Impact of a short-term Iyengar Yoga program
on the holistic health and well-being
of physically inactive people
aged 55 years and over

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Yoga is like music: the rhythm of the body, the melody of the mind, and the harmony of the soul create the symphony of life.

B.K.S. Iyengar
Light on Life
Abstract

The population in all western countries, including Australia, is rapidly ageing. People are living longer and the proportion of older people in the population is steadily growing. Keeping this ageing population healthy in mind, body and soul is thus a concern for countries, communities and individuals. In 2000, the Australian Government declared that there was a need for holistic research into health and well-being whilst ageing.

This research project was conducted to assess the impact of an eight week Iyengar Yoga program on the holistic health and well-being of physically inactive people aged 55 years and over. The theoretical perspective for the project was interpretivism. Participants were recruited from a retirement village on the Sunshine Coast, Queensland, Australia. A total of forty participants were randomly assigned to either the intervention group or the control group. Thirty-eight participants completed both pre- and post-intervention assessment. The participants in the Yoga group engaged in twice weekly Yoga classes and were asked to do three further days independent home practice. Participants in the control group continued with their usual daily routine.

Before and after the Iyengar Yoga program all participants were assessed for various physical health indicators including muscle strength, active range of motion, resting blood pressure, FEV₁, salivary IgA and salivary lysozyme levels. Their self-perceived physical, mental, spiritual and social health and well-being were assessed using the Life’s Odyssey™ Questionnaire and the SF12v2™ Health Survey. In the post-intervention assessment the participants were also asked an open-ended question about any noticeable changes in their health and well-being.

Overall muscle strength (p<0.0001), active range of motion (general scan upper extremity (p<0.001), trunk rotation (p<0.001), hip flexion (p=0.008), hip abduction (p<0.001) and hip extension (p=0.003)) improved significantly in the Yoga group compared to the control group. In addition, self-perceived physical well-being (p=0.003), self care (p=0.001) and emotional well-being (p=0.04)
improved significantly in the Yoga group. There was no difference in change in blood pressure, IgA or lysozyme levels between the two groups. Spiritual and social health and well-being showed a trend of improvement in the Yoga group, although this was also not statistically significant. Most of the participants of the Yoga group reported improvements in their health and well-being in the open-ended question.

The short-term Iyengar Yoga program was found to improve some aspects of holistic health and well-being in the elderly. The greatest improvements seen were in muscle strength and flexibility, although many participants additionally reported improvements in various aspects of self-perceived health. Further studies should be undertaken with a larger sample size and over a longer period of time to assess whether a longer-term program will have more profound effects, for example, on immune function or lung capacity.

Whilst this was a relatively small study, the results suggest that making Iyengar Yoga programs available to the elderly could have a beneficial impact on their health, thus reducing their reliance on already over-burdened public health systems.
Table of Contents

Abstract ................................................................................................................................. i
List of figures........................................................................................................................... v
List of tables........................................................................................................................... vi
Abbreviations and acronyms ............................................................................................... vii
Acknowledgements ............................................................................................................... viii
Statement of originality ......................................................................................................... ix
Introduction ............................................................................................................................ 1

Chapter 1  Literature review ................................................................................................. 3
  1.1 Demographics of the ageing population ........................................................................ 3
  1.2 Holistic health .................................................................................................................. 5
  1.3 Ageing well holistically ................................................................................................... 6
  1.4 Ageing well and physical activity ................................................................................... 10
  1.5 Ageing well holistically and Yoga ................................................................................ 15
    1.5.1 Yoga and its health concept ...................................................................................... 15
    1.5.2 Yoga research ............................................................................................................ 16
  1.6 Ageing well holistically and Iyengar Yoga ................................................................... 17
    1.6.1 Iyengar Yoga ............................................................................................................... 17
    1.6.2 Ageing well and Iyengar Yoga .................................................................................. 19
    1.6.3 Iyengar Yoga research .............................................................................................. 21

Chapter 2  Research design .................................................................................................. 25
  2.1 Research aim .................................................................................................................. 25
  2.2 Research questions ......................................................................................................... 25
  2.3 Epistemology .................................................................................................................. 26
  2.4 Theoretical perspective ................................................................................................. 27
  2.5 Theoretical frameworks ................................................................................................. 27
    2.5.1 Red Lotus Health Promotion Model .......................................................................... 28
    2.6.2 Health Belief Model .................................................................................................. 28
  2.6 Research methodology .................................................................................................... 29
    2.6.1 Participants .................................................................................................................. 30
    2.6.2 Randomisation .............................................................................................................. 31
    2.6.3 Intervention .................................................................................................................. 31
  2.7 Data collection methods ................................................................................................. 33
    2.7.1 General health and well-being .................................................................................... 34
    2.7.2 Physical health and well-being .................................................................................... 34
      2.7.2.1 Muscle strength ....................................................................................................... 34
      2.7.2.2 Active range of motion (aROM) ............................................................................. 35
      2.7.2.3 Resting blood pressure ............................................................................................ 36
      2.7.2.4 Respiratory function .................................................................................................. 37
      2.7.2.5 Immune function ..................................................................................................... 38
      2.7.2.6 Self-Perceived Physical Health and Well-Being ....................................................... 39
    2.7.3 Mental Health and Well-Being ................................................................................... 40
    2.7.4 Spiritual Health and Well-Being ................................................................................ 40
    2.7.5 Social Health and Well-Being .................................................................................... 40
  2.8 Data collection sessions ................................................................................................. 40
  2.9 Data Analysis Methods .................................................................................................. 41
    2.9.1 Quantitative data .......................................................................................................... 41
    2.9.2 Qualitative data ............................................................................................................ 44
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Systolic and diastolic blood pressure values by age of participant before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>48</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Absolute values for Forced Expiratory Volume in 1 second by age of participant before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>49</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Overall muscle strength on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>57</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Active range of motion (aROM) for the upper extremity by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>58</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Active range of motion (aROM) for trunk rotation by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>59</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Active range of motion (aROM) for hip flexion by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>60</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Active range of motion (aROM) for hip abduction by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>61</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Active range of motion (aROM) for hip extension by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>62</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Forced Expiratory Volume (FEV₁) by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>64</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Salivary IgA levels by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>65</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Salivary lysozyme levels by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>66</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Physical Well-Being sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>69</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Physical Component Summary (PCS) on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>70</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Life, Health and Attitude sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>72</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Emotional Well-Being sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>73</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Self Care sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>74</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Mental Component Summary (MCS) on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>75</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Purpose and Meaning sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>77</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Social Connectedness sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>78</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Rest, Pleasure and Play sub-scale on a scale of 0-100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over</td>
<td>79</td>
</tr>
</tbody>
</table>
List of tables

Table 1  Postures in Iyengar Yoga intervention  32
Table 2  Number and age range of female and male participants in the Yoga and control groups in the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  47
Table 3  Comparison of physical health parameters by groups before the 8 week Iyengar yoga program for physically inactive people aged 55 years and over  48
Table 4  Comparison of sub-scales of the Life’s Odyssey™ Questionnaire by group before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  50
Table 5  Comparison of self-perceived health parameters in the 8 domains and the two summary components of the SF12v2™ Health Survey by group before the 8 week Iyengar Yoga program  50
Table 6  Cronbach’s alpha for the Life’s Odyssey™ Questionnaire sub-scales before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  51
Table 7  Significant relationships between physical health parameters before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  52
Table 8  Relationships between self-perceived physical, mental, spiritual and social health parameters before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  52
Table 9  Comparison of physical health variables by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  55
Table 10  Comparison of immune function by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  56
Table 11  Comparison of outcomes by group for self-perceived physical, mental, spiritual and social health before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  68
Table 12  Summary of statistically significant results for the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over  82
# Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIHW</td>
<td>Australian Institute of Health and Welfare</td>
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<tr>
<td>aROM</td>
<td>Active Range of Motion</td>
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<td>FEV&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Forced Expiratory Volume in 1 second</td>
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<td>FVC</td>
<td>Forced Vital Capacity</td>
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<td>MMT</td>
<td>Manual Muscle Testing</td>
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<td>SIgA</td>
<td>Salivary Immunoglobulin A</td>
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<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>
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All those people, whose names I have not mentioned, who inspired me during my life to aim only for a holistic approach.
Dedication

To B.K.S. Iyengar
Statement of originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

.................................
Juliane M Vogler
5 March 2008
Introduction

Health is a fundamental component of human life. The philosopher Arthur Schopenhauer (1788-1860) highlighted the importance of health when he said that with health everything is pleasure, without it, nothing is enjoyable (1).

The Latin proverb *mens sana in corpore sano*, a sound mind in a sound body, implies that health is more than just physical functioning. This is consistent with the World Health Organisation definition of health as physical, mental and social well-being, and not merely the absence of disease or infirmity (2). This more holistic definition of health is considered to represent a more holistic understanding of health and well-being and has raised increased interest in practices which could impact on mental and social aspects of well-being, as well as physical health. The practice of Yoga is considered to be beneficial to holistic health and well-being, but as yet there has been little research conducted to determine the extent of any holistic health benefits.

In 2000 the Australian Government declared that there was a need for holistic research into health and well-being whilst ageing (3). Due to the increasing costs associated with caring for an ageing population, and the fact that this problem has not yet been addressed, it appeared reasonable and appropriate to conduct a research project assessing holistic health and using a holistic method as intervention. Because the limited research that has been done on the effects of Iyengar Yoga and the elderly has focused primarily on the physical health effects, evidence-based research is needed which looks at the effects of Iyengar yoga on holistic health and well-being whilst ageing.

This study could make a significant contribution to the fields of public health, health promotion and healthy ageing as it considers a broad range of health indicators on a physical level, as well as examining social, spiritual and emotional health and well-being and the interconnection of these components.
The purpose of this thesis is to report on the research project: *Impact of a short-term Iyengar Yoga program on the holistic health and well-being of physically inactive people aged 55 years and over* which was conducted on the Sunshine Coast, Queensland, Australia, in 2007.

This thesis is presented in four chapters. Chapter one, the literature review, describes the demographics of the ageing population, holistic health, ageing well holistically, the impact of physical activity on healthy ageing, the impact of Yoga on health, and the impact of Iyengar Yoga on health. Research undertaken to address health through the use of Yoga is reviewed, and the gaps in the research literature are identified.

Chapter two describes the research design, including the research aim and questions, followed by the epistemology, theoretical perspective, theoretical frameworks, methodology, and the methods of data collection and data analysis used in this research project.

Chapter three presents the research results in two parts: characteristics of the participants, and comparisons between study and control groups.

Chapter four presents a discussion of the research results with reference to the theoretical foundations and the literature. This is followed by the conclusion and the recommendations for future research.

The appendix consists of the following documents: Ethics Approval, Research Project Information Sheet, Privacy Record, Consent to Participate in Research forms, data collection questionnaires, and Standard Operating Procedure protocols.
Chapter 1  Literature review

This literature review focuses on literature pertaining to the issue of healthy ageing and the role of Yoga in this process. The review commences with an overview of the demographics of the ageing population in western countries. It then reviews the concepts of holistic health, ageing well holistically, the impact of physical activity on healthy ageing, the impact of Yoga on health, and the impact of Iyengar Yoga on health. Research undertaken to address health through the use of Yoga is reviewed, and the gaps in the research literature are identified.

1.1 Demographics of the ageing population

The population in all western countries, including Australia, is rapidly ageing. People are living longer and this trend is projected to continue. Additionally, the proportion of older people in the population has grown and is projected to grow further in the future (2). This section covers the definition of old age and some examples of how the population is ageing globally, in Australia and on the Sunshine Coast, Queensland. The financial burden on society is demonstrated with figures published by the Australian Government.

There appears to be no universal categorical definition for old age. The terms ‘old’, ‘elderly’, and ‘elder’, differ depending on culture, country and gender. The World Health Organisation (WHO) considers people 65 years old and above to be ‘old’ and people of 80 years and more as ‘oldest-old’, whereas in some countries, such as Ghana, Africa, ‘recent old’, ‘old’ and ‘very old’ are all based on a combination of the number of years lived, physical capacity and health (2).

Although population growth rates have not always been steady, the world’s population increased from three billion in 1959 to six billion in 1999. The United States Census Bureau’s latest estimations indicate further world population growth into the 21st century, although the rate of increase is expected to slow. The proportion of 60 to 69 year olds in the United States in
1996 was 5.5%, increasing to 5.7% in 2007, and is projected to increase to 8.1% in 2025 and 10.1% in 2050. The number of people aged 70 to 79 years of age increased from 2.9% in 1996 to 3.4% in 2007 and is projected to increase to 4.9% in 2025 and 7.2% in 2050. There was also an increase in people aged 80 years and above from 1.1% in 1996 to 1.4% in 2007 and this is projected to increase further to 2.2% in 2025 and to 4.9% in 2050 (4).

According to the Australian Bureau of Statistics, the proportion of the population aged 65 years and above was 13% in 2004, and is projected to be 28% in 2051. In June 2004, the average age of the Australian population was 36.4 years. This is projected to rise to between 39.9 years and 41.7 years in 2021. In 2004, the number of people aged 85 years and above made up 1.5% of the population and is projected to grow to between 2% and 3% in 2021, and between 6% and 8% by 2051. In 2051, almost half of the population in Australia will be older than 50 years (5).

People aged 65 years and above currently comprise between 13% and 17% of the population living on the Sunshine Coast, Queensland, Australia. The Sunshine Coast, together with Brisbane Coast and Hinterland areas represent the regions of Queensland with the highest proportion of people in this age group. People aged 55 to 64 years comprise 12 to 13% of the population of the Sunshine Coast, and this region has the highest proportion of people in this age group in Queensland (5).

In 2003-04 the Australian Government spent $5.8 billion on aged and community care, and $6.3 billion in 2005-06. Appropriations for 2006-07 were $6.9 billion. The expenditures for residential aged care increased from $3.6 billion in 1999-2000 to $5.4 billion in 2005-06. Expenditure for ageing support and strategies increased from $48.4 million in 1999-2000 to $226 million in 2004-05. In 2005-06 16.2% of the Department of Health and Ageing expenses by outcome were for aged care and population ageing (6).
This demonstrates that both globally and locally there is an increased proportion of elderly people in the population. This puts pressure on health systems and has economic consequences to society.

1.2 Holistic health

The term *holistic* is derived from the Greek *holos*, which means whole and relates to an understanding of reality in its integrated totality; the characteristics of which cannot be broken down into its constituent parts (7). Emerging knowledge from the science of quantum physics supports this holistic construction of health. This is distinct from the reductionist perspective of health popularised by Descartes, Newton and others during the Scientific Revolution, which has remained dominant over the last 300 years (8).

According to these reductionist scientists, in order to be able to understand the world or any other complex phenomenon such as the human body, it needed to be reduced to its smallest physical components. They reasoned that by understanding the parts, one could understand the whole. This was based on the assumption that the whole is only ever equal to the sum of the parts. (8)

Additionally, reality was divided into two universes. The material universe, composed of matter, was considered to be objective, quantitative, measurable, certain and comprehensible. The immaterial universe, composed of thoughts, emotions and human consciousness, was thought to be beyond understanding (8). This view of the world and health in particular, has prevailed in western cultures since the 1700s.

Despite the dominance of the reductionist perspective in science, and particularly in health science, the WHO defined health in 1948 as a “state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (2). According to Shearman and Sauer-Thompson, this holistic definition of health was considered revolutionary for the time (9). However, holistic health is considered to be more than the sum of physical,
mental, spiritual and social health. The foundation for a holistic approach to health is the connectedness between these components (8).

This concept of connectedness is reflected in both the science of quantum physics and in the beliefs of many spiritual traditions. Capra pointed out in ‘The Tao of Physics’ that spiritual traditions such as Hinduism, Buddhism, Chinese Thought, Taoism and Zen, have commonality with modern physics around the concepts of unity, mutual interrelations of all things and occurrence, and the interdependence and inseparability of single parts to the cosmic whole (10). Holistic health is, therefore, defined as physical, mental, spiritual and social health and the connectedness between those dimensions (8).

1.3 Ageing well holistically

This section discusses ageing and the importance of physical activity whilst ageing. The term ‘senescence’ is restrictive, as it only means the process of becoming old, growing old and showing the effects of old age (11). As further investigations into the chronological process of human beings are undertaken, the more complex it gets - variables appear to multiply. The ageing process shows high inter-individual variability due to the effects of numerous genetic and environmental factors (12).

Ageing starts at the point in time when a human being is born. A baby grows, develops and matures into an adult. Then, at a certain point or period, the ageing process changes, the process of maturing and developing decreases and slows down, while deterioration in function accelerates (13). According to Deepak Chopra, ageing is a continuous decline of physical and mental functioning which occurs with time and ends ultimately with death (14). We live longer lives now than in previous centuries, and these late years can be a time of ill-health and disease for many adults. In the past, people struggled with acute infections; these days people live long enough to experience the chronic diseases of old age (15). According to Hampton et al. the
gerontologist Bernard Stehler suggested four features of ageing in general: it appears universally, it is progressive, it is detrimental and it is intrinsic to each organism (16).

