think it is really important for older people to understand how they can keep healthy and active…"
>
> **(Angela: [X] June 2019)**

The program manager for [H] shared the desire for supportive technology to track participant progress, and for it to enable them to access resources. However, Sarah also saw cultural safety as a priority and wanted the technology to increase options for participants to contact program managers and each other.

> "…I would want to be able to track progress, individuals, the cohort as a whole, and engagement [with the technology]…I would want it to be...culturally safe in terms of the people that we're working with. So it's all customizable. So it's not just what's in the hospital in terms of how the participants actually see it…and having, resources and tools in real time and there for them and including sort of links to the community or a directory…and having the option to be able to talk back in real time potentially as well…[by] text or email…So having that coach in the pocket could be quite good... and then the ability [for participants] to talk to each other…"
>
> **(Sarah: [H] – June 2019)**

Community sport-based interventions have used a range of different models successfully, but all depend on effective collaboration to succeed. Funding is a key constituent and models range from fully-funded,[90] to partially funded,[91] and un-funded[92] programs. The greater the investment in terms of size and duration, the more programs need to report to, and collaborate with, funding organisations. This can mean program managers of fully funded programs may have to compromise how they deliver in order to meet funding conditions,[93] this can place a

[90] [H], [T], [N] and [F]
[91] [X] and [D]
[92] [E]
[93] [H] and [F]

heavy burden on community sports organisations, and these programs are subject to closure if funding ceases. Programs that receive limited or no external funding may struggle to scale up, require participant contributions that then exclude those who cannot afford to pay, but those that survive may be more resilient if governments or economic conditions change. Stakeholder engagement is critical to program referral and to the delivery of non-sport program elements such as participant education,[94] the supply of volunteer assistance,[95] or to providing participants with relevant service referral pathways to help improve their health.[96] Program managers for [D], [H] and [F] all identified some challenge with engaging stakeholders, but the common themes in the solutions were communication and building trust. Technology support in the form of the proposed framework could help with funding by making measurement, reporting and communicating outcomes easier. As well as helping report and acquit funding provided, reporting could be used to communicate program impact in order to win funding support. During the interviews program managers expressed a desire for technology support that went beyond the initial proposed framework, this included: enabling participants to record baseline data themselves ahead of program commencement,[97] help with recruiting and engaging non non-sport stakeholders,[98] improving the understanding of program objectives by participants and stakeholders[99], improving record keeping,[100] communication about the program and with participants,[101] ensuring program resources are recorded and retained after it has completed.[102] These suggestions have informed the amendments to the framework, and help identify ways to improve the effectiveness of the collaboration community sport-based interventions depend on for success.

[94] [N], [T] and [H]
[95] [D]
[96] [H], [T] and [N]
[97] [D]
[98] [N]
[99] [T]
[100] [F]
[101] [F], [H], [E] and [X]
[102] [F]

4.3 *Project Management and Design*: Understanding multi-layered program mechanics

Project management remains at the core of successful sport and health interventions. Each intervention involved group participation, which increases complexity compared with the health treatment of an individual. The modality and dosage required to help achieve positive change is less clearly understood than for the treatment of individuals using a traditional medical model, and requires ongoing and responsive project management. Each of the programs was organised in different ways to help reduce lifestyle disease symptoms and/ or its risk factors. The programs all aimed to aid participants in overcoming the barrier to ordinary community sport participation. Quotes below illustrate examples of these barriers, though some were common to more than one program.

[T] targeted people who were experiencing homelessness, disability, mental health issues or marginalisation, all of which could act as barriers to mainstream sport participation.

> "…[T] incorporates people who are struggling with homelessness or who are struggling with a disability or a mental health issue…I feel like they're happy to be part of a group…We don't want to take away from that aspect of the impact being, overcoming marginalization through sport as well [as]…improving our health."

(Adam: [T] – June 2019)

4.3.1 Fitness

A key barrier Edward raised with the women participating in [N] was their complete lack of physical fitness, that left them unable to begin learning basketball initially. [H] had to provide an introduction to movement in order to help inactive women develop gradually to be able to begin learning basketball.

> "…because a lot of the women that we initially get involved probably haven't done…any form of activity…in the early stages…it's sort of an introduction to movement type class with the view that [we] will move them into more rigorous stuff down the track…at their leisure."

(Edward: [N] – May 2019)

4.3.2 Confidence and ability to play sport

Sarah's insights into the barriers [H] participants faced began with their participation that 'sport' was not something they could be involved in. But she also raised the issue of sports clubs needing programs or activities tailored to non-participants, in order to succeed as [H] program providers.

> "… we find that sports, or the word sport, is a real barrier…because they [participants] haven't been- generally haven't been on a pathway of participation from when they were younger kids right through to adults. So if you see the sport they'll be like 'nope'. 'That's competitive' or 'I can't do that'...we need to talk about movement, or physical activity... as opposed to sport or exercise…the…personal goal setting is really lead by participant in terms of what it is that they wanted to get involved with, whether it's walking, or something more structured, like, regular swimming or joining a local group or club. And so we try to facilitate that on a one to one basis…"

> "…we have some really cool community providers that do tailor for that non-participant, the best approach, that includes activity rather than just competition or high performance…for example…a beginner's learn rugby skills participation avenue, rather than just, "Here, you can be in the third division team. Off you go."

(Sarah: [H] – June 2019)

4.3.3 Learning sport as an adult

Nick raised the issue of the resources needed to train adult beginners, explaining the example of the rowing club needing funding for equipment in order to deliver suitable training. The [F] program was able to provide funding to community sports clubs to buy suitable equipment, that they could not previously have afforded.

> "…their bid, initially, was part capital and, and part delivery. So they came in and said, "We need thirty thousand pounds to be able to buy stability boats," so that their target audience will feel more confident and can get in the water and can participate in rowing without the uncertainty or the fear of falling in the water…"

(Nick: [F] – August 2019)

[X] developed basketball into an accessible format for elders through replacing running with walking, enabling more people to play who previously could not have played community basketball. However, as program managers Angela and Helen explained, changing the perception of the game's suitability also proved an obstacle

> "…we struggled to get it going because the perception is always that basketball's a running game… for the older person…they couldn't get their head around it. So we have always struggled to even get into, retirement villages because of that perception…"

(Angela: [X] June 2019)

> "…the program has been that being something different, something new for this market... once they come along, and then once you break down that first fear barrier, which is, "I can't play basketball all the time," and, "It's a scary game," once people start doing it, then, um they're happy to come back and be involved in it. Helen

(Helen: [X] June 2019)

Participants in [D] as stroke survivors, had barriers to participation that related to the severity of the stroke they had experienced, the functionality they were left with and their rehabilitation progress. Mike explained that the eligibility to participate in some of the classes was based on an assessment of the participant's suitability.

> "…it depends upon the severity of the stroke basically. So those who are probably more able are pretty much eligible to come to classes….But those who are more able, they could come two or three classes [a week]…to the chair base standing, moving up class and they might do the Pilates and then [the] get active [class]. Those who have had a more severe stroke might anybody be eligible to come to the Monday class [chair-based exercises called 'Move on up']."

(Mike: [D] – December 2019)

4.3.4 Time poverty

A decrease in the average age of diagnosis meant that breast cancer survivors may be more 'time poor' than when diagnosis occurred at an older age, and less able to participate in [E]. This was because work and family commitments at this earlier life stage acted as a barrier to participation.

> "…the other thing is, you know, breast cancer survivors now being diagnosed so much younger and that demographic, it's really hard to put in to find time to come into a boat…typically a lot of our members are probably in their fifties and sixties and even old…younger women that are diagnosed, they just pushed to get through treatment and then they typically have a job and a family and their focus isn't so much on the fitness, but getting on with life…lots of them start, but they don't stick with it because of family commitments…"

(Beth: [E] – May 2019)

4.3.5 Cost barriers

As is reflected in interviews by program managers, one of the major barriers to being physically active was cost. Whilst [H], [T], [N] and [E] programs were free and [D], [F], [X] were low cost, the programs all aimed to mitigate the financial constraint that participants may face when joining a sports club or participating in many forms of physical activity. For example, Sarah the [H] manager described it best noting the high levels of deprivation, social isolation and wider determinants of health were a barrier for program participants. This could be equally true of [T] participants, many of whom were homeless, or [N] participants, who faced issues of domestic violence and poverty.

> "…readiness to change is very challenging…in some communities in New Zealand in terms of deprivation, social isolation…those wider determinants of health around cost and supportive relationships make it hard for behavioural interventions as well. So I guess the nature of the groups that we're targeting, the challenges that they're facing, uh, the challenges for us getting firsthand good engagement too…a lot of people live in communities that don't have good access to clinics and hospitals and medical care…a

> lot of people…have financial deprivation and low income and can't keep paying for stuff like [sports club participation]..”
>
> **(Sarah: [H] – June 2019)**

4.3.6 Modifying sport

The skills and physical abilities required to play certain sports can also be a barrier to participation [D] and [X] reformatted the sport, offering walking-based formats to accommodate the needs of participants who were older, de-conditioned or who had mobility and other health issues that prevent them from running. [N] provided introduction to movement and [D] classes that helped stroke survivors rehabilitate, enabling participants to transition to participate in modified sport as they progressed and were able to be more physically active. The project managers reflected that this was suited to the needs of their target community as illustrated in the quote below.

> “…our Friday class is ‘Get Active’, which is more of a high intensity aerobic exercise class, which is more about movement…just getting people working at a higher intensity for longer…it comes back to our screening, not everyone is eligible for that class based upon the intensity, but it's something where people can move towards depending upon how they…progress. We're also…going through an agreement [with Council] … to have access to walking football, walking netball as an opportunity for those individuals from our program who could be eligible to engage in these activities…”
>
> **(Mike: [D] – December 2019)**

[H] and [T] used taster sessions[103], other activities, and adult beginner instruction, to enable participants to develop the skills to participate in mainstream community sport. [E] and [T] adapted community sport training to de-emphasise competition and promote inclusion. [D] and [X] both identified participant transport as a potential barrier, as many were unable to drive for age-related reasons. As reflected in the previous section, this was something they drew on local government stakeholders to assist with. Participants in other programs however, travelled

[103] A format for beginner adults

themselves or depended on others to reach the intervention location in cases such as stroke survivors, who are not allowed to drive for at least 28 days after their stroke. [N] took place in villages and community locations in the Oceania region where many people would have no access to personal or public transport to attend the program, and homeless [T] participants would have struggled to travel far to attend. In all the cases where location was identified as an access issue by program managers, and they chose locations or planned for transport to help improve accessibility for participants.

> "…the obvious…challenge we have with stroke survivors is that we might have individuals who can't drive…even if it's a minor stroke or TIA, they're typically not allowed to drive the 28 days post stroke. So suddenly you're very aligned with carers, husbands or wives to basically ferry people to different exercise classes…because there's no guarantee that the care is able to get…individuals to, to certain sessions.…we have basically tried to deliver our classes in more community centres. they're not like the nicest places, but they have disabled access, toilets, ramps, all those sort of things…"
>
> **(Mike: [D] – December 2019)**

> "…our one-to-one sessions are likely to be in neutral community spaces...recreation facilities...out and about in the community, [and] group programs, usually again those recreation facilities. We're just out and about in nature…sometimes travel [for participants] can be quite the barrier to getting face-to-face…"
>
> **(Sarah: [H] – June 2019)**

4.3.7 Overcoming barriers

Each of the program designs reflected sensitivities and an understanding to help participants overcome barriers. Here they stand in contrast to traditionally run sport programs as program managers discussed them as having flexibility that is not always found in traditional club and community sport. Whilst some traditional sports such as skiing,[104] swimming,[105] or surf life-saving,[106] offer well-structured beginner courses for adult learners unfamiliar with these sports.

[104] Australian Professional Snowsports Instructors https://www.apsi.net.au/
[105] Austswim https://austswim.com.au/
[106] Surf Life Saving Australia https://sls.com.au/

Others however, such as rugby union,[107] soccer,[108] or cricket[109] have assumed that beginners are children and whilst social competitions and games offer opportunities for adults to play, some sports have not offered programs to teach adult beginners. Importantly each of the interventions used sports, or a modified version of them, to accommodate adult beginners with each of the interventions excluding [X] provided some form of pathway for participants into mainstream community sport. [X] did not plan to transition participants to mainstream basketball, but given their advanced ages and the use of mobility aids by some, this makes sense. It is possible that as the program expands some participants may go on to volunteer or officiate.

> **"…**we talk to them [they]…can become an active member of their association, you know, they could…volunteer, [be]a doorkeeper, stadium supervisor, a team manager for a little grandchild's team…"
>
> **(Helen: [X] June 2019)**

Therefore, project design and execution reflected a targeted approach as discussed in the opening of this chapter, with a strong local community focus that was built on the foundations of flexibility that were not considered present in sport or health plans by currently being offered by government. This helped drive the success of [F] across a range of different sports[110] helped drive [F] success.

> "…this small dance company…started delivering activities and engaging with the local community, and absolutely stormed this…they managed to open up and, and get people involved in physical activity that a large strategic [Leisure] organization and a team of 12 NHS professionals hadn't been able to achieve…for years…"

[107] Rugby Union Australia – Get into Rugby https://australia.rugby/participate/get-into-rugby
[108] Football Australia https://www.playfootball.com.au/#whereCanIPlay
[109] Cricket Australia https://play.cricket.com.au/
[110] In the United Kingdom dance is considered a sport

(Nick: [F] – Aug. 2019)

The intervention was able to challenge traditional, ineffective attempts to address inactivity, as they further explained below.

> "…in the past we'd been constrained by three, three main providers who always did everything…the way that they had always done it…this really challenged that landscape and it meant that all these other providers were doing…a lot differently than had been done in the past."

(Nick: [F] – Aug. 2019)

Each of the programs challenged the 'status quo' in a range of ways. From [E] defying historic recommendations and using paddling, a sport requiring upper body movement, to reduce the impact of lymphedema, to [X] or the walking football element of [D] reformatting sports so they could be played without needing to run, or [N] and [H] challenging cultural and gender norms for Pacifica women around inactivity. These projects, their plans, program managers and those supporting them, have innovated how sport works, to help meet the needs of participants and help them change their behaviour. It was not possible in the interviews to capture the full history of the walking formats of sport, or the rationale for the selection of program elements. This would require access to, and an examination of notes or program documentation dating back 10-20 years ago in the case of [T], [E] and [H], or to program notes now known to be lost for [F].

> "…there was quite a bit of front ended training needed for…the new [community sport] organizations that were being employed by the project... that training was never formalized… if you wanted to replicate it now, you'd probably have to ask me…That's not ideal because if it's not documented, or it hasn't been recorded or standardized, or developed into a package of training for future use, then obviously that can't be replicated…once the project [concluded]…our training was no longer needed…[it] probably being archived…and eventually maybe even deleted…

(Nick: [F] – August 2019)

There could be opportunities for exploration and analysis in the case of [X] and [D] as newer programs, and as pointed out by Nick it would be useful if technology could be used to capture program documentation to assist future study.

4.3.8 Recruitment

Once programs were designed the next challenge for some was recruitment. The common feature of the three programs that reported no problems recruiting participants, was that they used existing networks to refer people whether from homelessness, refugee and mental health services for [T] to health services, general practitioners and hospitals for [H] and [D].

> "…we source referrals from the hospital…70% coming from the hospitals, that's more referrals in nine months than what the traditional [exercise referral] scheme is had over three years…what 'sells' the program [in terms of retaining participants] is the rapport developed with participants and the relationships they develop with other stroke survivors…"
>
> **(Mike: [D] – December 2019)**

Programs that struggled to recruit did so for a number of reasons. Depending on word of mouth and a website for [E] has not been enough to raise awareness, television exposure in 2004 worked (Australian Broadcasting Corporation 2004) but there have been difficulties since then.

> "…We're lacking that visibility now and it's very hard to [gain it in a] very noisy marketplace out there…once people become aware of us, it's not that hard. You know, once they get hooked on dragon boating, they pretty much stick around…"
>
> **(Beth: [E] – May 2019)**

Poor internet coverage made it hard to get the word out about [N], and the program relied on:

> "…the National Basketball Federations contact their volunteers in the communities the program operates in…Facebook [to communicate]...[and]… national basketball players as role models for program delivery"
>
> **(Edward: [N] – May 2019)**

It was a challenge communicating about the [X] program and getting the word out. Large sums were spent in newspaper and television advertising that did not work.

> "…we struggled to get it going because the perception is always that basketball's a running game…they couldn't get their head around it… So we have always struggled …because of that perception…"
>
> **(Helen: [X] June 2019)**

Eventually a social media campaign worked to attract and recruit participants. This consisted of short videos that circulated on Facebook and ended up being shared a going viral.[111]

> "…We had some fabulous social media pieces where we put up a couple of videos…They travelled the world… we were getting people commenting on and saying, "This is my grandmother"… All of this sort of stuff it was just going absolutely crazy…The amount of people around the world that actually commenting on this program…"
>
> **(Helen: [X] June 2019)**

Social media, specifically Facebook, was mentioned as a communication tool by Edward, but none of the other program managers used social media campaigns for recruitment.

> "…social media is one of the primary ways [of communicating in] the Pacific Islands to seem to be on Facebook. And access to the internet, as you would know is, um, it seems so intermittent at best. So we, we try not to rely on emails…"
>
> **(Edward: [N] – May 2019)**

However, a social media campaign may have been less helpful in the case of [D], [H] and [F] where referrals were required, less useful for [T] that targeted participants experiencing homelessness who may have reduced or no access to data plans and devices that enabled social media access.

Some of the challenge of recruitment was that the program new, or new to that country or area, so networks did not exist. Another lesson is that the program recruitment pathway may be

[111] Basketball Victoria (1/8/2016) [Online as at 5/7/2020] https://www.facebook.com/watch/?v=1158326884227623 Basketball Victoria (24/8/2016) [Online as at 5/7/2020] https://www.facebook.com/watch/?v=1177261575667487

different than expected. Adding a burden of conducting the health check, the recruitment tool for [F] to General Practices did not work well. This was an unknown program, no additional payment was made to General Practitioners for the time taken to refer, and this proved an obstacle. A similar problem was encountered by the [D] program. Although there were around 1000 strokes per year in the local health region, there had only been 75 referrals to the program in nine months, and 70% of these referrals had come from the hospital. The program manager had found it difficult to engage with General Practitioners and communicate the value of the program to them to increase patient referrals. By contrast [H] did not require extra work of General Practitioners, so who incurs the burden of referral or recruitment activity may also be material to program success.

4.3.9 Communication

All of the program managers identified communication as an issue, in addition to the issues related to recruiting to programs, though it impacted their work in different ways. [F] began in 2009 and depended on developing and distributing flyers and paper media. This evolved over the project to become more computerised, and to use modern tools like Facebook to promote activities and communicate.

> "…we gave them [sports clubs] training and support around marketing, um, and back in 2009/2010, introducing them to the concept of social media as a way of promoting themselves…back then…people still thought Facebook was this weird thing that …you certainly didn't use it in business [or]…community sport…"
>
> **(Nick: [F] – August 2019)**

A range of communication issues arose for the [D] including communicating with the National Health Service, hospital and physiotherapists to make everything work. Making program communication easier for [D] participants was also an identified issue. The program manager explained that

> "…it would be helpful if participants could log into an app to provide some measures of quality of life or social isolation before they enrolled in a program. It would help if it was easier to gather information on medication adherence, diets, smoking cessation, alcohol consumption and physical activity goals."
>
> **(Mike: [D] – Dec. 2019)**

[H] had several communication issues. The language used in communication about the program had to be altered at times to avoid discouraging participants. Using words like 'sport' or 'exercise' had the effect of deterring people from participating so the program used 'movement' or 'physical activity' instead.

> "We find that… the word sport, is a real barrier… because they…generally haven't been on a pathway of participation from when they were younger kids right through to adults…they'll be like 'nope that's competitive' or 'I can't do that'." So... we need to talk about movement, or physical activity... as opposed to sport or exercise."
>
> **(Sarah: [H] – June 2019)**

The program manager also identified that communication mechanisms could be improved to reach more vulnerable families not currently engaged with health services, to increase referrals to [H]. She also would like to see improvement in the accessibility of resources and tools for participants in 'real time', including links to the community or a directory. Providing this as a digital resource could help. The program manger would also like to enhance communication between program leaders and participants by adding a chat function as more families want to text or email. She referred to this as a 'coach in the pocket' and would like to incorporate peer support communication, where participants were able to communicate with each other via a group chat function.

> "…resources and tools in real time…for them and including…links to the community or a directory … and having the option to be able to talk back in real time potentially …because we're seeing it more and more about families who want to text or email … having that coach in the pocket could be quite good…"
>
> **(Sarah: [H] – June 2019)**

The work of these programs has not been well publicised externally, making it difficult for the people most likely to benefit to find the program. It reduces the likelihood of referral, securing funding support, or that academics and experts will seek to contribute running, studying and improving programs. Gathering and sharing reports of the work being undertaken in this area could contribute to improving visibility and overcoming these barriers. However, it is worth noting Edward, the [N] program manager, identified competition as a potential barrier to sports sharing information about a successful program with each other:

> "…Unfortunately, sports may not want to share if they come up with a good idea, that they know works…"
>
> **(Edward: [N] – May 2019)**

The lesson to be taken from this is that communication, who does it, the tools used, how it is resourced and planned will be important to success.

4.3.10 Community sport-based interventions as sport development

Whilst much of this thesis focuses on the benefit to participants with lifestyle disease of community sport-based interventions, these programs also offer new ways to recruit people into community sport. [H] and [F] had program goals that included transitioning participants to mainstream community sport, depending on what they enjoy. [F] focused on participants identifying mainstream sport or physical activity they can sustain participation in, and the same was true of [H].

> "…Some of the activities might have been kind of starter activities that would feed in to more mainstream activities further down the line…There was a rugby league project that started getting people into touch rugby…[and a] tennis club started …delivering Zumba classes on the tennis courts…which took off…But then they'd be given a flyer of information to people to come along and join the tennis club as well…"
>
> **(Nick: [F] – August 2019)**

Some [E], [T] and [N] program participants have also progressed to mainstream or community sport. This reflects a progression in participant skills, fitness and confidence, and also growth of the sport amongst a new cohort who were previously disengaged.

> "… Parramatta program I think that's one of the reasons why our numbers have dropped. Is that a whole lot of our participants have gone and found a local team to play for…so they don't need to turn up to our sessions as much…"
>
> **(Adam: [T] – June 2019)**

[D] was being run as a pilot program with the intention that, once fully developed and evaluated, it could be run in a community sport setting. It could also act as a transition between post-hospital care and participation in modified sport, or incorporate modified sport or provide a pathway to sport participation or volunteering, dependent on participant ability. Intervention programs to improve lifestyle disease, if planned well and supported, could form part of community engagement and growth plans for sports clubs and sport governing bodies.

[F] demonstrated that a funded intervention program, as well as changing behaviour, can help sport develop and create programs.

> "…the interventions … needed to find their own funding through income generation. After the second Public Health funding phase, we hired a consultancy who did a lot of training …around sustainability and around different funding sources, and supported them [sports clubs] to be able to apply for their own funds to continue the work. By the end of the six years, probably 50% of the projects who'd been funded in the first phase, had no further requirement for funding either because they had found their own or were making sufficient income…"
>
> **(Nick: [F] – Aug. 2019)**

The design and management of these programs included multi-layered program elements to achieve success. They identified and addressed barriers to participation including financial, skill acquisition, physical capabilities and transport. Flexible and innovative approaches were taken to program development to solve problems, overcome recruitment and communication

challenges. Whilst there are more opportunities for these programs to evolve, and for technology to assist, it is also evident that they offer opportunities for mainstream sport to grow through meeting the needs of those currently not participating.

4.4 Made to Measure: Importance of recording and effective measurement for sustainability and success

Recording and effectively measuring programs is essential to understanding and being able to describe their impact, recognise ways to evolve and improve, and to evaluate success. This type of measurement can help communicate the value of programs when they seek funding, volunteer support, or to recruit participants.

4.4.1 Baseline or screening measurement

There are a range of ways to measure programs and individuals, but it is difficult to evaluate impact accurately without conducting baseline measures before and intervention commencement. Only two of the programs, [D] and [F] started by screening participants. [D] conducted the most detailed screening using the American College of Sports Medicine's health history questionnaire (American College of Sports Medicine 2013). This includes background information on family history of cardiovascular disease and other chronic conditions, the individual's personal signs and symptoms of cardiovascular disease, their own personal history of high cholesterol and high blood pressure. The program collected information on the participant's medications, hospitalisations, lifestyle, alcohol consumption, smoking and general background information, height, weight, BMI, waist circumference, peripheral systolic and diastolic blood pressure, central blood pressure, indices and markers of arterial stiffness, and how fast blood travels through the body, cholesterol and blood glucose measures, walking tests for aerobic capacity, endurance, a 'G Walk Test' for walking symmetry, gait analysis. The

program planned to introduce sit-to-stand tests to evaluate muscle strength. Participants then went through a series of psychosocial questionnaires, looking at things such as anxiety, depression, self-confidence, social isolation, loneliness and quality of life.

> "…Some well-funded sports clubs or Leisure Centres running GP referral programs don't track evidence to demonstrate that what they implement is actually effective. This undermines progress in service delivery… [Mike]…wants this program to collect valid data using robust parameters."
>
> **(Mike: [D] – December 2019)**

[F] conducted initial screening to refer to the project in the form of the 'Health Check' carried out by a GP or Leisure Centre staff. This mirrored the National Health Service process and involved asking questions and taking blood pressure measurements to identify whether people aged 40-74 were at increased risk of cardiovascular disease, diabetes or kidney disease. Over time this evolved into sports clubs conducting additional physical activity screening, and eventually the program the registration and screening process was put on line, and the team in the [F] office would do an initial assessment and address any risks that might be inherent with individual participants before commencement.