Research has been carried out to identify the changes that occur on a physical level as individuals age. For example, muscle strength and joint flexibility decrease with ageing, endocrine and nervous system functions decline, and cardiovascular function lessens in inactive individuals (17, 18). Decline in pulmonary and cardiovascular function has been demonstrated in a longitudinal study with 998 relatively healthy individuals (419 males, 579 females) aged 55 years and over. Cardiopulmonary physiological measurements were conducted four times over a 6 year period and showed a progressive decline in Forced Expiratory Volume (FEV₁), a pulmonary function, and maximal exercise heart rate. The decline in FEV₁ in the female participants was less than in males; however, the decline in both sexes was independent from baseline measurements and body mass, smoking status, medications, or other associated health indicators (18).

Forced Expiratory Volume was one of five indicators identified as potential biomarkers of ageing in a study published in October 2007. Eighty-six men living in Kyoto City and considered to be in good health underwent health examinations consisting of more than 60 test items, including anthropometric measurements, cardiovascular and respiratory functions and physical and chemical characteristics of blood and urine. From 29 potential physiological indicators five indicators were selected as candidate biomarkers: Forced Expiratory Volume in one second, systolic blood pressure, hematocrit, albumin and blood urea nitrogen (19). The Australian Institute of Health and Welfare (AIHW) has also described in 2007 high blood pressure as an increasing biomedical risk factor with increasing age (20).

A review of immunosenescence published in November 2006 identified a number of studies showing that the immune system undergoes age-associated changes. These changes accumulate and create a continuing
deterioration in the ability to resist infections and build up immunity after vaccination (21).

Miletic et al. for example, found in their research that their elderly participants had a significantly lower salivary IgA secretion rate compared to the young participants and that the analysis of the salivary immune response can provide a general picture of the function of the total mucosal immune system (22).

However, according to the WHO, it is important to differentiate between the normal ageing processes, which are universal biological changes that occur with age, and the processes of ageing, which are markedly influenced by the environment, way of life, and state of health. These external factors are related to or alter with ageing, but are not due to ageing itself (2). Knowledge of these processes of ageing provides opportunities to adopt strategies to expand and improve the quality of a healthy lifespan.

In recent years models of optimal ageing have been developed. Aldwin and Gilmer reviewed models of successful ageing (23). These included Rowe and Kahn’s three elements for successful ageing (disease prevention, maintenance of cognitive and physical functions, and a dedication to an active lifestyle), developed in 1998, and Vaillant’s 2002 Model of Ageing Well, which consists of six indicators of healthy ageing (23). The first three indicators are related to physical health: non-disability at the age of 75 years as evaluated by a physician, good subjective physical health, and the extent of a non-disabled lifespan. The remaining three indicators are: interviewer-evaluated good mental health, objective social support, and self-rated life satisfaction in eight areas.

Aldwin and Gilmer further outline the growing interest in the study of wisdom and ageing well and its complexity. They report that there is a complex relationship between ageing well and spirituality, including religiosity (23). For example one study demonstrated that religious activity might have protective effects in pulmonary function decline in older people (24).
Ageing well also includes considering death and dying. Death can be considered as a physiological, psychological and spiritual process and dying peacefully is what many people long for, but might find difficult to realise (23). There are various cultural conceptions about how to die well, including the concept that through birth and death, human beings assist in balancing nature’s complex energy network (25).

Strategies for healthy ageing have been developed by most of the governments of western countries to address the current situation where people live longer, older people make up a greater proportion of the population and the enormous health care costs associated with those who do not age healthily. The Australian Department of Health and Ageing has developed the ‘Active Australia’ program to encourage citizens to follow guidelines which incorporate more physical activity and healthy eating into their life styles in order to ‘feel better’, ‘enjoy better health’ and to ‘have a healthier state of mind’ (26).

The governments of the United States, Canada and Germany try to persuade their residents to change their behaviour to incorporate more physical activity. Countries with cold winters even provide hints on how to be more active in winter. Germany additionally combines physical activity, such as long distance strolls with cultural topics such as literature, architecture and art, by providing walking trails from one interesting place to another (27). According to the literature cited above the approaches of western countries to tackle the issue of healthy ageing are congruent and physical activity plays a major role.

However, more research has to be done regarding promotion of more holistic healthy ageing. In a review of healthy ageing in Australia in 2000, the (then) Commonwealth Department of Health and Aged Care acknowledged the necessity for such research (3).
1.4 Ageing well and physical activity

One of the main factors contributing to healthy ageing is the maintenance of physical activity. More and more epidemiological evidence indicates a strong relationship between physical inactivity, mortality and various diseases. Physical inactivity is considered to be second to tobacco use in terms of contribution to the burden of disease in Australia (28). This section discusses research on the importance of physical activity to physical and mental health.

The assessment of physical fitness has changed in recent decades from a focus on motor performance and athletic fitness to an emphasis on functional dimensions related to general good health and disease prevention (17). This is probably influenced by the socio-political situation of an ageing population in most western countries. Outcomes of research addressing health and disease prevention and the resulting changes in political decisions and practice should lighten the load for the welfare systems and improve the health and well being of older people.

Many researchers and institutions consider physical activity to be essential to human health during the ageing process. Different studies have focussed on different aspects of health. For example, the American College for Sports Medicine suggests that the proportion and extent of decline in physiological function will slow or even reverse with activity or exercise (29). Physical activity is associated with muscle mass, flexibility, endocrine, cardiovascular, neural and pulmonary functions (17). In contrast, Brukner and Khan, the authors of Clinical Sports Medicine, consider that the most significant benefits of exercise for older people are within the cardiovascular system (30).

In a publication on physiological, psychological and social effects of exercise and recreation of older adults, Seedsman states that those older people who do not have the time for regular activity of mind and body, in the end have to pay the price for leaving it undone (31). Loellgen writes in a journal for medical practitioners, that many people dream about replacing physical activity, which can sometimes be strenuous and arduous, with a pill to age
healthily. He suggests that regular physical activity, and only physical activity when older, provides the possibility of becoming an active senior and enables the maintenance of life-quality and self-determination. He further suggests that everyday activity should be considered as training and not as a burden. Further, those activities, appropriately adjusted to age, including training for strength, endurance and flexibility, should be done regularly, at least four times a week (32).

In the 2006 international conference of the European Group for Research into Elderly and Physical Activity, Duarte and Appell postulated that a decrease in muscle strength could increase the degenerative processes of other organs as the result of disuse or negative biomechanical effects. They emphasise the interdependence of skeletal muscle morphology, functional changes in the muscles and degeneration of the nervous system. This could be useful in explaining the ultimate loss of strength with advanced age and increasing inability to complete everyday activities. Duarte and Appell suggest that the benefits of physical activity in the aged muscle, especially noticed after strength training, are chiefly due to neural adaptations which may slow down or prevent the effects of ageing (12).

McMurdo found evidence for the effectiveness of exercise in the prevention of falling in seniors, but stressed that only individually, professionally tailored exercise, including strength and balance training with an incorporated walking plan, would lead to this success. Falling has numerous causes and some falls amongst the elderly are impossible to prevent. Nevertheless, seniors should be motivated to be physically active and to take the acceptable risks of life, such as walking (33).

Sacks, Campos and Souza describe the link between joint movements in the intervertebral disc and its nutrition, and the ageing process. They point out that spinal joint movements are a basic factor for disc nutrition and health and therefore, appropriate posture in everyday activities, together with adequate exercise, enhance stability for the spine and its joint functionality and maintain disc nutrition (34).
Recently published recommendations from an Expert Panel from the College of Sports Medicine and the American Heart Association emphasise the crucial role of regular physical activity in public health in older adults (35). They state that there should be definite differences in the recommended levels of physical activity for adults and older adults. They also stress the necessity of a plan for the activities. These activities should include aerobic intensity, muscle strengthening aspects, activities to maintain and improve flexibility, balance exercises (which may be critical to lessen falls and fall injuries) and eventually the incorporation of prophylactic and therapeutic recommendations.

The Expert Panel also points out the importance of various factors in promoting physical activity in older adults. Firstly, reducing sedentary behaviour in seniors on a low level of physical activity has shown health benefits in lowering the risk for cardiovascular diseases. Further, they put emphasis on increasing moderate activity, instead of aiming for high level activities, and focus on a stepwise approach in order to decrease risk and increase engagement. These recommendations also include the importance of approaching physical activity on an individual basis, as well as on a community level. This team of experts finally concludes that almost all older adults should be physically active in order to maintain, improve or restore their health (35).

Research has been undertaken to assess the effectiveness of individualised aerobic training at ventilatory threshold in relatively healthy retirees (36). The study demonstrated that an individualised, twice-weekly interval walking training program for three months was significantly more effective in improving participants’ VO₂ max and submaximal cardiorespiratory adaptation than standard programs (36).

Fahlman et al. assessed indicators of immune function in older women before and after 10 weeks of endurance training. They reported significantly improved ventilatory measures and attenuation of a decrease in cellular immune measures within the training group, whereas the non-exercising
control group experienced a decrease in the immune measures, which the authors claim to be the normal response in winter (37).

Shimizu et al. assessed the relationship between daily physical activity and mucosal immunity, in particular salivary immunoglobulin A (SIgA), in seniors in the age range of 64 to 86 years. The intensity level of physical activity was evaluated by electrical step count, energy expenditure and activity duration at specific intensity. The obtained data were stratified into quartiles. Saliva samples were collected in the morning. SIgA concentration and sIgA secretion were significantly higher (indicating better mucosal immunity) in seniors who averaged a step rate of 6833 steps per day than seniors who averaged 2963 steps. The team concluded that 7000 steps per day might be regarded as moderate daily physical activity and could be used as a goal to improve mucosal immune function (38).

The Finnish Centre for Interdisciplinary Gerontology and the Department of Health Sciences examined physical activity as a predictor for mental well-being among older adults in an eight-year follow-up study. At baseline, 1224 seniors aged 65-84 years were interviewed on mental well-being factors such as depressive symptoms, anxiety, loneliness, self-rated mental vigour and meaning in life; 663 people were interviewed in the follow-up. The researchers found that baseline mental well-being, mobility status and age predicted mental well-being in the follow-up and suggest that mental well-being is linked with activity, better health and mobility status (39).

Other research looked at the effects of exercise on 156 people aged 50 years and over with major depressive disorders, and suggested that exercise training might be considered as an alternative treatment to antidepressants. The exercise group after 16 weeks of aerobic exercise treatment showed an equivalent alleviation in depression to those on standard medication (40).

Lee and Park assessed whether physical activity moderates depressive symptoms and disability in 645 adults aged 65 years and over in a one-year follow-up study. They assessed the participants’ depressive symptoms and
functional disability using a 15-item Geriatric Depression Scale, Physical Functioning Scale and physical performance tests, and found physical activity of moderate or vigorous intensity significantly reduced the link between depression and disability. The researchers suggest physical activity as a potential tool in lessening the depression-disability connection in later life, in particular in seniors with high levels of physical and mental impairment (41).

Further, research was conducted to evaluate the impact of a 12 week program of physical activity on various aspects of well-being in 36 older adults living in congregate housing in comparison to 22 non-participants. The assessments included self-reported measures of vitality, self-rated health, mental health, social functioning, role limitations due to emotional problems, knowledge of physical activity performance and self-efficacy for exercise. After adjustments for differences in baseline characteristics the research found statistically significant improvements in only self-rated health and self-efficacy for exercises in the participants of the program in contrast to the non-participants (42).

Whilst there is a significant body of research on the effects of physical activity on physical health, and to a lesser degree on mental health, little research has addressed the effects of physical activity and exercise on more than one or two components of health. No research was found by the author that addressed the effects of physical activity on a combination of physical, mental, social and spiritual health in older people.
1.5 Ageing well holistically and Yoga

1.5.1 Yoga and its health concept

Yoga is based on the ‘Yoga sutras’ written by Patanjali thousands of years ago. He is considered the father of Yoga. In his writings he systematised the concept of Yoga in the form of aphorisms. These aphorisms profile a way of life which allows each individual to develop a healthy body and mind which can lead to liberation and self-realisation (43).

The concept of positive health from Ayurveda, a traditional Indian science, which is considered the sister of Yoga and shares the same philosophical background, is used to explain how Yoga works. From an ayurvedic point of view, a person is considered to be healthy when the physiological systems are in equilibrium; that is, when the body tissues and wastes are in the right amount and performing their inherent functions properly, and when the soul, the mind and the senses are contented (44).

Yoga targets two types of issues – the maintenance of health during the lifespan, and the treatment of disease. Therefore, one task of Yoga is to prevent imbalance and the other is to restore balance (44). Yoga gives recommendations on how to maintain health and how to prevent imbalances in the body, based on daily and seasonal routines and rules to protect against disease. The daily guidance includes sleep, hygiene, care of the body, exercise, diet and ethics. Yoga considers humans as an inseparable part of the universe and any change of the macrocosm will affect the microcosm. For each season, different regimes are suggested in order to maintain balance. Yoga calls imbalance of physical factors ‘disease’ and names the origins of disease as being exogenous, endogenous or mental (45).

Yoga practice emphasises maximising strength and resilience through energy management. For a beginner, this involves preventing the wasting of energy and then later, maintaining and increasing energy. Specific postures and
breathing techniques have particular effects; therefore, sequences have been developed for the specific needs of the Yoga practitioner (44).

Yoga provides recommendations on how to approach practice in the different stages of life. Adults are recommended to do postures to maintain physical strength and firmness in order to be supported against mental and emotional stress. Older people should focus their practice on maximising their oxygen intake and attaining protection against fragility and debility (44). There are no restrictions; Yoga can be done by everyone, regardless of age, illness or infirmity (46).

Yoga has become more and more popular in western countries in recent times. More than 90% of people interviewed in 2005 in an American Psychological Association poll believed that perception and thoughts affect physical health and that Yoga would be helpful in reducing their stress, managing their weight and improving their general sense of well-being (47). A survey conducted by the Harvard Medical School found that people who are already Yoga practitioners consider it helpful for various health conditions (47).

1.5.2 Yoga research
The effects of Yoga on various health indicators have been the subject of some research. For example Smith et al. conducted a randomised trial with 131 participants in which they compared the effects of a 10 week Hatha Yoga program (non-classified style) and a progressive relaxation program. There was no difference in blood pressure between the two groups at the end of the intervention (48).

Carlson et al. conducted a study using a mindfulness stress reduction program which included gentle yoga as one component of the intervention. They found a significant decrease in overall systolic blood pressure in the 12 month follow-up assessment in comparison to the measurements taken one week before the first class (49).
A study conducted in 2006 with seniors of a mean age of 66.3 years assessed their sense of coherence before and after participating in a 14 week program focusing on physical activity, including Yoga, or a form of self-reflection such as meditation. The results demonstrated a significant strengthening of the sense of coherence in the participants regardless of which program they participated in. The research team concluded that aged-based, group-oriented and systematic programs which encourage an active daily life would promote coherence and health-improving experiences (50).

As with the range of studies assessing the impact of physical activity on health and well-being, most of the studies focussing specifically on Yoga are confined to one or two health indicators. There are no studies that the author is aware of that investigate the effect of Yoga on holistic health and well-being for people of any age.

1.6 Ageing well holistically and Iyengar Yoga

This section provides a description of Iyengar Yoga, its relevance to ageing and introduces some studies which used Iyengar Yoga as an intervention.

1.6.1 Iyengar Yoga

A description of Iyengar Yoga is given below in order to explain the difference between Yoga in general and Iyengar Yoga in particular. The term Iyengar Yoga was coined by pupils of B.K.S. Iyengar to differentiate his approach from other styles of Yoga (51). Iyengar is one of the leading contributors to the introduction and popularisation of Yoga in the west and is considered as a modern day master of Yoga. He was born on 14 December 1918 in Bellur in the state of Karnataka, India, and started practising Yoga under the guidance of his brother-in-law T. Krishnamacharya when he was aged sixteen and in very poor health (48).

Iyengar's approach to Yoga is strongly based on the traditional disquisition of Patanjali’s Yoga sutras. He systemised over 200 asana (postures) and
pranayama (breathing) techniques and analysed their underlying anatomical and physiological principles. He summarized the insights he attained through his studies of Yoga in his first book published in 1966, which today is considered a modern classic about Yoga (51). Although Iyengar's way of teaching has spread all over the world he endeavours to keep the traditional core and clarity of Yoga. To Iyengar, Yoga is philosophy, science, art and therapy in one (52). In his book 'Tree of Yoga' Iyengar describes Yoga as “the union of body with the mind and of mind with the soul” (53).

Iyengar's Yoga philosophy regards humans as an inseparable part of the world and the universe, and recognizes in human beings five different sheaths (kosas) of being. These sheaths have to be fully integrated and in harmony with each other in order to reach wholeness. Aspects of the physical 'body' such as the skin, bones, muscles and internal organs belong to the outermost layer (annamaya kosa). This outer sheath encloses the energetic body (pranamaya kosa) of the second sheath, which encompasses breath and emotions. The third sheath is the mental body (manomaya kosa) where thought and obsessions are located. The intellectual body (vijnamaya kosa) where intelligence and wisdom reside is the fourth sheath. The fifth and final sheath is the soul body or core (anandamaya kosa). According to Iyengar, when various sheaths are aligned and brought into harmony with each other, integration and unity are achieved. The physical body must connect with the energetic and the organic body and these must in turn connect with the mental, the mental with the intellectual body, and the intellectual body with the soul body or core (43).