> "…the NHS Health Check program which launched in about 2008/2009, it was a national program [for people aged] 40-74 [and around 200,000 people per year in out county were] identified as being as at…risk of, of cardiovascular disease…so there was a need to develop an intervention…For [a] GP to perform the health checks, [they received] quite a small sum of money. Um, and so what they were doing was basically just doing the health check, and then doing another health check in six months' time. But not necessarily doing the stuff in the middle, which would take more time. And they were saying that they weren't being paid to do that. So when, so somebody might have had really high blood pressure and that was easy, they'll just write a prescription and send them off to, send them off to a pharmacist and, and that would be done….what we have to do, is…have another recruitment route…we actually, we trained leisure staff to carry out the health checks…they eventually became paid the same source, using the same, electronic systems, record the information in those systems…further into the program …we managed to put the registration process on line, so anybody that showed an interest in becoming involved in one of the activities would go through an online registration process…which would include physical activity screening, and then we had

> a team in my office…who would then do an initial assessment [what] that person had selected, because they could choose what they wanted to do…"
>
> **(Nick: [F] – August 2019)**

Whilst it did not conduct participant screening, [H] did undertake initial interviews and a baseline assessment with each participant, and worked to identify participant goals. It was somewhat surprising that screening was not used in more of the programs, given the prevalence of pre participation exercise screening, that places the responsibility for providing 'clearance to exercise' on physicians (Maiorana et al. 2018).

4.4.2 Measuring participant progress

The next question is how participant progress is measured. Only [D] took consistent detailed quantitative measures at baseline of all participants, and repeated them at every twelve weeks. This measurement was being undertaken to evaluate effectiveness, using standardised measurement tools and instruments applicable to cardiovascular health, stroke care, physical, psychological, sociological functioning to quantify impact. In future they could be set if the program continues.

> **"**What I'm trying to do is to demonstrate that … what we do at the moment works well so we can get, buy in from the NHS, from the Stroke Association, from our local clinical commissioning group, especially that this is the type of service that should be undertaken rolled out to the wider, to the wider population…"
>
> **(Mike: [D] – December 2019)**

Using quantitative, standardised measures recognised by health practitioners enables results to be better understood, communicated and independently impact to be evaluated and compared with standard care. Accurately quantifying impact then enables comparison between cohorts to learn whether the value of varying elements of the program, which can inform decision making and improvement.

This was a pilot program seeking to demonstrate efficacy and detailed measurement was undertaken to enable the NHS to evaluate whether the program was suitable for patient referral. The director did intend that the program, once developed, could be run by the local football club … some measurement may be able to be reduced, but the validity and the effectiveness of the program needed detailed measurement, and the program then needs to be evaluated.

> "…obviously some of the measures that…we're using at the moment are very robust and valid…we use some fancy equipment to show that…what we're doing works. But when you start to roll it out…you can then say, well, we know that this works [and] …we've now simplified what we're doing because we've shown that it works scientifically…"
>
> **(Mike: [D] – December 2019)**

The baseline health check used to refer participants to [F] was not repeated, but new participants were measured using the Loughborough single item (Milton, Clemes & Bull 2013) to gauge baseline inactivity the Stanford 7 Day Recall (Richardson, M et al. 2001) to assess total self-reported physical activity level at baseline. These two measures were then repeated at three, six, nine and twelve months to track change, acting as effective progress measures. In the final stages accelerometry was used to gather real time physical activity data and compare it against the self-reported data.

> "…The Stanford Seven Day Recall at baseline [was]… used to track change…we used the Loughborough single item tool to assess whether somebody was by, by definition inactive at baseline or not… everybody register[ed] for the project…would be followed up by different means…if they were still participating in the project…by a paper questionnaire…If they weren't participating, they would be sent [a] postal survey…by mid-way through the project, we centralized a team. And they were able to pick up a phone and call these people and, and conduct telephone surveys to gather…their Seven Day Recall via that…"
>
> **(Mike: [D] – December 2019)**

4.4.3 Program measurement

Six of the programs, [D], [F], [N], [X], [T] and [H] took quantitative measures of the program in terms of participant numbers. All six of these programs were required to prepare reports to funding bodies. These and the overall participant measures would be used in [T]reporting.

> "…each month [the] program [manager] reports on the health outcomes of the activities that they performed…'
>
> **(Adam: [T] – June 2019)**

[N] also gathered quantitative measures in terms of program duration, the number of coaches, referees and score board managers that had been developed as part of the program.

> "…we get a monthly report on…the length of time…in the session…hours…and numbers…how much training…of locals in terms of…new coaches and referees…people that can manage the score board and…deliver programs and so on.."
>
> **(Edward: [N] – May 2019)**

Consistent qualitative measurements were also used. Two of the programs, [X] and [T] administered participant surveys inviting participants to self-report activity levels.

> "…we run a, a survey at the end of each year [at T] ... of participants to get their feedback and to see what benefits them and get a little bit of an input on the program and see if we can improve it … that also helps us with… Trying to pitch for refunding or just to indicate the service we're delivering to those vendors…"
>
> **(Adam: [T] – June 2019)**

[H] participants complete self-reported surveys at the start, completion and 6 months post-intervention for each participant.

> "…we use surveys of…self-reported behaviours around nutrition, physical activity, um, and spending together as a family… progress around activity, confidence around setting goals, confidence around changing goals…"
>
> **(Sarah: [H] – June 2019)**

[H] managers also recorded a rubric around the efficacy, health, lifestyle and behaviour of participants upon entry to, and graduation from, the program. Survey results were also

incorporated into reports to funding organisations. [H] reporting to satisfy funders was described as time consuming, but has evolved over time to refocus on participant engagement rather than just the numbers participating or weight loss.

> "…there is a lot of reporting …we report quarterly how many and where they come from, the ethnicities, their…demographics... and then we were report [using] Results Based Accountability(Friedman 2005), so, you know, challenges and successes. We do a lot of storytelling through case studies…"

(Sarah: [H] – June 2019)

The nature of measurements taken, and the reason for measurement, changed over time with [H]. Previously participant body-weight measurements were taken and weight-loss was considered an individual measure of success, and a measure of program efficacy. However, the program has moved away from weight, to measures of engagement with the program over time. This has been identified as critical to behaviour change, and to participants sustaining a healthy lifestyle.

> "…they [funders] always…wanted us to track weight and weight loss. That was…deficit based and actually quite harmful to children… given that children are still growing…I would want to be able to track…progress, individuals the cohort as a whole, and engagement…I would want it to be...culturally safe in terms of the people that we're working with…"

(Sarah: [H] – June 2019)

In a similar manner, [N] did not measure participants or their behaviour change outcomes, but did gather 'stories of change'. These are the personal stories of participants, how the program has impacted their lives, and they were used in quarterly narrative program reports. The program manager, Edward, explained the need for greater clarity about the information people would like gathered about the program

> "…we don't know what people want to know."

(Edward: [N] – May 2019)

[E] did not carry out measurement of participants, but did gather stories from some participants of their experience for publication on the website. These testimonials, whilst useful for promoting the program, were not consistent or robust enough to be described as measurement. However, from time-to-time researchers writing about the program gathered participant data based on the measurements needed for their research.

> "…we use it for our website…responses, things like that. But it's not…in any types of specific interview or format… we don't really ask them, the only time we would really ask and just say we wanted to do a publication that we're going to do a news release and we'd ask for a quote or soundbite, yeah, but we really don't go and say, so what did you get out of this? And then we get enough feedback that we don't have to do that…"
>
> **(Beth: [E] – May 2019)**

4.4.4 Other measures

It is difficult to evaluate the impact of a program that fails to take accurate, consistent baseline and progress measures of all participants. Social desirability may influence the outcomes of self-reported measures (Caputo 2017), reducing their accuracy. Testimonials and qualitative measures make it difficult to compare the relative impact of the program between individuals, or to make a strong case for the impact of the program on health (van Wijngaarden, Meide & Dahlberg 2017). It is also difficult using testimonials and qualitative measures alone to compare one intervention with another, with alternative forms of treatment, or with standard care.

[D] had not completed annual program reports as the program was too new. [E] prepared an annual organisational report and the other five programs completed reports. Uniquely the [F] project was evaluated to a set standard, namely the Nesta Standards of Evidence for quality evaluation (Puttick & Ludlow 2012), a method used in the UK.

> "…the evaluation budget was, was in the region of about £250,000…over the course of, over the course of the six-and-a-bit years… which to some people…distressed them because that was a huge amount of money, but …in the context… it was less than 5% of the budget…"

(Mike: [D] – December 2019)

The context for this distress was that the United Kingdom had implemented austerity measures in 2010, following the 2008 global financial crisis, that had seen poverty increase including amongst working people (Poinasamy 2013). However, the evaluation reports were large scale and, the project was deemed successful by Sport England and funding partners.

4.4.5 Program success measures

In addition to quantity and quality measures, in order to plan and manage a project, success measures are needed, otherwise it risks being a 'pilot' program or test whose objectives remain unclear. There was variation in success measures, having them at all, and who set them. [E] and [T] did not have predetermined success measures. Edward identified "repeat attendance" by participants as its key success measure for [N]. [X]'s program managers identified securing finding to expand nationally as the success of the program.

> "…success…it's going national…a program that gives the, another opportunity for, for another targeted market group to be involved in basketball. And we obviously had numbers that we needed to address and we needed to find out if their physical activity improved…"

(Angela: [X] June 2019)

At the time of interview, the project management team were awaiting the decision, but later in 2019 funding was approved, although the program was suspended in 2020 due to COVID-19

pandemic measures.[112] [H] focused on engagement and the ability of participants to sustain healthy lifestyle behaviours centred around nutrition and physical activity. Participants set their own success measures themselves.

> "…I think success would- would definitely be started with engagement. Because we can get 100 people through the door, no problem. But if we're not meaningfully connecting with these people and seeing engagement over time, then we're less likely going to see, an outcome until there is a behaviour change…But success…it's relative to a person, but for us it's around being able to competently sustainably continue healthy lifestyle behaviours cantered around nutrition and physical activity…"
>
> **(Sarah: [H] – June 2019)**

[F] success measures included attracting the target population[113] and getting them to change their behaviour and become more active. Of 22,000 total participants the program managed to gather data from 60% of program participants.

> "…we'd gathered…probably 60% of the total participants' data. So, we had…22,000 at the end of it all…a data set of about 12 to 15 thousand people…who we'd ongoing, you know, self-report and baseline and three-, six-, nine- and 12-month data for, so it was a big, quite a robust pool of data to be able to work with…that's why it was deemed to be successful on that basis really.
>
> **(Nick: [F] – August 2019)**

The final report was not able to be found, and the interview with Nick was conducted almost five years after [F] concluded. The 2013 final evaluation report under the NHS funding showed that against a target of recruiting 5,800 participants [F] by then had recruited 13,000, and by then 62% of participants had increased their physical activity after 6 months against a target of 58% (County Durham Sport 2013). This was considered a success (County Durham Sport 2013), but the program ran for almost three years more on additional funding from Public Health England and Sport England, but these reports could not be found. The [D] program was

[112] Basketball Australia, Walking Basketball – COVID19 Update [Online as at 5/7/2020] https://australia.basketball/participate/walking-basketball/
[113] 40–74-year-olds at risk of cardiovascular disease

in a pilot phase at the time of interview and had not set success measures. In some way each of the programs tells a story of success, even if it remains more narrative, experimental, or qualitative. The choice to attend by participants also represents a level of success, as participation in each program is voluntary.

4.4.6 The other benefits of measurement

In addition to being able to better communicate about a program, to recruit participants, or secure funding, measurement can help facilitate academic study that in turn can contribute to understanding and improving programs. [E], [T] and [H] have all featured in academic journal articles written based on data collected by or about the program. Mike has collected sufficient measurements and applied the necessary rigor to [D] to enable the evaluation of the pilot and he intended to publish his results. He had also applied to establish a control group to better evaluate impact.

> "…the data work we've been collecting for us nine or 10 months is I guess more service evaluation. It's…data which hopefully we can compare to literature, but we don't have our own control group. I'm going through an NHS ethics at the moment to…allow me to have that sort of control group…the challenge with that is that that study wasn't designed to look at that. That doesn't really demonstrate causation. It demonstrates the exercise may have a benefit, but…you can't be wholly confident that …the people who are engaged in exercise and having less strokes and having a few hospitalizations because they engaged in a program, or it might…[be] because of …other things. But as you said, the more, the more robust evidence that we can acquire better that the, I guess the longevity of these types of programs that that can be delivered…"
>
> **(Mike: [D] – December 2019)**

[X] and [N] have not collected the necessary measurements or data to enable publication, though future study could be undertaken. Disappointingly, given its relatively large budget, 22,000 participants and the effort that went into measurement and reporting, [F] results did not make it to academic publication. In spite of using the measurement instruments used, the Program Manager did not think data collection was rigorous enough for academic publication.

> "…but it wasn't a clinical research project, it wasn't an academic piece of work in terms of, in terms of publication…it was, it was a community intervention and like, as I've said…audit evaluation at best…we use kind of…nester criteria…in terms of the quality of evaluation…so it was, it was a large scale evaluation…It was a lot of data [and we] made it more and more robust as time went on in terms of how we would collect at the data…but nowhere near the level of quality in evidence that…would be needed in academic circles.
>
> **(Nick: [F] – August 2019)**

Only the [D] program manager who had an academic background, identified academic publication as a possible program goal, so it is unsurprising that data-gathering methodologies fall short of academic standards. The value to be had, if data collection was made easier, is that greater study of the impact of these programs could be conducted, programs could be replicated, feedback provided to help programs improve, the demonstration of impact and search for funding could become easier.

It is difficult to evaluate the impact of a program that fails to take accurate, consistent baseline and progress measures of all participants. Social desirability may influence the outcomes of self-reported measures (Caputo 2017), reducing their accuracy. Testimonials and qualitative measures make it difficult to compare the relative impact of the program between individuals, or to make a strong case for the impact of the program on health (van Wijngaarden, Meide & Dahlberg 2017). It is difficult using testimonials and qualitative measures alone to compare one intervention with another, with alternative forms of treatment or standard care. If programs were designed to be measured consistently, meaningfully and in ways that evaluate their impact on lifestyle disease symptoms and risk factors this could contribute to the recognition of their success, opportunities for further study and improvement, and to securing funding and support to improve sustainability and growth.

4.5 Conclusion

Custom program design based on understanding of the potential barriers to physical activity and health faced by the targeted cohorts, saw the deployment of creative solutions to help individuals overcome them. Effective collaboration was important to intervention success and funding models, reporting requirements and stakeholder engagement all impacted program delivery. Technology support may offer help with funding by making measurement, reporting and communicating outcomes easier, and with a range of program elements identified by program managers. Multi-layered program design identified and addressed barriers to participation including financial, skill acquisition, physical capabilities and transport. There are more opportunities for programs to evolve, assisted by technology, and they offer opportunities for mainstream sport to grow through meeting the needs of those currently not participating. This could make it easier to share results, be recognised for success, to provide opportunities for further study and improvement, and to securing funding and support to improve sustainability and growth.

4.6 Amended framework

The initial framework was developed to guide a program manager through a series of steps in order to design and plan a community sport intervention to address lifestyle disease. It will assist in: establishing the available equipment and resources, determining the suitability of the intervention for the participants, screening participants for their ability to participate safely, identifying delivery partners, establishing appropriate measurement intervals and measures to be gathered. The original proposed framework design proposed at 3.3 strived:

- for inclusive practice in terms of gender, race, ethnicity, disability status, socio-economic status, religion
- to provide transparent practices and processes

- to produce a program design that is likely to have a positive impact that extends beyond the life of the intervention
- to exclude measurements that involve confirmation bias or are limited to outputs only, rather than outcomes
- to avoid using modalities that have no scientifically demonstrated efficacy beyond the placebo effect – such as naturopathy, faith-healing, or the use of chiropractic for anything other than back pain.
- to assist program managers to identify and select activities, practices and partnerships that are most likely to lead to program success
- to help program managers to identify measurements that can be taken to determine the effectiveness of a program
- to help program managers to gather evidence, report on the program and provide data for publication to help with program publicity and iterative change to drive success and attract resources

The first framework was developed from reading both peer reviewed and grey literature sources, identifying program elements they included and composing a logical sequence of steps. In part, sequence selection was based on essential conditions and necessary inter-dependencies. For example, in order to select an activity, a suitable space and equipment must first be available. In other instances, elements in the sequence were selected based on the researcher's experience of developing and leading interventions and knowledge of sport skill development. Participant characteristics can enable or preclude participation so it is important to identify preferences, barriers and aversions for participants early in the process of design and participant recruitment. For example, someone who has not learned to swim will be unable to participate in a swimming intervention until they acquire this skill. A person terrified of heights may be unable to participate in a climbing intervention, certain health conditions may

preclude some sports for other participants, and religious and cultural values may prevent participation or require modifications such as single gender activities. Successful recruitment to an intervention requires a process of matching potential participants to available activities, and the selection of suitable non-sport activities, and activity providers to address the identified health issues. These were the types of considerations that led to the development of the proposed framework and sport scales.

4.6.1 How interviews changed the framework

The interview data and analysis confirmed the sequence of steps developed in Phases 1-5 of the initial proposed framework, and the use of the sport scales. However, interviews revealed additional themes, and interviewees were invited to suggest things they thought could be helpful in a framework. On the basis of the interviews the draft framework was revised to add sixth phase sequence of steps see Appendix 8. Amended Framework. This prompts program managers to consider whether they will target a single lifestyle disease, multiple diseases or behaviours that contribute to lifestyle disease more broadly.

As set out in Table 3 Coding table starting at 3.4.1 [E] intervention targeted breast cancer only, the [D] program targeted stroke survivors only- one aspect of cardiovascular disease. The [F] program had all people with, or at risk of, cardiovascular disease as its' initial target and was expanded to include people with or at risk of Type 2 Diabetes. [H] targeted all lifestyle disease, inactivity and contributing nutrition behaviours, [N] and [T] targeted behavioural change rather than disease and aimed to address inactivity, nutrition and a range of other behaviours, whilst [X] only targeted inactivity. Based on the interviews, each approach appeared to have potential benefits, but without measurement it is not possible to say which approach is more effective.

The amended framework then challenges program managers to consider the recruitment of participants, partners, volunteers and funders, and to develop a marketing plan for the program. The framework then prompts the program manager to plan how they will communicate about the intervention to partners, volunteers, funders, government, facility owners, participants, as well as how they will communicate about the intervention externally for example to the media. It then prompts them to consider how they will communicate in terms of sharing resources with participants and whether and how they will facilitate communication between participants. This reflects the range of communication issues and opportunities raised by program managers, as well as other barries to success like recruitment, that interventions like [F] and [N] program managers identified could have been reduced with better communication plans.

Finally, the program manager is prompted to consider the intervention duration for each participant, the overall intervention duration and to develop plans for follow-up. The [H] program manager identified that some participants needed longer or shorter interventions than the program structure was funded to provide. [N], [X], [T] and [E] are ongoing programs and participants are free to continue attending. Failure to follow up intervention participants at two, five and ten years on from commencement of the intervention hampers the ability of program manager to evaluate program success and the impact on individuals.

4.7 Creating successful interventions for lifestyle disease

A successful community sport-based intervention for lifestyle disease will be one that reduces disease symptoms, severity, incidence or recurrence. It will also be one that participants want to attend, and which demonstrates that those who do so change their health behaviours in ways that help reduce disease. Current practice varies from the least formal [E] that doesn't specifically measure attendance, to interventions like [N], [T] and [X] that measure overall

program attendance but may not closely track individuals, and which take testimonials or self-reports related to symptoms or health behaviour, through to [H] and [F] with structured measurement for individuals and the program and [D] which takes detailed measurement of individuals that would be comparable to a health setting.

As established in 2.2.1 and 2.2.2, inactivity and poor nutrition contribute to lifestyle disease. So, if an intervention is able to measure that the people involved increase their levels of physical activity and/or improve their nutrition, continue to attend, and sustain these behaviours this can amount to success. The evidence discussed at 5.5.1 and 5.5.2 suggests community sport-based interventions can be successful, and program managers need therefor to design programs with the aim of achieving these outcomes and measuring them for individuals and the group.

However, to continue improving the design and delivery of community sport-based interventions, to compare them to 'as usual care' or to gin a deeper understanding of their impact, more structured methods and measurement will be required. The questions spanning each of the target diseases, and summarised in the table at 2.11, highlight the need for further study to identify; the most effective intervention models for short-, medium-, and long-term improvement, the best sports to use in terms of effectiveness and adherence, the most effective dose duration and frequency, the barriers and facilitators to success, the best intervention structure to reduce DALYs lost, disease symptoms or reoccurrence. In order to conduct this research, community sport-based interventions need to be developed using structured methods, and they need to adopt measures relevant to the specific conditions they seek to impact. The specific measurements that provide evidence of effectiveness are discussed at 5.5.5.1-5.5.5.6 and a discussion of behavior change evidence follows at 5.5.3. Designing community sport-

based programs to gather this evidence will assist not only in evaluating the success of each individual intervention, but also in comparing different programs, and comparing outcomes between participants and those who do not participate and receive ‘as usual care’. These comparisons are essential to learning how to keep improving intervention practice.

5 Discussion, implications and conclusions

5.1 Introduction

This chapter outlines the contribution of this research to the field of knowledge about community sport-based programs designed to reduce lifestyle diseases. As established from the literature discussed in chapter 2, lifestyle disease has an enormous impact on human health, mortality (World Health Organization 2018d) and the global economy (Ding et al. 2016). The rationale for selecting the five lifestyle diseases, cardiovascular disease, breast cancer, colorectal cancer Type 2 Diabetes and obesity, that contribute significantly to global mortality, and whose outcomes and incidence can be modified through changing behaviour, namely inactivity (World Health Organization 2019e) and poor nutrition (Forouhi & Unwin 2019), is explained in detail at 2.8.

This research draws on academic sources and grey literature sources in chapter 2 to frame the discussion of lifestyle diseases and community sport-based interventions, and the data collected and discussed in chapter 4 is then positioned to provide evidence and further the understanding of the organisation, impact and sustainability of these interventions. This discussion remains centred on the significant global and national impact of the lifestyle disease, particularly the five target diseases described in the literature review. It draws in the interventions described in chapter four to add to a discussion of the questions, conclusions, contributions that the thesis makes to addressing the barriers to widespread use of the interventions. It explains how the Amended Framework[114] could help program managers develop, lead, evaluate, report on and communicate about community sport-based interventions to reduce lifestyle disease.

[114] Amended based on feedback

This research should not be viewed as advocating the replacement of healthcare for the treatment of lifestyle disease, but rather as complimenting it or assisting in addressing the social determinants of health such as low income or geographic distance from facilities (Marmot & Bell 2019; Perman, Mullins & Newhouse 2015) that create barriers to accessing health care. Community sport interventions for lifestyle disease can work to compliment surgical and pharmaceutical approaches to disease treatment and this will be discussed for each disease in the sections 5.5.4 and 5.5.5. This research illustrates the strong potential for community sport-based interventions to contribute to disease reduction following onset or identified risk, through helping people increase their physical activity levels 5.5.1, improve health and nutrition 5.5.2 behaviours 5.5.3. It has also developed a framework that could be used to improve the effectiveness, efficiency, sustainability and impact of these interventions.

5.2 Research Aims

This study explored the nature and impact of community sport-based programs designed to reduce lifestyle disease, and developed a framework to support future program development. The aim is to advance the understanding of community sport-based interventions, to help make designing, measuring, evaluating and publishing intervention results easier, in the hope that this will help address barriers to securing funding, measuring and publication of results and the increased use of community sport-based programs to reduce lifestyle disease.

Chapter 2 provided a comprehensive overview of lifestyle disease, its impact on Australia and globally, using quality literature sources. This chapter provides a summary of the findings of this study in the context of existing academic literature and discusses the questions raised for the overall research. It then relates the findings to the impact of the lifestyle disease, and what is known so far about the potential community sport interventions have to reduce lifestyle disease. The aim of this research is to share the work that has already been done, but has not

made it into the academic literature, and to provide a framework that, if used could help more intervention results be shared. The framework is discussed in terms of how the elements and structure could assist in intervention establishment, management, evidence gathering, reporting, promotion or problem solving that could help reduce lifestyle disease.

This research posed four overarching questions. The first was whether more community sport interventions to reduce lifestyle had been conducted than had been evaluated and described in academic literature. The second question was whether these interventions were effective. The third question was whether improving the methodology, consistency of design, implementation, measurement and reporting would make it easier to, conduct, measure, evaluate and sustain community sport interventions to reduce lifestyle disease. A draft framework was proposed to improve intervention methodology based on the intervention elements and questions arising from the literature review.

The fourth question was whether the proposed framework could be applied to the issues identified in the literature review, and to real world examples, to help answer pertinent questions related to health impact, outcomes and behaviour change. Semi-structured interview questions were developed from the literature review and used to ask intervention program managers how the community sport interventions they ran worked, what the impact on lifestyle disease was, what the issues were for them, and what could be done to improve the interventions. Questions were also designed to test whether the proposed framework could help, whether it needed amendment and how it needed to change. Additional findings, a discussion of the contributions of this study, its limitations and implications concludes the chapter.

5.3 Community sport stakeholder interviews

Program managers of community sport-based interventions to address lifestyle disease were recruited, and semi-structured interviews conducted, to answer the overarching questions of this research, gather insights into program success, impact, barriers and facilitators to success.[115] These interviews provided invaluable insights into the ways practitioners sought to address difficult problems in the real world.

Each of the interventions sought to address serious health issues with the enormous economic and disease impacts. They demonstrated innovative approaches, controlled costs to participants, and in spite of a range of obstacles faced, they achieved levels of success that deserve attention and study. The insights of the program managers captured during the interviews and set out in chapter 4, suggest ways their work could be made easier, replicated, expanded on, as well as a range of issues that need further resources. Some reflect the issues that led to the questions posed for each disease in chapter 2[116] others such as the communication issues are new.

5.4 There are more interventions than are evident in the literature

Peer reviewed academic sources on community sport interventions to reduce lifestyle disease were difficult to find. However, it was evident from grey literature sources, and the interviews with program managers, that more work is being done than has been published in the academic literature. This is concerning because it reduces the sharing of results, methodology, impact, potential opportunities to reduce disease, as well as the opportunities to promote successful

[115] As described at 3.1 Semi-structured Interviews and 3.2 Recruitment Strategy, questions developed from the literature process described at Appendix 8. Thesis Logic Model,
[116] 2.7.1.8, 2.7.2.5, 2.7.3.3, 2.7.4.10 and 2.7.5.6

programs. This in turn makes it more difficult for others who may wish to reproduce these results in their own communities, learn from successes and failures, and improve public health.