According to Iyengar, if there is no communication between the core and the physical body, the core cannot bring its radiance to the motion and action of the outermost, the physical body and there is darkness in life instead of light. Disharmony and disturbance of one of these sheaths creates disease and despair. True health demands effective operating of the physical sheath and vitality, strength and sensitivity of the more subtle, inner levels of being (43).
In Iyengar Yoga, proper body alignment is of major importance in attaining a range of benefits for health and well-being. Yehudi Menuhin, the world famous violin virtuoso, was responsible for bringing Iyengar Yoga to the western world. He stated that years of practising Iyengar Yoga convinced him that basic attitudes in life have their physical equivalents in the body and therefore critical practice must start with alignment of our body as a steady refining approach (54). The establishment of stability and mobility and their connectedness to each other are regarded as important components in the practice of Yoga (55).

Iyengar Yoga uses props such as blocks, belts and benches. If a person is unable to perform an asana (Yoga posture) due to inability or lack of strength, props are used as support and guidance in order to obtain benefit from the asana (56).

Iyengar talked about Yoga in day-to-day life and pointed out the importance of Yoga in maintaining the structural body, keeping the respiratory, circulatory, nervous, digestive and hormonal system in balance and getting mental uplift and intellectual clarity. He states that through the practice of Yoga, perception and understanding of the body and to some extent the mind are obtained (57).

According to Patricia Walden, who has been studying with him for over 40 years, Iyengar has added new dimensions to his practising and teaching of Yoga over time. There are now fewer poses per class but each pose has more depth. He encourages his pupils to explore and most of all emphasises that the purpose of practice is to come closer to the soul, by balancing action and reflection (58).

1.6.2 Ageing well and Iyengar Yoga

Mr Iyengar, now 89 years of age and looking back on more than 70 years of intense Yoga practice and teaching, provides a good example of ageing well through the practice of Yoga. Gabriella Giubilaro, an Iyengar Yoga teacher and physicist, interviewed B.K.S. Iyengar in 1998, the year he celebrated his
80th birthday, about his practice over those last decades of his life. Giubilaro found that Iyengar was full of health, energy, vitality and spirit. Iyengar revealed that when he was younger he focussed on the physical component of well-being, whereas in his later years his emphasis has been on the mental and intellectual levels. He believes that his practise of Yoga gives beauty to his inner body including his cells, fibres, tendons, muscles and organs. He believes that if one were to think of old age, the mind would take shelter to escape and the body would fail. Whenever his body starts failing he starts to enthuse it for work by rejuvenating and recouping the part of the body that was dull. He keeps in his heart the will to work, to maintain the extreme refinement of his body and sharpness of his intelligence. He continues to practise in order to maintain the space of the physical body, to see that the life energy does not shrink from the body. Iyengar believes ageing is equivalent to shrinking (59).

Suza Francina (60) states in her book ‘The new Yoga for people over 50’ that you are never too old to do Yoga but always too old not to do Yoga. Francina was working in the field of caring for the elderly when she attended her first Yoga class. At the class she found herself surrounded by flexible and vital students in their mid-60s, and felt very inflexible, even though she was not even half their age. The elderly people she was caring for and those in the Yoga class had only one thing in common – their chronological age. Francina has since become an Iyengar Yoga teacher herself, specialising in teaching people over 50 years of age, many of whom only started practising after the age of 70 or 80 years or older. She discovered that with Yoga practise, even those beginners who struggled to get up from the floor initially progressed to vital standing and inverted poses. Vanda Scaravelli, born in 1908 and a long term Yoga practitioner, stated in her book ‘Awakening the Spine’ that being 70 or 80 years old is not a limitation to start practising Yoga; talking about old age is an obstacle and only an excuse to be inactive (61).

A number of research projects have been conducted using Iyengar Yoga as an intervention and these are outlined in the next section.
1.6.3 Iyengar Yoga research

Few studies exist which examine the effects of Iyengar Yoga on the health and well being of older people. Therefore all published studies were included in the review. This included a range of study designs including those with and without control groups. For each study mentioned the research design has been described.

A study by Williams et al. compared an Iyengar Yoga therapy program to an educational program in participants with non-specific lower back pain. The participants were primarily self-referred and screened by physicians for inclusion or exclusion criteria and then randomly assigned to either of the intervention groups. Both programs were 16 weeks long. The participants of the Yoga group were asked to attend one 1.5 hour class per week and encouraged to undertake home practice for 30 minutes per day, five days per week. Both groups were asked to complete questionnaires and spinal range of motion measurements after the intervention. Three months after the intervention, a set of questionnaires was posted to all participants. Forty-two participants completed the three month follow-up assessment. Outcomes from multivariate analyses demonstrated significant differences between the groups in the functional and medical categories but not for the psychological and behavioural outcomes. Univariate analyses indicated significant reduction in pain intensity, functional disability and pain medication usage in the Yoga group compared to the other group (62).

Sabina et al. conducted a double-blinded randomised controlled trial to assess the benefits of a four week Iyengar Yoga program in comparison to an active control group provided with stretching exercises, in adults aged 18 to 76 with mild to moderate asthma. Inclusion criteria were a minimum age of 18 years, established diagnosis of mild-to-moderate asthma, Forced Expiratory Volume in one second (FEV$_1$) or Forced Vital Capacity (FVC) values below normal, stable asthma medication dosing, and being new to Yoga. Excluded were people currently smoking or with a history of smoking, pregnant women, and those in which exercise was contraindicated. Participants assigned to the Yoga group participated in twice-weekly 90 minute Yoga sessions and were
encouraged to practise at home. Also, they were asked to continue with home practice for a further three months for 20 minutes, three times a week. Participants allocated to the control group underwent, according to Sabina et al., a ‘sham’ intervention of basic muscle stretching exercises with the same number of classes lasting for one hour. The assessments consisted of: frequency of rescue inhaler use; Mini Asthma Quality of Life Questionnaire with its four domains (symptoms, activity limitation, emotional function and environmental stimuli); FEV\textsubscript{1}; medication use; asthma symptom score; health care utilisation; and compliance with the assigned intervention. Forty-five participants completed the assessments prior to and after the intervention plus the final follow-up assessment in week 16. Significant within-group differences in FEV\textsubscript{1} and morning symptoms scores were revealed in both groups at four and 16 weeks, although no significant differences between the groups were found (63). Thus, the four week Iyengar, Yoga program had no effect on pulmonary function in this group of asthmatics.

Other research into Iyengar Yoga examined mental health in young adults with symptoms of depression, as Yoga is believed to have an uplifting effect on mood. Participants new to Yoga and other forms of complementary or alternative medicine and aged between 18 and 29 were screened and randomly assigned to either the Iyengar Yoga or to the control group. The Iyengar Yoga program, which was specifically tailored to alleviate depression, consisted of twice weekly classes, each of 60 minutes, over five weeks. The Beck Depression Instrument and Spielberger Trait Anxiety Inventory were administered before and after the intervention, while the Profile of Mood States was administered before and after the first, fifth and last classes. Morning cortisol samples were collected on three occasions – before, in the middle, and after the intervention. The participants of the Yoga group showed significant decreases in self-reported symptoms of depression and trait anxiety, which appeared by the middle of the program and were maintained to the end. Further, the participants of the Yoga group showed a decrease in levels of negative mood and fatigue and a trend in higher morning cortisol levels by the end of the Yoga program compared to the control group (64).
Iyengar Yoga was assessed in a pilot study as a possible non-pharmacological treatment for symptoms of osteoarthritis of the knees. Participants were aged 50 years and over with symptomatic osteoarthritis in at least one knee and were not involved in an exercise program prior to the intervention. Exclusion criteria included a history of surgery or injections. The assessments before and after the 8 week Iyengar Yoga intervention consisted of medical history and rheumatological physical examinations. The eight week intervention consisted of once weekly classes for 60-90 minutes, taught by a Senior Iyengar Yoga teacher. Participants were asked to attend at least five sessions and not to start other physical therapy interventions whilst being involved in this project. Seven participants attended at least five classes and completed pre and post Yoga program assessments. Statistically significant reduction in pain and physical function in the Western Ontario and McMaster University Osteoarthritis Index were found. There were also trends of improvement in stiffness and arthritis impact. No unfavourable effects were reported (65).

The effects of Iyengar Yoga and walking exercise on cognition and quality-of-life were assessed in a study on relatively healthy seniors aged 65-85 years. Participants were randomised to a six month Iyengar Yoga class, walking exercise group or to a control group. The participants allocated to the exercise groups (Iyengar Yoga and walking) were additionally asked to undertake home practice. Assessments were undertaken before and after the intervention. Data collection methods included a set of cognitive measures focussed on attention and alertness, an encephalogram, a set of questionnaires relating to health and mood states and some physical tests, such as balance and flexibility. None of the healthy seniors participating in the exercise groups (Iyengar Yoga and walking) showed relative improvements in cognition in comparison to the control group. However, those engaged in the Iyengar Yoga program showed significant improvements in the quality-of-life and physical measures compared to the walking and control groups (66).

Another study conducted to assess an eight week Iyengar Yoga program looked specifically at age-related changes in gait amongst participants aged
between 62 and 83 years. Potential participants were screened and people with an asymmetric gait pattern, use of an assistive device for walking or evidence for neuromuscular illness, major orthopaedic diagnosis, severe rheumatoid arthritis or osteoarthritis, symptomatic lung or heart disease and obesity were excluded. Nineteen healthy participants completed the eight week Iyengar Yoga course, which consisted of two 90 minute classes each week and at least 20 minutes of directed home practice on alternate days. The results showed significant improvements in peak hip extension, stride length and marginally significant trends in reduction of anterior pelvic tilt. Those participants engaged in home practice were more likely to show this improvement (67).

Conclusion
The world’s population is ageing and it is becoming increasingly important to find effective methods for keeping this ageing population healthy and well. This literature review described the demographics of the ageing population, holistic health, ageing well holistically, the impact of physical activity on healthy ageing, the impact of Yoga on health, and the impact of Iyengar Yoga on health. Research undertaken to address health through the use of Yoga was reviewed.

Research into the impact of Iyengar Yoga on health was concentrated on specific physical or mental health indicators. Studies on older people were focussed on people with specific disease conditions rather than the general population. The review of literature identified that there have been no studies assessing the impact of Iyengar Yoga on a combination of physical, mental, spiritual and social health and well being.
Chapter 2  Research design

This chapter of the thesis describes the research design. It includes the research aim and specific research questions. It then describes the epistemology, theoretical perspective, theoretical framework, methodology, research participants, intervention, and data collection and analysis methods.

2.1  Research aim

The aim of the research was to assess the impact of a short term Iyengar Yoga program on the holistic health and well-being of physically inactive people aged 55 years and over.

2.2  Research questions

The overall research question was:
What impact does an eight week Iyengar Yoga program (the program) have on the holistic health and well-being of physically inactive people aged 55 years and over?

Sub-questions for the research included the following:

- What impact does the program have on general health and well-being?
- What impact does the program have on physical health and well-being?
  - What impact does the program have on musculoskeletal function?
  - What impact does the program have on respiratory function?
  - What impact does the program have on immune function?
  - What impact does the program have on self-perceived physical health and well-being?
- What impact does the program have on mental health and well-being?
- What impact does the program have on spiritual health and well-being?
- What impact does the program have on social health and well-being?
- What relationships are there between the various dimensions of holistic health assessed in this study?
2.3 Epistemology

The epistemology for this research project is constructivism. Epistemology is a branch of philosophy that investigates the origin, nature, methods and limitations of human knowledge (68). According to Crotty, epistemology requires an understanding of what is involved in developing knowledge, or how we come to ‘know what we know’ (69). In constructivism meaning is not created or simply assigned to an object; instead meaning is constructed through interaction with objects of this world (69).

Constructivism was explicitly applied at two levels: in the process of implementing the Iyengar Yoga intervention; and in the interpretation of results in order to assess the impact of the intervention on participants’ holistic health and well-being.

At the process level, constructivist epistemology was consistent with the nature of Iyengar Yoga as a practice that is responsive to the individual needs of participants. The participants in this research project were provided with a specifically tailored Iyengar Yoga program that was co-designed via the ongoing interaction between the Iyengar Yoga instructor and the Yoga participants. The Yoga asanas (Yoga postures) were modified and supported with aids/props such as chairs and bolsters in order to adjust them to the participants’ current abilities and needs. This process of continual interaction between the Iyengar Yoga instructor and the participants resulted in a co-constructed Yoga program specific to the needs of the participants.

At the impact level, constructivist epistemology was applied to the interpretation of results from the data analysis. Changes in physical health were assessed using measurements of muscle strength, active range of motion, blood pressure, and lung and immune function. Changes in physical, social, mental and spiritual health were assessed using questionnaires assessing holistic health before and after the Iyengar Yoga program. Additionally, the research participants had the opportunity to report changes
regarding their holistic health and well-being, in general or in particular, in an open-ended question attached to the post intervention questionnaire.

Whilst this study could be considered from a natural science perspective as an ‘objective’ study, according to Crotty (69) research results from the natural sciences can be considered social constructions and human interpretations. In this project, the results from measurements of physical health indicators and statements of physical, social, mental and spiritual health and well-being were provided by the participants and interpreted by the researcher, who then constructed meaning from the results.

2.4 Theoretical perspective

The theoretical perspective chosen for this research project is interpretivism. Interpretivism has been linked back to the thoughts of the German sociologist Max Weber (1864 -1920). Weber proposed the necessity in human sciences and social sciences for an interpretative approach of Verstehen (understanding) in contrast to an explicative approach of Erklaeren (explaining) which is traditionally found in natural sciences. Modern interpretivism seeks to understand and also explain the meaning of particular phenomena (69).

The aim of this research project was to assess the impact of a short term Iyengar Yoga program on the holistic health and well-being of physically inactive people aged 55 years and over. In order to achieve this aim, the researcher was required to interpret the research results to understand and explain what happened to the holistic health and well-being of participants.

2.5 Theoretical frameworks

This section of the thesis presents the two theoretical frameworks used in this research project: the Red Lotus Health Promotion Model, and the Health Belief Model.
2.5.1 Red Lotus Health Promotion Model

This project is guided by the Red Lotus Health Promotion Model which is a new model of modern health promotion underpinned by a system of values and principles (70). Specific values in the model relevant to this research include the following: holistic health paradigm, constructivist epistemology, salutogenic focus, health is purposeful, empowering health promotion strategies and ecological science.

A holistic health paradigm is the health paradigm used to understand health in this research. The holistic health and well-being of older people was assessed before and after the Yoga program by looking at the interrelated dimensions of spiritual, mental, social and physical health and well-being. Yoga purports to have effects on the musculoskeletal system, on the physiological system and on the psyche (44). The value of a constructivist epistemology is consistent with the epistemology for this research which recognises the interaction between the teaching of Yoga and the participants’ response to it.

The value of a salutogenic focus is consistent with the practice of Yoga which aims to create health by maintaining or if necessary restoring health. The value that health is purposeful agrees with the positive concept of health that Yoga embodies. The value of empowering health promotion strategies is congruent with the Yoga philosophy of motivating and supporting people to increase their awareness of themselves and, additionally, to be able to influence their own state of health. The value of ecological science acknowledges that people live in a complex ecosystem and each being is worthy of respect. This is consistent with the ‘Yoga value’ of yama which states that every creature should be treated with respect and care (44).

2.6.2 Health Belief Model

The Health Belief Model is the behaviour change model used to explain behaviour change in this research project. The Health Belief Model proposes that an individual will change behaviour in regard to a present health problem when a combination of four different belief modes is present: 1) sensitivity to
the health problem; 2) awareness of the seriousness of consequences of this problem; 3) action to approach this health problem has to be considered as valuable; and 4) benefit will outweigh the effort to undertake this action (71).

Showing interest in attending Yoga classes can indicate consciousness about an obvious health issue. When engaging in an Iyengar Yoga class, awareness about present health issues is likely to increase and relatively soon or even simultaneously, perception of the seriousness and/or consequences of the problem will arise if not already in existence. The understanding and the experience of the benefits occurs during or after the Yoga practice, simultaneously with perception of the physical and mental energy that needs to be invested in order to generate the process of engaging in a Yoga practice, and receiving the benefits from this action (43).

Iyengar Yoga regards the body as the temple of the soul and therefore worthy of respect. The body is seen as an instrument with which to express our mental and spiritual being. The teaching of Iyengar Yoga – instructions given in a group – is mainly on a physical level but affects the physical, mental and spiritual body as an entirety in each individual. Iyengar Yoga aims to bring consciousness to each part of the body in order to explore the effect of the mind on the body and vice versa (72).

2.6 Research methodology

The methodology used in this research was an experimental study. In an experimental study it is important that the independent variable, such as an exposure or an intervention takes place under known, clearly defined and controlled conditions. In addition it is fundamental that the experiment includes at least two groups, an experimental group, which is exposed to the intervention and a control group which is not exposed to the intervention (73).

Both groups should be examined under standardized conditions to decrease variability between testing conditions. The classic experiment is characterised by having participants randomly allocated to either the experiment or control
group. Preferably an experiment also involves testing the experimental and control groups before and after the intervention, or manipulation of the independent variable. Pre and post-tests are necessary to determine whether a change occurred in the variables being measured and in order to evaluate possible relationships between variables (73).

This research project included a Yoga group and a wait-list control group to which participants were randomly allocated. Tests were conducted on both groups before and after the intervention period. The wait-list control group was provided with the same eight week Iyengar Yoga program after the post-intervention data collection.

Approval for this research was obtained from the University of the Sunshine Coast Human Research Ethics Committee, approval number S/07/118.

2.6.1 Participants
Research participants were recruited from a single retirement resort at the Sunshine Coast in Queensland, in order to ensure that research participants had relatively similar living conditions. The research project was advertised in this particular retirement resort via circular post. The project was limited to a maximum of 40 participants due to the financial constraints of this project.

Inclusion criteria were: 1) participants had to be 55 years and over; and 2) participants had to be new to Iyengar Yoga. The only exclusion criterion was participation in physical activity for more than 30 minutes on average each day. This definition of ‘physical inactivity’ is a level of activity below the recommended level described in the Australian Guidelines for Physical Activity (26).

There were no further exclusion criteria because this project aimed to recruit participants from the general population. Yoga is an ancient method, which does not exclude a particular group of people due to specific limitations or
medical conditions. Therefore age and gender were the only demographic features collected.

Potential participants who satisfied the inclusion criteria attended a research information session held at the retirement resort. Attendees that agreed to participate in the research then completed the ‘Consent to Participate in Research’ form (see Appendices) and the disclaimer form required by the Australian Iyengar Yoga Association (see Appendices).

2.6.2 Randomisation
At the conclusion of the research information session, participants were randomly assigned to the Yoga group or the wait-list control group via the following process. Prior to the information session, numbers between 501 and 540 had been assigned to either the Yoga group or the wait-list control group by the researcher through a random allocation process. After the completion of the consent forms, participants were asked to nominate a number between 501 and 540. Participants were then assigned to either the Yoga group or the wait-list control group based on the pre-assigned group for that number.

2.6.3 Intervention
The intervention consisted of an eight week Iyengar Yoga program in which participants attended 90 minute group-based yoga classes twice weekly and were asked to engage in at least 15 to 20 minutes of home practice on three further days each week. This design was based on a prior published study (67). There was no financial cost to participants associated with participating in the research project.

The Iyengar Yoga program was conducted by the principal researcher who is an internationally certified Iyengar Yoga teacher. The Iyengar Yoga instructor conducted two separate yoga groups at different times of the week. Each group consisted of 10 participants to ensure adequate individual attention and personal safety.
The Iyengar Yoga program included the Yoga asanas (Yoga posture) listed in Table 1 in Sanskrit. Due to the complexity of the Yoga postures, detailed explanations are not provided here. Interested readers should refer to books such as "Light on Yoga" (54) and 'Health through Yoga" (44) for further details about the asanas. These were gradually introduced to the participants of the Yoga group and, depending on their needs and limitations, modified and supported with appropriate aids such as belts, blankets, blocks, bolsters, chairs, and the walls.

Table 1: Postures in Iyengar Yoga intervention (where asanas were exclusively performed with an aid, the aid is provided in English in parentheses)

<table>
<thead>
<tr>
<th>Posture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tadasana</td>
<td>Ardha Uttanasana</td>
</tr>
<tr>
<td>Adho Mukha Svanasana</td>
<td>Utthita Hasta Padangusthasana I &amp; II</td>
</tr>
<tr>
<td>Vrksasana</td>
<td>Utthita Trikonasana</td>
</tr>
<tr>
<td>Virabhadrasana II</td>
<td>Ardha Chandrasana</td>
</tr>
<tr>
<td>Swastikasana</td>
<td>Upavistha Konasana</td>
</tr>
<tr>
<td>Baddha Konasana</td>
<td>Bharadvajasana (chair)</td>
</tr>
<tr>
<td>Ardha Gomukhasana</td>
<td>Parvatasana (chair)</td>
</tr>
<tr>
<td>Namaskar/ Prstha Namaskar</td>
<td>Supta Tadasana</td>
</tr>
<tr>
<td>Supta Padangusthasana I+II</td>
<td>Viparita Karani</td>
</tr>
<tr>
<td>Urdhva Prasarita Padasana</td>
<td>Uttthita Maricyasana (chair/ wall)</td>
</tr>
<tr>
<td>Laying down bent- knee twist</td>
<td>Pavanamuktasana I (chair)</td>
</tr>
<tr>
<td>Supta Baddha Konasana (support big bolster)</td>
<td>Purvottanasana II (chair)</td>
</tr>
<tr>
<td>Savasana (variations)</td>
<td></td>
</tr>
</tbody>
</table>

Before and after class there was the opportunity for queries and feedback. At the end of each session recommendations for home practice were given and participants were encouraged to explore and practise the asanas which they prefer and perceive as beneficial to them.
Participants in the wait-list control group were asked to continue with their usual lifestyles and not to change their physical activity pattern or to engage in new exercises or physical activity over the intervention period. It was assumed that participants of the control group adhered to this agreement as they were provided with the same program after the post intervention data collection.

2.7 Data collection methods

The researcher administered all data collection tests and instruments. Assessments were conducted for participants in the Yoga group and the control group at the same two time points: baseline (pre-intervention) and at eight weeks (post-intervention). Data collection reports for pre and post testing were kept as two separate documents in order to minimise the potential impact that the researcher’s knowledge of the baseline data could have on the collection of post intervention data. The operating procedure protocols for measuring each parameter (Appendices) were strictly followed to ensure consistency in assessments. Data collection and the Yoga program took place at the Sunshine Coast retirement resort where the participants lived.

Various dimensions of holistic health and well-being were assessed using a combination of non-invasive tests for physical health indicators and two questionnaires to assess self-perceived general, physical, mental, spiritual and social health and well-being. An open-ended question was included in the post-intervention assessment in order to obtain information about individuals’ perceived changes that had occurred over the eight week period. The participants of the Yoga group were additionally asked about the frequency of their engagement in home practice. No assessment of changes in activity profile of participants was undertaken.
2.7.1 General health and well-being

General health and well-being was assessed with the General Health domain of the Medical Outcomes Study Short Form 12 Health Survey version 2 (SF-12v2™) (74). The SF-12v2™, a widely used Health Survey throughout the world, is a 12 item short version of the SF36v2™. It assesses eight domains of self-perceived health including Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional and Mental Health (75). The General Health domain is calculated from responses to the first question of the SF-12v2™.

2.7.2 Physical health and well-being

Physical health and well-being incorporated a range of physical functions as well as self-perceived physical health and well-being. Physical functions included muscle strength, active range of motion, respiratory function, blood pressure, and immune function.

Self-perceived physical health and well-being was assessed by the Physical Component Summary of the SF-12 and the Physical Well-Being sub-scale from the Life’s Odyssey™ Questionnaire (75). The Life’s Odyssey™ Questionnaire has been used to assess health status in general populations. It includes seven sub-scales including: Life and Health Attitudes; Social Connectedness; Emotional Well-Being; Physical Well-Being; Rest, Pleasure and Play; Purpose and Meaning; and Self Care. The Physical Well-Being sub-scale includes responses to 10 questions with a scale of one to five, representing responses ranging from strongly disagree to strongly agree (75).

2.7.2.1 Muscle strength

Muscle strength of major muscle groups was assessed using Manual Muscle testing (MMT). Muscle strength tests were conducted for the groups of muscles responsible for hip flexion and abduction, knee extension, shoulder flexion and abduction and trunk rotation and extension.
MMT is a common method in the field of physiotherapy and was designed to measure muscle strength, which develops tension against resistance. Reliability of this measure increases when a single person performs the measurements (76, 77). Gravity plays an integral role in this testing procedure. Standard procedures for MMT were used. The proximal joint segment is stabilised by either using a firm testing surface, positioning of the person being tested, and/or manual holds of the examiner. Additional confirmation that the intended muscle or muscle group is being tested is achieved by palpation (76-78) (see Appendices: Standard Operating Procedure for Musculoskeletal Assessment for full details).

Scores for the muscle tests range from Grade 3- to Grade 5. Grade 3- equates to movement through the complete test range in a gravity-eliminated position. Grade 3 equates to movement through the complete test range against gravity. Grade 3+ equates to movement through the complete test range against gravity and additional minimum resistance. Grade 4 equates to movement through the complete test range against gravity and additional moderate resistance. Grade 5 equates to movement through the complete test range against gravity and additional maximum resistance (76).

2.7.2.2  Active range of motion (aROM)
Active range of motion was measured for the upper extremity, hip flexion, hip extension, hip abduction and trunk rotation. A general scan for the range of motion in joints of the upper extremity was undertaken using the placing hands behind the back technique. This includes scapular, shoulder and elbow movements in a complex way and reveals the flexibility of the entire shoulder girdle (76).

Hip flexion, hip extension, hip abduction and trunk rotation were measured using a universal goniometer, a commonly used device for measuring joint angles in a clinical environment. In order to determine an active range of motion the individual performs each movement unassisted, within their personal range of ability. This technique is used for both diagnostic and
evaluative purposes in the field of physiotherapy (76, 77). Reliability increases when a single person performs the measurements (76, 77).

For measurements of hip flexion, hip extension and hip abduction, the neutral zero method was used in which the goniometer is placed preferably lateral to the joint; the stationary arm of the goniometer lies parallel to the longitudinal axis of the proximal joint segment, and the moveable arm of the goniometer lies and then moves parallel to the moving distal segment of the joint (76, 77) (see Appendices for Standard Operating Procedure for Musculoskeletal Assessment).

Trunk rotation was measured from the top in degrees from zero position. The pivot point of the goniometer was placed over the top of the centre of the skull and the stationary arm of the goniometer was hold in zero position while the moveable arm was moved with the shoulder to the side in the direction that the individual was turning, using the acromion as the reference point.

2.7.2.3 Resting blood pressure
Resting blood pressure was measured using the auscultatory method. A stethoscope and a sphygmomanometer were used to indirectly measure arterial pressure via the vascular pressure in the brachial artery in the upper arm. Blood pressure can be considered an indicator for physical health and is commonly used in clinical, paramedic and sports medicine (17).

Both systolic blood pressure and diastolic blood pressure were assessed. Systolic pressure is produced by contraction of the left ventricle in order to move the blood through the arterial system. This pressure normally reaches 120 mmHg in a healthy human at rest. When the heart relaxes to allow it to refill with blood, the arterial blood pressure decreases to between 70 and 80 mmHg (12). This is the diastolic blood pressure reading.

Resting blood pressure was measured in all participants on the left upper arm. The participants were asked to bend their exposed arm and rest it on a table to bring the elbow to heart level. The cuff was placed around the upper arm,
just above the elbow, the brachial pulse was palpated, and then the cuff was inflated until the brachial pulse disappeared. The pressure was immediately released through the pressure valve at the speed of two to three mmHg/sec. The first and fifth sound Korotkoff were used to determine the values for systolic and diastolic blood pressure, respectively. The measurement was taken only once in each assessment.

2.7.2.4 Respiratory function
Pulmonary function is considered an important indicator of respiratory and overall health (79). A relatively simple test of pulmonary function is forced expiration. Forced Expiratory Volume in one second (FEV₁) is a measurement of the volume of air exhaled in the first second by a forced expiration after full inspiration. This was assessed using a Spiro II spirometer (Medical International research).

Spirometric measurements are rapid, non-invasive and painless tests and are commonly performed in clinical settings and sport medicine to assess pulmonary function. These measurements are useful indicators of lung diseases or abnormalities in clinical settings (80) and can also be used to reveal changes in lung function (29).

Before the measurement was taken, the purpose of the test was explained to the participant and clear instructions and demonstrations of the breathing pattern were provided. Participants were informed of the importance of fully enclosing the mouthpiece with their lips but the use of a nose clip (as is recommended) was voluntary in order to avoid discomfort and/or restriction of respiration. Each participant was asked to fully and slowly inspire as much air as they possibly could, and then to expire all of the air as quickly and as completely as possible. Three successive measurements of FEV₁ were taken with the participant in the standing position in order to increase the reliability of the measurement. Between each measurement the participants were asked to take several normal breaths at a resting pace.
2.7.2.5 Immune function

Immune function was assessed using tests for salivary IgA (SIgA) and salivary lysozyme. Analysis of saliva can provide a general indication of the entire mucosal immune system. This, as well as the non-invasive nature of these tests, explains why assays utilising saliva, rather than serum or blood, are increasing in popularity with research scientists. Salivary IgA (sIgA) antibodies and lysozyme (antibacterial enzymes) play major roles in immune protection of mucosal surfaces, and, therefore, the body. SIgA (specific) and salivary lysozyme (non-specific) are both sensitive to psychological and environmental stressors, increasing the risk of infection in the presence of these agents (81).

Saliva samples were collected from participants using Salivette® cotton swabs. Participants were asked to chew the cotton swab for at least one minute. They were also asked not to eat or drink for one hour before the saliva collection and not to use lipstick that day. The samples was kept cool on the collection day, then centrifuged at 1000 x g for 2 minutes, and stored at -20°C.

**Salivary IgA**

The saliva samples for the IgA assays were defrosted on the day the assay was conducted and split into two parts, one to use for the IgA assay on the same day and one was returned to the -20°C freezer for the lysozyme assays at a later stage.

The salivary IgA concentration was measured using Salivary Secretory IgA Indirect Enzyme Immunoassay kits from Salimetrics LIC, State College, USA, according to the manufacturer’s procedure outlines (82). All samples were tested in duplicate. Within sample %CV (Coefficient of Variations) were all within acceptable limits.

The micro plate reader, VERSAmax ™ from Molecular Devices, Sunnyvale, USA, and the software, SOFTmax POR 3.1.2(2), were used to read the
samples. SIgA values were determined from a standard curve, reported as mean concentration (μg/ml) and then entered into SPSS for further analysis.

**Salivary lysozyme**
The salivary lysozyme concentration was measured using the sandwich ELISA Human Lysozyme EIA Kit from Biomedical Technologies Inc. Stoughton, USA, according to the manufacturer’s assay procedure in the kit.

The saliva samples were defrosted again immediately before assayed for the lysozyme. Saliva samples were initially diluted 1:2000, then repeated at 1:1000 where necessary, in order to obtain values within the range of the standard curve. All samples were tested in duplicate. Within sample %CV (Coefficient of Variations) were all within acceptable limits.

The micro plate reader, VERSAmax ™ (Molecular Devices, Sunnyvale, USA), and the software, SOFTmax PRO 3.1.2(2), were used to reading the samples. Lysozyme values were reported as mean concentration (ng/ml) and then entered into SPSS for further analysis.

**2.7.2.6 Self-Perceived Physical Health and Well-Being**
Self-perceived physical health and well-being was assessed with two measures: the Physical Component Summary of the SF-12v2™, and the Physical Well-being sub-scale of the Life’s Odyssey™ Questionnaire (74, 75). The SF12v2™ is a validated and widely-used health survey. The Life’s Odyssey™ Questionnaire is currently the only instrument available to assess physical, mental, social and spiritual health. Whilst it has not been formally validated, it has been used in many thousands of participants over a 10 year period.

**Physical Component Summary**
The Physical Component Summary was computed from the eight domains of general health status assessed by the SF-12. The PCS is transformed to have
a mean score of 50 and a standard deviation of 10 in the general US population.

**Physical Well-Being Sub-Scale**
The Physical Well-Being sub-scale was computed from the Life’s Odyssey questionnaire. This sub-scale has a score range of 0-100 with higher scores indicating better health and well-being.

### 2.7.3 Mental Health and Well-Being
Mental health and well-being was assessed with four measures: three sub-scales of the Life’s Odyssey™ Questionnaire – Life, Health and Attitude, Emotional Well-Being, and Self Care; and the Mental Component Summary (MCS) of the SF-12. Each of the sub-scales of the Life’s Odyssey has a score range of 0-100 with higher scores indicating better health and well-being. The MCS is transformed to have a mean score of 50 and a standard deviation of 10 in the general US population.

### 2.7.4 Spiritual Health and Well-Being
Spiritual health and well-being was assessed with the Purpose and Meaning subscale of the Life's Odyssey™ Questionnaire. This sub-scale has a score range of 0-100 with higher scores indicating better health and well-being.

### 2.7.5 Social Health and Well-Being
Social health and well-being was assessed with the Life’s Odyssey™ subscales Social Connectedness, and Rest, Pleasure and Play. These sub-scales each have a scoring range of 0 to 100 with higher scores indicating better health and well-being.

### 2.8 Data collection sessions
Each participant completed the data collection tests in the same sequence in both the pre-intervention and post-intervention testing sessions. Each data collection took approximately one hour to complete. Data collection sessions
took place over a week period. The data collection occurred in the following sequence:

- Questionnaires: Life’s Odyssey™ and SF12 v2™, participant sitting
- Saliva collection: Salivette®, participant sitting
- Blood pressure measurement, participant sitting, left arm
- Forced Expiratory Volume (1 second), participant standing
- MMT (Manual Muscle testing) and active range of motion (aROM)
  - Participant sitting:
    - Measurement of muscle strength in hip flexion, knee extension, shoulder flexion, shoulder abduction and possibly trunk rotation optional
    - Assessment of active range of motion for general scan for upper extremity and trunk rotation
  - Participants lying on their sides:
    - Measurement of muscle strength in hip abduction
  - Participants in supine position:
    - Measurement of muscle strength in trunk rotation
    - Assessment of active range of motion for hip flexion and hip abduction
  - Participants in prone position:
    - Measurement of muscle strength in trunk extension
    - Assessment of active range of motion for hip extension.