The data gathered from grey literature sources cited in chapter 2, and through semi-structured interviews in the chapter 4 provided evidence that there had been greater use of community sport interventions to reduce lifestyle disease than had been described in peer reviewed journals, answering the first overarching research question. This data also demonstrated that community sport interventions offer the potential to improve lifestyle disease, and identified a range of common themes related to the difficulties associated with funding, participant recruitment, working with delivery partners, measurement, communication both internal to the intervention and externally about it, as discussed in 4.2 Effective Collaboration and 4.4 Made to Measure. It has also demonstrated the variety and innovation of approaches, and set out a selection of challenges that differ between the interventions as discussed at 4.1 Custom Designed.

5.5 Evidence of effectiveness

At an overarching level the evidence gathered from interviewing the program managers of [N], [X], [T], [E], [H] and [F] showed that they appeared to be successful in helping participants become more physically active. [D] appeared to be on-track to do so, but the pilot had not been completed or evaluated at the time of interview. [N], [T], [D], [H], interventions also appeared successful in helping participants to improve targeted health related behaviours. Whilst interventions appeared to work, a lack of rigorous method and measurement made it difficult to pinpoint their critical success factors, but the following discussion is organised to discuss their effectiveness in addressing the issues raised in chapter 2.[117]

[117] 2.2.1 Inactivity, 2.2.2 Poor Nutrition, 2.7 Target Lifestyle Diseases

5.5.1 Inactivity

Each of the programs sought to reduce participant inactivity, and appeared effective in helping participants be more physically active. This could be used as a proxy for health improvement, because becoming more active is associated with: improved treatment and health outcomes for people following diagnosis of colorectal cancer (DeTroye et al. 2018; Guercio, B et al. 2019; Meyerhardt et al. 2006; Van Blarigan et al. 2018), breast cancer (An et al. 2020; Cannioto et al. 2020; Ibrahim & Al-Homaidh 2011; Lahart et al. 2015; Luo, H et al. 2019), cardiovascular disease (Porter et al. 2019; Richardson, C et al. 2004), to improving or reversing Type 2 Diabetes (Ades 2015; Hordern et al. 2012; Zanuso et al. 2017), to managing obesity (Ball et al. 2001; Bauman et al. 2017; Kilpeläinen et al. 2011 ; Kwasnicka et al. 2020; Oja et al. 2017), and to improving the health of people with cardiovascular disease (Deveza, Elkins & Saragiotto 2017; Oja et al. 2017; Porter et al. 2019).

[E] succeeded in heling breast cancer survivors become more active using dragon boating and whilst [X] used modified basketball to help people over 65 become more active, with neither using other structured program elements. However further measurement would be necessary to evaluate how long increased activity was sustained for, and to provide a comparison with pre-program-participation rates of physical activity. [H] targeted people at risk of lifestyle diseases and [F] targeted people at risk of cardiovascular disease and later Type 2 Diabetes. Both programs were multi-sport, large scale interventions that successfully helped people increase their physical activity rates. Whilst participation was time limited, both created a pathway for participants into mainstream community sport, to help sustain activity. Each of these programs allowed participants to choose between a selection of community sport activities, and whilst the measurement conducted was insufficient to determine the impact of the program to on lifestyle or cardiovascular disease symptoms, it was sufficient to measure an

increase in physical activity rates by participants. Given the [H] and [F] programs involved 50,000 and 22,000 respectively, a follow-up study of a representative sample of participants evaluating physical activity, lifestyle and cardiovascular rates compared with a similar group of non-participants could be a worthy investment as both took place in countries with public health systems that could benefit, if these interventions work to reduce disease and the resultant health costs. As they were also multi-sport programs, it may be possible in a follow-up study to compare the impact of participation in different sports.

There is some indication that participation in particular sports may have better results than others for people with cardiovascular disease (Oja et al. 2017; Porter et al. 2019), but the sports associated with reductions in disease risk differed between these studies.[118] This points to a need for community sport-based intervention programs to take consistent measurements, in order to learn whether particular sports are more or less effective than other when used as part of interventions for lifestyle disease, and raises the question of which sport has the best outcomes for a specific disease or type of participant.

In spite of the 20-year duration of [H], the huge reach of the [F] program over six years, [F] no longer runs and [H] has not spread outside New Zealand. These community sport-based programs have demonstrated they work to address inactivity, a key risk factor for lifestyle disease. However, despite their impact and potential to be used in other geographic locations, they remain under-utilised and [F] is entirely missing from the academic literature. It is difficult to accurately evaluate the health impact of these or other community sport-based

[118]Reduction in CVD mortality for participation in swimming, racquet sports and aerobics, but not for cycling, running and football. Oja
Reduced risk of CVD associated with participation in racquet sports, aerobics, running, and walking, but not for bicycling, softball/baseball, gymnastics, swimming, basketball, calisthenics exercises, golfing with cart, golfing with walking, bowling, or weight training. Porter

interventions, or compare them with usual care, if the measurements taken are not able to be compared with those used in healthcare settings.

For example, doctors use five-year relative survival rates, disease free survival rate, or progression free survival rate to compare different cancer treatment options, and whether they are likely to extend a person's life, induce remission or halt disease progress (American Society of Clinical Oncology 2020). As raised in the questions at 2.8.2.5 following the literature review for Breast Cancer, and in chapter 4, it is not currently possible to evaluate [E] in this way, as ongoing monitoring of individuals is not carried out. At 2.8.3.3 it was also suggested that a 10 year follow-up may be needed to compare the cost effectiveness of a community sport based intervention for colorectal compared with no intervention (Kolovos et al. 2020), on the basis that the full impact may not be realised until a decade had elapsed. As discussed at 2.8.4.3, even relatively small amounts of weight loss combined with exercise can reverse Type 2 Diabetes or prevent pre-Diabetes progressing (Ades 2015; Sampson et al. 2020), however to demonstrate sustained behavior change participants in the Norfolk Study were followed up for two years post intervention. This suggests a need for community sport-based programs to be designed to include consistent and regular measurement of disease indicators, during and post intervention, in order to improve the understanding of what they offer to improve lifestyle disease.

5.5.2 Nutrition

Poor nutrition was identified as a key contributor to lifestyle disease, [H] was designed to help participants improve their nutrition, and provided individual support as well as group sessions involving physical activity tasters, nutrition education and information sessions about relevant community support services. Participants in the [H] and [T] interventions also reported improved understanding of healthy eating and improved nutrition behaviour such as eating

more vegetables. [H] included cooking classes and [T] partnered with Oz Harvest to provide healthy food at sessions, nutrition education and information about accessing healthy food for participants. The [N] program also included a nutrition education component, but this was less of a focus than other education elements of the intervention related to reproductive health, domestic and family violence. Evaluation of participant behaviour change outcomes related to nutrition for [H], [T] and [N] lacked the detail necessary to determine the impact of the nutrition component of the program on lifestyle disease symptoms, or related risk factors for a reduction in DALYs[119]. More rigorous measurement, of weight, adiposity, glucose tolerance, blood pressure, even if only applied to a sample of participants, could have enabled the evaluation of the impact of these programs and a comparison between them and usual care. This is particularly important given the successes demonstrated in the academic literature in two community sport programs that used a combination of soccer and diet and a randomised controlled trial using swimming and diet all of which showed success in reducing markers of diabetes.[120] Success was also demonstrated in reducing obesity using a soccer and behaviour change program that included nutrition education.[121] It appears that community sport-based programs that include nutrition education can work to help participants change behaviour, but further study is required to establish what is the most effective approach, and how this might vary with different groups, individuals and in different settings.

5.5.3 Behaviour change

Community sport-based programs may set out to help participants change a range of health behaviours rather than just focussing on inactivity or nutrition, or they may focus on specific but related goals or program outcomes such as wight loss. Improvements to participant cardiovascular health and physical performance have been demonstrated (Deveza, Elkins &

[119] Disability Adjusted Life Years
[120] 2.7.4.5 – 2.7.4.7
[121] 2.7.5.1

Saragiotto 2017; Mohr et al. 2014; Sequi-Dominguez et al. 2020)[122], as have weight and body-fat loss (Budden et al. 2020; Kwasnicka et al. 2020; Wyke et al. 2015), and others have delivered participant education on issues that act as barriers to healthy living such as mental health,[123] domestic and family violence,[124] and engagement with health and support services.[125]

An attempted Cochrane Review of policy interventions implemented through sporting organisations for promoting healthy behaviour change concluded that there were no rigorous studies evaluating the effectiveness of sport based interventions to increase healthy behaviours, attitudes, knowledge or the inclusion of health-oriented policies (Priest et al. 2008b). An attempted systematic mapping review of interventions in community sports clubs by Geidne et al. (2019) acknowledged previous literature reviews were unable to find controlled studies assessing health promotion, health and behaviour change of interventions, and that without rigorous evaluation the effectiveness, facilitators and barriers for interventions would not be understood. The researchers recommended creating feasible, effective, long-lasting interventions in sports clubs to test implementation in these settings (Geidne et al. 2019). They also noted that almost 60% of the health promotion interventions targeted males in team sport, and focused on a single health behaviour such as physical activity or alcohol consumption, in one layer of the club at an intrapersonal level (Geidne et al. 2019). This underscores to the novelty of [T], [N] and [H] as programs that target multiple health behaviours. It appears community sport-based interventions may offer many opportunities to improve lifestyle disease but a lack of rigorous measurement and evaluation is hindering efforts to understand benefits, communicate value, compare programs, expand successful programs secure funding to make programs sustainable and to continue evolving and improving delivery. Effective

[122] [D],
[123] [T]
[124] [N]
[125] [T], [H], [N]

evaluation offers sport, government and participants the opportunity to understand the return on investing time, funding and resources in these programs. The framework proposed at Appendix 2 and refined at Appendix 8 aims to make it easier for program managers to design, measure and evaluate interventions with greater rigor. This is no substitute for a randomised controlled trial, step-wedge trial or rigorous study of the type required for a Cochrane Review. However, it is resource intensive and difficult to implement programs of this standard in a community setting. Improved methodology and reporting could help leaders in this sector make the case for the investment necessary to carry out rigorous studies, and the pilot model used in [D], or feasibility studies, can provide evidence of the potential of an intervention, or investigate trial data collection and design (Blatch-Jones et al. 2018; O'Regan et al. 2019).

5.5.4 How community sport-based interventions can help address barriers to improving health

As discussed at 2.8.5 and 4.1, access to the activities, services and goods that facilitate human health is unequal, and the practices and conditions that lead to this are referred to as the 'social determinants of health' (Cockerham, Hamby & Oates 2017). Some people or groups face barriers due to socioeconomic status, gender, ethnicity, and disability (Marmot & Bell 2019), but health can also be impacted by an individual's genetics, health literacy, competing needs including childcare and transport access, social circumstances, environment, behavioural choices, access to medical care, healthy food, safety and sanitary conditions of the person's environment (Perman, Mullins & Newhouse 2015). Individuals can choose to change their behaviour; they may have access to health and allied services to assist them to do so, they may face barriers such as low income, a lack of knowledge of available services and transport.

Findings described at 4.1 outlined the ways in which community sport interventions were designed to helped participants overcome barriers. All of the program managers mentioned cost or low income as a barrier to participation in community sport, and in the case of [D] in

accessing physiotherapy at market rates. Each of the intervention models described in chapter 4 was offered free of charge or on a low-cost basis for participants, reducing financial barriers to access and addressing low income as a key social determinant of health (Cockerham, Hamby & Oates 2017; Marmot & Bell 2019; Perman, Mullins & Newhouse 2015). Cost is an identified barrier to paediatric participation in community based sport (Reece et al. 2020; Somerset & Hoare 2018), but a range of other barriers may operate for adults such as a lack of time, physical ability, individual choice or a lack of availability of suitable opportunities within the sport system (Lim et al. 2011).

The [F] program showed at scale, and all of the programs showed in varied forms, ordinary sport clubs, pitches, waterways, courts, fields and community halls can be used to engage people, help them increase their physical activity and improve their lifestyle behaviour. Running interventions in community sport settings where they are most needed, can improve accessibility by reducing the need to travel and community sport facilities[126] and waterways,[127] are generally more numerous than hospitals[128] or specialist therapeutic exercise facilities. As described by Adam, the program manager of [T], participants who had already disengaged with health and support services were able to access the program in community settings close to them, and connect with relevant services through the program. The added advantage Adam reported of using outdoor settings for the program, over indoor facilities, was that this reduced participant stress, which has been identified as another barrier that contributes to social determinants of health (Cockerham, Hamby & Oates 2017).

[126] There are an estimated 97.7 million square metres of community sport infrastructure in Australia https://www.sportaus.gov.au/__data/assets/pdf_file/0009/677970/KPMG_Value_of_Community_Sport_Infrastructure_final.pdf

[127] Royal Life Saving estimates there are 1,077 public aquatic facilities in Australia https://www.royallifesaving.com.au/__data/assets/pdf_file/0003/21945/RLS_FactSheet_33_SWIMMING_PARTICPATION-2.pdf and there are over 300 patrolled beaches in Australia according to Surf Life Saving Australia's App https://beachsafe.org.au/

[128] This varies between countries as well as between rural and urban settings. Statistica estimates there are 1,330 hospitals in Australia https://www.statista.com/statistics/651506/australia-number-of-hospitals-by-type/

In the case of [N], [T] and [H], presentations by relevant allied service providers were incorporated into the program, as discussed at 4.1.5. This helped participants understand these services and what they offered, so they could self-refer or seek a referral to these services rather than requiring the participant to identify which organisations may be able to provide them with assistance. This was shown to have multiple benefits, including helping [T] participants who had disengaged with services identify and access homeless services and providers to help them improve their physical, mental and nutritional health. It also enabled [N] participants to understand and access health care and domestic violence services they may previously have been unaware of, and it helped [H] participants develop awareness of health, nutrition, mental health and social support services they could access locally. This is important because it can be difficult for individuals to identify and navigate the services aligned their needs, and incorporating education into community sport-based health interventions can help better understand health issues and how to navigate the health system and allied health and social services. As described in chapter four, this helped provide a 'wrap around' service approach (Kasthurirathne et al. 2020; Winters & Metz 2009) that encouraged participants in [H], [N] and [T] to engage with services based on their health needs or other concerns related to domestic violence or issues requiring referral. When a 'wrap around' service approach is used in healthcare settings where populations have been identified as experiencing clinical, behavioural, social risk, and social determinants of health factors,[129] it can improve health care outcomes, reduce costs of health service provision and improve the coordination of care (Kasthurirathne et al. 2020). It makes sense to include this approach in community sport interventions to address lifestyle disease, especially for populations targeted by [N] and [T]

[129] For example, a health centre in a refugee community, or a health centre at an aging in place community

who had little or no access to private transport due to having low income or to experiencing homelessness.

Community sport-based interventions offer opportunities to address the barriers to healthy eating, regular physical activity and engagement with health services that may have contributed to people developing lifestyle diseases. Where they are successful, as demonstrated in [N], [X], [T], [D], [E], [H], [F], they merit further study. The rigor applied to the measurement of [D], described in 4.4 together with its model that provided affordable, accessible post-stroke physiotherapy, could see the National Health Service (NHS) in the United Kingdom fund its expansion in community and community sport-based settings.

5.5.5 How community sport-based interventions can help the target diseases

5.5.5.1 Cardiovascular Disease

Community sport-based interventions have been shown to be effective in helping to improve cardiovascular health in people with, or at risk of, cardiovascular disease. As discussed at 2.8.1.1 a swimming-based randomised controlled trial worked to help sedentary women with hypertension to improve their cardiovascular health (Mohr et al. 2014), the Football Fans in Training intervention using soccer described at 2.8.1.5 helped overweight male football fans at risk of hypertension to lose body fat and lower their blood pressure (Wyke et al. 2015). These interventions measured blood pressure, and worked to lower it, as hypertension is a risk factor for cardiovascular disease. The Changing the Physical Activity Landscape (CPAL) program discussed at 2.8.1.7, coded [F] for program interviews, and thematically analysed in chapter 4, successfully used cycling, cricket, rowing, tennis, bowls, rugby, cricket, football, touch rugby and dancing to increase physical activity in a population of 40–74-year-olds with an estimated or actual risk of cardiovascular disease greater than 20%. However, whilst the Health Check

referral to the program included blood pressure measurement to identify those at risk of cardiovascular disease, this measure was not included in participant records or intervention reports, and participant blood pressure was not measured during or post intervention. So, it cannot be confirmed that participant blood pressures were lowered. Instead, a measure of physical activity levels was used as described in 4.4 and the program proved successful at helping participants increase their levels of physical activity.

Each of the interventions described at 2.8.1-5 ran for six months or less. The CPAL program was designed to provide a pathway to mainstream community sport participation, which is a sensible idea as regular participation in sport was shown to lower the risk of death even in people with cardiovascular disease as discussed at 2.8.1.2, and increasing physical activity levels after a cardiac event has been shown to reduce mortality 2.8.1.3. Unfortunately, neither [F], [D] the swimming (Mohr et al. 2014), football (Wyke et al. 2015), or CPAL (County Durham Sport 2012) interventions were structured to include long term follow-up to test the lifetime or mortality impact, but doing so or completing a follow-up study, could improve understanding and practice. There has also been no test of the optimum intervention duration for the management or treatment of cardiovascular disease its' risk factors or symptoms. The swimming based intervention examined effectiveness of longer less intense doses of swimming training versus shorter more intense doses (Mohr et al. 2014). Further study should examine dose impact and effectiveness in terms of frequency of sessions, duration of sessions, the number of months or years of treatment needed for effective treatment.

The [F] program set as an objective for participants to complete at least 150 minutes per week of physical activity. However this reflects a minimum physical activity standard for health (United Kingdom Government 2019), rather than the amount necessary to improve cardiovascular disease symptoms, lose weight or improve health. The new draft World Health

Organization guidelines suggest that it may be necessary to do more to improve health (World Health Organization 2020a), suggesting a need for more study of intervention physical activity dose rates greater than 150 minutes per week.

The [D] program described in Chapter 4 aimed to identify the effective measures that cardiac rehabilitation programs would need to take in future, if run in community settings. As it was running in a pilot phase, it was taking detailed health, medication, lifestyle, physiological, psychological and behavioural measurements of the participants undergoing rehabilitation after a stroke. The program manager explained that the pilot would need to identify which measurements were needed and which could be removed if it proved successful, and suitable to be rolled out in community and sport settings. The data gathered at interview was collected too early in the pilot to determine if it was successful, or whether it would be able to be developed and considered suitable to be rolled out in community sport settings. However, once completed, the results of this pilot may offer insight into measurement selection that could assist a range of community sport programs.

These interventions from the academic literature and interviews[130] appear to have had some success, but knowledge of an intervention as large as [F] appears limited, and was absent from academic literature. The barrier to publication is that the intervention was not structured or measured with sufficient rigor. This was identified by the program manager:

> "…reporting was nowhere near the level of quality in evidence that would be needed in academic circles…"
>
> **(Nick: [F] – August 2019)**

[130] 2.7.1.1, 2.7.1.5, 2.7.1.7, [F] & [D]

These programs[131] indicate that sports with a significant cardiovascular component such as soccer, rugby, swimming, cricket, tennis cycling, rowing, touch rugby, can be used successfully in interventions to increase physical activity. More work needs to be done to measure the impact of each on weight-loss, reductions in body fat, improvements in systolic and diastolic blood pressure and the relative efficacy and suitability of each sport. Further work also needs to be done on the impact of including nutrition and other education, and on overall program design for cardiovascular disease.

It is unfortunate that the work of [F] remains under-studied to date and has not been replicated or built on, as it demonstrated success over a relatively short time-span, at using community sport-based programs to help large numbers of people at risk of cardiovascular disease to become more physically active. Follow-up research could be used to try to establish impact. However, the work of the [D] program, and the aim of this research is to develop and share a framework for future program design that should help ensure measurements are taken, results are evaluated and easier to share.

The questions raised at 2.8.1.8 that are unable to be answered yet include: whether some sports may be more effective than others when used in intervention program for cardiovascular disease, the impact of dose duration, frequency, intensity and intervention duration, the barriers, facilitators and critical success factors for interventions. Questions also arise regarding the impact of interventions on reducing DALYs lost, on improving survival, and why apparently successful interventions are being conducted but remain relatively unknown. Each of these unanswered questions indicates a need for a more structured approach to intervention design, measurement, evaluation and publication, to identify the contribution community sport-

[131] 2.7.1.1, 2.7.1.5, 2.7.1.7, [F] & [D]

based interventions can make to addressing this leading cause of death (World Health Organization 2017a).

5.5.5.2 Breast Cancer

Community sport-based interventions offer opportunities to improve the health of breast cancer survivors during and post-treatment. As discussed at 2.8.2.1 being physically active, in the form of cardiovascular and resistance exercise, following a breast cancer diagnosis can significantly reduce; mortality and disease recurrence, medication-related symptoms, and improve overall quality-of-life. Regular sport participation is associated with lower cancer mortality and, as discussed at 2.8.2.2, sport can be effective therapy for people diagnosed with cancer. The academic literature discussed at 2.8.2.5 raises the need for greater study of the effectiveness of community sport-based interventions for breast cancer. This including; evaluating the impact and effectiveness of different sports in symptom management, the suitability of particular sports at different stages of treatment, further study of effective dose rate in terms of session frequency, dose duration, intervention duration, dose intensity, the barriers, facilitators and critical success factors for interventions reduction of DALYs lost and survival impacts at 5- and 10-years post intervention.

In order to answer these questions and to understand the impact of [E], interventions need to be structured to include regular measurement at baseline, during the intervention, at its conclusion, 5- and 10-years post intervention. The reason for follow-up measurements at these intervals is that this is how the success of other cancer treatments are evaluated (Cancer Australia 2020; Xie et al. 2017). Measuring at the same intervals as the health sector could enable evaluation of the comparative impact of community sport-based interventions compared with usual care.

At over 11% of global cancer diagnosis, and over 6% of cancer deaths (International Agency for Research on Cancer 2019a) breast cancer has a significant impact on human health, but as discussed at 2.7.2 lifestyle change offers the chance to reduce the burden of disease (Danaei et al. 2005). Given the potential for significant reductions in breast cancer recurrence and mortality when survivors are physically active post diagnosis (Cannioto et al. 2020; Ibrahim & Al-Homaidh 2011), opportunities for improving treatment by being more physically active (Cormie et al. 2018), the potential a range of sports offer to prevent and manage cancer (Luo, H et al. 2019) discussed at 2.8.2.1 and 2.8.2.2, as well as the enduring success of [E] discussed in chapter 4, more exploration of the potential of community sport-based interventions is needed.

5.5.5.3 Colorectal Cancer

Community sport-based interventions offer the opportunity to assist colorectal cancer survivors manage the disease and its symptoms. As discussed at 2.8.3.1 participating in sport and physical activity can reduce the health and cost impact of colorectal cancer, by reducing mortality (Kahl 2018; Meyerhardt et al. 2006), extending survival time (Guercio, B et al. 2019), reducing cancer progression and improving the functional well-being of patients. It can also reduce the physical, psychological and psycho-physical symptoms and treatment side effects of cancer (Ferioli et al. 2018). This includes but is not limited to bone and muscle loss, weight imbalance, neuropathy, lymphedema, pain, fatigue, sleep disorders, depression and anxiety (DeTroye et al. 2018; Ferioli et al. 2018) .

The questions raised at 2.8.3.3 included: the need for further study of the barriers to participation in physical activity by people with colorectal cancer, disease co-morbidities, the

underrepresentation of female patients in interventions, and whether it was possible to design interventions and measurement to enable cost-effective, longer-term delivery and follow-up. It is possible, based on the example of the EuroFIT program discussed at 2.8.3.2 that the benefits of community sport-based interventions for colorectal cancer may not be evident till 10 years post intervention. This indicates the need for better measurement, evidence-gathering and follow-up on far longer timescales than are usually used in community sport-based interventions.

Colorectal cancer was not specifically targeted by any of the programs described in Chapter 4. However, 4 of the programs simply targeted lifestyle disease generally, and did not screen for any specific disease, or follow-up on participant disease outcomes. This research to develop a framework to make it easier to run community sport programs targeting lifestyle disease seeks to make screening, measurement and reporting easier and it could improve the ability to identify and measure participant outcomes and enable follow up on the longer-term impact of programs, including on people with, or at risk of, colorectal cancer. The impacts of disease described at 2.8.3 make the case for further research to explore what contribution community sport-based interventions can make to improving the health of colorectal cancer survivors.

5.5.5.4 Type 2 Diabetes

Community sport-based interventions offer opportunities to help people manage Type 2 Diabetes. As discussed at 2.8.4.5 and 2.8.4.6 soccer-based interventions had a positive impact on markers of Type 2 Diabetes including: reducing blood glucose, increasing fat burning, decreasing insulin-like growth factor binding protein 3 levels, reduced muscle breakdown (Vieira de Sousa et al. 2017). The small randomised controlled trial of a swimming and medication intervention 2.8.4.7, whilst conducted in a research rather than a community-sport

setting, also found that swimming could also be used to help improve Type 2 Diabetes and Metabolic Syndrome, based on similar blood markers (Tan & Guo 2019). The [F] intervention that originally focused on increasing physical activity in adults aged 40-74 at risk of cardiovascular disease, widened its focus. As explained in chapter 4, the program manager explained that:

> "…after a couple of years the criteria expanded to people at risk of Type 2 Diabetes."
>
> **(Nick: [F] – August 2019)**

As discussed at 2.8.4.9 the final report acknowledged that Return on Investment calculations could be expanded to include the impact of increased physical activity achieved under the program on Type 2 Diabetes and other health outcomes (County Durham Sport 2013). This intervention demonstrated effectiveness in terms of assisting adults to increase their physical activity, but specific measures related to impact on diabetes, such as blood sugar, were not taken, as explained in 4.4.

People with Type 2 Diabetes can reduce mortality and improve glycaemic control by increasing their rates of physical activity, even if they do not lose weight (Miller & Dunstan 2004), as set out at 2.8.4.3. When people with prediabetes or high risk of Type 2 Diabetes losing 2-3kg of weight and increasing their physical activity over a two-year period they can reduce their risk of Type 2 Diabetes by 40 - 47% (Sampson et al. 2020). Given the health and financial impact of Type 2 Diabetes discussed in 2.8.4.1 and 2.8.4.2 and the promise demonstrated by these community sport-based interventions, they merit further support and more specific research needs to conducted.