2.9 Data Analysis Methods

2.9.1 Quantitative data
Quantitative data were analysed with the assistance of SPSS version 14.0 (83). Data were entered into SPSS directly from the data collection reports. Data entry was checked immediately after entering data for each participant. After all data were entered, identification codes were chosen randomly and double-checked.

Data transformation
In order to answer the research questions for the various components of holistic health, data measuring the same underlying construct were grouped to give a summary variable, as follows:

- Data for muscle strength were summed and then transformed (using the formula \[\frac{(actual\ value - minimum\ possible\ value)}{range}\times 100\]) to provide a value for overall muscle strength on a scale of 0 – 100 as demonstrated by Ware et al. (74). This transformation permits all results to be presented on a consistent scale, allowing comparability of results and ease of interpretation.

- Variables for the active range of motion (aROM) for left and right sides of the body were summed to generate the summary variables aROM upper extremity, aROM trunk rotation, aROM hip flexion, aROM hip abduction, and aROM hip extension.

- The average of the three FEV\(_1\) measurements was calculated to give a mean FEV\(_1\) value.

- For each category of the questionnaire, Life’s Odyssey™, the results within the category were summed as recommended by the authors and then transformed using the formula \[\frac{(actual\ value - minimum\ possible\ value)}{range}\times 100\] to give a value on a scale of 0 – 100. Cronbach’s alpha was used to check the internal consistency of questions within each category. A range of 0.7 – 0.8 is considered acceptable (84).

- For the Health Survey, SF12v2™, the results were processed as outlined in the SF12v2 User’s Manual (74) to give the domains General Health, Physical Functioning, Role Physical, Role Emotional, Bodily Pain, Mental Health, Vitality, and Social Functioning, which are presented on a scale of 0 – 100. From these 8 domains, the overall summary variables Physical Component Summary (PCS) and Mental Component Summary (MCS) were computed. These components are
transformed to have a mean of 50 ± SD of 10 in a general US population.

**Statistical analysis**

The distribution of data for each variable at baseline was assessed for normality using the Kolmogorov-Smirnov test (83). Whilst the data for some variables were normally distributed, data for other variables did not have a normal distribution. Therefore it was appropriate to analyse all data with non-parametric statistical tests. Wilcoxon signed-rank tests were used to assess whether there was a significant difference between baseline and end of study data for each variable. The Wilcoxon signed-rank tests were performed separately for the Yoga and the control groups. The change in each variable over the eight week period was calculated for the Yoga and control groups and compared between groups using the Mann-Whitney test (84). Correlations between parameters prior to intervention for the combined control and Yoga groups were identified using a bivariate Spearman’s correlation analysis ($r_s$). These were reported at the $p < 0.01$ level to reduce the likelihood of Type I error associated with multiple pair-wise comparisons. All other results were considered significant at $p < 0.05$.

Results are presented as box plots (generated in SPSS version 14.0) and tables showing medians, minima, maxima and the $p$ values for Wilcoxon signed-rank and Mann-Whitney tests.

Further multivariate analysis was considered, in particular, the possibility of assessing how changes in the muscle strength and aROM variables behaved in combination with one another and how these changes might discriminate between the two groups. However, this was not explored further because of the small sample size, lack of statistical power and low numbers of cases to potential variables. The assumption has been made that sufficient analyses had been conducted to adequately explore the original research questions.

Power analyses were performed on the change in salivary IgA and lysozyme levels over the 8 week period to determine the size of the effect that could be
detected by the Mann-Whitney test. These calculations were performed using SAS version 9 (SAS Institute 2000) and the repeated random sampling method described by Nichols et al. (85).

2.9.2 Qualitative data
Responses obtained from the participants in the Yoga group on the open-ended question in the post trial assessment were approached from the viewpoint of interpretivism and therefore puts emphasis on the meaning and the essence of the data (86).

The procedure for analysing and interpreting the data was undertaken as follows. The first step was the process of familiarisation which occurred through reading the responses several times. Themes in the data were then identified and assigned to the thematic framework provided by the research sub-questions. Responses were therefore assigned to the themes of general, physical, mental, spiritual and social health and well-being. Within each of these themes, key sub-themes were identified.

In order to investigate the interrelationships between the themes, the original data were revisited for those participants who reported on two or more themes. Again, these emerging themes were identified, and coded and grouped accordingly. Data were rearranged and analysed using this framework in order to understand the interconnectedness of the various elements of health and well-being reported by participants of the Yoga group.

Conclusion
This chapter described the research design for this project. The research is located within a constructionist epistemology with interpretivism as the theoretical perspective. An experimental approach was chosen as the methodology. The intervention, a short-term Iyengar Yoga program, and the recruitment of the research participants were described. The data collection methods for various physical health indicators and the questionnaires were
presented. Finally, the data analysis methods used in this research were explained.
Chapter 3 Results

This chapter presents the research results in two sections: characteristics of the participants, and comparisons between the Yoga and control groups.

The first section presents descriptive data about the participants at baseline, including demographic characteristics, and physical, mental, spiritual and social health variables. Results for each of these variables are presented separately for the Yoga group and the control group.

The second section of this chapter presents the results of statistical analyses comparing the study outcomes in the Yoga and control groups for the physical, mental, spiritual and social variables of health and well-being across two time points. Additionally, the data obtained from the single open-ended question are presented after the relevant quantitative data.

Most of the variables were normally distributed. The exceptions were: active range of motion hip extension after intervention, and the change in this variable over the 8 week period, salivary IgA before intervention, the change in the SF12 v2™ Physical Component Summary, and the change in the SF12v2™ Mental Component Summary.

3.1 Participant characteristics

3.1.1 Demographics

Forty participants initially registered to participate in the research project. Two participants, one from the Yoga group and one from the control group, withdrew from participation. The participant from the Yoga group withdrew after week three of the intervention as the program did not meet her expectations, and the participant from the control group withdrew due to influenza during the period of the post intervention tests. Data were collected at baseline and at the end of the study period from a total of 38 participants.
including 32 females and six males. Sex distribution was evenly spread across the Yoga and control groups, with 16 females and three males in each group.

Overall, participants ranged in age from 56 to 94 years (mean 73.21 years, median 72.50 years). The age range in the control group was greater than in the Yoga group, with the age of the participants in the Yoga group ranging from 66 to 86 years (mean 75 years, median 76 years) and the age of the participants in the control group ranging from 56 to 94 years (mean 71 years, median 72 years). There was no significant difference in age between the two groups (Mann-Whitney, U=126.5, n₁=19, n₂=19, p= 0.12). The age group and sex distribution of participants in the Yoga and control groups are presented in Table 2.

<table>
<thead>
<tr>
<th>Age range (years)</th>
<th>Yoga group female</th>
<th>Yoga group male</th>
<th>Control group female</th>
<th>Control group male</th>
</tr>
</thead>
<tbody>
<tr>
<td>56-65 had 0</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>66-75 had 9</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>76-85 had 7</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>86 and over</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>3</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>

3.1.2 Physical health and well-being

The Yoga group recorded slightly lower scores than the control group in most of the physical health parameters at baseline, but the differences between the two groups at this time were not statistically significant (see Table 3).
Table 3: Comparison of physical health parameters by group before the 8 week Iyengar yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Yoga group (n=19) Median (Min – Max)</th>
<th>Control group (n=19) Median (Min – Max)</th>
<th>P value^</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>76 (66-86)</td>
<td>72 (56-94)</td>
<td>0.12</td>
</tr>
<tr>
<td>Overall muscle strength (%)</td>
<td>53.9 (34.6–71.2)</td>
<td>59.6 (36.5-80.8)</td>
<td>0.11</td>
</tr>
<tr>
<td>aROM upper extremities (cm)†</td>
<td>28 (0-90)</td>
<td>20 (0-77)</td>
<td>0.41</td>
</tr>
<tr>
<td>aROM trunk rotation (deg)</td>
<td>20 (0-42)</td>
<td>24 (4-80)</td>
<td>0.51</td>
</tr>
<tr>
<td>aROM hip flexion (deg)</td>
<td>198 (128-226)</td>
<td>210 (158-280)</td>
<td>0.45</td>
</tr>
<tr>
<td>aROM hip abduction (deg)</td>
<td>56 (32-80)</td>
<td>58 (28-100)</td>
<td>0.53</td>
</tr>
<tr>
<td>aROM hip extension (deg)</td>
<td>11 (0-20)</td>
<td>16 (0-28)</td>
<td>0.19</td>
</tr>
<tr>
<td>FEV1(L)</td>
<td>1.57 (0.66-2.40)</td>
<td>1.87 (0.78-3.74)</td>
<td>0.26</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>140 (110-164)</td>
<td>130 (98-160)</td>
<td>0.21</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>76 (60-85)</td>
<td>78 (60-96)</td>
<td>0.47</td>
</tr>
<tr>
<td>Salivary IgA (μg/ml)</td>
<td>894 (182-6351)</td>
<td>843 (147-10130)</td>
<td>0.64</td>
</tr>
<tr>
<td>Salivary lysozyme (ng/ml)</td>
<td>1078 (194-33500)</td>
<td>2028 (424-5926)</td>
<td>0.89</td>
</tr>
</tbody>
</table>

^ Mann-Whitney test, † Sum of both sides of each person, smaller value indicates greater flexibility

The resting values for systolic blood pressure at baseline ranged from 98 to 164 mmHg with an average value of 135.7 mmHg (SD 16.2 mmHg). The resting values for diastolic blood pressure at baseline ranged from 60 to 96 mmHg with an average of 74.7 mmHg (SD 9.3mm Hg) (see Table 3 and Figure 1).

Figure 1: Systolic and diastolic blood pressure values by age of participant before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over
Forced Expiratory Volume in 1 second (FEV\textsubscript{1}) ranged from 0.66 L to 3.74 L with an average of 1.8 L (SD 0.6 L) (Figure 2). The values for mean FEV\textsubscript{1} presented in Figure 2 are absolute values, unadjusted for race, height or weight. A trend of decreasing FEV\textsubscript{1} with increasing age was apparent (Figure 2).

![Figure 2: Absolute values for Forced Expiratory Volume in 1 second by age of participant before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over](image)

3.1.3 **Self-perceived physical, mental, spiritual and social parameters**

The Yoga group scored slightly lower than the control group in four of the sub-scales of the Life’s Odyssey™ Questionnaire at baseline, but these differences were not statistically significant different. The Yoga group scored slightly higher than the control group in the Emotional Well-being and Physical Well-being sub-scales at baseline but these differences were again not statistically significant (see Table 4).
Table 4: Comparison of sub-scales of the Life’s Odyssey™ Questionnaire by group before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Yoga group (n=19) Median (Min – Max)</th>
<th>Control group (n=19) Median (Min – Max)</th>
<th>P value^</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life &amp; Health Attitudes</td>
<td>75.0 (55.0-100.0)</td>
<td>77.5 (37.5-95.0)</td>
<td>0.63</td>
</tr>
<tr>
<td>Social Connectedness</td>
<td>67.5 (35.0-95.0)</td>
<td>70.0 (50.0-100.0)</td>
<td>0.53</td>
</tr>
<tr>
<td>Emotional Well-being</td>
<td>72.5 (20.0-90.0)</td>
<td>65.0 (40.0-80.0)</td>
<td>0.67</td>
</tr>
<tr>
<td>Physical Well-being</td>
<td>72.5 (35.0-85.0)</td>
<td>65.0 (32.5-87.5)</td>
<td>0.53</td>
</tr>
<tr>
<td>Rest, Pleasure &amp; Play</td>
<td>77.5 (55.0-95.0)</td>
<td>80.0 (52.5-100)</td>
<td>0.93</td>
</tr>
<tr>
<td>Purpose &amp; Meaning</td>
<td>62.5 (37.5-95.0)</td>
<td>67.5 (42.5-97.5)</td>
<td>0.53</td>
</tr>
<tr>
<td>Self Care</td>
<td>81.3 (45.0-100.0)</td>
<td>77.5 (45-87.5)</td>
<td>0.33</td>
</tr>
</tbody>
</table>

^ Mann-Whitney test

In two of the domains of the SF12 v2™ - Physical Functioning and Mental Health – there were statistically significant differences between the groups at baseline, with the Yoga group scoring lower in these domains than the control group (see Table 5).

Table 5: Comparison of self-perceived health parameters in the eight domains and the two summary components of the SF12 v2™ Health Survey by group before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Yoga group (n=19) Median (Min – Max)</th>
<th>Control group (n=19) Median (Min - Max)</th>
<th>P value^</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Functioning (PF)</td>
<td>18.8 (0-50)</td>
<td>37.5 (0-50)</td>
<td>0.01*</td>
</tr>
<tr>
<td>Role Physical (RP)</td>
<td>50 (25-100)</td>
<td>75 (25-100)</td>
<td>0.10</td>
</tr>
<tr>
<td>Bodily Pain (BP)</td>
<td>75 (25-100)</td>
<td>75 (25-100)</td>
<td>0.62</td>
</tr>
<tr>
<td>General Health (GH)</td>
<td>60 (25-100)</td>
<td>60 (25-85)</td>
<td>0.79</td>
</tr>
<tr>
<td>Vitality (VT)</td>
<td>50 (25-75)</td>
<td>50 (0-100)</td>
<td>0.28</td>
</tr>
<tr>
<td>Social Functioning (SF)</td>
<td>75 (0-100)</td>
<td>100 (50-100)</td>
<td>0.27</td>
</tr>
<tr>
<td>Role Emotional (RE)</td>
<td>75 (25-100)</td>
<td>75 (50-100)</td>
<td>0.18</td>
</tr>
<tr>
<td>Mental Health (MH)</td>
<td>62.5 (50-87.5)</td>
<td>75 (62.5-100)</td>
<td>0.001**</td>
</tr>
<tr>
<td>Physical component summary</td>
<td>40.1 (20.8-63.9)</td>
<td>43.6 (25.8-53.8)</td>
<td>0.22</td>
</tr>
<tr>
<td>Mental component summary</td>
<td>49.1 (31.0-62.2)</td>
<td>53.4 (45.9-68.5)</td>
<td>0.11</td>
</tr>
</tbody>
</table>

^ Mann-Whitney test, * p<0.05, ** p< 0.01

Validity tests on the results for The Life’s Odyssey™ Questionnaire sub-scales of Physical Well-Being, Rest, Pleasure and Play, and Self Care were below the recommended range of 0.7 - 0.8 for Cronbach’s alpha (83) (see Table 6).
Table 6: Cronbach’s alpha for Life’s Odyssey™ Questionnaire sub-scales before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Life’s Odyssey subscale</th>
<th>Cronbach’s alpha score</th>
<th>N of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life &amp; Heath Attitudes</td>
<td>0.82</td>
<td>10</td>
</tr>
<tr>
<td>Social Connectedness</td>
<td>0.73</td>
<td>10</td>
</tr>
<tr>
<td>Emotional Well-being</td>
<td>0.75</td>
<td>10</td>
</tr>
<tr>
<td>Physical Well-being</td>
<td>0.61</td>
<td>10</td>
</tr>
<tr>
<td>Rest, Pleasure &amp; Play</td>
<td>0.66</td>
<td>10</td>
</tr>
<tr>
<td>Purpose &amp; Meaning</td>
<td>0.80</td>
<td>10</td>
</tr>
<tr>
<td>Self Care</td>
<td>0.57</td>
<td>10</td>
</tr>
</tbody>
</table>

3.1.4 Relationships between variables

Bivariate correlations (Spearman’s) were conducted to investigate significant relationships (threshold p value <0.01) between several of the health parameters measured in this research. In the physical parameters, statistically significant negative correlations were found between age and FEV₁ and age and aROM trunk rotation. Statistically significant negative correlations were also found between SIgA and hip extension and between aROM in the upper extremity and hip extension (Table 7). Statistically significant positive correlations were found between gender and FEV₁, SIgA and aROM in the upper extremity, overall muscle strength and FEV₁ and overall muscle strength with various flexibility measurements (aROMs). Several of the flexibility measurements were also significantly correlated with each other (see Table 7).
Table 7: Significant relationships between physical health parameters before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean FEV&lt;sub&gt;1&lt;/sub&gt;</th>
<th>aROM upper extremity</th>
<th>aROM trunk rotation</th>
<th>aROM hip flexion</th>
<th>aROM hip abduction</th>
<th>aROM hip extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.423**</td>
<td>-0.488**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td>0.008</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salivary IgA</td>
<td>0.463**</td>
<td>-0.457**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td>0.003</td>
<td>0.004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle</td>
<td>0.452**</td>
<td>0.571***</td>
<td>0.430**</td>
<td>0.421**</td>
<td>0.614***</td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td>0.004</td>
<td>&lt;0.001</td>
<td>0.007</td>
<td>0.008</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

* † decrease in aROM in upper extremity indicates increase in flexibility

In the psychosocial parameters, significant positive relationships were found between several of the sub-scales of the Life’s Odyssey™ Questionnaire and the two summary components of the SF12 v2™ Health Survey (Table 8). Correlations between physical and mental components are shown by a positive correlation between the Self-Perceived Physical Well-Being sub-scale and both the Purpose and Meaning sub-scale of Life’s Odyssey™ and the Mental Component Summary of the SF12 v2™.