5.5.5.5 Obesity

It appears that sport-based interventions for obesity can help participants achieve measurable results. These include clinically significant weight-loss, reductions in waist circumference, percentage body fat, systolic and diastolic blood pressure as outlined in the four examples beginning at 2.8.5.1 (Canterbury Bankstown Bulldogs 2018, 2020; Kwasnicka et al. 2020; Western Bulldogs 2017, 2019; Wyke et al. 2015). Whilst the examples discussed are from football codes,[132] it is possible that participants in other sport based interventions, such as the multi-sport [F] program (County Durham Sport 2013), achieved weight or fat loss, but this was not a target of the program, and therefore not reported on.

The questions arising from the literature at 2.8.5.6 included; the effective dose of activity in terms of session duration, frequency and intervention duration to achieve immediate and lasting change or to reduce the risk of loss of DALY's, the relative effectiveness of different sports whether some sports achieving this when used for interventions, he contribution of diet to the intervention, what best promotes adherence and the need to identify the barriers, facilitators and critical success factors for interventions.

5.5.5.6 Interventions with non-specific lifestyle disease targets

It is important to note that community sport-based interventions may not have specific disease targets, but rather behavioural ones, and these broader interventions also offer great potential to help people improve their health. [H], [T], [N], and [X] all focussed on increasing the physical activity levels of participants. [H], [T] and [N] also included nutrition education.

[132] Soccer, AFL and NRL

None of these programs screened for disease or disease risk factors, when enrolling participants. Neither did they measure any of the risk factors during the intervention or at any stage, so it is not possible to evaluate their impact in terms of reducing specific diseases or disease risk. However, the programs targeted participants for a range of other reasons that are directly relevant to the social determinants of health (Cockerham, Hamby & Oates 2017; Marmot & Bell 2019; Perman, Mullins & Newhouse 2015) including ethnic disadvantage,[133] those on low income,[134] those at identified risk or who have developed chronic disease,[135] people who were homeless or marginalised,[136] had poor health or who lived in communities with high rates of domestic violence.[137] All of these issues can contribute to lifestyle disease as outlined in 5.5.4, and it makes sense for interventions to target people with these additional barriers to good health. However, it may then prove more difficult to distinguish between the impact achieved by addressing the health issue, compared with the impact of addressing other non-health issues.

As discussed at 2.2.1 and 2.2.2, inactivity and poor nutrition are key contributors to lifestyle disease. [H], [T], [N], and [X] all demonstrated success at assisting participants to become more physically active. [H] has run for over twenty years, uses a commissioning model and helps participants find pathways to regular physical activity of their choice that can be sustained beyond the life of the intervention.[138] The [N] intervention is designed to train local people in order to sustain basketball in communities, providing a pathway to regular sport participation for participants after the intervention team leaves. [T] has run for over ten years in Australia, and it and [X] are designed to be ongoing programs. Participants can continue to attend for as

[133] [H] People of Māori or Pacifica background – in New Zealand
[134] [N], [X], [T], [D], [H]
[135] [N], [X], [T], [D], [E], [H], [F]
[136] [T]
[137] [N], [H]
[138] 12 months for families with children and 6 months for adults without children

long as they wish. According to the program manager some [T] participants have left the intervention to form their own soccer team and play in ordinary leagues.

The advantage of targeting behaviour that contributes to lifestyle disease, rather than a specific disease, is that it increases the accessibility of the program to a greater number of people who may benefit. However, these specific programs may miss opportunities to tailor education, information, program delivery or referral to the specific issues a participant may have. As well as physical activity and nutrition education, [H] participants also had an individual monthly session with a program manager, which could provide opportunities to set more individual goals or address issues. [T], [H] and [N] all included program elements where community, non-profits, health, university and mental health organisations, could provide education on the services they could offer participants if needed. This then enabled participants in these less-specific programs to gain awareness of services and organisations that could assist them with their specific issues.

The disadvantage of more general programs is that their health and specific disease outcomes are more complex to measure, and it would likely be expensive and time consuming to do so. Adam, the [T] program manager, said that whilst participants are surveyed annually, fitness testing and deep interviewing is not used as participants do not like it. Sarah, the [H] Program Manager said that the program had moved away from measuring weight loss and towards measuring activity, confidence goal setting.

> "[H] would like to change the way it is measured to focus on engagement… Engagement over time is really important and we want to capture the reasons for this at graduation, and the reasons people leave. Success is relative to the person but for us it's around being able to competently sustainably continue healthy lifestyle behaviour centred around nutrition and physical activity."
>
> **(Sarah: [H] – June 2019)**

[H] recorded participant rubrics and used Results Based Accountability system to measure(Friedman 2005), [T] surveyed participants annually and [N] recorded some participant testimonials. All four of the programs had to prepare reports to secure funding, and it could be argued that investing in measurement of disease markers and participation impacts could help improve the ability to communicate the success of the programs and rationale for further investment.

The lengthy duration and apparent success of [H] and [T] suggests that they merit more detailed measurement and study. It may be that a modified framework, a version of the framework that enables greater detail to be captured and monitored more easily, or enabling individuals to access and populate their own information, could lead to a greater understanding of the impact, potential and effectiveness of more general interventions. A detailed follow-up study of a sample of participants may also provide valuable information. Community sport-based interventions like [H], [T], [N] and [X] that aim to help participants reduce lifestyle disease more broadly by targeting behaviours like inactivity and nutrition, rather than specific diseases offer substantial opportunities to improve health, even if measuring their impact on specific diseases may be more challenging.

5.6 How improving intervention methodology can help

One of the overarching questions of this research is whether using the proposed framework to improve design, implementation, measurement and reporting would make it easier to, conduct, measure, evaluate and sustain community sport interventions to reduce lifestyle disease. Common themes arising during the interviews and discussed in chapter 4 related to the

difficulties associated with funding,[139] participant recruitment,[140] working with delivery partners,[141] measurement, communication both internal to the intervention and externally about it.[142] Further issues raised by one or more of the program managers, discussed in chapter 4, and that 4.1 included: success measures, transport, misunderstandings about the program, participant recruitment, facilities issues, reporting, innovation, flexibility, visibility, time poverty of participants, participant readiness to change, participant deprivation and competition between sports that may reduce willingness to share about the programs being delivered.

5.6.1 How community sport organisations can design lifestyle disease interventions for success

Across the community sport interventions described in the literature in chapter 2 and the programs included in chapter 4, there was variation and much diversity in the program design in terms of program elements, duration, measurement, objectives and program design. The interviews with program managers in this study also provided evidence of a wide variation between programs, and the many things that need to be considered in order to design successful community sport-based interventions for lifestyle disease.

5.6.2 Program elements and objectives

Program elements described in chapter four ranged from modified sport such as [E], and [X] to those that added education and behaviour change program components such as [H], [N], [T]. [D] also added rehabilitation to enable people to play modified sport, and took functional and health measures to determine participant ability before referring to modified sport. Some

[139] 4.1.3, 4.2.1, 4.2.2
[140] 4.3.1
[141] 4.2.2.5, 4.2.3
[142] 4.3.2

programs such as [H] and [F], included incentives such as training leading to paid officiating work, uniforms, money, and vouchers for food and sports equipment. The differing delivery formats, program durations, and outcomes makes it difficult to compare the impact of each program against others, highlighting a need for guidance for program development and evaluation.

Sport intervention programs such as [E], [T] and [X] missed the opportunity to demonstrate impact when their measurement focus remained on outputs such as the number of participants attending, or sessions delivered, rather than on outcomes such as changes participants experienced as a result of attending the program. A range of financial,[143] resource and participant issues[144] were mentioned that provided a barrier to this level of measurement and evaluation.

5.6.3 Target cohorts

Other variation in outcomes reflected the cohort targeted. [X], [T], [N] and [H] targeted people at risk of, or who may have, one or more lifestyle diseases[145]. Only [H], as part of the referral process, required disease risk to be identified by the individual or a physician. In a sense [X], [T], [N] and [H] took a more holistic approach, targeting participant behaviour such as inactivity, nutrition, or health and mental health service access. This aligns with the academic literature on the impact of inactivity discussed in Chapter 2 and the World Health Organization's Guidelines that recognise the importance of physical activity and healthy eating to prevent and manage"

[143] [F] and [H]
[144] [N], [X] and [T]
[145] All lifestyle diseases rather than a specific disease, including obesity, cardiovascular disease, Type 2 Diabetes, cancers, obesity etc.

> "…noncommunicable diseases such as cardiovascular disease, diabetes, breast and colon cancer…Physical activity also has benefits for mental health…and can contribute to the maintenance of healthy weight and general wellbeing…"(World Health Organization 2020a)

Health service access also needs to be delivered appropriately.

> "…Ensuring populations receive the right care, at the right time, in the right place, in accordance with their needs and local contexts, requires effective integration of providers and care settings… as well as…the empowerment of individuals and communities, with recognition of the importance of skills, local context and health needs."(World Health Organization 2019f)

[F] took a similar approach to [X], [T], [N] and [H], but targeted people with confirmed cardiovascular disease or identified disease risk factors according to a general practitioner or the screening test. It was later expanded to include people with or at risk of Type 2 Diabetes.

[E] and the [D] program targeted people with diagnosed breast cancer or stroke respectively. [E] in its enduring format only consisted of modified dragon boat paddling and aimed to enable breast cancer survivors to be physically active during and after treatment. The [D] Program aimed to assist people who had survived a stroke at rehabilitating and included a range of functional tests and measurements to evaluate participant progress. The [D] and [E] programs could be characterised as 'treatment' for disease symptoms, with [H] and [F] operating in a similar way for participants with more advanced disease and to reduce disease risk, slow disease progression or reverse disease symptoms in at-risk participants. [X], [T], [N] may have had similar impacts on participants who had lifestyle disease, but this was not a stated or measured program objective.

5.6.4 Program duration

One of the points of variability between programs was intervention duration. Community sport-based interventions in usually only run for a short duration. Many of the programs outlined in

chapter two ran for between twelve weeks and six months, with no ongoing follow-up planned. The objective of treatment health settings is to improve the health outcomes for patients. Following diagnosis based on taking a clinical history of symptoms, a physical examination and measurements,[146] that may also include referral to a specialist, a course of treatment is prescribed, [147] and follow-up care is undertaken to establish whether to alter, continue or cease treatment. The diagnosis may change over time as more evidence of symptoms and the impact of treatment is gathered (Committee on Diagnostic Error in Health Care; Board on Health Care Services & Institute of Medicine; The National Academies of Sciences 2015). In health settings, treatment for each of the lifestyle diseases discussed in this thesis is not concluded after an arbitrary twelve week or six-month cut-off, instead healthcare professionals will set further appointments with the patient for follow-up, or the patient may set appointments themselves, enabling further evaluation and treatment or advice to be provided (Committee on Diagnostic Error in Health Care; Board on Health Care Services & Institute of Medicine; The National Academies of Sciences 2015). However, the [H] intervention limited participation to six months for adults and twelve months for families, and the [F] programs offered participants three-to-six-month formats, dependent on the sport. Both programs aimed to assist participants to continue being more physically active beyond the conclusion of the program, but there was no further long-term follow-up by the program nor opportunity for participants to seek further support.

[146] Such as weight, BMI and waist to hip measurements for obesity, cancer markers in the blood, lymph nodes or body for breast and colorectal cancer, blood pressure and cardiac function for cardiovascular disease and glycated haemoglobin (A1C), fasting blood sugar or glucose tolerance test for Type 2 Diabetes- measurement includes sending patients to pathologist and imaging services for blood tests, x-rays, magnetic resonance imaging etc.

[147] Such as blood pressure lowering medication for hypertension, diet for overweight and weight-loss surgery for some forms of obesity, surgery, radiotherapy and chemotherapy for cancer, and metformin or other medications for Type 2 Diabetes

The [E], [D], [X], [N] and [T] programs enabled people to continue participating in the program indefinitely. The [N] program design included training local people to run the program and to coach and officiate basketball, and this provided a pathway for participants to more mainstream basketball, in a similar manner to the pathway to community sort participation provided by [H] and the [F] program. [T] and the [D] program included ongoing regular checks with participants, but only the [D] program provided the level of detailed measurement to evaluate the impact of ongoing participation. As discussed in 4.1 Custom Designed the detailed measurement included cholesterol and blood glucose, a 3-metre walking circuit, 4 four 10-meter walks, three at self-selected pace, one at a maximum velocity, a G Walk test of walking symmetry and gait, a 6 minute walk test of aerobic capacity and walking endurance, 30 seconds of sit to stand activity to test muscle strength, psychosocial questionnaires examining anxiety, depression, self-confidence, social isolation and loneliness. This was conducted at baseline assessment, repeated at 12 weeks, and the plan was to reassess at six- and 12-months post screening. At the time of interview the pilot was still ongoing, but since then the 6 and 12 month program reports have been prepared (Faulkner 2019, 2020), and comparisons between participants at screening and 12 months show the impact of the program on participants. These include average reductions in systolic blood pressure of 9 mmHg and in diastolic blood of 3 mmHg, average mean arterial blood pressure reductions of 5 mmHg, increased walking speed of 0.16 metres/ second, average timed Up and Go speed reductions of 5 seconds, average increases of 75m in a 6 minute walk test (Faulkner 2020). Further work will need to be done to compare these results with ordinary care to complete the objective of the pilot, which was to test whether [D] worked to provide effective, affordable, accessible rehabilitation following the conclusion of NHS care. However, as acknowledged in the second report, the COVID-10 pandemic has disrupted delivery.

5.6.5 Co-design

Community sport interventions to improve lifestyle disease can also create opportunities for co-design to improve the responsiveness to of the intervention to feedback, can help address local issues, identify and overcome barriers to participation, understand and incorporate cultural practices. An example of the benefits of co-design came from rural Nepal where people with chronic obstructive pulmonary disease (COPD) were not receiving enough support to self-manage their chronic conditions. They benefited from a co-designed process where patients, their families, community representatives, local government representatives, primary care practitioners, community health workers, policymakers, state-level government representatives and academics all contributed to the development of a model of integrated care (Yadav et al. 2021). The integrated care model was built on existing services and programs and included community screening for people over 40 with COPD symptoms, primary healthcare management for symptomatic COPD patients, the development of referral pathways for severe cases to and from secondary/tertiary-level health care and establishing a community-based support system with roles for community health workers, patients, their caregivers and community representatives (Yadav et al. 2021). In Nepal co-design involving patients, community and health helped create a model that enabled existing services to be better utilised. Co-design can also be important at the level of service providers as demonstrated in the South Pacific where it helps key stakeholders collaborate, form alliances and partnerships to control cancer in resource constrained settings (Hyatt et al. 2021). Health service provision benefits from co-produced, interdependent work where professionals and users create, design, produce, deliver, assess, and evaluate the relationships and actions that contribute to individual and population health, rather than a model where professionals produce health products for customers to buy (Batalden 2018). When healthcare services and community programs are co-designed this can help build trusting relationships between patients and healthcare

professionals, which can in turn improve engagement (Batalden 2018), and help incorporate the unique knowledge and experience patients have of healthcare. A degree of co-design in occurred in [N], [T], [D] and [F] as these programs worked with a range of community stakeholders, collaborating to co-design program content for participants and to provide pathways to relevant services.

The [F] recruitment expanded from general practitioner referrals to enable pharmacy and leisure centre staff to carry out health checks and refer people when participant numbers were low. Program design, data collection and reporting processes were changed over time based on feedback and barriers identified amongst participating sports organisations. Intervention design at club level in [F] also reflected that the sports organisations involved had considered ways to overcome barriers to adult participation. For the rowing club this took the form of purchasing pontoon boats to help adults avoid tipping over whilst learning to scull, the tennis club used Zumba classes to initially attract adults to the tennis club before providing them with tennis lessons, and the cricket club used 'Bums and Tums' and yoga classes on pitches adjacent to the cricket grounds for the adult parents and spectators, who were then recruited into a Masters Cricket Team or to volunteer at the club. This reflected new approaches to sport outreach, engagement and growth. The program manager attributed the success of most of the 20,000 [F] participants spread across 23 sports and leisure providers to being able to be flexible and try a variety of approaches. [F] used a co-design process at a commissioning level with the sport providers, that enabled each sports club to innovate.

The [H] program allowed for individual or family participants to set their own activity and nutrition goals, the program activities were then individually tailored to help them achieve this. There is some evidence that when people set their own physical activity goals they are more

likely to increase their physical activity behaviour (Beauchamp, Crawford & Jackson 2019). Individualised goals complicate measurement and evaluation because each participant can set different goals, making comparisons at a group or cohort level difficult, and generalisations about the health impact of the program harder. However allowing program flexibility may be more successful at achieving long term behaviour change (Beauchamp, Crawford & Jackson 2019), and measurement will need to remain individualised and compare participant behaviour with their baseline behaviour. The long duration, and reported success at achieving behaviour change suggests this more flexible approach has merit in reducing lifestyle disease.

Program managers can design interventions to improve lifestyle disease in community sport organisations in ways that become more successful, accommodate innovation and encourage learning and growth. This includes up-front planning that describes what success could look like, flexible approaches, measurement and evaluation, planning, the use of co-design to flag issues, increase engagement, and help programs evolve. Reporting can then be used to improve practice over time, compare results and learn from other practitioners or modalities.

5.6.6 Measurement of health outcomes

A key to successful program design is establishing clear, measurable goals from the outset, selecting measures that will indicate progress against these goals, and scheduling these measurements at regular intervals. The risk of failing to do so is that programs essentially run as ‘pilots’, initial tests of what might work, never getting past the ‘proof of concept’ phase to

become programs where measures of success are understood and practice evolves and improves based on progress against success measures.[148]

Each of the programs described in chapter 4 had different participant target groups and intended outcomes [D], [E] and [F] specifically targeted participants who had undergone treatment or had been diagnosed with a disease, whereas others such as [T], [X], [H] and [N] were more holistic in their approach to the improvement of lifestyle disease or its risk factors.

The [D] Program targeted stroke survivors and included detailed measurements of all participants that should enable the program to be evaluated usual care in terms of participant health and functionality when it is completed and the results written up. This intervention was the clearest in its design, and measurement against outcome goals related to stroke rehabilitation. As discussed at 4.4 [D] used health, fitness and functional measures which were to be repeated to evaluate health improvement[149]. The [D] measurements were detailed and the assessment tools and protocols used were consistent, planned to be carried out at baseline 12 weeks, 6 and 12 months. This enabled the program to identify the impact of participation on individuals, to respond to their needs, referring participants to more strenuous exercise sessions or modified sport as their physical capacity increased. Mike, the program manager, designed the [D] program and its measurement protocol, and ongoing follow, to enable the National Health Service to evaluate program effectiveness compared with usual care, in order to demonstrate its suitability for investment and expansion. Mike acknowledged the need to reduce the number and complexity of tests used to measure participants, once the pilot program

[148] The researcher was given a £1.3M budget to transform paediatric health inequality in the London Borough of Barking & Dagenham by getting children swimming, but the original 'project' amounted to an aspiration with nothing capable of being measured or evaluated.

[149] cholesterol and blood glucose, a 3m walking circuit, 4 four 10-meter walks, three at self-selected pace, one at a maximum velocity, a G Walk test of walking symmetry and gait, a 6 minute walk test of aerobic capacity and walking endurance, 30 seconds of sit to stand activity to test muscle strength, psychosocial questionnaires examining anxiety, depression, self-confidence, social isolation and loneliness. This was conducted at baseline assessment, repeated at 12 weeks, and the plan was to reassess at six- and 12-months post screening.

had been evaluated and prior to eventual rollout in community sport settings. Thereafter work could be done to identify which measures needed to be retained.

> "…obviously some of the measures that…we're using at the moment are very robust and valid…we use some fancy equipment to show that…what we're doing works. But when you start to roll it out…you can then say, well, we know that this works [and] …we've now simplified what we're doing because we've shown that it works scientifically…"
>
> **(Mike: [D] – December 2019)**

Simplifying measurement could reduce the barriers to then running the program in community sport settings. The interview was conducted when the program was undergoing it initial pilot, so it was too early for results to have been produced, evaluated or published. Since then the six month (Faulkner 2019) and twelve month (Faulkner 2020) reports have been completed, though academic publication of results could not be found. The 12 month report comparing participant screening and follow-up shows average reductions in systolic and diastolic blood pressure of 9 and 3 mmHg respectively, average mean arterial blood pressure reduction of 5 mmHg, increased walking speed of 0.16 metres/ second, average timed Up and Go speed reductions of 5 seconds, average increases of 75m in a 6 minute walk test (Faulkner 2020). The 12-month report acknowledges that the COVID-19 pandemic had an impact on [D], but given the reported results, the program shows promise. This pilot could provide an approach for program managers of community sport-based interventions to improve lifestyle disease. It demonstrates the merits of beginning an intervention with a pilot that includes detailed measurement, as it can evaluate intervention designs and help avoid difficulties that would compromise a Randomised Controlled Trial (RCT) if the study began with an RCT and skipped the pilot phase (Vogel & Draper-Rodi 2017). If success is demonstrated, measurements can be identified that need to be retained in order to evaluate performance in the long term, and the lessons from the pilot study can help contribute to further study design (Blatch-Jones et al.

2018). In the case of [D] Mike was awaiting permission to establish a control group for the intervention, although participants would not be randomised:

> "…I'm going through an NHS ethics at the moment to give it to me that capacity whereby people might want to come in and be assessed so we get data on their health and they might want to engage in our program or might not be able to because of distance and so on…which allow me to have that sort of control group..."
>
> **(Mike: [D] – December 2019)**

The [F] program targeted people with cardiovascular disease, and later Type 2 Diabetes, and appeared to show a positive impact on increasing participant physical activity. Referral to [F] was based on a standardised health check, but this health check was not repeated at the conclusion of program participation for comparison. Two self-report tools were used, the Loughborough Single Item (Milton, Clemes & Bull 2013) was used to gauge baseline (in)activity, and the Stanford 7 Day Recall (Richardson, M et al. 2001) was used to assess total physical activity level at baseline, then to track change at three month intervals, at three, six, nine and 12 months. Accelerometer data were gathered in the final stages of the project to compare real time physical activity data and with self-reported data. No post-program follow-up was conducted to enable evaluation of the impact of the program on mortality or DALY's lost. In the words of the program manage reflecting on measurement:

> "…It's really important for any intervention to have robust data collection, to know what tools to use to achieve that. These days you need to be able to demonstrate outcomes with validated measurement tools or somebody will just look at your intervention and say, "Well it's not valid data because you didn't use the right tool to measure."
>
> **(Nick: [F] – August 2019)**

Given the size of the intervention, geographic constraints of its delivery[150], and granularity of Sport England segmentation and population data (Sport England 2010), it may be possible to

[150] To one county

use NHS health data in a follow-up study to compare cardiovascular outcomes at a population level. This could be done between the region in which the intervention took place, and a similar population in another part of the country, to draw causal inferences regarding the program impact at a population level. Whilst not as robust as a randomised controlled trial, a population study of this kind could help inform decision makers considering whether it would be worth repeating the program elsewhere, whilst avoiding many of the evaluation challenges mentioned by program managers of [N], [X], [T], [D], [H], [F].

The [F] program design was for the intervention to provide at least 150 minutes per week of moderate intensity physical activity[151] (World Health Organization 2020a), and [D] participants had to be provided with sufficient program delivery to achieve this level of activity every week. [N], [T], [X] and [H] were once a week programs that did not offer the minimum amount of activity within the program to satisfy the World Health Organisation guidelines (World Health Organization 2020a), but sought to increase participants' physical activity levels, though no specific target was set, nor specific measures of total physical activity conducted. Interviewing participants at baseline, regular intervals and at the conclusion of [H] could show whether participants had increased their total levels of physical activity, but failing to do so reduces the ability to understand the full impact of programs.

Programs described in the academic literature in chapter 2 used some measurement. This included blood pressure for the cardiovascular disease interventions that used swimming (Mohr et al. 2014), and football (Wyke et al. 2015), blood tests for the football-based interventions for Type 2 Diabetes (Vieira de Sousa et al. 2017) and for the programs for obesity and

[151] This is the minimum level advised for adult health for the management of hypertension, diabetes, raised cardiovascular risk, asthma, and chronic obstructive pulmonary disease. Moderate intensity is the equivalent of a brisk walk

overweight, weight, BMI waist circumference, percentage body fat, systolic and diastolic blood pressure were measured for the football intervention (Wyke et al. 2015). The program manager of [H] expressed concern with using weight loss as a measure of success, describing this as a 'deficit based', a definition of success focused on what a participant has lost rather than gained. She also expressed concern that weight loss goals could be harmful to children if they were still growing. The [T] program manager explained that participants may not respond well to measurement, due to a lived experience of homelessness and disengagement. However, without measurement of at least some markers related to disease it is difficult to accurately understand how the program has impacted participant health, or to evaluate program effectiveness compared with no care or usual care. It may not be possible or prudent for all participants in interventions like [T] or [H] to be measured. The size, scope, apparent success and enduring nature of these interventions suggests they may have a lot to teach us. It may be that sampling, or other measurement, needs to be designed to help evaluate program health impacts, in ways that avoid the negative consequences feared by program managers.

When programs like [T], [E], [N], [X] fail to measure specific health indicators for participants, not only does this impair the ability to understand program impacts on the health of individuals, it means the potential of these community sport-based interventions to improve lifestyle disease remains poorly understood. [E] targeted people who had breast cancer, but did not conduct baseline participant measurements, collect program output measures,[152] outcome,[153] or any type of measurement that would enable evaluation of the impact on mortality or disability adjusted life years (DALYs) lost, compared with standard models of care. Previous small studies have examined the psychosocial impact of participation in [E] (Mitchell & Nielsen

[152] Such as how many individuals participated per week, for what duration, how many were retained each year and activities completed
[153] Such as how participation impacted the lives of individuals

2002), social support relationships (McDonough, Sabiston & Ullrich-French 2011), and decision-making related to joining group physical activity programs designed for survivors (Weisenbach & McDonough 2014). However, in spite of this program having run for over two decades, its' impact on mortality or DALY's lost has not been evaluated. This is in spite of the recognition that participation could provide an alternative to conventional clinic or community-based physical exercise, be effective as an exercise therapy to alleviate disease symptoms or treatment impacts on the physical and psychological health of survivors (Luo, H et al. 2019).

5.6.5 Evaluation

The evaluation of community sport-based programs to address lifestyle disease is dependent on measurement being undertaken. Intervention evaluation is essential to determine the success or failure of programs in achieving their objectives, impacting participant health overall, to identify and to examine areas for program improvement, to compare the intervention with other forms of care, or no care, and to learn lessons that enable programs to evolve and improve. Publishing evaluations also enables people to learn from work that has been done and to replicate or further develop it.

If community sport-based interventions for lifestyle disease select objectives related to health improvement, build in measurement from the initial design phase to evaluate participant progress, they will be better able to understand the impact of their work and to continuously improve intervention viability, efficiency, and select the most effective duration and program structure. Failing to design clearly from the outset, to measure and learn, also risks missing opportunities to identify barriers and social determinants of health, and address them up-front. Whether the goal includes education, changing attitudes, behaviour or participant health, measuring whether these have been impacted can be as simple as asking direct questions of participants, and can help programs evolve and improve. It is recommended that intervention

design sets health outcome measures relevant to the disease or behaviour targeted, and that measurements are then conducted regularly to evaluate individual and program progress. The purpose of the development of the framework as part of this research, is to help make design, measurement, reporting and evaluation easier.

Currently evaluating community sport-based programs is usually difficult, expensive, and studies that randomise the control group to be inactive are likely to be considered unethical, meaning permission would be denied on the basis of the health risks described in the literature on inactivity at 2.2.1. However, in many parts of Australia, and across the world, the COVID-19 pandemic has forced the closure of community sport and community sport-based intervention programs, in effect creating a global natural experiment (Thomson 2020). In 'natural experiments' who receives a treatment or intervention is determined by circumstances outside the researcher's control, and these types of circumstances are used in economics and epidemiology to improve the rigor of observational studies in medicine and to support inferences about causal relationships between interventions and outcomes (Khullar & Jena 2021). Groups and participants in programs who were able to continue could be compared with those forced to cease due to lockdowns. This is especially pertinent to [E] and [S] as versions of these programs take place in multiple states and countries, subject to different lockdown conditions and timing. Future follow-up observational studies (West et al. 2008), may help to improve understanding of the value and impact of these interventions, where pandemic lockdowns have randomised people to cease participation.

5.7 Sport Development

Community sport-based interventions to improve lifestyle disease present a sport development opportunity, as discussed at 4.3.10[154]. Sport development was not a specific focus of this research, but it became evident that it was taking place through interventions, and should be noted as a contribution that interventions offer to the overall business of sport. A previous Cochrane Review could not find controlled evaluation studies, uncontrolled studies meeting the inclusion criteria, or rigorous studies, evaluating the effects of interventions organised through sporting organisations to increase participation in sport (Priest et al. 2008a), but grey literature sources reveal a range of programs for adults, run by sport organisations, that have been funded since 2019 through the recent Move It Aus – Participation Grants (SportAus 2021). This includes programs run by Taekwondo (Taekwondo Australia 2021), Netball (Netball Queensland 2021), Surf Life Saving (Surf Life Saving Australia 2021), Basketball(Basketball Australia 2021), Football (Football Australia 2021), Gymnastics (Gymnastics Australia 2019), Ultimate Frisbee (Ultimate Australia 2021), but some of the links to successful grant recipients do not have program information yet, and as the Walking Football page notes the COVID-19 pandemic has prevented activities being delivered in parts of Australia (Football Australia 2021). Whilst these programs may have excellent sport development potential, it is too early for evaluation to have been conducted.

The [F], [T] and [N] programs would not meet the study inclusion criteria for the Cochrane Review, but have also provided effective pathways to mainstream sport for targeted cohorts for whom participation in sport may be challenging. In some cases, such as the development of walking formats for basketball and football, modifying the way community sport is played can enable more people to participate who were excluded by the traditional format. Focussing on

[154] Community sport-based interventions as sport development

inclusion over competition as discussed in [N], [X], [T], [E], [H], [F] and the Football Fans in Training Program described in chapter 2 (Wyke et al. 2015), was important to intervention success, and this is supported in the literature (Corepal et al. 2020). [T], [D] and [H] use community sport, but the remaining intervention programs described in Chapter 4 were designed and led by sport organisations, with the [F] program demonstrating that community sport organisations could successfully increase participation across a wide range of sports, using different programs, activities and incentives. This study did not specifically seek to identify sport development opportunities, but recognises that developing a framework to better enable community sport-based interventions to be evaluated and understood will have important implications for sport development and identifying how to increase sport participation. Priest et al. (2008a) acknowledged the health benefits of increasing physical activity and recommended that interventions conducted to increase sport participation include rigorous evaluation to examine effectiveness, socio-demographic differences in participation and cost-effectiveness of these strategies (Priest et al. 2008a). The literature and research evidence support the need for rigorous, controlled studies of community sport-based interventions, to evaluate whether they increase participation in sport.

5.8 Framework development and amendment

Based on the outcome of this analysis, the framework was amended, and the rationale for doing so is discussed at 4.6.

The initial draft framework for the design, management, measurement and evaluation of community sport-based intervention to address lifestyle disease, as outlined at 3.7 Appendix 2 & Appendix 3 was developed to assist with intervention design, to gather data, help address the gaps in information, and questions identified from the literature as set out at 2.11 and Appendix 1. Considering the series of steps in sequence as part of intervention design aimed

to make designing and lead these interventions in a more evidence-based, consistent and reporting results easier for program managers. The eventual aim of data collection from interventions using the framework was to enable the questions identified in the literature at Appendix 1. to be studied and, in future, answered.

As mentioned at 1.4 and 3.1 the relative scarcity of evidence of community sport-based programs in academic literature prompted efforts to find and interview program managers as part of this research. The themes arising during the literature review then informed the questions used in the semi-structured interviews with program managers.

Following the thematic analysis of the case studies created from the interviews, the framework was amended at Appendix 8 to add a sixth column prompting program managers to consider; whether the intervention will target a single lifestyle disease, multiple diseases or lifestyle disease more broadly, how they will recruit participants, partners, volunteers and funders, and how they will market the intervention. It prompts program managers to plan how they will communicate with partners, volunteers, funders, government, facility owners and participants about the intervention, as well as how to share resources with participants, whether and how participants will communicate with each-other. The revised framework also prompts the program manager to consider the duration of the intervention for each participant, overall and to plan for any follow-up.

These changes were made because the program managers raised issues including: communication, success measures, transport, misunderstandings about the program, participant recruitment, reporting, innovation, flexibility, program visibility, time poverty of participants, participant readiness to change, participant deprivation and competition between sports that may reduce willingness to share about the programs being delivered.

Each of the framework elements prompts program managers to consider and plan for issues and measurement that should help reduce problems, improve consistency, gather evidence and help with evaluation and reporting. It should also help improve intervention outcomes for people with lifestyle disease. Improved evidence gathering and reporting should help program managers identify and explain program impact, tell success stories and market the program to participants, volunteers and funders. Telling these stories should help demonstrate the impact and value of community sport-based interventions, and assist in securing funding and support for their expansion. Eventually collected data, if shared, could be studied and academics and program managers to learn and improve intervention over time. The benefit to people with lifestyle disease is that, like medical treatments, community sport-based interventions could be studied, better understood, improved over time and made more widely available to those most likely to benefit from them.

5.9 Conclusions

This thesis explored the importance of reducing lifestyle diseases using community-based sport and it targeted cardiovascular disease, breast cancer, colorectal cancer, Type 2 Diabetes and obesity. It can by concluded that community sport-based interventions can, and do, reduce lifestyle diseases. However, in spite of the impact of these diseases on health and economies, community sport-based interventions appear to be under-studied and under developed. The poor knowledge of the program results described throughout this thesis, is likely to have contributed to this.

The researcher acknowledges the limitations of the research methods used see Appendix 9. She was limited to conducting her research in English, the only language she speaks fluently, and did not have the resources to advertise her research, read responses or interview in multiple

languages. The initial search strategy used did not produce evidence in the academic literature, that was later found in grey literature. The program manager for [H] explained at interview that the names of sports and sport terminology may be avoided as participants may not perceive the program as suitable for them to join, and the researcher only learnt of this 20-year program when Sarah volunteered to participate after hearing of the research. Had the researcher not understood from her own professional experience the way community sport-based interventions are funded, reported on and recorded in the United Kingdom, she would not even have known to look for evidence of [F] and the reports were not discoverable using academic search techniques. It is likely there are other relevant programs occurring that have not been included, and future research strategies should address language barriers and look for terminology and techniques used to describe interventions where community sport-related words are not used.

One barrier identified is that many community-based sport programs are not designed to include sufficient robust measurement. The interventions described in this research also did not include long term follow-up to assess impacts on mortality and DALYs. This research concludes by arguing that failure to measure limits the ability of program managers to understand and talk about the significance of outcomes. This in turn limits their ability to secure further funding to sustain, grow and publicise their work. A lack of knowledge that these community sport-based interventions exist, or of their impact, also acts as a barrier to recruitment and community support.

There was no evidence of a standard methodology for community sport-based interventions in the literature or in the interviews conducted as described in chapter 4, and a variety of approaches demonstrated success. The [F] program, with its commissioning model that

allowed sports clubs to design their own approaches, demonstrated the value of innovation. [H] with its approach tailored to individual goals appears successful, as does the modified sport alone model of [E]. Without greater use of consistent measurement, it is not possible to compare different intervention methodologies or results. Neither is it possible to compare the impact of community sport-based interventions with usual care, or no treatment.

In order to progress, community sport-based interventions need to be structured to include consistent measurement and to report results. This would enable program managers, health sector leaders and governments to better understand intervention impact, and could provide a rationale for investment. It could also lead to an understanding of the most effective ways to design, develop and lead interventions in future. The available evidence discussed in chapter two and four indicates that community sport-based interventions can work to help people increase their levels of physical activity, overcome barriers to health improvement and social determinants of health, and that they help people change other health behaviours. Long running, and large cohort programs such as [F], [H], [T], [E] discussed in chapter four provide an urgent imperative for further study and wider use of community sport-based interventions given the national and global impact of lifestyle disease described in chapter 2. Improved intervention structure, better measurement, and the sharing of results over time should help overcome the problems and themes identified during chapters two and enable interventions to evolve and improve over time.

5.10 Implications for theory

This research contributed to the understanding of community sport-based interventions through gathering evidence that has not yet reached academic literature. It confirmed that more community sport-based interventions are being carried out than are evident from the academic

literature, that they are under-studied but demonstrate some positive impacts in terms of modifying behaviour, improving symptoms and/or reducing disease. The academic and government literature reviewed in chapter two makes a clear case that more needs to be done to address lifestyle disease. This research offers a further avenue for exploration and suggests that introducing a more structured, consistent methodology into intervention design and management could assist program managers to measure and report, and the sector to realise the potential of programs to contribute to health improvement.

The logical implication is that the framework developed and refined through this research should be piloted, evaluated, further refined if necessary, and if successful, made widely available. This research also implies that as measurement and knowledge of interventions improves, this could also provide opportunities for the medical and research sectors to study how community sport-based interventions could best work to enhance recovery from surgery, to improve tolerance or effectiveness of medications, to reduce disability and mortality. It also implies that different sports, program structures, doses and approaches could be studied to determine which is the most effective.

This research also implies that community-based sport could have an important role in improving lifestyle disease, reaching a new audience and expanding its impact. Programs like [X], [T], Walking Football, [N] and the [F] program worked to reach new audiences and transform inactive, previously disengaged people into regular players, officials and volunteers. This re-imagines sports development and offers a new opportunity to grow sport when previous literature suggested there was not a strong understanding of 'what works'.

5.11 Implications for policy and practice

The first implication from this research is that potentially effective approaches to improving lifestyle disease using community sport are under-studied academically and under-used in

practice. The researcher recommends the World Health Organization establishes a clearinghouse or repository for adding case files.

The second implication of this research for managers in the sport sector, is that community sport-based interventions may provide an opportunity to grow community sport participation, increase the development of officials, and the recruitment and development of volunteers, as demonstrated by the [F], [N] and [T] programs described in chapter 4. It offers an opportunity to reach a new type of audience who previously have not played the sport as seen with [F], [N] and [E] and it may help overcome perceptions that your sport is unsuitable for older people or those with health conditions such as [X] or Walking Football.

For fans of the National Rugby League at 2.8.5.3, Australian Football League at 2.8.5.4 and Soccer at 2.8.4.5 and 2.8.4.6 community sport intervention programs have provided a new way for them to engage, related to their own health. Communicating about these interventions provides new ways for sport to demonstrate relevance to, and engagement with, the community. Community sport-based interventions provide opportunities to engage with the health sector, non-profits and universities, and may provide opportunities to secure funding from new sources such as health, or to demonstrate value to sponsors. They could also create more jobs for skilled graduates in sports science and exercise physiology, and opportunities to employ and retain them in clubs.

Running community sport-based interventions also challenges sport leaders to think about and engage with community sport, rather than just focusing on the elite game and high performers. A more inclusive approach may be required than some sports may be used to, and challenges may arise including: a need for extra equipment, added complexity, program demands where volunteers may lack skills or confidence, the risk of something going wrong, cultural clashes with alcohol and other sponsors, or ‘macho’ club cultures.

The implications of this work for the wider community are that community sport-based interventions may offer accessible opportunities to improve lifestyle disease, health and patient outcomes that may also help reduce an individual's healthcare costs and reduce the strain on healthcare services. However more study and evidence are required, and whilst the framework developed in this research may assist, it will take time and resources to do so.

A challenge for community sport-based interventions is gaining the trust of, and referral from, the healthcare sector. This was highlighted by the [D] and [F] programs in 4.3.1. Without the trust of the health sector and government it will be difficult for sport organisations to secure resources. The commissioning models of [F] and [H] that worked together with health and government, and the government funding for [T] and the expansion of [X], demonstrate that trust is growing. This research, by publicising little known success and proposing a framework to enable interventions to be developed, measured, evaluated and shared, offers the opportunity to help further build the trust necessary to expand these interventions to improve lifestyle disease.

5.12 Limitations

The strength of this research is that it sought to identify and describe community sport-based interventions for lifestyle disease that have previously failed to make it to academic literature. It also sought to establish via interviews, whether community sport-based programs were effective, how they worked, and the decision-making that had gone in to their creation and management.

It acknowledged the impact of lifestyle disease globally, and in Australia, and sought to better understand and offer a way to improve treatment using community sport. Section 1.8 has previously outlined the delimitations of this research, that it excluded mental health interventions, and focussed on interventions to address/treat disease. As set out in the table at

2.11 the literature review uncovered a range of outstanding questions arising from the programs that it appeared could not be presently answered. Part of the initial framework design was aimed at enhancing measurement and data collection to enable them to be answered in future.

Other limitations that became apparent during the progress of the research related to terminology and definitions. Whilst the researcher focussed on community sport settings, much of the health literature focussed on physical activity, which included sport, but also at times included active recreation activities such as walking or going to the gym. Some activities, such as trail riding on a horse, bicycle touring, dancing, could be described by some as active recreation, by others as physical activity or sport, and this has changed over time (Sport England 2016). Sometimes active transport such as walking and cycling for travel are considered separately, but these forms of activity and active recreation can contribute to achieving the WHO activity targets (World Health Organization 2020a) and can be encompassed by wider definitions of sport.

Heath and disease measurement and definitions of good nutrition, discussed in chapter 2, varied internationally. Access to treatment for lifestyle disease varied between countries, and measures of treatment cost reflect, in part, the availability of treatment. It is crucial to remember when comparing international data, that in some parts of the world there is no access to treatments for cancer, cardiovascular disease, Type 2 Diabetes or obesity that are more available Australia and many Organisation for Economic Co-operation and Development member countries (Organisation for Economic Co-operation and Development 2021).

The recruitment of program managers to participate in semi-structured interviews to better understand community sport-based interventions for lifestyle diseases, also faced limitations. The researcher's inability to speak any language other than English fluently left her unable to recruit participants who did not also speak English. As outlined in chapter 3, only interviews

with program managers based in Australia, the United Kingdom and New Zealand have been included. Whilst the gender balance of the interviewees was almost even with four being female and five male, seven interviewees identified as white, one identified as of mixed European and New Zealander background and one participant chose not to disclose. This, together with the average mid-forties age of participants, may mean that the accuracy or richness of data gathered is limited. Further study of other countries and linguistic groups is needed to address this.

The outbreak of the COVID-19 pandemic, as declared in March 2020 (World Health Organization 2020d) put an end to data collection for this research, and proved a limitation. Evidence of program disruption was also seen in reporting on [D] (Faulkner 2020) and in programs funded under the 'Move it Aus – Participation Grants' (SportAus 2021). Whilst these limitations are acknowledged, they do not detract from the significance of the findings.

5.13 Implications for methodology

The research methodology was hampered by difficulties finding evidence of programs when some of the largest interventions not to use 'sport' or 'exercise' terminology, for fear of deterring participants (Cavill et al. 2016). Differing definitions of 'sport' and 'physical activity' also made finding literature incredibly difficult. Without direct experience of having delivered relevant programs in the United Kingdom and of speaking to others leading programs in the sector, it could have been tempting to give up.

The researcher remains focussed on producing work that is useful to the sport sector and sufficiently robust to win the trust of the health and government sectors. This research needs to bridge the gap between the technical language and approach of the health sector, and language, approaches and priorities of sport.

Understanding, describing and discussing the size and scope of lifestyle diseases in chapter 2 required a sound level of medical literacy and lifestyle disease, however this research has sought to avoid overly-technical language. By developing the framework based on this work, the researcher aims to make it easier for current program managers, sports science graduates, staff and volunteers in community sports organisations to develop and run interventions to improve lifestyle disease. The fact the framework is based on sound research should help build trust, but the researcher does not expect that users would need to read all of the underlying scientific research.

5.14 Implications for further research

This research, and the framework that has been developed from it, was always intended to assist practitioners who design, develop and lead community sport-based interventions to improve lifestyle disease. As such, the next logical step is to field-test the framework in real world settings and study whether it achieves this end. The researcher intends undertaking this work, and has begun developing the framework into a digital application to improve its accessibility and useability. Using the framework proposed in Appendix 8, and analysing outcome measurements over time and a range of community sport-based interventions could enable examination and evaluation of program theory evaluation as outlined at 2.5. This could assist with program replication, understanding the contribution of program elements to success, and it could help identify areas for improvement.

The global impact of lifestyle disease discussed at 2.2, but that the cost of blood tests described for Type 2 Diabetes at 2.8.4.3 or the [D] program described at 3.4.5 [D] in Chapter 4 will be prohibitive in many countries. The implication of conducting systematic research into community sport interventions to improve lifestyle disease in places where this is affordable, and sharing the results, is that effective approaches can be more readily identified and the

methodology standardized for global use. If shared, knowledge of effective standard intervention methodologies offers the potential to improve lifestyle disease and address social determinants of health (Cockerham, Hamby & Oates 2017; Marmot & Bell 2019; Perman, Mullins & Newhouse 2015).

The choice was made to exclude interventions to improve mental health, or that were designed for children and young people, in order to limit this research. These could prove fertile areas for other researchers. It may be that the framework could be adapted on the basis of appropriate study of these areas.

This research shows that community sport interventions can be used to improve lifestyle disease, that more of them are occurring than evident in the academic literature, that they offer opportunities to address social determinants of health, but that a lack of a consistent, systematic approach is holding back the potential of these programs to grow, scale up, improve and become sustainable. It then proposed and developed a framework to assist in improving the design, consistency, measurement evaluation and reporting on interventions in the future. The next steps, already being undertaken by the researcher, are the development of the framework into a 'proof of concept' digital application. This is to be used, together with the thesis once published, to source funding support for the development of the full application to the appropriate health and ethical standards for use, testing in the real world, refinement under academic supervision, and eventual distribution to all program managers. The aspiration is to make it easier for program managers to establish, manage, measure and report on their own interventions, to make it easier to gather data for academic study to improve practice and to articulate the value of this work to potential funders to help secure the support required for community sport-based interventions to play their part in helping reduce lifestyle diseases.

Appendices

Appendix 1. Table Summarising the Literature Reviewed

Table 6 Summary of literature reviewed

Citation	Lifestyle Disease	Sport	Study Type / Design	Conclusion	Outstanding Issues
(Lozano-Sufrategui et al. 2017)	Overweight/ Obesity	Soccer	14 older men, small study	Design of health interventions needs to include education and may need to modify the sport activity to emphasise behaviours that the cohort finds motivating- in this case teamwork, cooperation and relationship- building rather than competitiveness.	What do different cohorts find motivating to continue participating?
Trombetti, A. et al. (2018)	Age related frailty	Structured moderate intensity physical activity program	Single-blind, randomised controlled trial, running for 2 years, studying 1635 sedentary adults aged 70-89 with functional limitations living in the community in 8 centres in the USA	Long-term, structured, moderate-intensity physical activity program was not show to improve frailty status as measured by the Study of Osteoporotic Fractures Index or major mobility disability	Would building up to more intense exercise have conferred benefit? Had participants been randomised to the groups based on frailty status would results have been different? Did other health indicators change e.g., blood pressure, glycaemic control?
(Reimers, Knapp & Reimers 2012)	Life expectancy	All Sport Physical Activity	A literature review synthesising literature on life expectancy in relation to physical activity, and comparing athletes to non-athletes, seeking to establish whether physical activity increases life expectancy.	Being regularly physically active is associated with a life expectancy increase of 0.4-6.9 years in aerobic endurance athletes compared with non-athletes. Results are inconsistent for other athletes. Being physically active reduces arterial hypertension, diabetes mellitus type 2, dyslipidaemia, coronary heart disease, stroke, and cancer, and all-cause mortality by about 30% to 35% compared with people who are inactive.	It is unclear whether high intensity sports offer further life expectancy increases
(Preidt 2017) only include moderate intensity activity.	Parkinson's disease	Physical Activity Program	Randomised controlled trail with 128 patients with Parkinson's, ages 40 to 80 randomised to intense exercise, moderate exercise or no exercise.	Vigorous exercise, where the heart rate reaches 80-85% of its maximum, three times a week in early-stage Parkinson's can delay the onset or worsening of symptoms for 6 months. Moderate exercise did not work.	further study is needed to determine how long the effect can persist for. This highlights the need for greater research into the benefits of intense exercise for lifestyle diseases.