Table 8: Relationships between self-perceived physical, mental, spiritual and social health parameters before the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Life and Health Attitudes</th>
<th>Social Connectedness</th>
<th>Emotional Well-Being</th>
<th>Purpose and Meaning</th>
<th>Rest, Pleasure and Play</th>
<th>Physical Well-Being</th>
<th>Self Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Component Summary</td>
<td>r&lt;sub&gt;s&lt;/sub&gt; = 0.497**</td>
<td>0.546**</td>
<td>0.632***</td>
<td></td>
<td>&lt;0.001***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td>0.003</td>
<td>0.001</td>
<td>&lt;0.001***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental Component Summary</td>
<td>r&lt;sub&gt;s&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life and Health Attitudes</td>
<td>r&lt;sub&gt;s&lt;/sub&gt; = 0.443**</td>
<td>0.692***</td>
<td>0.613***</td>
<td>0.448**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td>0.005</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Connectedness</td>
<td>r&lt;sub&gt;s&lt;/sub&gt; = 0.464**</td>
<td>0.426**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td>0.003</td>
<td>0.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purpose and Meaning</td>
<td>r&lt;sub&gt;s&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ** p<0.01, *** p< 0.001
There were no significant relationships found between the physical parameters and the questionnaire responses in the 38 participants at baseline.

In summary, the two groups were well matched for sex and age. There were no statistically significant differences at baseline for physical health variables or the majority of the self-perceived health variables.

### 3.2 Comparison of study outcomes in Yoga and control groups

The following section presents comparison of study outcomes in the Yoga and the control groups. Individual participants in the Iyengar Yoga group attended between 10 and 16 classes (average 14 classes). Home practice varied from never to daily or almost daily (average three times per week).

Results for self-perceived general health and well-being are presented first, followed by results for the range of physical health parameters, and results for the self-perceived physical, mental, spiritual and social health and well-being. Finally, results from the analysis on the interconnectedness between the variables are presented.

#### 3.2.1 Self-perceived general health and well-being

This section reports on changes in how the participants perceived their general health and well-being after the eight week period. General Health is one of the eight domains of the SF12 v2™ Health Survey, and consists of a single question. There was no significant change in this domain in either the Yoga group (Wilcoxon, z=-1.16, n=8, p=0.31) or the control group (z=-0.43, n=8, p=0.60) over the eight week period and there was no significant difference in the changes between the Yoga group and the control group (Mann-Whitney, U=169.5, n₁=19, n₂= 19, p= 0.74). For completeness the scores are shown later in this thesis as part of Table 11.
In the open-ended question, participants in the Yoga group reported changes and improvements in their self-perceived general health and well-being. Three themes emerged from the data analysis: increased feeling or sense of well-being; increased stamina; and increased energy. The following comments capture the essence of this third theme: "more energy", "full of energy", "I feel energised" and "I felt energised after each class".

### 3.2.2 Physical health and well-being

This section focuses on changes in the physical variables of health after the eight week period. The participants in the Yoga group improved significantly in overall muscle strength and in the active range of motion in the upper extremity, trunk rotation, hip flexion, abduction and extension (see Table 9). In the control group there were no significant changes in overall muscle strength. However there was a statistically significant decrease in flexibility in the control group. Forced Expiratory Volume in one second improved in both the Yoga and control groups but this improvement was only statistically significant in the control group.

There was a statistically significant difference between the Yoga group and control group in the changes in overall muscle strength, and active range of motion in the upper extremity, trunk rotation, hip abduction and hip extension that occurred over the eight week period (see Table 9).

Neither the Yoga group nor the control group had any statistically significant changes in salivary immune function over the eight week period. Data analysis identified extreme variability in both SIgA and lysozyme in both groups (see Table 10).
Table 9: Comparison of physical health variables by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yoga group</th>
<th>Control group</th>
<th>Between group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Median (Min – Max)</td>
<td>After Median (Min – Max)</td>
<td>Change Median (Min – Max)</td>
</tr>
<tr>
<td>Overall muscle strength (%)</td>
<td>53.9 (34.6-71.25)</td>
<td>67.3 (50.0-76.9)</td>
<td>11.5 (0-34.6)</td>
</tr>
<tr>
<td>aROM upper extremities (cm)</td>
<td>28 (0-90)</td>
<td>14.00 (0-59)</td>
<td>-7 (-33-0)</td>
</tr>
<tr>
<td>aROM trunk rotation (deg)</td>
<td>20 (0-42)</td>
<td>42 (4-80)</td>
<td>16 (0-60)</td>
</tr>
<tr>
<td>aROM hip flexion (deg)</td>
<td>198 (128-226)</td>
<td>212 (180-248)</td>
<td>10 (-18-72)</td>
</tr>
<tr>
<td>aROM hip abduction (deg)</td>
<td>56 (32-80)</td>
<td>70 (40-92)</td>
<td>16 (-8-36)</td>
</tr>
<tr>
<td>aROM hip extension (deg)</td>
<td>11 (0-20)</td>
<td>20 (0-20)</td>
<td>4 (-4-12)</td>
</tr>
<tr>
<td>FEV1(L)</td>
<td>1.57 (0.66-2.40)</td>
<td>1.59 (0.85-2.55)</td>
<td>0.11 (-0.25-0.50)</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>140 (110-164)</td>
<td>138 (110-160)</td>
<td>-2 (-34-20)</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>76 (60-85)</td>
<td>78 (60-94)</td>
<td>0 (-8-14)</td>
</tr>
</tbody>
</table>

^ Wilcoxon signed rank test, # Mann-Whitney test, * p<0.05, ** p<0.01, *** p< 0.001
Table 10: Comparison of immune function by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yoga group</th>
<th>Control group</th>
<th>Between group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Median (Min – Max)</td>
<td>After Median (Min – Max)</td>
<td>Change Median (Min – Max)</td>
</tr>
<tr>
<td>Salivary IgA (μg/ml)</td>
<td>894 (182-6351)</td>
<td>1174 (283-3022)</td>
<td>-194 (-4177-1852)</td>
</tr>
<tr>
<td>Salivary lysozyme (ng/ml)</td>
<td>1078 (194-33500)</td>
<td>1214 (575-10926)</td>
<td>-26 (-25978-4440)</td>
</tr>
</tbody>
</table>

^ Wilcoxon signed rank test,  # Mann-Whitney test
3.2.2.1 Muscle strength

The Yoga group showed a significant improvement in overall muscle strength, with strength increasing by an average of 26% (Wilcoxon, $z= -3.73$, $n=18$, $p<0.001$). The control group showed a slight decrease in overall muscle strength, decreasing by an average of 2.8% ($z= -1.27$, $n=10$, $p=0.22$) (see Figure 3), however this was not statistically significant.

![Box plot showing muscle strength before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over.](image)

**Figure 3**: Overall muscle strength on a scale of 0 -100 by group before and after the 8 week lyengar Yoga program for physically inactive people aged 55 years and over. The symbol º in the figure represents an outlier.

The change in muscle strength over the eight week period was significantly different between the control and Yoga groups (Mann-Whitney, $U=9.5$, $n_1=19$, $n_2=19$, $p<0.001$) (see Table 9).
In the open-ended question, some of the participants of the Yoga group stated they had experienced an important change with regard to improvement in muscle strength during and after the Yoga program. Two themes were detected in the data: one of improved leg strength and the other of improved back strength. For example, a 71 year old female participant who suffered from a chronic lack of strength in her legs reported that after the 8 weeks she had “stronger leg muscles”.

3.2.2.2 Active range of motion

Active Range of Motion (aROM) for the upper extremity (see Appendix Standard Operating Procedure: Musculoskeletal assessment) significantly improved in the Yoga group by an average of 10.8 cm (z= -3.62, n= 17, p<0.001). There was no significant change in the control group (z = -1.11, n=15, p= 0.28) (see Figure 4). A lower value for the aROM in the upper extremity indicates greater flexibility.

![Figure 4: Active range of motion (aROM) for the upper extremity by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbol ° in the figure represents an outlier.](image-url)
There was a significant difference in the median change in active ROM for the upper extremity between the Yoga group and the control group over the 8 week period (U=76.5, n₁=19, n₂=19, p= 0.002) (see Table 9).

The active ROM in trunk rotation deteriorated significantly in the control group by an average of 9 degrees (z= -3.11, n=17, p<0.001). In contrast, active ROM in trunk rotation improved significantly in the Yoga group by an average of 20 degrees (z= -3.62, n=17, p< 0.001) (see Figure 5).

![Figure 5: Active range of motion (aROM) for trunk rotation by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbols o and * in the figure represent outliers and extreme cases respectively.]

The median change in aROM in trunk rotation over the 8 week period was significantly different between the Yoga group and the control group (U= 10, n₁=19, n₂=19, p< 0.001) (see Table 9).
Active ROM in hip flexion improved significantly in the Yoga group ($z= -2.56$, $n=16$, $p=0.008$), by an average of 14 degrees, while the participants in the control group remained stable (average improvement of 2 degrees) ($z= -0.52$, $n=16$, $p=0.62$) (see Figure 6).

There was no significant difference in the change in hip flexion between the Yoga group and the control group ($U=121$, $n_1=19$, $n_2=19$, $p=0.08$) (see Table 9).

The active ROM in hip abduction improved significantly in the Yoga group ($z= -3.53$, $n=17$, $p<0.001$) by an average of 15 degrees, whereas there was a slight decrease (by an average of 5 degrees) in the control group ($z= -1.45$, $n=16$, $p=0.15$), which was not statistically significant (see Figure 7).

Figure 6: Active range of motion (aROM) for hip flexion by group before and after the 8 week iyengar Yoga program for physically inactive people aged 55 years and over. The symbol * in the figure represents outliers.
There was a significant difference in the median change in aROM in hip abduction over the 8 week period between the Yoga and the control group (U= 43.5, n₁=19, n₂=19, p< 0.001) (see Table 9).

Active ROM in hip extension improved significantly in the experimental group by an average of 5 degrees (z= -2.85, n= 13, p= 0.003), while the control group remained stable (z= -1.57, n=9, p=0.16) (see Figure 8).
There was a significant difference in the change in aROM in hip extension over the 8 week period between the Yoga group and the control group (U=75, n₁=19, n₂=19, p< 0.001) (see Table 9).

Analysis of qualitative data from participants in the Yoga group identified changes in active range of motion as one of the major improvements experienced during and after engagement in the eight week Iyengar Yoga program. Some participants reported a general improvement in flexibility, while others commented on an improvement in moving around and getting up and down. One female participant reported a change in “getting up and down off the floor by myself”, as she had been unable to do that previously. One male participant reported “I can dry my toes with a towel and not have to use the hairdryer”. Another participant reported that a bad shoulder was no longer as stiff as before.
3.2.2.3 Resting blood pressure
There was a slight drop (4-5mmHg) in the systolic blood pressure over the eight week period in both groups, but this was not statistically significant (Yoga group; z= -1.13, n=15, p=0.27: control group; z= -1.48, n=16, p=0.15). There was no significant change in diastolic blood pressure in either group (Yoga group; z= -1.42, n=15, p=0.16: control group; z= -1.16, n=13, p=0.28).

There was no significant difference in the median changes between the Yoga group and the control group for either systolic blood pressure (U= 176, n1=19, n2=19, p=0.90) or diastolic blood pressure (U=130, n1=19, n2=19, p=0.13) over the eight week period (see Table 9).

3.2.2.4 Respiratory function
There was a statistically significant improvement in the Forced Expiratory Volume in one second in the control group (z= -2.42, n=19, p=0.014) of an average of 150 ml. In contrast, the Yoga group showed an average improvement of 80 ml, which was not statistically significant (z= -1.79, n=19, p=0.07) (see Figure 9).
There was no significant difference in the changes in FEV₁ between the Yoga and the control group (U=156, n₁=19, n₂=19, p= 0.47) (see Table 9). Despite the lack of statistically significant changes, analysis of qualitative data from participants in the Yoga group identified a sub-theme related to ease of breathing. For example, one female participant reported that her “breathing is better” and that she experienced “faster recovery after breathlessness”.

### 3.2.2.5 Immune function

**Specific – IgA**

Median IgA levels were higher in the Yoga group after the eight week intervention, however this was not statistically significant (z= -0.32, n= 19, p= 0.76). The median IgA level of the control group remained stable (z = -0.48, n = 19, p = 0.65) (see Figure 10). There was high variability in the results in both of the groups (see Table 10), with similar proportions of participants experiencing increases and decreases in IgA levels.
Figure 10: Salivary IgA levels (µg/ml) by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbol “*” in the figure represents an outlier. One extreme case in the before control group and one in the before Yoga group are not shown.

There was no significant difference between the Yoga and the control groups in the change in salivary IgA levels over the eight week period ($U = 177, n_1 = 19, n_2 = 19, p = 0.93$) (see Table 10). Power analysis revealed that there needed to be a median difference in change in salivary IgA levels of approximately 850 µg/ml between the control and Yoga groups for the Mann-Whitney test to detect a difference 80% of the time ($power = 0.8$).

**Non-specific – lysozyme**

There were no significant changes in salivary lysozyme over the eight week period in either the Yoga group ($z = -0.40, n=19, p= 0.71$) or the control group ($z= -0.04, n=19, p= 0.98$) (see Figure 11). There was a high variability in the results for SLgA in both groups (see Table 10), with similar proportions of participants experiencing increases and decreases in lysozyme levels.
There was no significant difference between the Yoga group and the control group in the change in salivary lysozyme over the eight week period ($U=167$, $n_1 = 19$, $n_2 = 19$, $p = 0.71$) (Table 10). Power analysis revealed that there needed to be a median difference in change in lysozyme levels of approximately 3000ng/ml between the control and Yoga groups for the Mann-Whitney test to detect a difference 80% of the time ($power = 0.8$).

**Figure 11**: Salivary lysozyme levels by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbols º and * in the figure represent outlier and extreme cases respectively. One extreme case in the before control group, one in the before Yoga group and one in the after control group are not shown.

### 3.2.2.6 Self-perceived physical health and well-being

Data from the Life’s Odyssey™ and the SF12 v2™ questionnaires, and the open-ended question in the post-intervention assessment are presented. An overview of the results in both groups is provided in Table 11.