Citation	**Lifestyle Disease**	**Sport**	**Study Type / Design**	**Conclusion**	**Outstanding Issues**
(Miller & Dunstan 2004)	Overweight, obesity and Type 2 Diabetes.	Physical activity	Systematic review summarises current evidence relating to the effectiveness of physical activity interventions for treating overweight and obesity and Type 2 Diabetes.	Decreasing sedentary behaviour can reduce obesity for all age groups. Combining diet and physical activity is more effective than physical activity strategies alone. Most programs are unsuccessful in producing long term changes, but combined lifestyle strategies, continued professional contact and self-help groups can help maintain weight loss.	Are programs offered for the same duration as a medical intervention? Would engaging in sport that's ongoing with a pathway to participation be more effective?
(Tennis Australia 2012)	Overweight, obesity and Type 2 Diabetes, Cardiovascular Health	Cardio Tennis	Opinion	Tennis Australia developed a modified program called Cardio Tennis for beginners to learn elements of tennis as part of a fitness program. Professor Gary Jennings, a cardiologist and director of the Baker IDI Heart and Diabetes Institute, said this type of program could lead to an increase in life expectancy due to the benefits exercise for cardiovascular health, lowering blood pressure, reducing the likelihood of developing diabetes, and lowering blood glucose. Cardio Tennis could be used by tennis clubs as part of an intervention to improve the health of people with cardiovascular disease if an appropriately designed program were developed.	Needs a health intervention to be run as an RCT to test efficacy
(2015).	Overweight, Type 2 Diabetes, Hypertension and Cardiovascular Disease	Football	Randomised Controlled Trial	The 2013 Football Fans in Training Randomised Controlled Trial, worked with male fans 35-65 years of age with a BMI of 28-30 who attended Scottish Premier League Football Clubs, and who were classed as being at high risk of ill health including Type 2 Diabetes, Hypertension and Cardiovascular Disease. The intervention group received dietary guidance, and an exercise program of pedometer-based walking with goal-setting and diary records, and vigorous pitch-side physical activity sessions. They achieved clinically significant weight-loss, reduction in waist	

				circumference, percentage body fat, systolic and diastolic blood pressure compared with the control group. The intervention was also considered good value in the UK	
Citation	**Lifestyle Disease**	**Sport**	**Study Type / Design**	**Conclusion**	**Outstanding Issues**
(Ades 2015)	Type 2 Diabetes Mellitus	Regular Exercise	Researched Opinion piece	Programs using regular exercise and weight reduction can prevent T2DM in high-risk individuals and put it into remission, but behaviour change programs are not widely available in the United States and are usually not covered by health insurance	Health workers often can't prescribe such programs so must prescribe medications – what happens in countries where they can choose such programs?
(Oliveira et al. 2017)	Overweight/ obesity	Group Sport	systematic review and meta-analysis of the effects of group sports on health-related physical fitness of overweight youth	Group sports were found to improve body composition, cardiorespiratory endurance, and hand grip strength but not flexibility and neuromotor fitness	highlights the elements of physical health that need to be considered when setting evaluation measures for adults. Do individual sports impact different health measures compared with group sports?
(Campbell et al. 2012)	Breast Cancer	Exercise Intervention	5-year follow-up of RCT	Those who self-reported as engaging in sufficient physical activity recorded functional and psychological benefits compared with those who weren't active. No difference was seen for long term treatment related side effects such as osteoporosis, lymphoedema or cardiotoxicity	Article recommends women participate in supervised physical activity and behaviour change due to benefits implications for physical and psychological functioning. Need more detail of the exercise used, more details of health and survival rates, and whether 'exercisers' at 5 years were the group assigned to exercise during the study
(Dragons Abreast Australia 2015).	Cancer	Dragon Boating	Study to learn whether paddling Dragon Boats could help women recovering from breast cancer. Previous medical thinking was that women who had been treated for	Following participation in his three-month program of strenuous, repetitive upper body exercise in the gym and to learning and paddle dragon boats, none of the 24-volunteer breast-cancer survivors had lymphedema and they were healthier, fitter and happier. The program has spread throughout Canada, Australia and across the world	

			breast cancer should avoid rigorous upper body exercise so as not to develop lymphedema, a debilitating and chronic side effect of treatment.		
Citation	**Lifestyle Disease**	**Sport**	**Study Type / Design**	**Conclusion**	**Outstanding Issues**
(Rogers et al. 2017)	Breast Cancer	Physical Activity & Behaviour change	RCT	Test of the impact of physical activity on sleep on breast-cancer survivors. physical activity program reduced perceived global sleep dysfunction at 3 and 6 months, primarily because of improvements in sleep quality aspects not detected with accelerometer	Mechanism for improvement unclear
(Richardson , C et al. 2004)	Cardiovascular disease	Physical Activity	Observational study of 9824 U.S. adults aged 51-61 years	Regular moderate to vigorous physical activity associated with substantially lower mortality compared with sedentary individuals. High cardiovascular disease risk individuals were 21% of the population and 64% of deaths due to sedentary lifestyle	Sedentary US adults at pre-retirement increase their risk of dying, and those with a high cardiovascular disease risk appear benefit most from being physically active
(Mohr et al. 2014)	Cardiovascular disease	Swimming	A randomised controlled trial to test the hypothesis that high-intensity swim training improves cardiovascular health status in sedentary premenopausal women with mild hypertension and to test whether more intense, shorter swimming could benefit health.	Arterial hypertension is associated with cardiovascular morbidity and mortality, obesity and an inactive lifestyle add to this risk. Sixty-two women were randomized into high-intensity, moderate-intensity and control groups for a 15-week trial. Both the high and moderate intensity swimming groups participated 3 times per week whilst the control group did not change their lifestyle. Both groups lost body-fat, with more being lost by the moderate intensity group, and both groups saw similar performance increases and adaptations in spite of the shorter time spent and distances swum by the high intensity group.	This opens up questions of the need to study the intensity of exercise in interventions. Is more intense exercise for shorter periods as good for other conditions? Other sports?
(McGale, McArdle &	Depression/ Mental Health	Soccer-based	Pilot study to investigate the effectiveness of a team-based sport/psychosocial	The Individual Exercise Group showed greater perceived social support than the Behind the Net	Possible that interaction with researcher checking heart rate

Gaffney 2011)		Behind the Net	intervention, called Back of the Net v's individual exercise with 104 18–40-year-old sedentary males	Group Exercise-based interventions were shown to be effective in reducing symptoms of depression	monitors created sense of more personal attention.
Citation	**Lifestyle Disease**	**Sport**	**Study Type / Design**	**Conclusion**	**Outstanding Questions**
(Clough et al. 2016)	Mental Health	Extreme sport	Question whether extreme sport interventions benefit mental health	Extreme adventurous physical activities are linked to enhanced psychological health and well-being outcomes	Extreme sports are often excluded from health interventions but could they have wider benefits
(Correll et al. 2015)	Mental Health and lifestyle disease		Systematic review.	Showed antipsychotics, antidepressants and mood stabilizers taken to treat schizophrenia, depression and bipolar disorder raise the risk of physical lifestyle diseases including obesity, diabetes mellitus, thyroid disorders, hyponatremia and cardiovascular disorders. People with moderate to severe mental illness have shorter lifespans than the general population due to physical illness, and unhealthy lifestyle. People with mental ill health may gain a physical health benefit from an exercise intervention	Could participating in a community sport intervention reduce symptoms or side effects of medications?
(Fee 2018)	Postpartum Depression (Mental Health)	Exercise	RCT to either a 6-month phone-based or exercise intervention	Both interventions reduced the incidence of postpartum depression from a predicted 30-40% or an average 15%, to 8%. The wellness intervention appeared to lower depressive symptoms more and the exercise intervention was better at lowering stress	How would this work face to face?
(Priest et al. 2008a)	Any	All Sport	Systematic review of interventions implemented through sporting organisations to increase participation in sport	No controlled evaluation studies were found nor any uncontrolled studies meeting other inclusion criteria. In spite of the scientific evidence that increased physical activity has positive impacts on health, there weren't rigorous studies evaluating the effects of interventions organised through sporting organisations.	Rigorous studies need to be carried out to determine the most effective interventions that sporting organisations can use to increase people's participation.
(Leenaars et al. 2015)	Any	Any	Systematic literature review to identify collaborative initiatives between the primary care and sport	The barriers to referral of patients, sport professionals' lack of medical knowledge, and health professionals' lack of time. Different shared interests and different cultures were seen as barriers	Insight into collaboration and factors that facilitate or hinder collaboration between these sectors

			sectors in order to promote physical activity, and the barriers and facilitators in these initiatives	to the promotion and organisation of physical activity in the community.	
Citation	**Lifestyle Disease**	**Sport**	**Study Type / Design**	**Conclusion**	**Outstanding Issues**
(Weed 2016)	inactivity	All	Paper examines the evidence for the UK Government's theory that sport can be used as a public health intervention to increase physical activity among the physically inactive and less active population deliver improvements in the physical health of the population	No top-tier evidence from controlled designs to support, the effectiveness of sport as a public health intervention to increase physical activity. Sport participation has stalled or fallen 1990, in spite of UK Government investment since 1997. BUT there's a lack of rigorous studies evaluating the effects of interventions organised through sporting organisations to increase participation. AND 'investment' may have been in facilities or programs for elite performers not 'learn to play' for beginners	Need to investigate what sort of programs work with beginners an non-athletes
(Gusi et al. 2008)	overweight, moderately obese, or moderately depressed elderly women	Walking	randomised controlled trial to assess the cost-utility of adding a supervised walking programme to the standard "best primary care"	This exercise program was shown to be a cost-effective addition to 'best care' to help patients to increase their physical activity, and it was cheaper than a leisure centre program. Exercise programmes have been shown to reduce the use of healthcare services and medicines when targeted towards patients with particular diseases but they don't make a difference when targeted at the general population	Question whether results might be different for a similar cohort of men? How does a walking intervention compare with a leisure centre program in countries or at latitudes where winter light levels and weather are a barrier to participation?
(Anokye et al. 2011)	All	Exercise on Referral	systematic review of the literature on the clinical cost effectiveness of exercise referral schemes from a United Kingdom National Health Service Perspective	Exercise on referral schemes are more costly than usual care for people with pre-existing conditions (Obesity, Hypertension & Depression), but that they are more effective and lead to higher QUALY gains than the base case	Need to measure cost effectiveness for people with lifestyle diseases including diabetes, coronary heart disease and cancer. What were specifics of the exercise undertaken, dose rate and intensity in order to improve outcomes?

(Ding et al. 2016)	All lifestyle disease	Inactivity	Global analysis of major non-communicable diseases, coronary heart disease, stroke, Type 2 Diabetes, breast cancer, and colon cancer attributable to physical inactivity, to determine the economic burden of physical inactivity.	Literature review and research on direct health-care costs, productivity losses, and disability-adjusted life-years (DALYs) attributable to physical inactivity were estimated for 142 countries. The level of physical inactivity was based on national data from each country. Physical inactivity cost health-care systems international $ (INT$) 53·8 billion worldwide in 2013. P Physical inactivity related deaths cost $13·7 billion in productivity losses 13·4 million DALYs worldwide. High-income countries have a greater proportion of economic burden (80·8% of health-care costs and 60·4% of indirect costs), whereas low-income and middle-income countries have a larger proportion of the disease burden (75·0% of DALYs)	Important to appreciate the size and scope of the problem, as well as the potential impact of programs that treat and prevent these diseases.

Appendix 2. Proposed Framework

To use the framework, work down the column, then go to the top of the next column to start the next phase.

Phase 1 questions	Phase 2	Phase 3	Phase 4	Phase 5
About the Illness & suitability to participate	**About the Person**	**About the Sport**	**Other Program Elements**	**Measurement**
What lifestyle disease does the person have that they want to improve? E.g., Type 2 Diabetes	Does the person have a history of sport participation? (Preferences? Aversions? Desire to learn?)	What sports are available locally that the person can participate in?	To achieve the desired outcomes, what other behaviour needs to change?	Select elements to measure progress [or not] towards the intended goal(s). Draw on the medical model for the disease, and partner expertise if measures not known. Always choose evidence-based measures where possible.
Does the person have any other injuries, illness, risk factors to exercise? E.g., occasional vertigo	What is accessible to the person? (Geographically? Logistically? Financially? Culturally?) Are there measures that might make participation more accessible?	Of the available sports, which ones are likely to be able to offer a positive impact?	What would be good measures of these other behaviours changing?	Always measure at baseline (before starting the intervention) Select measurement intervals that identify whether progress is being achieved, and follow-up measures post-program to see whether behaviour has changed
What outcome, if measured, would indicate an improvement in the condition? E.g., Measurable weight reduction, improved glycaemic control, reduced need for medication	Does the person have skills gaps or other barriers to participating in certain sports? (e.g., never learned to swim, can't participate in mixed gender group for religious reasons)	What resources are available? Anything else needed? How intense is the sport? (Use scales at 2.2 to grade it) How Complex is the sport? (grade it) How risky is the sport? (grade it) Are there versions or modifications that simplify the sport? Reduce risk? Lower intensity?	Which local organisations, non-profits, individuals or groups have the expertise to partner to deliver activities/ education that might change these other behaviours?	Measure the costs and other inputs required. Did you have to buy/ hire resources to deliver the program? Are there any other inputs or outputs you need to measure? E.g., to satisfy a sponsor or partner?
Does physical activity have the potential to improve disease	What does the person find most motivating? • Team v individual	How individual/ team focussed is the sport? (grade it)	How should these other elements be delivered? Frequency? Dose	Identify how and when you will report on the program, who to

symptoms or outcomes? NB: Some are unsuitable – e.g., melanoma	activities, novelty & high-risk v routine • Complexity v simplicity • High intensity vs low intensity • Short v long duration		amount? Group work or one-to-one?	and what other evidence you need to gather along the way [photos, measures, testimonials]
Outcome: Person identified as having potential to be helped by a sport intervention, any requirements for program modification recorded OR person identified as unsuitable for the program at this time	**Outcome:** Characteristics of the person, their skills, history, barriers to participation revealed to assist program selection, design and modification.	**Outcome**: Helps match the sport to the person and identify necessary modifications	**Outcome**: Design of non-sport elements of the program completed and/or partner sourced to deliver these. Potentially great source of referrals to program	**Outcome**: Measures selected for progress, success and reporting, evidence gathering and report planned for

Figure 3 Proposed framework

Appendix 3. Sport Scales

In order to complete the grading of different elements of sport in Phase 3 above, use the sport scales below

Intensity

Low (walking pace or less, low level strength requirements)								High (sprint pace, maximal muscle exertion, highly fatiguing)	
1	2	3	4	5	6	7	8	9	10

Teamwork

Low (solo sport)								High (requires team of 7 or more players)	
1	2	3	4	5	6	7	8	9	10

Risk Taking

Low (no/ little additional risk of injury compared with normal life)								Risk of death from ordinary participation[155]	
1	2	3	4	5	6	7	8	9	10

Complexity

Low (simple, repetitive movements e.g., run on flat ground)								High (multiple movement types, pieces of equipment or adherence to complex rules required)	
1	2	3	4	5	6	7	8	9	10

Variability

Low (Activity remains consistent throughout)								High (Activity highly variable over the course of play)	
1	2	3	4	5	6	7	8	9	10

[155] Rock Fishing is currently thought to be Australia's most dangerous sport, with 158 recorded deaths in the past 13 years. https://www.northernstar.com.au/news/dangers-of-rock-fishing-highlighted/3380668/

Equipment Requirements

Low (no special equipment or clothing required)								High (Requires multiple pieces of specialised equipment and/ or clothing)	
1	2	3	4	5	6	7	8	9	10

Appendix 4. Semi-structured Interview Guide/Template

Demographics:
Name,
Age,
Ethnicity,
Job Role – with relation to the project
With which sport/ organisation?
Professional background?
Number of similar pieces of work led/ managed previously

1) Please explain who the target group was for your intervention. (Age of participants, condition targeted, any other characteristics about participants that the intervention was targeting e.g., low SEC, Indigenous, people with disabilities etc)
1.1 How did you recruit participants?
1.2 Did you encounter challenges relating to the target group?

2) Which setting(s) was your intervention designed to take place in?
2.1 Did you encounter any challenges related to the setting?

3) Please outline the sport(s) activities to be used in your design?
3.1 Did you encounter any challenges related to the sport(s) selected?

4) What equipment did you have available to use?
4.1 Did you encounter any challenges related to the equipment used?

5) What was the structure of the intervention?
5.1 How long was it designed to run?
5.2 How frequently did sessions take place?
5.3 How long were the sessions?
5.4 How many people attended the sessions? (Participants? Leaders? Others)
5.5 Was any incentive used?
5.6 Did you encounter any challenges related to the structure of the intervention?

6 Did you use/partner with people from other organisations to conduct the intervention?
6.1 What was the intention of using this partner?
6.2 How successful did you think the partnership work was?
6.3 What measures of success were you looking for?

7 Did you carry out any measurements of the intervention:
7.1 Before commencement?
7.2 During the intervention?
7.3 At the end?
7.4 After completion?
7.5 What were you measuring? What would success have looked like?

8 How long has the intervention run for?
8.1 How many or the candidates made it all the way?
8.2 If yes, how did you retain them?
8.3 If there were drop-outs, why?

9 How sustainable is it for your club to continue running the intervention?
9.1 What are the benefits to your sports club
9.2 What are the challenges your club faces to sustaining the intervention?

10 Have you written up the results of your work?
10.1 Did you need to complete a report on the intervention?
10.2 Have you published the results?
10.3 If you have published results, where did you publish them?
10.4 If you did not write up or publish results, what were the barriers to doing so?

11 What would have made it easier for you to set up and lead this intervention? (What should you have thought about/ done before or during the intervention that you forgot?)

12 If there was a framework or app designed to make your life easier what 3 things do you wish were included?

Appendix 5. Case study and thematic analysis [T] example

Case Study

Program Name: [T]

Sport: Soccer

Organisation Delivering the Intervention:

The Big Issue – a non-profit organisation "…dedicated to supporting and creating work opportunities for homeless, marginalised and disadvantaged people." The organisation began in Australia in 1993 in an effort to address homelessness, and it was based on the successful United Kingdom street magazine model. The Big Issue in Australia runs 6 social enterprises including: The Big Issue Magazine,[156] the Women's Subscription Enterprise,[157] The Big Issue Classroom,[158] the Community Street Soccer Program[159], The Big Idea[160] and Homes for Homes[161].

[T] is a weekly training session that promotes social inclusion and personal change, enabling participants to get fit, socialise, seek support and advice in a safe and non-threatening environment. The program enables support staff to work with players, who may have given up on traditional support systems and link them to services that address issues including homelessness, substance abuse, family breakdown and mental illness.[162]

Position of the Interviewee:

NSW and ACT State Coordinator for [T]

Interviewee Demographic Information:

31-year-old male, studied journalism and politics at University, graduated and was employed by the Big Issue as a Vendor Support worker, then he moved to working in the Big Issue

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[156] *Production and sale of a fortnightly print magazine - The Big Issue* magazine [Online 4/6/2020] https://www.thebigissue.org.au/the-big-issue-magazine/about/

[157] A subscription service to receive the print magazine and contracted project work for women who may not be safe or able to sell magazines in public places – The Women's Subscription Enterprise [Online 4/6/2020] https://www.thebigissue.org.au/about/

[158] A workshop where homeless people and those with disabilities educate school children on disadvantage in the community – The Big Issue Classroom [Online 4/6/2020] https://www.thebigissue.org.au/classroom/

[159] Weekly community soccer training that helps people get fit, connect with others whilst enabling support services to connect in a safe setting with people who have disengaged - Community Street Soccer [Online 4/6/2020] https://www.thebigissue.org.au/community-street-soccer/about/

[160] Five months of lectures, online seminars and discussions delivered by influential 'thought leaders', social enterprise practitioners and people who have experienced homelessness to university students. Students develop and submit their business plan for their 'Big Idea' into a competition. [Online 4/6/2020] https://www.thebigissue.org.au/the-big-idea-about/

[161] A pledge to donate 0.1% of the sale price of a home to create housing for the homeless [Online 4/6/2020] https://homesforhomes.org.au/

[162] Community Street Soccer [Online 4/6/2020] https://www.thebigissue.org.au/community-street-soccer/about/

classroom program and from there to the role of State Coordinator of the Street Soccer Program. This was his first experience of running a program of this type.

Target Population:

Marginalised people in the community including people in a low socio-economic position, those struggling with homelessness, disability, mental health issues – a wide range of people facing challenges. Participant demographics vary between communities and between each of the programs. Permitted age range is 16 years and older, but most participants are adults, and some range into their mid-70's.

Health issues:

Participants have a wide range of health issues including but not limited to Type 2 Diabetes, obesity, breast cancer, colon cancer, cardio vascular disease, mental health issues were also specifically mentioned.

Setting:

Indoor recreation centre basketball court, outdoor sports fields- currently in 18 locations across Australia, all in the community, most outdoors

Equipment:

Soccer balls, goals

Funding:

Federal Department of Health – no problems identified

How Is it Implemented:

- People are invited to come down and play a game of soccer.
- Recruitment is by word of mouth, via online information or through advertisements within the Big Issue Magazine, most referral is via local services such as the Wayside Chapel, Parramatta Mission, services for people experiencing homelessness, the Community Migrant Resource Centre, Macquarie Hospital who bring a group of, of their patients from the mental health ward.
- Sessions occur weekly for 2 hours, in community settings, mostly outdoor, and occasionally at indoor facilities. Sessions are usually run by two [T] staff members and sometimes volunteers or social workers from other services may also attend.
- Groups are mixed gender, except for one Melbourne program with women only. The program first started in 2007 and people can come for as long as they like.
- In the NSW ACT cluster, programs un on Monday in Sydney (except public holidays), Wednesday in Canberra, Thursdays in Newcastle and Parramatta.
- Attendance fluctuates in each location but at present Sydney gets over 25 participants to a session. Since starting in 2007 the program has officially engaged with 8000 people.
- The format is to play soccer – though this may change form 1 big game to multiple small sided games depending on how many participants turn up. We find soccer is really inclusive, it's played in different cultures, and we include everyone regardless of ability.

It's an easier game than Rugby League or Union and a higher intensity workout from constant running and sprinting.

- During the session, either at the start, in the middle or at the end an activity is run to promote health awareness. This may be a discussion, or a talk from a guest speaker to educate the group on key health issues within. For example, Beyond Blue talking about Mental Health, the Brain Foundation talking about mental health research, universities who run programs based on trying to improve our participant's nutrition, education on health outcomes and healthy choices, working with organizations like OzHarvest to deliver nutritional outcomes. They also bring food to some sessions, so even if people can't play, they can watch and eat something.
- The program has a national competition where players from all 18 locations are brought together to compete over a weekend. Players who attend regularly and demonstrate a sense of fair play will be nominated to compete. The weekend is also about changing behaviours not just the competition. That is the only 'incentive' used for participants.

Challenges:

- Raising awareness of our programs, ease of communication – that's the biggest challenge. The Big Issue Magazine has been around for 23 years and people still don't understand what we do. We need somewhere potential participants and service providers can go, Ask Izzy or Start It Up apps can help, but awareness of them isn't great.
- Participant behaviour, sometimes due to past experiences or, or through mental health issues such as schizophrenia, also the issue (predominantly around homelessness) of people attending the program intoxicated or under the influence. Dealing with this in the first instance can be hard, but we manage quite well. Most of our problems are behavioural change issues.
- Getting participants to attend regularly
- Settings- outdoor settings have the challenge of wet weather making delivery difficult or leading to cancellation, but indoor settings or those with lots of noise can be claustrophobic for participants
- Contact occurring as part of the sport can exacerbate participant feelings of agitation if they are already agitated
- Behavioural change
- Never having played soccer before, not feeling comfortable with it

Measurement:

Participant feedback about activities, food and switching to better nutrition or personal behaviour change is gathered. Annual formal participant surveys are used, but not fitness testing or deep interviewing as participants don't like it. Session attendance is reported we don't track how long participants have attended – they may drop in and out depending on whether they get work or move location. We prepare monthly reports on the health outcomes and how activities performed, any connections made with local services and individual outcomes – for example eating healthily or contacting a supplier for job search

Sustainability: This depends on the charges to use the space in different locations

Pathways to mainstream Sport: Participants do transition. In Parramatta a group of participants joined a local soccer team, but participants also transition into work

Publication: The State Coordinator was under the impression some research had been published. Evidence was found of a case study being provided in the book *Sports-Based health interventions(Sherry 2016)* and a German article looked at heart rate and movement patterns for female street soccer participants (Randers et al. 2018), but neither publication appeared to examine the impact of the program as a health intervention.

Table 7 Thematic Analysis

Theme	Sub-themes	Definition of sub-theme	[T]	Example quotes
Intervention Method	How was your intervention structured?	• Location, frequency of sessions, duration of sessions? • What was the length of the intervention for a participant? • How was the intervention facilitated? • How many staff to participants?	• weekly for 2 hours in community settings, mostly outdoor facilities. • Participants may come as long as they like • Two [T] staff members facilitate and sometimes volunteers or social workers attend • Participant numbers vary, up to 25 in Sydney • [T] aims to promote social inclusion and behaviour change, enabling participants to get fit, socialise, seek support to address issues including homelessness, substance abuse, family breakdown and mental illness.	
	Setting	Where did the intervention take place?	Indoor recreation centre basketball court, outdoor sports fields- currently in 18 locations across Australia, all in the community, most outdoors	

	Equipment	• What equipment was used? • Was it adjusted to meet participant needs?	• Soccer balls, goals • No extra adjustments	
	Sport	• What sport was used? • Was the sport modified in some way?	• Soccer • Sometimes small sided games are used – depends on numbers. Focus on inclusion, not just competition	"We find soccer is really inclusive, it's played in different cultures, and we include everyone regardless of ability. It's an easier game than Rugby League or Union and a higher intensity workout from constant running and sprinting."
	Were there program elements other than sport?	• Education, • provision of services or goods, • incentives	• Always an activity to promote health awareness. This may be a discussion, or a talk from a guest speaker • OzHarvest bring food to sessions to promote good nutrition and there is a national competition where players from all 18 locations are brought together to compete over a weekend. Regular attendance and demonstrate a sense of fair play leads to nomination and the weekend is also focussed on	

			behaviour change not just the competition.	
	Were there other delivery partners/ agencies who delivered elements of the program?	Non-profits, volunteers, government, community groups?	• Beyond Blue who talk about Mental Health, the Brain Foundation who talk about mental health research, Universities who run programs to help participants to improve their nutrition, education on health outcomes and healthy choices, OzHarvest to deliver nutritional outcomes, and bring food to sessions	
	Recruitment	How did you source participants	Recruitment is by word of mouth, via online information or through advertisements within the Big Issue Magazine, most referral is via local services such as the Wayside Chapel, Parramatta Mission, services for people experiencing homelessness, the Community Migrant Resource Centre, Macquarie Hospital who bring a group of, of their patients from the mental health ward	
	How many weeks/ months/ years did the intervention run for overall?		Started in Australia in 2007. Has officially engaged with 8000 people – it's ongoing. In the NSW ACT cluster, programs	

			run on Monday in Sydney (except public holidays), Wednesday in Canberra, Thursdays in Newcastle and Parramatta	
	Did you forget anything that a framework could have reminded you to include?			

Theme	**Sub-themes**	**Definition of sub-theme**	**[T]**	**Example quotes**
Disease	Which of the target disease(s) did you work with?	• One or more than one disease? • What were they?	• More than one • Participants have a wide range of health issues including but not limited to Type 2 Diabetes, obesity, breast cancer, colon cancer, cardio vascular disease, mental health issues were also specifically mentioned.	
	Did participants also have other health issues?	Medication, substance misuse, poor nutrition, mental health issues etc	[T] targets marginalised people in the community including people in a low socio-economic position, those struggling with homelessness, disability, mental health issues	
	Were there other issues that impacted participant health?	Domestic violence, poor housing, homelessness,	Homelessness, mental ill-health, violence, substance (mis)use, unemployment, now/ no income, disability, disconnection with	

			traditional support systems	

Theme	Sub-themes	Definition of sub-theme	[T]	Example quotes
Participants	What cohort did you work with?	Men? Women? Both? Age?	Mixed gender in NSW ACT- all welcome Permitted age range is 16 years and older, most are adults some are up to mid-70's.	
	Were there other participant target characteristics?	Did the participants have to reside in a particular area or be from a particular group/ income level/ background to participate?	– a wide range of people facing challenges. Participant demographics vary between communities and between each of the programs.	
	Screening	Did you screen participants? How? Would more thorough participant screening have helped with the success of the intervention?	Screening not used, but sometimes participant behaviour related to past experiences, mental health issues such as schizophrenia, or being intoxicated needs to be dealt with	

Theme	Sub-themes	Definition of sub-theme	[T]	Example quotes
Measurement	Did you measure participants, if so what	Outcomes/ outputs/ effectiveness?	Both Participant feedback about activities, food and switching to better nutrition or personal behaviour change is gathered. Monthly reports on the health	"…we had a participant who regularly takes the food home and gloats about how well she's been cooking recently… and how much healthier she's been eating. And she used to be the one that always

			outcomes, activity success, any connections made with local services and individual outcomes – for example eating healthily or contacting a supplier for job search Annual formal participant surveys are used, but not fitness testing or deep interviewing as participants don't like it. Session attendance is reported we don't track how long participants have attended – they may drop in and out depending on whether they get work or move location.	dived for the chips. But now she's also diving for … the vegetables and fruit that come along as well…"
	How did you measure participants?	What tools and measures did you use?	Participant feedback, annual survey	
	When/ how often did you measure	Did you measure at baseline, what intervals during? Afterwards?	Annual survey, feedback as and when, session counts and reflection. No baseline or formal follow-up	
	Did you have a success measure?	• A participant success target? • Was there an intervention success target?	•	

	How did you measure the program?			