There were statistically significant improvements in the Yoga group in three Life’s Odyssey subscales: Physical Well-Being, Emotional Well-Being and
Self Care. There was no significant change in any of the other self-perceived physical health and well-being variables in the Yoga group. There were no significant changes in any of the self-perceived physical health and well-being variables in the control group.
Table 11: Comparison of outcomes by group for self-perceived physical, mental, spiritual and social health indicators before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before Median (Min-Max)</th>
<th>After Median (Min-Max)</th>
<th>Change Median (Min- Max)</th>
<th>P value^</th>
<th>Before Median (Min-Max)</th>
<th>After Median (Min-Max)</th>
<th>Change Median (Min- Max)</th>
<th>P value#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life &amp; Health Attitudes</td>
<td>75 (65-100)</td>
<td>75 (62.5-100)</td>
<td>2.5 (-20-20)</td>
<td>0.34</td>
<td>77.5 (37.5-95)</td>
<td>87.5 (52.5-95)</td>
<td>5 (-15-22.5)</td>
<td>0.09</td>
</tr>
<tr>
<td>Social Connectedness</td>
<td>67.5 (35-95)</td>
<td>70 (50-92.5)</td>
<td>7.5 (-22-20)</td>
<td>0.06</td>
<td>70 (50-100)</td>
<td>75 (57.5-95)</td>
<td>2.5 (-22.5-30)</td>
<td>0.69</td>
</tr>
<tr>
<td>Emotional Well-being</td>
<td>72.5 (20-90)</td>
<td>77.5 (42.5-87.5)</td>
<td>5 (-30-35)</td>
<td>0.04**</td>
<td>65 (40-80)</td>
<td>65 (32.5-100)</td>
<td>-2.5 (-25-45)</td>
<td>0.99</td>
</tr>
<tr>
<td>Physical Well-being</td>
<td>62.5 (30-82.5)</td>
<td>72.5 (35-85)</td>
<td>8.75 (-10-25)</td>
<td>0.003**</td>
<td>65 (32.5-87.5)</td>
<td>70 (22.5-92.5)</td>
<td>2.5 (-32.5-27.5)</td>
<td>0.61</td>
</tr>
<tr>
<td>Rest, Pleasure &amp; Play</td>
<td>77.5 (55-95)</td>
<td>77.5 (60-95)</td>
<td>5 (-22.5-25)</td>
<td>0.27</td>
<td>80 (52.5-100)</td>
<td>75 (37.5-100)</td>
<td>0 (-22.5-25)</td>
<td>0.69</td>
</tr>
<tr>
<td>Purpose &amp; Meaning</td>
<td>62.5 (37.5-95)</td>
<td>75 (42.5-100)</td>
<td>5 (-12.5-42.5)</td>
<td>0.10</td>
<td>67.5 (42.5-97.5)</td>
<td>72.5 (37-97.5)</td>
<td>0 (-17.5-20)</td>
<td>0.73</td>
</tr>
<tr>
<td>Self Care</td>
<td>81.3 (45-100)</td>
<td>92.5 (50-100)</td>
<td>5 (-35-32.5)</td>
<td>0.001**</td>
<td>77.5 (45-87.5)</td>
<td>76.3 (50-95)</td>
<td>0 (-20-20)</td>
<td>0.51</td>
</tr>
<tr>
<td>Physical functioning (PF)</td>
<td>18.8 (0-50)</td>
<td>25 (0-50)</td>
<td>0 (-25-12.5)</td>
<td>0.82</td>
<td>37.5 (0-50)</td>
<td>37.5 (0-50)</td>
<td>0 (-25-12.5)</td>
<td>0.18</td>
</tr>
<tr>
<td>Role Physical (RP)</td>
<td>50 (25-100)</td>
<td>75 (25-100)</td>
<td>0 (-37.5-75)</td>
<td>0.25</td>
<td>75 (25-100)</td>
<td>75 (25-100)</td>
<td>0 (-42.5-50)</td>
<td>0.41</td>
</tr>
<tr>
<td>Bodily Pain (BP)</td>
<td>75 (25-100)</td>
<td>75 (25-100)</td>
<td>0 (-50-75)</td>
<td>0.77</td>
<td>75 (25-100)</td>
<td>75 (25-100)</td>
<td>0 (-25-25)</td>
<td>0.45</td>
</tr>
<tr>
<td>General Health (GH)</td>
<td>60 (25-100)</td>
<td>60 (25-100)</td>
<td>0 (-25-35)</td>
<td>0.31</td>
<td>60 (25-85)</td>
<td>60 (25-100)</td>
<td>0 (-35-25)</td>
<td>0.60</td>
</tr>
<tr>
<td>Vitality (VT)</td>
<td>50 (25-75)</td>
<td>75 (0-100)</td>
<td>25 (-50-75)</td>
<td>0.16</td>
<td>50 (0-100)</td>
<td>50 (0-75)</td>
<td>0 (-75-25)</td>
<td>1.0</td>
</tr>
<tr>
<td>Social Functioning (SF)</td>
<td>75 (0-100)</td>
<td>100 (25-100)</td>
<td>0 (-75-100)</td>
<td>0.36</td>
<td>100 (50-100)</td>
<td>100 (25-100)</td>
<td>0 (-75-50)</td>
<td>0.78</td>
</tr>
<tr>
<td>Role Emotional (RE)</td>
<td>75 (25-100)</td>
<td>75 (25-100)</td>
<td>0 (-37.5-25)</td>
<td>0.29</td>
<td>75 (50-100)</td>
<td>75 (50-100)</td>
<td>0 (-37.5-25)</td>
<td>0.50</td>
</tr>
<tr>
<td>Mental Health (MH)</td>
<td>62.5 (50-87.5)</td>
<td>75 (50-87.5)</td>
<td>0 (-25-25)</td>
<td>0.22</td>
<td>75 (62.5-100)</td>
<td>75 (50-100)</td>
<td>0 (-25-25)</td>
<td>0.07</td>
</tr>
<tr>
<td>Physical component summary</td>
<td>40.1 (20.8-63.9)</td>
<td>42.5 (27.5-59.2)</td>
<td>0.2 (-14.6-17.5)</td>
<td>0.55</td>
<td>43.6 (25.8-53.8)</td>
<td>45.1 (17.4-58.9)</td>
<td>1.8 (-4.41-10.66)</td>
<td>1.0</td>
</tr>
<tr>
<td>Mental component summary</td>
<td>49.1 (31.6-62.2)</td>
<td>53.7 (41.7-65.6)</td>
<td>1.3 (-12.7-20.3)</td>
<td>0.24</td>
<td>53.4 (45.9-68.5)</td>
<td>54.6 (34.8-63.8)</td>
<td>1.6 (-18.9-10.1)</td>
<td>0.85</td>
</tr>
</tbody>
</table>

^ Wilcoxon signed rank test, #Mann-Whitney test, *p<0.05, **p<0.01
There was a statistically significant improvement in the Yoga group in self-perceived Physical Well-Being ($z=-2.82$, $n=15$, $p=0.003$) with an average improvement of 15%. In contrast, the control group remained stable ($z=-0.54$, $n=16$, $p=0.60$) (see Figure 12).

![Figure 12](image)

**Figure 12**: Physical Well-Being sub-scale on a scale of 0 -100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbol *º* in the figure represents outliers.

There was no statistically significant difference between the changes in the Physical Well-Being sub-scale in the Yoga group and the control group over the eight week period ($U=113.5$, $n_1=19$, $n_2=18$, $p=0.08$) (see Table 11).

For the Physical Component Summary (PCS) of the SF12 v2™ questionnaire, neither of the groups showed significant changes over the eight week period (Yoga group; $z=-0.63$, $n=17$, $p=0.54$: control group; $z=-0.02$, $n=17$, $p=1$) (see Figure 13).
There was no significant difference between the Yoga and the control group in the change over the eight week period in the Physical Component Summary (U=167, n₁=19, n₂=19, p=0.70) (see Table 11).

Qualitative data analysis identified several sub-themes related to improvements in physical health and well-being. These sub-themes included: body awareness; balance and walking; posture; body shape; daily activities; and other specific changes. Most of the participants reported improvements in at least two or three of these areas.

Of those participants who indicated increased body awareness, participants noted that they intended to, or already observed themselves taking more care about how they stand, walk and sit.
With respect to the sub-theme about improved balance, one of the participants, a 69 year old female, reported a “big improvement in balance”. Four of the participants reported improvements in walking. Some reported that the quality of their walking had improved, for example, they could “walk taller and straighter with more ease and stability”. Another participant reported that she could now walk further without experiencing backache, while another reported that she now walked more than she did before.

Some participants reported self-perceived changes in their posture. They felt themselves standing and/or sitting more correctly, or as one participant stated “I felt a high change in my posture”.

In relation to changes in body shape, one of the two participants that commented on this reported “I have changed my body shape, tightened up, muscles are tightening up”.

Two participants reported that some everyday activities were easier to perform than before, and that household tasks or getting dressed were also easier than before.

The last sub-theme which emerged in self-perceived physical health was individual specific improvements. For example, one participant reported on not experiencing constipation any more since engaging in the Yoga classes, while another participant reported it “freed up a section of my leg which had become bound with dead tissue” after surgery. To be “able to hold a pen again” and “walk without staggering and a walking stick” was an important experience for one participant. Another participant reported that after the first time she performed a particular Yoga asana, her back improved; while another participant reported a decrease in painkiller intake to manage her rheumatoid and osteoarthritic condition.
3.2.3 Mental health and well-being

There were no significant changes in the Life, Health and Attitude sub-scale over the intervention period in either the Yoga group (z= -1.01, n=16, p= 0.34), or the control group (z= -1.70,n=18, p=0.09) (see Figure 14).

![Figure 14](image)

**Figure 14**: Life, Health and Attitude sub-scale on a scale of 0 -100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbol “o” in the figure represents an outlier.

There was no significant difference between the Yoga group and the control group in the change over the eight week period in Life, Health & Attitude (U= 150, n₁=19, n₂=19, p=0.38) (see Table 11).

There was a significant improvement in the Yoga group for the Life’s Odyssey Questionnaire Emotional Well-being sub-scale (z= -2.04, n=14, p=0.04), with the participants improving on average by 9%. The control group showed no significant changes on this sub-scale (z= -0.20, n=19, p=0.99) (see Figure 15).
Figure 15: Emotional Well-Being sub-scale on a scale of 0 -100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over. The symbol " in the figure represents outliers.

However there was no significant difference between the Yoga group and the control group in the change over the eight week period (U=126.5, n₁=19, n₂=19, p= 0.12) (see Table 11).

There was a significant improvement in the Yoga group in the Life’s Odyssey™ Questionnaire Self Care subscale (z=-2.98, n=14, p=0.001), with participants improving on average by 11%. There was no significant change in the control group (z=0, n=16, p= 0.51) (see Figure 16).
There was a statistically significant difference in the change in the Self Care sub-scale between the Yoga group and the control group at the $p=0.05$ level ($U=81$, $n_1=17$, $n_2=16$, $p=0.05$) (see Table 11).

There were no significant changes in the Mental Component Summary (MCS) of the questionnaire SF12 v2™ in either the Yoga group ($z=-1.2$, $n=17$, $p=0.24$) or the control group ($z=-0.21$, $n=17$, $p=0.85$) (see Figure 17).
There was no significant difference between the Yoga and the control group in the change in the Mental Component Summary over the eight week period (U=147, n₁=19, n₂=19, p=0.22) (Table 11).

Analysis of the qualitative data identified a range of sub-themes related to improvements in the Yoga group including: emotional well-being; cognitive function; capacity to relax; and enjoyment.

With respect to emotional well-being, one participant reported that she felt much better emotionally and did not cry as much anymore, while another participant experienced an improvement in her self-confidence since attending the Yoga classes. With respect to the sub-theme of cognitive function, a number of participants commented on a positive shift in their ability to focus and increased clearness in their thinking. Within the third sub-theme of capacity to relax, a
number of participants commented on their increased ability to relax, to have a more relaxed attitude and to "feel less stressed".

The final mental health and well-being sub-theme to emerge from the qualitative data was related to the concept of enjoyment. Several participants reported on the joy they have experienced since being involved in the Yoga program. There were comments related to the enjoyment participants felt from the stretches, the asanas and the more relaxing Yoga poses. One participant specifically reported that “Supta Baddha Konasana gave me a very good feeling along my spine” and that it was “very relaxing”. Others reported that they enjoyed feeling the benefits and the improvements of this program and looked forward to improving further.

3.2.4 Spiritual health and well-being

The Yoga group experienced a 10% improvement in the Purpose and Meaning sub-scale but this was not statistically significant (z= -1.63, n= 19, p=0.10). The control group experienced no significant change in Purpose and Meaning (z=-0.36, n=17, p=0.73) (see Figure 18).
There was no significant difference between the Yoga and the control group in the change in Purpose and Meaning over the eight week period ($U = 140, n_1 = 19, n_2 = 19, p = 0.24$) (see Table 11).

Only a small number of participants provided qualitative data related to spiritual health and well-being. Both of these related to the sub-theme of peace and calm. For example, an 81 year old female declared she experienced a “return of inner peace and quiet, now at the end of my road I am content and at peace with my life (both as it was and is now)”, while an 86 year old male participant reported that he “found it as an aid to inner wellbeing” and that he” found more calmness”.

Figure 18: Purpose and Meaning sub-scale on a scale of 0 -100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over.
3.2.5 Social health and well-being

Participants in the Yoga group experienced a 6.6% improvement in the Social Connectedness sub-scale but this was not statistically significant (z= -1.90, n=19, p=0.058). Participants in the control group experienced a 2% improvement but this was not statistically significant either (z= -0.42, n=19, p=0.69) (see Figure19).

![Social Connectedness](image)

**Figure 19**: Social Connectedness sub-scale on a scale of 0 -100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

There was no significant difference between the Yoga group and the control group in the change in Social Connectedness over the eight week period (U=140, n₁=19, n₂=19, p=0.24) (see Table 11).

There was a 4% improvement in the Yoga group in the Rest, Pleasure and Play sub-scale but this was not statistically significant (z=-0.43, n=16, p=0.27). There
was no significant change in this sub-scale in the control group % (z = 0.26, n = 17, p = 0.69) (see Figure 20).

Figure 20: Rest, Pleasure and Play sub-scale on a scale of 0 -100 by group before and after the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

There was no significant difference between the Yoga group and the control group in the change in Rest, Pleasure and Play over the eight week period (U = 140, n₁ = 19, n₂ = 19, p = 0.24) (Table 11).

Qualitative data were provided by two Yoga group participants. One participant reported that she had made new friends in the Yoga class, while the other commented that he enjoyed the social side of being in the Yoga classes.
3.2.6 Relationships between health and well-being variables

There were no significant correlations (threshold \( p<0.01 \)) in the change in any variables in the Yoga group over the eight week period of the Iyengar Yoga program in the 19 participants who completed the program.

Analysis of the qualitative data however revealed that most participants in the Yoga group reported changes in more than one component of their holistic health and well-being over the eight week period of the Iyengar Yoga program.

Several participants reported an improvement in a personal physical health issue in combination with an improved energy level. For example, a female participant reported that she experienced an increase in muscle strength in her legs, which had been an on-going problem and that she felt more energised. Another female participant experienced a tissue recovery in her leg, with which she had suffered since a heart operation, an improvement in her breathlessness and remarked that she felt great, was more energised and had more stamina, and that everyday activities were easier to perform. Another participant stated that “at the start my knees ached terribly and felt unstable but improved amazingly, I felt a high change in my posture and felt energised after each class”.

Other participants reported an improvement in a physical health component together with increased enjoyment. For example, a 66 year old female participant commented that “after the first couple of weeks I experienced no more constipation (a previous common complaint), I found I could walk further without backache, because of a bad shoulder (unsuccessful surgery) I found arm exercise difficult, but feel it is not as stiff as before. I enjoyed the stretching and in particular the relaxation postures”.

The same pattern was revealed in another participant’s comments that “apart from enjoying the program very much, I have found it very beneficial health wise, mainly I am less stressed and able to focus better, also found the stretching
exercises improved my general mobility and balance, Supta Baddha Konasana gave me a very good feeling along my spine + very relaxing”, and a 69 year old female participant reported a “big improvement in balance, in walking, relaxed more, enjoyed stretching and feeling the benefits; I must report that my first experience with the bolster was very good for my lower back, from that day my back improved.”

Other participants reported changes on a physical level and on a mental and cognitive levels of health and well-being. For example, one participant explained that “I move more freely, I have discovered I can do a lot more than I expected to”, while a male participant remarked that “I can dry my toes with a towel, I enjoyed being in the class, I can pick up items that I drop, I find I focus more”.

One participant’s response suggested a relationship between a physical, energetic and social component of holistic health as she reported that muscle strength in her legs and back had improved, that she felt more energised and made new friends.

Another participant’s comments suggested a relationship between physical, mental and spiritual components of health, according to her statement, “A return of inner peace and quiet, lost the ability to write coherently and clearly … I believe I am thinking clearly, can hold a pen, walk without staggering and a walking stick; now at the end of my road I am content and at peace with my life (both as it was and is now)”.

Summary
This chapter presented the results for this research project in two sections. Firstly, the characteristics of the participants at baseline were presented, including physical, mental, spiritual and social variables of health and well-being. This was followed by the comparison between the Yoga and the control groups. Further, the data, which were obtained from the open-ended question, were presented. In summary, analysis of the quantitative data indicated the Yoga group showed statistically significant improvements in the physical health parameters of muscle strength, active range of motion, and self-perceived
physical health and well-being, compared to the control group. In addition, the Yoga group experienced improvements in the mental health parameters of self-perceived emotional well-being and self care. A summary of the significant results is presented in Table 12.

Table 12: Summary of statistically significant results for the 8 week Iyengar Yoga program for physically inactive people aged 55 years and over

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yoga group</th>
<th>Control group</th>
<th>Between group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall muscle strength (%)</td>
<td>11.5***</td>
<td></td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>aROM upper extremities (cm)</td>
<td>-7***</td>
<td></td>
<td>0.002**</td>
</tr>
<tr>
<td>aROM trunk rotation (deg)</td>
<td>16***</td>
<td></td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>aROM hip flexion (deg)</td>
<td>10**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aROM hip abduction (deg)</td>
<td>16***</td>
<td></td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>aROM hip extension (deg)</td>
<td>4**</td>
<td></td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td></td>
<td>0.13*</td>
<td></td>
</tr>
<tr>
<td>Emotional Well-being</td>
<td>5*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Well-being</td>
<td>8.75**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self Care</td>
<td>5**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ Wilcoxon signed rank test, # Mann-Whitney test, * p<0.05, ** p< 0.01, *** p<0.001

Analysis of the qualitative data revealed a range of sub-themes associated with physical, mental, spiritual and social health and well-being and the interconnectedness between them. The following chapter discusses the meaning of these results.
Chapter 4  Discussion

Participation in a short-term Iyengar Yoga program by physically inactive people aged 55 years and over resulted in some improvements in physical and mental health and well-being. This chapter discusses the meaning of these results with respect to the literature and the research design. The first section discusses the demographics of the participants, followed by the characteristics of the Yoga group. The next section discusses the effects of Iyengar Yoga on physical health parameters and its effects on self-perceived physical, mental, spiritual and social health and well-being. Finally, the interconnectedness between these parameters of health and well-being is discussed.

4.1  Participants’ characteristics

Age and level of physical activity were the only inclusion criteria in this study, as this project aimed to have participants typical of the general population. However this resulted in a high level of variability in many of the variables.

4.1.1  Demographics

Although there was no statistically significant difference found in age between the Yoga and the control groups, the age distribution varied. The participants of the control group had greater variability, with the ages being spread over a wider range, while the majority of the participants in the Yoga group were in the range 66 to 85 years of age. The median age of the Yoga group was greater than that of the control group.

4.1.2  Physical health and well-being

Participants were randomly allocated to the control and Yoga groups, resulting in two groups that were not significantly different to each other prior to the intervention. Differences between the two groups in mental health and self-perceived physical function can thus be attributed to chance.
4.1.3 Relationships between variables

Blood pressure of the 38 participants varied in both systolic and diastolic values. The Australian Institute of Health and Welfare (20) report an increase in blood pressure with ageing but this was not apparent in this study.