Theme	Sub-themes	Definition of sub-theme	[T]	Example quotes
Partners	Did you work with others outside your organisation to deliver the program?	Groups? Individuals,	The Big Issue Magazine, set the program up Beyond Blue, the Brain Foundation, Sydney University, the Migrant Resource Centre in Parramatta, OzHarvest are delivery partners	"…it also does depend on the locations… what services are around there…at Parramatta we've had more success with those organizations that are helping out with migrant communities because that just makes up the big demographic within Parramatta whereas at the Sydney program we've had more success with those services that are offering help with homelessness and mental health issues. Because that's a, more of a makeup of that community."
	Where there any issues with how this arrangement worked?		Not really	
	What could have helped you overcome these challenges?			

Theme	Sub-themes	Definition of sub-theme	[T]	Example quotes
Money	Who pays?	Participant? Government? Someone else?	Federal Department of Health funds 100%	

			(free to participants)	
	Was funding a constraint?	Did funding issues provide obstacle to establishing/ equipping/ growing the intervention?	No problems identified	
	Were there other funding challenges?	Intervention period to short, unable to measure, external financial pressures like GFC impact	no	
	Securing funding	• Did a lot of effort go in to securing funds? • Does the need to satisfy funder change how the intervention is run	no	
	Sustainability	Does the intervention pursue a funding model that makes/ will make it sustainable?	Not really – as long as venue hire remains affordable	

Theme	**Sub-themes**	**Definition of sub-theme**	**[T]**	**Example quotes**
Publication	Have you published your data in an academic journal?	Was it published in an academic journal?	There has been academic publication about [T] but neither publication appeared to examine the impact of the program as a health intervention. A case study was included in the book *Sports-Based health interventions(Sherry 2016)* and a German article looked at heart rate and movement patterns for female street soccer participants (Randers et al. 2018)	
	Could you publish on the strength of the data/ information you have collected?		Unlikely given current measures	
	Did you publicise what your		Big Issue website www.thebigissue.org.au/community-street-soccer	

	work somewhere else?			

Other Themes arising

Theme	Sub-themes	Definition of sub-theme	[T]	Example quotes
Pathways to Mainstream Sport	Do participants go from the program to join other sports	As Players Officials Volunteers	Participants do transition. In Parramatta a group of participants joined a local soccer team	
Communication	Communication to improve referrals		Raising awareness of our programs, ease of communication – that's the biggest challenge.	"The Big Issue Magazine has been around for 23 years and people still don't understand what we [T] do."
	Communication about allied services, and to recruit participants		potential participants and service providers need somewhere they can go. Ask Izzy or Start It Up apps (also Big Issue projects) can help, but awareness of them isn't great.	
Challenges	Participant behaviour		sometimes due to past experiences or, or through mental health issues such as schizophrenia, also the issue (predominantly around homelessness) of people attending	

			the program intoxicated or under the influence	
	Contact		Contact occurring as part of the sport can exacerbate participant feelings of agitation if they are already agitated	
	No experience of soccer		People may not feel comfortable with soccer if they aren't familiar with it	
	Setting		outdoor settings have the challenge of wet weather making delivery difficult or leading to cancellation, but indoor settings or those with lots of noise can be claustrophobic for participants	
	Behaviour change		Most problems are behavioural change issues	
	Attendance		Getting participants to attend regularly	
Travel				

Appendix 6. Ethics Approval

WESTERN SYDNEY
UNIVERSITY

HUMAN RESEARCH ETHICS COMMITTEE

2 May 2019
Associate Professor Terry Sloan
School of Business

Dear Terry,

Project Title: "Reducing lifestyle diseases using community based sport"

HREC Approval Number: H13128
Risk Rating: Low 1 - LNR
I am pleased to advise the above research project meets the requirements of the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018).
Ethical approval for this project has been granted by the Western Sydney University Human Research Ethics Committee. This HREC is constituted and operates in accordance with the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018).
Approval of this project is valid from 2 May 2019 until 2 August 2019.
This protocol covers the following researchers:
Terry Sloan, Bastien Wallace, Keith Parry, Emma George

Summary of Conditions of Approval

1. A progress report will be due annually on the anniversary of the approval date.

2. A final report will be due at the expiration of the approval period.

3. Any amendments to the project must be approved by the Human Research Ethics Committee prior to being implemented. Amendments must be requested using the HREC Amendment Request Form.

4. Any serious or unexpected adverse events on participants must be reported to the Human Research Ethics Committee via the Human Ethics Officer as a matter of priority.

5. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the Committee as a matter of priority.

6. Consent forms are to be retained within the archives of the School or Research Institute and made available to the Committee upon request.

7. Project specific conditions:
There are no specific conditions applicable.

Please quote the registration number and title as indicated above in the subject line on all future correspondence related to this project. All correspondence should be sent to humanethics@westernsydney.edu.au as this email address is closely monitored.

Yours sincerely

Professor Elizabeth Deane
Presiding Member,
Western Sydney University Human Research Ethics Committee

Western Sydney University
ABN 53 014 069 881 CRICOS Provider No. 00917K
Locked Bag 1797 Penrith NSW 2751 Australia
westernsydney.edu.au

Appendix 7. Ethics Amendment Request Approval

WESTERN SYDNEY
UNIVERSITY

REDI Reference: H13128
Expiry Date: 2 August 2019

HUMAN RESEARCH ETHICS COMMITTEE

20 June 2019

Associate Professor Terry Sloan
School of Business

Dear Terry,

RE: Amendment Request to H13128

I wish to formally advise you that the Human Research Ethics Committee has approved your request to amend your approved research protocol H13128 "Reducing lifestyle diseases using community based sport"

The approved amendments are:

Conduct remote interviews via telephone or skype in overseas sites - New Zealand and Canada.

Project specific approval conditions:

Please quote the registration number and title as indicated above in the subject line on all future correspondence related to this project. All correspondence should be sent to humanethics@westernsydney.edu.au as this email address is closely monitored.

Regards

Professor Elizabeth Deane
Presiding Member,
Western Sydney University Human Research Ethics Committee

Appendix 8. Amended framework

To use the framework, work down the column, then go to the top of the next column to start the next phase. The Sport Scales at Appendix 3 still apply and remain unchanged.

Phase 1 questions	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**
About the Illness & suitability to participate	**About the Person**	**About the Sport**	**Other Program Elements**	**Measurement**	**Intervention design**
What lifestyle disease or risk factors does the person have that they want to improve? E.g., Type 2 Diabetes/ inactivity	Does the person have a history of sport participation? (Preferences? Aversions? Desire to learn?)	What sports are available locally that the person can participate in?	To achieve the desired outcomes, what other behaviour needs to change?	Select elements to measure progress [or not] towards the intended goal(s). Draw on the medical model for the disease, or disease risk, and partner expertise if measures not known. Always choose evidence-based measures where possible.	Target disease(s), single/ multiple? Or will you target lifestyle disease more broadly
Does the person have risk factors to successfully participating? These could be risk factors to exercise like vertigo, other injuries or illness, OR the person may face domestic violence, homelessness, transport barriers, poverty.	What is accessible to the person? (Geographically? Logistically? Financially? Culturally?) Are there measures that might make participation more accessible?	Of the available sports, which ones are likely to be able to offer a positive impact?	What would be good measures of these other behaviours changing?	Always measure at baseline (before starting the intervention) Select measurement intervals that identify whether progress is being achieved, and follow-up measures post-program to see whether behaviour has changed	Recruitment of participants, partners, volunteers and funders / program marketing plan
What outcome, if measured, would indicate an improvement in the condition?	Does the person have skills gaps or other barriers to participating in certain sports? (e.g., never learned to swim, can't participate	What resources are available? Anything else needed? How intense is the sport? (Use scales at 2.2 to	Which local organisations, non-profits, individuals or groups have the expertise to partner to deliver	Measure the costs and other inputs required. Did you have to buy/ hire resources to deliver the	Communication plan and tools– to partners, volunteers, funders, government, facility owners, participant.

E.g., Measurable weight reduction, improved glycaemic control, reduced need for medication		in mixed gender group for religious reasons)	grade it) How Complex is the sport? (grade it) How risky is the sport? (grade it) Are there versions or modifications that simplify the sport? Reduce risk? Lower intensity?	activities/ education that might change these other behaviours?	program? Are there any other inputs or outputs you need to measure? E.g., to satisfy a sponsor or partner?	Also about the intervention externally e.g., to media, sharing of resources to participants and communication between participants.
Does physical activity have the potential to improve disease symptoms or outcomes? NB: Some are unsuitable – e.g., melanoma		What does the person find most motivating? • Team v individual activities, novelty & high-risk v routine • Complexity v simplicity • High intensity vs low intensity • Short v long duration	How individual/ team focussed is the sport? (grade it)	How should these other elements be delivered? Frequency? Dose amount? Group work or one-to-one? Referral of participant for support external to the intervention?	Identify how and when you will report on the program, who to and what other evidence you need to gather along the way [photos, measures, testimonials, rubric, evaluations or reflections by others, participant feedback on their feelings/ outcomes/ success]	Intervention duration – per participant and overall, include plans for follow-up
Outcome: Person identified as having potential to be helped by a sport intervention, any requirements for program modification recorded OR person identified as unsuitable for the program at this time		**Outcome:** Characteristics of the person, their skills, history, barriers to participation revealed to assist program selection, design and modification.	**Outcome**: Helps match the sport to the person and identify necessary modifications	**Outcome**: Selection of non-sport elements of the program completed and/or partner sourced to deliver these. Potentially great source of referrals to program	**Outcome**: Measures selected to enable the evaluation of progress and success, to gather relevant evidence that could inform future change or retention of program elements and reporting to satisfy reporting requirements	

Figure 4 Amended framework

Appendix 9. Search Protocol for Literature Review

Search Design – PICO

Population	Adults with/ at high risk of: 1. Cardiovascular Disease, 2. Breast Cancer, 3. Bowel & Colon Cancer, 4. Type 2 Diabetes & Metabolic Syndrome, 5. Obesity & overweight
Intervention	Health Intervention program run by or using a sport
Comparison	No Intervention, standard medical intervention
Outcome	1. Blood pressure, resting heart rate, cardiovascular fitness 2. HRQOL*, Fitness, Sleep quality 3. HRQOL*, Fitness, Sleep quality 4. Glycaemic control, 5. Weight and fat measurement

*HRQOL is conceptualized as the five different ways in which disease and treatment can impact well-being and quality of life: impairment, functional status, perception of health, social interactions, and duration of life.

Phase 1

I executed the following searches for these diseases in Peer Reviewed Journals from 2000 – 2018, in English in the databases: Informit, Ausport, SportDiscuss and Medline, using the search terms:

1. "Sport* Intervention*" AND "Cardiovascular Disease*" "Sport* Intervention*" AND "Heart Disease*"
2. "Sport* Intervention*" AND "Breast Cancer*"
3. "Sport* Intervention*" AND "Bowel Cancer*" "Sport* Intervention*" AND "Colon Cancer*"
4. "Sport* Intervention*" AND "Type 2 Diabetes" "Sport* Intervention*" AND "Diabetes Myelitis" "Sport* Intervention*" AND "Metabolic Syndrome" "Sport* Intervention*" AND "Pre-Diabetes"
5. "Sport* Intervention*" AND "Obesity" "Sport* Intervention*" AND "Overweight"

Results:

These were all of the broadly relevant results I got. Many others were dismissed on the basis that they focussed on children, fad diets or sports science issues related to high performance, professional and elite athletes.

Table 8 Phase 1 results

Title	Profile: For the love of the game
Source	NSW Doctor, The, Vol. 9, No. 2, Mar/Apr 2017: 24-25
Abstract	A pioneer of sports medicine, Dr Jeni Saunders has worked with some of the country's top athletes. She shares her insight on exercise, sports and the country's burgeoning obesity crisis.
Title	Can you outrun an unhealthy diet?
Author	Noakes, Manny; Wycherley, Tom; Martin, Jane; Shrapnel, Bill; McMillan, Joanna

Source	Australasian Science, Vol. 36, No. 5, Jun 2015: 46
Abstract	An editorial in the 'British Journal of Sports Medicine' has blamed excess sugar and carbohydrates, and not a lack of exercise, behind the surge in obesity.
Title	Social success: Now to the story of the former Australian rugby star who took on social media and won
Author	Mark Ferguson; Djuro Sen; Bill Young; Matt Dunning
Source	Seven News (SEVEN NETWORK); Time: 18:00; Broadcast Date: Tuesday, 20th May 2014; Duration: 2 min., 48 sec.
Abstract	Now to the story of the former Australian rugby star who took on social media and won. Front rower Matt Dunning was constantly ridiculed for his size, until now. He's lost 40 kilograms and in doing so, he is taken on the internet bullies by documenting his amazing transformation online.
Title	Bridging the Indigenous health divide: football and men engaging
Author	McCoy, Brian F.
Source	Indigenous People, Race Relations and Australian Sport. Hallinan, Chris and Judd, Barry (eds). London: Routledge, 2014: 38-50
Abstract	
Title	Build it and they will come: Outcomes from a successful cardiac rehabilitation program at an Aboriginal Medical Service
Author	Dimer, Lyn; Dowling, Ted; Jones, Jane; Cheetham, Craig; Thomas, Tyra; Smith, Julie; McManus, Alexandra; Maiorana, Andrew J
Source	Australian Health Review, Vol. 37, No. 1, 2013: 79-82
Abstract	Objective. Cardiovascular disease (CVD) is the leading disease burden in Aboriginal Australians, but culturally appropriate cardiac rehabilitation programs are lacking. We evaluated the uptake and effects on lifestyle, and cardiovascular risk factors, of cardiac rehabilitation at an Aboriginal Medical Service (AMS). Methods. The program involved weekly exercise and education sessions (through 'yarning') for Aboriginal people with or at risk of CVD. Participants' perceptions of the program and the impact on risk factors were evaluated following 8 weeks of attendance. Results. In twenty-eight participants (20 females) who completed 8 weeks of sessions, body mass index (34.0_5.1 v. 33.3_5.2 kgm-2; $P < 0.05$), waist girth (113_14 v. 109_13 cm; $P < 0.01$) and blood pressure (135/78_20/12 v. 120/72_ 16/5 mmHg; $P < 0.05$) decreased and 6-min walk distance increased (296_115 v. 345_135m; $P < 0.01$). 'Yarning' helped identify and address a range of chronic health issues including medication compliance, risk factor review and chest pain management. Conclusions. AMS-based cardiac rehabilitation was well attended, and improved cardiovascular risk factors and health management. An AMS is an ideal location for managing cardiovascular health and provides a setting conducive to addressing a broad range of chronic conditions.
Title	Healthy lifestyle programs for physical activity and nutrition [Reprint]
Author	Closing the Gap Clearinghouse (Australia)
Source	Journal of the Home Economics Institute of Australia; Vol. 19, Issue: 1; 2012: 38-44
Abstract	Indigenous Australians suffer the worst health of any population group in Australia, with a high burden of disease and low life expectancy. It is estimated that chronic diseases - such as cardiovascular disease, diabetes and chronic kidney disease - are responsible for 80% of the mortality gap between Indigenous and other Australians, yet these diseases have preventable risk factors, including being overweight and obese, poor nutrition and physical inactivity. This resource sheet reviews the evidence on intervention programs aimed at these lifestyle risk factors. It outlines what works, what doesn't, and what further research is needed, regarding general population and Indigenous-specific programs for physical activity and nutrition, including their effectiveness, sustainability, and management.
Title	Healthy lifestyle programs for physical activity and nutrition

Author	Closing the Gap Clearinghouse (Australia); Australian Institute of Health and Welfare; Australian Institute of Family Studies
Source	[Canberra, A.C.T.: Closing the Gap Clearinghouse], 2012. 10 pp. Resource sheet / Closing the Gap Clearinghouse no. 9. ISBN 9781742492728.
Abstract	Indigenous Australians suffer the worst health of any population group in Australia, with a high burden of disease and low life expectancy. It is estimated that chronic diseases - such as cardiovascular disease, diabetes and chronic kidney disease - are responsible for 80% of the mortality gap between Indigenous and other Australians, yet these diseases have preventable risk factors, including being overweight and obese, poor nutrition and physical inactivity. This resource sheet reviews the evidence on intervention programs aimed at these lifestyle risk factors. It outlines what works, what doesn't, and what further research is needed, regarding general population and Indigenous-specific programs for physical activity and nutrition, including their effectiveness, sustainability, and management.
Title	The cost-effectiveness of Australia's Active After-school Communities program.
Author	Moodie, M.; Carter, R.; Swinburn, B.; Haby, M.
Source	Obesity; Issue: 28; Nov 2009: Epub
Abstract	The objective of this study was to assess from a societal perspective the cost-effectiveness of the Active After-school Communities (AASC) program, a key plank of the former Australian Government's obesity prevention program. The intervention was modelled for a 1-year time horizon for Australian primary school children as part of the Assessing Cost-Effectiveness in Obesity (ACE-Obesity) project. Disability-adjusted life year (DALY) benefits (based on calculated effects on BMI post-intervention) and cost-offsets (consequent savings from reductions in obesity-related diseases) were tracked until the cohort reached the age of 100 years or death. The reference year was 2001, and a 3% discount rate was applied. Although the program has intuitive appeal, it was not cost-effective under base-case modelling assumptions. To improve its cost-effectiveness credentials as an obesity prevention measure, a reduction in costs needs to be coupled with increases in the number of participating children and the amount of physical activity undertaken.
Title	Are Immigrants at Risk of Heart Disease in Australia?: A Systematic Review
Author	Dassanayake, Jayantha; Dharmage, Shyamali C; Gurrin, Lyle; Sundararajan, Vijaya; Payne, Warren R
Source	Australian Health Review, Vol. 33, No. 3, Aug 2009: 479-491
Abstract	We systematically reviewed the peer-reviewed literature to establish the prevalence of cardiovascular disease (CVD) among immigrants in Australia and whether being an immigrant is a CVD risk factor. Of 23 studies identified, 12 were included. Higher prevalence of CVD was found among Middle Eastern, South Asian and some European immigrants. Higher prevalence of CVD risk factors was found among Middle Eastern and Southern European immigrants. Higher alcohol consumption was found among immigrants from New Zealand, the United Kingdom and Ireland. Smoking and physical inactivity were highly prevalent among most immigrants.
Title	Effects of a 12-month exercise program on cardiorespiratory health indicators of Vietnam War veterans resident in the tropics.
Author	Kerr, RM; Leicht, AS; Spinks, WL
Source	Aust J Rural Health, 2008 Jun; 16 (3): 132-6
Abstract	OBJECTIVE: To measure the effect of a combined aerobic and resistance exercise program on key cardiovascular disease risk factors (i.e. body composition or anthropometry and cardiorespiratory function) of Australian male, Vietnam War veterans living in the tropics. DESIGN: Twelve-month exercise program with assessments at commencement, 3, 6 and 12 months. SETTING: North Queensland regional centre. PARTICIPANTS: Australian male, Vietnam War veterans (n = 164) resident in north Queensland. MAIN OUTCOME MEASURES: Measurement of heart rate, blood pressure, skinfold and girth measurements, exercise heart rate response and estimated aerobic capacity to determine whether the implementation of a simple aerobic and resistance exercise program could positively change selected cardiovascular disease risk factors in Vietnam Veterans. RESULTS: Significant improvements were reported for systolic blood pressure (131.1 (SD 15.7) reduced to 122.7 (12.4) mmHg), diastolic blood pressure (82.7 (9.1) reduced to 76.3 (10.3) mmHg), resting heart rate (73 (11) reduced to 69 (11) bpm), sum of skinfolds (127.5 (40.3) reduced to 99.5 (32.1)

	mm), waist girth (103.2 (12.0) reduced to 100.5 (12.1) cm), hip girth (105.3 (9.6) reduced to 103.7 (10.4) cm) and aerobic capacity (2.17 (0.39) increased to 2.36 (0.34) L min(-1)). CONCLUSION: Participation in a combined aerobic and resistance training program elicited significant anthropometric and cardiorespiratory benefits that might lead to a decreased risk of developing cardiovascular disease for male Vietnam War veterans resident in rural and regional areas.
Title	Effect of aerobic exercises on patients with early coronary artery disease
Author	Mazumdar, S; Verma, SK
Source	Journal of Exercise Science and Physiotherapy, Vol. 4, No. 1, Jun 2008: 66-68
Abstract	The purpose of the study was to examine the effects of aerobic exercises on patients of early coronary artery disease. The study was conducted on thirty male adult patients of stable angina, ranging in age from 40 to 60 years (mean 53.2 years). Six weeks cardiac rehabilitation program (CRP) consisting of light aerobic exercises was administered to the subjects with intermittent monitoring of their cardiovascular fitness. Intensity of exercise programme (CRP) was increased every two weeks. The results revealed that there was a gradual increase in cardiovascular fitness but the exercise tolerance had decreased during this period.

Whilst the results were broadly relevant, none covered lifestyle disease interventions in community sport settings or clubs.

Alerts were set for search results using these terms to be emailed to the researcher. However, between these searches in 2018 and further searches in 2021, useful results were not returned.

Phase 2

Google alerts were set using the terms:

1. Sport intervention and Cardiovascular Disease
2. Sport intervention and Breast Cancer
3. Sport intervention and Bowel Cancer
4. Sport intervention and Diabetes
5. Sport intervention and Obesity
6. Sport intervention and Health
7. Physical Activity intervention and health

Over time these searches proved the most productive, yielding a range of news articles, news of journal publications, releases of high-quality relevant data such as from the Australian Institute of Health and Welfare.

Phase 3

Due to the limited results in Phase 1, during Phase 2 the researcher repeated the searches in Phase 1, substituting "Sport" for the names of specific sports, selecting sports based on the National Sports Organisations listed in the Australian Sports Directory (SportAus) – such as basketball, cricket, rugby, tennis, swimming, golf, surfing etc. and searching for sports where she was aware interventions had been conducted for example NRL, Dragon Boating

For example, "Dragon boats" **+ "**Breast cancer" found
Spooner, Graham. Library News [online]. Nursing. Aust, Vol. 7, No. 2, Winter 2006: 18. Availability: <https://search-informit-com-au.ezproxy.uws.edu.au/documentSummary;dn=140473377528735;res=IELHEA> ISSN: 1443-1491. [cited 26 Sep 18].

But this article is about College Library staff participating in the Dragons Abreast dragon boat race in Darling Harbour on Sunday 12 February not about the merits of the program and it just refers to the website.

The results table below shows the results gathered using these searches, that were deemed relevant, later added to with content from alerts. These are extracted from a much larger Excel table that noted the applicable disease(s) and began noting questions arising for the researcher as she read the articles, reports and sources.

Table 9 Phase 3 search results

Author	Date published	Title	Resource class	Publisher/ Journal name	Journal Volume	Sport 1	Sport 2
STEVINSON, C., WILTSHIRE, G. and HICKSON, M.,	Jul-05	Facilitating participation in health-enhancing physical activity: a qualitative study of parkrun	Journal	International Journal of Behavioural Medicine,	22(2), pp.170-177	Running	
Dr Nick Cavill, Emma Adams, Suzanne Gardner and Sarah Ruane	2016	Tackling Inactivity: Executive Summary Report	Report	Sport England	page 6	All Sport	
Khan KM , Thompson AM , Blair SN , et al .	2012	Sport and exercise as contributors to the health of nations.	Journal	Lancet	380:59–64. doi:10.1016/S0140-6736(12)60865-4	Soccer	
Oja P , Titze S , Kokko S , et al .	2015	Health benefits of different sport disciplines for adults: systematic review of observational and intervention studies with meta-analysis.	Journal	Br J Sports Med	2015;49:434–40.doi:10.1136/bjsports-2014-093885	Soccer	
Krustrup P , Helge EW , Hansen PR , et al .	2018	Effects of recreational football on women's fitness and health:	Journal	Eur J Appl Physiol	2018;118:11–32.doi:10.10	Soccer	

		adaptations and mechanisms.			07/s00421-017-3733-7		
Milanović Z , Pantelić S , Čović N , et al .	2018	Broad-spectrum physical fitness benefits of recreational football: a systematic review and meta-analysis.	Journal	Br J Sports Med	2018. doi: 10.1136/bjsports-2017-097885. [Epub ahead of print 25 Jan 2018]. doi:10.1136/bjsports-2017-097885	Soccer	
Ottesen L , Jeppesen RS , Krustrup BR .	2010	The development of social capital through football and running: studying an intervention program for inactive women.	Journal	Scand J Med Sci Sports	2010; 20(Suppl 1):118–31.doi:10.1111/j.1600-0838.2010.01	Soccer	
Football as Medicine Peter Krustrup, Daniel Parnell		Prescribing Football for Global Health Promotion	Book	Routledge	1st Edition	Soccer	
Western Bulldogs	4/10/2017	Daughters of the West Program	Web Page	Will be reviewed by Victoria University		Physical Activity	
Felipe Lobelo, MD PhD	12/08/2018	Group, recreational sports are effective for reducing chronic disease risk factors in adults	Journal	October 2018 edition of Mayo Clinic Proceedings Woodruff Health Sciences Center | Aug. 21, 2018		Group sport	Soccer

Syann Cox	Sep-12	Game of Life: How sport can make us healthier, happier and richer	Grey literature	Sport and Recreation Alliance		All Sport	
Oughton and Tacon	(2007),	Sport's Contribution to Achieving Wider Social Benefits	Report	Department of Culture Media and Sport		All Sport	
Tauren Dyson	14/08/2019	Exercise may extend the lives of advanced colorectal cancer patients	News report				
MAZZILLI, KAITLYN M.1; MATTHEWS, CHARLES E.1; SALERNO, ELIZABETH A.1,2; MOORE, STEVEN C.1		Weight Training and Risk of 10 Common Types of Cancer	Journal	Medicine & Science in Sports & Exercise			
Guercio BJ, et al.	21/08/2019	Exercise linked to longer PFS (progression free survival), fewer treatment-related toxicities in metastatic colorectal cancer		J Clin Oncol. 2019;doi:10.1200/JCO.1901019			
Leah Lawrence	August 19, 2019	Can Physical Activity Delay Progression in Metastatic Colorectal Cancer?					
A.Campbell, N.Mutrie, S.Tovey, S.Barry, J.Mcloed	1/12/2012	Five year follow up of an exercise intervention during breast cancer treatment	Journal Article	Journal of Science and Medicine in Sport	Volume 15, Supplement 1, December 2012, Page S334		
Rogers, L. Q. Courneya, K. S. Oster, R. A. Anton, P. M. Robbs, R. S. Forero, A. McAuley, E.	2017	Physical Activity and Sleep Quality in Breast Cancer Survivors: A Randomized Trial	Journal Article	Med Sci Sports Exerc	49(10)	Physical Activity	
Laura Q. Rogers, MD	3/02/2018	Aerobic exercise may improve sleep quality for breast cancer survivors	Online Article	HemOnc Today		Physical Activity	

Dragons Abreast Australia		Dragons abreast Australia	Website			Dragon Boating	
Anne May	February 13, 2018	Exercise reduces some chemotherapy-related side effects	Journal Article	HemOnc Today		Physical Activity	
The Cancer Letter	Mar. 2, 2018	A phase III trial seeks to determine whether diet and exercise can cure breast cancer					
BY KRISTIE L. KAHL	30/01/2018	Physical Activity Interventions Are Important, Feasible for Survivors	Conference Paper	Cancer Updates, Research & Education		Physical Activity	
Kelley GA, Kelley KS.	23/10/2017	Exercise and cancer-related fatigue in adults: a systematic review of previous systematic reviews with meta-analyses	Journal Article	BMC cancer	17(1): 693	Physical Activity	
Branson Chen	4/12/2017	Does Exercise Combat Cancer Fatigue?	Online Review	Medical News Bulletin		Physical Activity	
Patrick Wood	7/05/2018	World-first' call for exercise to be prescribed to all Australian cancer patients	ABC News Website			Physical Activity	
Prue Cormie, Morgan Atkinson, et. al.	10/07/1905	Clinical Oncology Society of Australia position statement on exercise in cancer care		Medical Journal of Australia	Med J Aust || doi: 10.5694/mja18.00199	Physical Activity	
Catherine Granger	16/08/2018	Exercise and cancer care: A physiotherapist's guide to fitness during (and after) treatment					
Helen Leask	2019	Exercise Is Cancer Medicine, Says Global Coalition	website	Medscape Medical News		Physical Activity	
Warburton DER, Nicol	2006a	Health benefits of physical activity: the evidence	Journal	Canadian Medical	March 14, 2006 vol. 174, issue 6, pp.801-809 DOI:		

CW and Bredin SSD				Association Journal,	https://doi.org/10.1503/cmaj.051351		
Hamer M and Stamatakis E	2009	Physical activity and mortality in men and women with diagnosed cardiovascular disease	Journal	European Journal of Preventive Cardiology	vol.16, issue 2, pp.156-160	All Sport	
Philip A. Ades	7/07/1905	A lifestyle program of exercise and weight loss is effective in preventing and treating Type 2 Diabetes mellitus: Why are programs not more available?	Journal Article	Preventive Medicine 50–52	80	All Sport	
Islam NS, et al.	2018	Culturally tailored intervention improves HbA1c in immigrants		Clin Diabetes. 2018			
Vieira de Sousa M1, Fukui R, Krustrup P, Dagogo-Jack S, Rossi da Silva ME.	2017	Combination of Recreational Soccer and Caloric Restricted Diet Reduces Markers of Protein Catabolism and Cardiovascular Risk in Patients with Type 2 Diabetes.	Journal Article	J Nutr Health Aging	21(2): 180-186	Soccer	
Jordan Rosenfeld	14/08/2019	How to manage cardiometabolic syndrome					
Peter Russell	12/08/2019	Wearable Tech Offer to Thousands at Risk of Type 2 Diabetes					
Cragg JJ, Noonan VK, Krassioukov A, Borisoff J.	2013	Cardiovascular disease and spinal cord injury: Results from a national population health survey.		Neurology	81(8):723-728		
Mohr M, Nordsborg NB, Lindenskov A, et al.	2014	High-Intensity Intermittent Swimming Improves Cardiovascular Health Status for Women with Mild Hypertension.	Journal	BioMed Research International.	2014: 728289. doi:10.1155/2014/728289.	Swimming	
Dockery & Peckitt	1/09/2017	Benefits of footy go beyond physical health: new research	Study report			AFL	

School of Hard Knocks	11/02/2018	Website for School of Hard Knocks	Conversation			Rugby	Physical Activity
Ludwik Donimirski	3/01/2018	Application of the SIMPLE Program for Weight Loss at Pathways to Housing: A Feasibility Study	Feasibility Study	NIH US National Library of Medicine		Physical Activity	
Narcis Gusi, Maria C Reyes, Jose L Gonzalez-Guerrero, Emilio Herrera, and Jose M Garcia	8/07/2008	Cost-utility of a walking programme for moderately depressed, obese, or overweight elderly women in primary care: a randomised controlled trial	Journal Article	BMC Public Health	Vol.8 231	Walking	
Y.D.Miller, D.W.Dunstan 2	1/04/2004	The effectiveness of physical activity interventions for the treatment of overweight and obesity and Type 2 Diabetes	Journal Article	Journal of Science and Medicine in Sport	Volume 7, Issue 1, Supplement 1, , Pages 52-59	Physical Activity	
Oliveira, Ana; Monteiro, Ângela; Jácome, Cristina; Marques, Alda; Afreixo, Vera	1/06/2017	Effects of group sports on health-related physical fitness of overweight youth: A systematic review and meta-analysis	Journal Article	Scandinavian Journal of Medicine & Science in Sports	Vol. 27 Issue 6, p6048p	All Sport	Physical Activity
Debra Kibbe	29/01/2018	Georgia Shape: Working Toward A Healthier Future For Georgia's Children	Online article	Georgia State University Hub		Physical Activity	
Jonah Comstock	4/01/2018	23andMe launches 100,000-person study of genetics and weight loss	Website	Mobi-health News			
Lozano-Sufrategui, Lorena; Pringle, Andy; Carless, David; McKenna, Jim	22/04/2016	'It brings the lads together': a critical exploration of older men's experiences of a weight management programme delivered through a Healthy Stadia project	Journal Article	Sport in Society	Volume 20, 2017 - Issue 2, P303-315	Soccer	

UK Rugby	19/12/2017	Move Like a Pro programme set for January return	Website			Rugby	
Robert Preidt	11/12/2017	Vigorous Exercise May Help Slow Parkinson's Disease	Online Review	WebMD, Health Day News		Physical Activity	
Robert Virtue	27/10/2017	Every bit of exercise helps stroke patients, researchers find	ABC News Article	ABC		Physical Activity	
Pavey TG, Anokye N, Taylor AH et al.	2011	The clinical effectiveness and cost effectiveness of exercise referral schemes: a systematic review and economic evaluation	Journal	Health Technology Assessment,	vol.15, issue 44		
Scott Buzby	2019	Lifestyle changes as important as medication to prevent, treat Type 2 Diabetes		Endocrine Today			
Amy Reyes	2019	Activity Trackers Work Best with Coaching	website			Physical Activity	
7 WADAM	30/01/2018	Crisis Intervention training underway in Hattiesburg	TV report				
Australian Bureau of Statistics	4/01/2018	2018. 4364.0.55.001 - National Health Survey: First Results, 2014-15	Web Page	Australian Government			
Golf Industry Council	May-18	Golf delivers economic and wellness benefits [online].	Journal	Australasian Leisure Management	No. 124, Sep/Oct 2017: 53. [cited 13 May 18].	Golf	
Matt Phillips		Parkrun: free, fun and a new way to inspire travel					
By Tom Walker	5-Sep-19	Personalised care on NHS could make physical activity a 'miracle cure'		Sports Management		Physical Activity	

County Durham Sport,	2012	Changing the Physical Activity Landscape in County Durham	Report	PO Box 370, Durham, DH7 8WT | Tel: 0191 372 9115 | www.countydurhamsport.com			
County Durham Sport	2013	Changing the Physical Activity Landscape County Durham Sport and NHS County Durham: Final Evaluation Report summary	Report	PO Box 370, Durham, DH7 8WT | Tel: 0191 372 9115 | www.countydurhamsport.com			
Department of Culture, Media and Sport	2013	CASE Program	Website				
Sport England	2020	SPORT FOR ALL' HIGHLIGHTS ETHNICITY GAP IN SPORT: People from black and minority ethnic backgrounds are far less likely to be physically active	Report			All Sport	Physical Activity
Michelle O'Shea, Hazel Maxwell, Megan Stronach, Sonya Pearce	2020	Sport can be an important part of Aboriginal culture for women – but many barriers remain		The Conversation		All Sport	Physical Activity
Wanrudee Isaranuwatchai, et. al.,	2020	Prevention of non-communicable disease: best buys, wasted buys, and contestable buys	Journal				

Phase 4

The difficulties encountered attempting to locate academic sources using these searches, together with three search results, made it clear why a systematic approach to reviewing the literature may not be the best approach.

A few months before the researcher applied to undertake postgraduate study, the United Nations Education Cultural and Scientific Organisation called for more research, better measurement and evaluation and a practice model that has been tested and validated in order to measure the role of physical education, physical activity and sport in the achievement of Sustainable Development Goals that include improving public health and reducing lifestyle disease (United Nations Education Cultural and Scientific Organisation 2017). This was an early indication, to the researcher, of a gap in the research.

Two attempted Cochrane reviews in 2008 could not find any controlled evaluation studies, uncontrolled studies meeting other inclusion criteria, or rigorous studies evaluating the effects

of interventions organised through sporting organisations to increase participation in sport (Priest et al. 2008a), nor any rigorous studies evaluating the effectiveness of policy interventions organised through sporting organisations to increase healthy behaviours, attitudes, knowledge (Priest et al. 2008b). In 2016 another intended review was proposed (Flatz et al. 2016), but even up till 2021, no evidence is apparent of successful completion.

Instead of a classically structured robust literature review, the researcher used a more narrative approach. She used high quality data to define and describe lifestyle disease, its contributing factors, the impact in terms of human health and economics, both for Australia and globally. She took a similar approach to each of the five target diseases. The researcher then discussed evidence for community sport-based programs – first from academic sources where available, then from grey literature sources. Academic literature was also used to outline a range of other matters relevant to the thesis including the social contribution of community sport, the opportunity sport offers to promote good health and workplace health interventions.

Phase 5

The searches were re-run on the 28th of February 2021 for the past 2.5 years to capture the 2018 – 2021 period, since the original searches were conducted screening for publications related to community sport-based interventions for lifestyle disease.
I repeated the following searches for these diseases in Peer Reviewed Journals from 2000 – 2018, in English using the search terms:

1. "Sport* Intervention*" AND "Cardiovascular Disease*" "Sport* Intervention*" AND "Heart Disease*"
2. "Sport* Intervention*" AND "Breast Cancer*"
3. "Sport* Intervention*" AND "Bowel Cancer*" "Sport* Intervention*" AND "Colon Cancer*"
4. "Sport* Intervention*" AND "Type 2 Diabetes" "Sport* Intervention*" AND "Diabetes Myelitis" "Sport* Intervention*" AND "Metabolic Syndrome" "Sport* Intervention*" AND "Pre-Diabetes"
5. "Sport* Intervention*" AND "Obesity" "Sport* Intervention*" AND "Overweight"

Results

I screened each of the search results. Articles were excluded if they focussed on children, fad diets, kinesiology taping, animal studies, psychosis, bariatric surgery, the impact of being diabetic on unrelated surgical outcomes, the economic value of sport, compression garments or sports science issues related to high performance, professional and elite athletes. Articles were marked for further examination that appeared broadly relevant. Nothing came up for bowel or colon cancer, and the pinned results are below. The 15 pinned results were then examined for relevance, and marked for inclusion in the amended literature review if they were determined to have changed or advanced the research since the original searches were conducted. If they were excluded the reason is given below.

Table 10 Phase 5 results

Title	Overweight and obese men's experiences in a sport-based weight loss intervention for men
Citation	(Budden et al. 2020)
Abstract	A study of 27 men's experience of male only competitive sport-based weight loss program. This was a small study (27 players 10 coaches) of men who had participated in the UK based MAN v FAT Football (MVFF) program. This is designed for men with a body mass index of

	(or greater than) 27.5. and encourages men's participation in a community-based weight loss program that incentivizes weight loss through participation in a football league, and since 2016 MVFF has supported the weight loss efforts of several thousand men. This was a study seeking insight into how men experience a male-only competitive, sport-based weight loss program. Important to success: the appeal of sport, competition on a level playing field, being part of a team, camaraderie, accountability, men sharing issues with other men, gender-sensitized environment, likeminded and similar men, and perceptions that traditional weight loss programs are tailored towards women. Player experiences (i.e., competence and enjoyment) and functional supports in the program (e.g., player handbook, weight loss coach) were reported to drive outcomes of effective weight loss and program retention. Interventions aiming to target men may be more successful working with rather than against formulations of identity such as masculinities, and this can be achieved by tailoring program content (e.g., messaging), settings (e.g., among men sharing similar characteristics such as body-type or goals), and mode of delivery (e.g., through organized sports, and leveraging competition to drive healthy behaviours).
Evaluation	Rather than examining how community sport-based interventions work to improve lifestyle disease, this small study focussed on participant motivation and ergo program design for weight loss programs in in community sport settings - Included
Title	Inter-Individual Variability in Metabolic Syndrome Severity Score and VO_2max Changes Following Personalized, Community-Based Exercise Programming
Citation	(Seward et al. 2019)
Evaluation	Personalised individual program not community sport-based -Excluded
Title	High intensity interval training exercise-induced physiological changes and their potential influence on metabolic syndrome clinical biomarkers: a meta-analysis
Citation	(Serrablo-Torrejon et al. 2020)
Evaluation	High Intensity Interval training not community sport-based interventions but maybe worth referring to – Included
Title	Long-Term Physical Activity Levels After the End of a Structured Exercise Intervention in Adults With Type 2 Diabetes and Prediabetes: A Systematic Review
Citation	(Booth et al. 2020)
Abstract	Systematic review of exercise intervention for people with diabetes and prediabetes – needs more study to evaluate long term physical activity levels.
Evaluation	Not community sport-based intervention – but maybe worth referring to - Included
Title	Beyond general resistance training. Hypertrophy versus muscular endurance training as therapeutic interventions in adults with Type 2 Diabetes mellitus: A systematic review
Citation	(Acosta-Manzano et al. 2020)
Abstract	Systematic literature review showing Hypertrophy Training and Muscular endurance training produce beneficial effects well comparable with aerobic training and both can be used as potent therapeutic interventions for the management of T2DM depending on patients' limitations/preferences.
Evaluation	Not a community sport-based intervention, but suggests more muscle-training focused sports could be explored but maybe worth referring to - Included
Title	Effect of Exercise Intervention On Cardiac Function In Type 2 Diabetes Mellitus: a Systematic Review
Citation	(Verboven et al. 2019)
Abstract	Systematic literature review to examine the impact of exercise intervention, and different types of exercise, on cardiac function and structure in T2DM combining both pre-clinical and clinical

	studies when well-defined exercise protocols were provided, and cardiac function in T2DM patients or validated animal models was examined. Different exercise intervention modalities and exercise types seemed equally effective in improving cardiac structure and function. Exercise training elicits significant improvements in diastolic function and beneficial remodelling in T2DM and DCM animal models, but not necessarily improvements in systolic function and left ventricular structure, regardless of exercise type. Therefore, exercise intervention should be a cornerstone in the treatment of T2DM patients not only to improve glycaemic control but also to specifically enhance cardiac function.
Evaluation	Not about community sport-based intervention, but maybe worth referring to – Included
Title	Sports Therapy and Recreation Exercise Program In Type 2 Diabetes: Randomized Controlled Trial, 3-month Follow-up
Citation	(Szilágyi et al. 2018)
Abstract	Prospective longitudinal study, 208 type II diabetic patient randomly assigned to sports therapy and recreation sports program for 6 months or a control receiving no intervention. Results: The intervention group showed significant decrease in concentration of glucose in blood, reduction in weight BMI, body fat percentage and visceral fat. They also showed significant improvement in right and left arm curl test, chair stand test and the 6-minute walk test. Conclusions: A 24-week-long sports therapy program is a successful intervention for improving parameters affected by Type 2 Diabetes.
Evaluation	Included
Title	Train like an athlete: applying exercise interventions to manage Type 2 Diabetes
Citation	(Savikj & Zierath 2020)
Abstract	The beneficial effects of aerobic exercise on glycaemic control seem to rise with training intensity, with superior adaptations achieved by high-intensity interval training (HIT). Training with low carbohydrate availability ('training low') improves cardiorespiratory function and skeletal muscle oxidative capacity more than conventional training in healthy untrained individuals. Examinations of various training regimens are warranted to assess the safety, efficacy, feasibility and beneficial effects in the Type 2 Diabetes population. Just like competitive athletes, individuals with Type 2 Diabetes should be encouraged to adopt training regimens that improve fitness and metabolism.
Evaluation	Included
Title	The PAPHIO study protocol: a randomised controlled trial with a 2 x 2 crossover design of physical activity adherence, psychological health and immunological outcomes in breast cancer survivors
Citation	(Pudkasam et al. 2020)
Abstract	The establishment of a small randomised controlled trial.
Evaluation	No findings yet – Excluded
Title	Short-term (< 8 Wk) High-intensity Interval Training In Diseased Cohorts
Citation	(Blackwell et al. 2018)

Abstract	Systematic review and meta-analysis compares CRF gains in randomized controlled trials of short-term (<8 wk) HIIT versus either no exercise control (CON) or moderate continuous training (MCT) within diseased cohorts. HIIT elicits improvements in objective measures of CRF within 8 week in diseased cohorts compared with no intervention. When compared with MCT, HIIT imparts statistically significant additional improvements in measures of CRF, with clinically important additional improvements in V˙O2peak in cardiovascular patients. Comparative efficacy of HIIT versus MCT combined with an often-reduced time commitment may warrant HIIT's promotion as a viable clinical exercise intervention.
Evaluation	Not a community sport intervention- Excluded
Title	High Intensity Exercise for 3 Months Reduces Disease Activity In Axial Spondylarthritis (Axspa): a Multicentre Randomised Trial of 100 Patients
Citation	(Sveaas et al. 2020)
Abstract	Intervention for a type of arthritis
Evaluation	Not relevant to this study excluded
Title	Effectiveness of Mobile Health Interventions Promoting Physical Activity and Lifestyle Interventions to Reduce Cardiovascular Risk Among Individuals With Metabolic Syndrome: Systematic Review and Meta-Analysis
Citation	(Sequi-Dominguez et al. 2020)
Abstract	Systematic review and meta-analysis was to analyse the effect of mobile-based health interventions for reducing cardiometabolic risk through the promotion of physical activity and healthy lifestyle behaviours. CONCLUSIONS: Overall, mobile-based health interventions aimed at promoting physical activity and healthy lifestyle changes had a strong positive effect on cardiometabolic risk indicators among individuals with metabolic syndrome.
Evaluation	Health promotion not community sport intervention but maybe worth referring to -Included
Title	Effects of Exercise after Percutaneous Coronary Intervention on Cardiac Function and Cardiovascular Adverse Events in Patients with Coronary Heart Disease: Systematic Review and Meta-Analysis
Citation	(Zhang & Chang 2019)
Abstract	Exercise program has been associated with improved cardiovascular outcomes in patients sustaining coronary artery disease. However, little is known about the role of exercise after percutaneous coronary intervention (PCI). There was no firm evidence to support the beneficial effects of exercise after PCI for the CHD patients to improve heart function or to reduce the incidence of adverse cardiovascular events.
Evaluation	Exercise not community sport - excluded
Title	Impact of an 8-Week Exercise and Sport Intervention on Post-Traumatic Stress Disorder Symptoms, Mental Health, and Physical Fitness among Male Refugees Living in a Greek refugee camp
Citation	(Knappe, Colledge & Gerber 2019)
Abstract	Small study on refugees more focused on PTSD & Mental Health not addressing lifestyle disease
Evaluation	Excluded
Title	Incidence of Major Adverse Cardiac Events In Men Wishing To Continue Competitive Sport Following Percutaneous Coronary Intervention
Citation	(Guy et al. 2019)
Abstract	This is not about sport interventions but rather about evaluating return to sport guidelines and safety
Evaluation	Excluded

Phase 6

In a similar manner to phase 3 the researcher repeated the searches in Phase 6, limiting results to the past 2.5 years, substituting "Sport" for the names of specific sports, selecting sports based on the National Sports Organisations listed in the Australian Sports Directory (SportAus).– such as basketball, cricket, rugby, tennis, swimming, golf, surfing etc. and searching for sports where she was aware interventions had been conducted for example NRL, Dragon Boating.

Results excluded - concussion, ADHD, other unrelated diseases, sport overuse injuries,

Two relevant results were pinned and are presented below. They too were evaluated for relevance marked accordingly in green for inclusion

Table 11 Phase 6 results

Title	Swimming intervention alleviates insulin resistance and chronic inflammation in metabolic syndrome
Citation	(Tan & Guo 2019)
Abstract	This was a randomised controlled trial of 100 patients with metabolic syndrome and 100 healthy individuals. All participants had blood tests for the serum levels of interleukin (IL)-1, high sensitivity C-reactive protein (hs-CRP), tumour necrosis factor α (TNF-α) and IL-8 Patients were randomly divided into five groups (groups A-E). Patients in group A got conventional drug treatment. Patients in groups B-E got conventional treatment, plus a swimming intervention for 15, 30, 45 and 60 min each time, respectively, four times a week for 3 months. Changes in the homeostatic model assessment of β-cell function and insulin resistance (HOMA-IR) score, and in the serum levels of IL-1, hs-CRP, TNF-α and IL-8 were recorded. Furthermore, muscle tissues were collected from patients, and the expression levels of insulin receptor substrate-1 (IRS-1), glucose transporter type 4 (GLUT4) and protein kinase B (Akt) in the tissues were detected by western blot assay. The results revealed that HOMA-IR and the serum levels of IL-1, hs-CRP, TNF-α and IL-8 were significantly higher in metabolic syndrome patients as compared with those in the normal controls, while swimming intervention reduced HOMA-IR and these serum levels to different extents. Swimming intervention also promoted IRS-1 and Akt phosphorylation, and increased GLUT4 expression level. Thus, it is concluded that swimming intervention may improve metabolic syndrome through multiple pathways.
Evaluation	Not a community sport intervention but highly relevant - Included
Title	Five-year cost-effectiveness analysis of the European Fans in Training (EuroFIT) physical activity intervention for men versus no intervention
Citation	(Kolovos et al. 2020)
Abstract	Lifestyle interventions can increase physical activity but few successfully engage men. This study aims to investigate the 5-year cost-effectiveness of EuroFIT, a program to improve physical activity tailored specifically for male football (soccer) fans compared to a no intervention comparison group. Conclusions We conclude the EuroFIT intervention is not cost-effective compared to no intervention over a period of 5 years from a societal perspective, but is more effective and less expensive (i.e., dominant) after 10 years. We thus suggest that EuroFIT can potentially improve public health in a cost-effective manner in the long term.
Evaluation	This is relevant but already included in my thesis – Already included

Phase 7

Check thesis to verify any items already incorporated, then incorporate these references into chapter 2.

Appendix 10. Table of questions that gave rise to coding themes and interview questions

Where the same question applies to multiple diseases, it is not repeated, the initials of the other disease have been added in the disease column.

Table 12 Questions that gave rise to coding themes and interview questions

Disease	**Question Arising**	**Program Element**	**Theme**
Cardiovascular Disease BC, CRC, T2D, O	What's more effective longer duration, less intense activity? Or more intense shorter duration?	Dose	Method
Cardiovascular Disease BC, CRC, T2D, O	How frequently should doses occur	Dose	Method
Cardiovascular Disease BC, CRC, T2D, O	Are some sports more effective than others to use in intervention programs?	Sport selection	Method
Cardiovascular Disease BC, CRC, T2D, O	If interventions are effective, why are they not widespread, well researched and discussed?	Publication & Measurement	Publication & Measurement
Cardiovascular Disease BC, CRC, T2D, O	What is the opportunity cost of not conducting health interventions using sport?	Measurement	Measurement
Cardiovascular Disease	What contribution do dietary control, smoking cessation and behaviour change make to the intervention?	Measurement	Measurement
Breast Cancer	Which sport-based interventions are effective in symptom management for breast cancer?	Sport selection, sport suitability, equipment suitability	Method
Breast Cancer CVD, CRC, T2D, O	Are different sports more suitable at different stages of treatment?	Sport selection, sport suitability, equipment suitability	Method
Breast Cancer CVD, CRC, T2D, O	What's the optimal dose duration? Session frequency? Dose intensity?	Dose	Method
Breast Cancer CVD, CRC, T2D, O	Do sport interventions reduce the loss of DALYs?	Measurement	Measurement, Evaluation

Breast Cancer CVD, CRC, T2D, O	Do they impact survival rates at five years post diagnosis, or longer?	Measurement	Measurement, Evaluation
Breast Cancer CRC CVD, CRC, T2D, O	What are the barriers, facilitators and critical success factors for interventions?	Sport selection, sport suitability, equipment suitability, participant skill, participant preference, participant barriers, partner capabilities, financial (money	Method, Money
Colorectal Cancer CVD, BC, T2D, O	What's the impact of co-morbidities on successful participation in sport-based interventions?	Measurement	Measurement, Evaluation
Colorectal Cancer	Why are women underrepresented in sport-based interventions?	Participant preference, participant barriers,	
Colorectal Cancer CVD, BC, T2D, O	What's the mortality impact at 10 years or longer?	Measurement	Measurement, Evaluation
Colorectal Cancer CVD, BC, T2D, O	How can interventions and measurement be designed to enable cost-effective, longer-term delivery and follow-up?	Measurement, Money	Measurement, Evaluation, Money
Type 2 Diabetes CVD, BC, CRC, O	What is the most effective treatment for short-, medium-, and long-term improvement?	Sport selection, measurement	Method, measurement
Type 2 Diabetes O	How many months or years do people need to participate in intervention to manage or reverse disease or to reduce the loss of DALY's?	Dose	Method, measurement
Type 2 Diabetes CVD, BC, CRC, O	Which sport best promotes adherence?	Sport selection	Method, evaluation
Type 2 Diabetes	Are there any other intervention design factors that are important?		

CVD, BC, CRC, O			
Obesity	All questions arising have been covered above		

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