The decrease in FEV$_1$ found with increasing age is congruent with the findings of Hollenberg et al. (18). Participants were not excluded from this research project for any medical conditions including lung function, and the downward trend of lung function with increased age represents an expected decline in this physical parameter.

The correlation found between an increase in age and a decrease in trunk rotation (flexibility) is also consistent with the literature (13).

No statistical correlation was apparent between age and overall muscle strength in this study. This may be a type II error due to variability within the group or an indication that strength is not related to age in physically inactive retirement home residents.

No logical explanation could be found for a correlation between increased IgA and decreased flexibility in the upper extremity and in hip extension. It is possible these are type I errors. Further research is required to determine whether a genuine correlation exists between range of motion and salivary IgA levels.

The correlation found between an increase in overall muscle strength and active range of motion is sound and well known. Stronger muscles means the body can move joints and limbs further (78).

The correlations found between the sub-scales of the Life’s Odyssey™ Questionnaire and the two summary components of the SF12 v2™ are expected as these categories are related to each other and there is a tendency for individuals to be consistent in the way they approach and answer questions.
The correlation between self-perceived physical well-being and both the Mental Component Summary and Purpose and Meaning shows that there is a relationship between physical and mental health.

4.2 Comparison of the study outcomes

4.2.1 General health and well-being
All participants in the Yoga group reported improvements in their health and well-being in the open-ended question post-intervention. This was not confirmed by an improvement in responses to the General Health question of the SF12v2™ Health Survey. This may be because the survey is norm-based to a US population and not an Australian population (74). Further, it has to be taken into consideration that this was only a single question and is therefore less reliable than a set of questions. The qualitative data suggest that participants in the Yoga group attributed their improvements to participation in the Iyengar Yoga classes.

4.2.2 Physical health and well-being
Participation in Iyengar Yoga resulted in improvements in a number of physical health parameters in the elderly in this study.

4.2.2.1 Muscle strength
The measured improvement in overall muscle strength and the results from the open-ended question in the post-intervention assessment clearly indicate that the eight week Iyengar Yoga program had a positive impact on this fundamental physical parameter of health and well-being in aged people. In contrast, the participants of the control group showed, on average, a slight decrease in overall muscle strength over the eight week period, though this was not statistically significant. No participants in the Yoga group deteriorated in muscle strength during the study.

Prior to the study, Yoga participants self-reported low levels of physical activity. This changed over the eight week period of their engagement in Iyengar Yoga.
They were involved in twice weekly classes of 90 minutes each, plus additional home practice. Some participants reported doing more walking and other exercises due to their perceived physical improvement and confidence attained in the Yoga classes. Regular exercise can maintain muscle strength and/or muscle mass in the elderly (17). Similar increases in physical activity did not occur in the control group, and as such the effects on muscle strength may have resulted from a combination of the Yoga program itself and the additional physical activity undertaken as a result of participating in the Yoga program.

This increase of physical activity is a change in behaviour, and can be interpreted as the presence of the four belief modes of the Health Belief Model. The participants may have been interested in undertaking a Yoga program due to awareness of a deficiency in their health or a need to maintain their health (belief mode 1). These days the consequences of the lack of exercise on health are well-known (belief mode 2). Having engaged in this program, they may then have perceived the Iyengar Yoga program to be valuable to their health (belief mode 3) and that the benefit outweighed the effort of undertaking the program (belief mode 4) (71).

McMurdo, a speaker at the international conference of the European Group for Research into Elderly and Physical Activity (EGREPA), described muscle weakness as one of the causes of falls in older people. She further emphasised that only a professionally developed exercise plan is successful in addressing the weaknesses that result in falls and that progressive muscle strengthening is one important part of that plan (33). An Iyengar Yoga program, through its muscle strengthening effect, and its effects on balance and flexibility could reduce the incidence of falls in elderly people.

Iyengar Yoga puts emphasis on proper alignment in performed asanas to balance the entire physical body. Therefore weak muscles will be strengthened where needed by performing asanas. In addition, taking the didactics of teaching Iyengar Yoga into consideration, the outermost layer of the body has to be balanced before a Yoga practitioner can penetrate deeper into the more subtle layers of the body.
Increasing muscle strength is the effect of Yoga on the outermost layer of the body and is, therefore, a response that is expected to be seen early in the Yoga program (43).

### 4.2.2.2 Active range of motion

Participation in Iyengar Yoga caused an improvement in flexibility in the elderly participants in this study, as measured by active range of motion. The improvement was also noted by many participants and reported in response to the open-ended question post-intervention.

For beginners, the performance of Yoga asanas often results in an increase in flexibility, particularly when there is poor existing physiological range of motion. The Yoga group improved in range of motion in the upper extremity, in trunk rotation and in hip abduction, and to a lesser, but still statistically significant degree, in hip extension.

These findings are consistent with other research using Iyengar Yoga as intervention. Kolanski et al. found in their pilot study a 39% decline in stiffness when using Iyengar Yoga as an eight week intervention with once weekly classes and no home practice to treat knee osteoarthritic symptoms, however this was not statistically significant (65). Moreover, DiBenedetto et al. found significant improvements in peak hip extension and stride length and a marginally significant trend towards improved average anterior pelvic tilt at comfortable walking speed, when assessing changes in gait in the elderly after a specifically designed eight week Iyengar Yoga program (67). The methods of measurement cannot be compared and the research designs are very different, but both studies support the findings of this project – that Iyengar Yoga can improve flexibility.

Sacks et al. described posture and the spine joint movements as a fundamental factor affecting intervertebral disc nutrition and its influence on the ageing process (34). The participants of the Yoga group improved significantly in trunk rotation and therefore, spinal joint movement. The resultant improvement in
intervertebral disc nutrition could slow the ageing process. The Yoga group participants also reported more flexibility in particular movements, their ability to perform every-day activities and an improvement in posture.

In contrast, the participants of the control group deteriorated significantly in trunk rotation over the eight weeks, raising concern that deterioration in flexibility can occur rapidly in the absence of physical activity.

With regard to the ontology of Yoga, flexibility can be considered as a component of the outermost layer and the finding of an increased range of motion in the participants of the Yoga group undertaking that level of engagement was expected.

Geeta S. Iyengar clearly outlined in her talk presented at the 7th French Iyengar Yoga Convention, the interconnectedness of mobility and stability and the importance to a Yoga practitioner of incorporating these into their practice. She explained that the word stability in Sanskrit refers to steadiness, firmness, establishment, and so on; that the opposite word mobility refers to motion, action and function. Mobility, with its kinetic energy, and stability, with its static energy, are crucial for making progress (55).

The author interprets stability on a musculoskeletal level as strength of muscles and firmness of the surrounding and connected tissues, and mobility as flexibility of muscles, the surrounding tissue, and range of motion of the joint systems and their interconnected functions. Therefore, an improvement in muscle strength and in range of motion could be seen as an improvement in balancing stability and mobility on a musculoskeletal level.

4.2.2.3 Blood pressure
The short-term Iyengar Yoga program did not affect resting blood pressure in the elderly participants in this study. This was similar to the study by Smith et al. (48), who found no changes in blood pressure between a group undergoing a 10 week program of a non-classified style of Hatha Yoga and another group undertaking progressive muscle relaxation classes.
In contrast, Carlson et al. (49) carried out a long-term study using a mindfulness stress reduction program (MSRP) that included relaxation, meditation and gentle Yoga (non-classified) as an intervention. They showed a mean decline in the systolic blood pressure at the 12 month follow-up (in comparison to the one week pre first class measurements) of 4.4 mmHg. The participants in that study were breast and prostate cancer outpatients and there was no control group.

The non-significant decrease of 5 and 4 mmHg in systolic blood pressure of the control group and the Yoga group respectively, could be attributed to familiarity with the testing procedure from the assessment prior to the intervention (White Coat syndrome). The lack of statistical significance in this change could be explained by the high variability of measurements within each group. Confounding factors include use of blood pressure medication (and changes to medication) and the presence of external stressors.

It was not expected that blood pressure would be affected by this Yoga program as it was not specifically designed to lower high blood pressure or to balance blood pressure disparities, although the participants with high blood pressure were always asked to modify specific Yoga postures (Yoga asanas).

According to the Yoga ontology, the cardiovascular and endocrine systems are located on a more subtle level in the outermost layer than the musculoskeletal systems; therefore, it takes more time and requires more practice to reach these components of our physical body on the inward journey of engaging in Iyengar Yoga. Thus, the short period of time that the participants, all new to Iyengar Yoga, engaged in this program and incorporated it into their daily lives was considered unlikely to be sufficient to impact on blood pressure. Further studies over a longer period of time including more frequent blood pressure measurements are suggested for clarification whether Iyengar Yoga has an effects on blood pressure.
4.2.2.4 Respiratory function

The short-term iyengar Yoga program had no impact on lung function as measured by Forced Expiratory volume in 1 second (FEV$_1$) in the elderly.

The statistically significant improvement in (FEV$_1$) in the control group does not actually differ remarkably from the statistically non-significant improvement in the Yoga group. The control group improved in the post-intervention assessment by an average of 150 ml, whereas the Yoga group improved on average by 80 ml. These slight improvements in both groups might have occurred because the participants were more familiar with this particular test in the post-testing than in the pre-testing. Additionally, some of the participants of the Yoga group experienced influenza over the 8 week period which may have been a limiting factor in their respiratory function. People with specific pulmonary problems or medical conditions were not excluded from this study and this could have been another confounding factor.

A study with iyengar Yoga as a four week intervention found interpersonal improvements in FEV$_1$ in adults with mild to moderate asthma, but no difference between the intervention and the control group (63).

These findings might be explained as in iyengar Yoga, breathing techniques are introduced at a later stage. For beginners, the asana work facilitates the breathing. The comment of a female participant of the Yoga group, that her breathing was better and that she did experience faster recovery after breathlessness, can be seen as an indicator that a beginners’ program might influence the breathing pattern or the quality of breathing on a more subtle level then we can measure using FEV$_1$.

Further studies over a longer period of time are suggested for clarification of an possible effect of iyengar Yoga on FEV$_1$ or on other respiratory functions.
4.2.2.5 Immune function

Participation in Iyengar Yoga had no significant effect on either specific or non-specific immune function in the elderly. The median salivary IgA increased in the Yoga group, while the median sIgA level remained stable in the control group. Fahlman et al. suggested in their study assessing the effect of endurance training on immune function in elderly women, that exercise may attenuate the decrease in cellular immune measures which normally occurs in winter (37). This study was also conducted in winter but had more positive results than the study by Fahlman et al. These results could indicate that this short-term Iyengar Yoga program had some effect on the participants' mucosal immunity.

The IgA levels in this study cannot be compared with the values from other studies. The saliva samples were collected with Salivette® cotton swabs and the producer of the enzyme immunoassay kit advises that these cause falsely high readings (82). This study aimed to assess the change in IgA levels between before and after the eight week period in the participants. Every sample was analysed under identical conditions and therefore the higher reading of the samples was accepted.

A statistical test should aim to achieve a power of 0.8; that is, it should have an 80% chance of detecting an effect if one genuinely exists (84). In this study, it was found that there needed to be a median difference between the control and Yoga groups of 850\(\mu\)g/ml and 3000ng/ml for change in salivary IgA and change in lysozyme respectively, before the Mann-Whitney test had an 80% probability of detecting an effect.

Salivary IgA levels are sensitive to stress and daily events (22), and it is likely that lysozyme is similarly affected. This study found a median difference in IgA levels of 95 \(\mu\)g/ml between the control and Yoga groups and a median difference in lysozyme levels of 137 ng/ml. Therefore, the level of change necessary for an 80% probability of detection is unlikely to occur, particularly for this sample size and with the frequency of sampling undertaken in this study.
High variability was observed in the salivary lysozyme and salivary IgA results. This is likely due to the large number of confounding factors. This winter had particularly unusual cold periods and some participants 'had to cope' with colds or influenza. Numerous participants were on medication for various diseases which might have influenced their mucosal immunity, a few participants in the Yoga group underwent minor skin surgery, and one participant in the control group had screws from an orthopaedic plate removed. Miletic et al. found high individual variability in sIgA levels and that stress and daily events may influence IgA concentration and secretion rate (22).

Further, this Iyengar Yoga program was designed to be a general class for beginners rather than one specifically designed to improve immune function. The results from this research project suggest that in order for Iyengar Yoga to positively impact on immune function, a specifically tailored program or a more long term program would be required. In addition, changes in methodology may provide further insight into the impact of Iyengar Yoga on immune function. Suggested changes include alteration of the timing of the saliva collection, taking into consideration other environmental influences, the collection of more saliva samples, and recording the incidence of infections in research participations.

4.2.2.6 Self-perceived physical health and well-being

Participants in Iyengar Yoga had a significant improvement in their self-perceived physical health as indicated by a positive change in their responses to the Life’s Odyssey’s™ Physical Well-Being sub-scale.

The Life’s Odyssey™ Questionnaire was used as per the authors’ design. However, the results of the Cronbach’s alpha test indicate that some of the subscales, specifically Physical Well-being, Rest, Pleasure and Play, and Self Care, may not be as reliable as expected. Despite this apparent limitation, each of the sub-scales were used as described by the instrument’s developers.
The significant improvement in the Life’s Odyssey™ Questionnaire subscale was not consistent with results in the Physical Component Summary of the SF12v2™ Survey. This is possibly due to the norm-basing of the SF12v2™ Survey to a North American population. It is likely that a North American population will have a different mean and standard deviation on the SF12v2™ Survey than an Australian population.

However, the self-perceived improvements in physical health are congruent with the results of a survey conducted by the Harvard Medical School in 2006, where Yoga practitioners perceived Yoga as helpful for improving various physical health conditions (47).
4.2.3 Mental health and well-being

Participating in the Iyengar Yoga program resulted in improved mental health and well-being as assessed by the Emotional Well-being and Self Care sub-scales of the Life’s Odyssey™ Questionnaire.

The improvement in the Life’s Odyssey™ sub-scale Emotional Well-being is supported by the responses recorded in the open-ended question. A number of participants of the Yoga group reported positive changes in their mental health and well-being, but this was less commonly reported than improvements in physical health and well-being. These self-reported improvements in mental health were not confirmed by improvements in the Mental Component Summary of the SF12v2™ survey. As already mentioned, the SF12v2™ was norm-based with a North American population and this could explain the failure of the SF12v2™ survey to support the results of the Life’s Odyssey™ Questionnaire and responses recorded in the open-ended question.

The improvement in Self Care could be due to the participants in the Iyengar Yoga program being encouraged to explore and reflect during and after the classes on whether and how they experienced or perceived an effect of the Yoga postures (Yoga asanas) on their well-being. The effects of restorative asanas were explained and participants were encouraged to incorporate postures they perceived as beneficial into their daily lives. The improvement of this sub-scale of the Life’s Odyssey™ might reflect the empowering effects the Iyengar Yoga program had on the participants. This is one of the values of the Red Lotus Health Promotion Model (70).

However, the low Cronbach’s alpha for responses in this category suggest that these results should be interpreted with caution. Also, the difference between the groups was not significant, so the improvement cannot necessarily be attributed to the Iyengar Yoga program.

An improvement in mental health following a short-term Iyengar Yoga program was also demonstrated by Woolery et al. They found a specifically designed five
week Iyengar Yoga program caused a significant decrease in self-reported symptoms of depression and anxiety in young adults with symptoms of depression as compared to the control group (64). Oken et al. also found an improvement in quality of life in a Yoga group in comparison to a walking group and a control group in their study (65).

Despite the Iyengar Yoga program in this study not specifically targeting mental health, significant improvements in this area were still found. These findings are consistent with the assigning of the different layers in the body, according to the Yoga philosophy. The energetic layer, which lies inside the physical body, encompasses emotions and the next inward layer, the mental layer, encloses thoughts (43). The more time a Yoga practitioner spends practising Yoga the deeper she/he can penetrate towards the innermost layer. In contrast, in regard to happiness and self-reliant contentedness, Mr Iyengar wrote that even relative beginners can experience the benefits (43).

In the open-ended question participants of the Yoga group reported enjoying either the program or the benefits they gained from the program. This could be interpreted as perceiving health as welcomed and meaningful, which links to the salutogenic focus of the Red Lotus Health Promotion Model (70).

4.2.4 Spiritual health and well-being

There was no statistically significant impact on spiritual health and well-being in the elderly as a result of participating in the short-term Iyengar Yoga program as assessed by the Life’s Odyssey’s™ sub-scale of Purpose and Meaning. This is not consistent with results found by Wiesman et al. after a 14 week program focusing on physical activity and self-reflection inclusive Yoga (non-classified) (50). They reported a significant strengthening of participants’ sense of coherence.

Despite the lack of statistically significant findings, there was a trend in the results towards improvement in the Yoga group in spiritual health and well-being. This is supported by the qualitative data in which there were comments
made about improvements to inner peace and calmness. These results are consistent with Yoga ontology in which Iyengar Yoga is believed to have a gradual impact on participants beginning with the outer sheath and slowly working its way down to the innermost core of the practitioner. The relative weakness of the effect of the eight week Iyengar Yoga program on spiritual health and well-being is therefore consistent with this ontology (43).

4.2.5 Social health and well-being

There was no statistically significant impact of the eight week Iyengar program on social health and well-being in the elderly as measured by the results obtained from the Life’s Odyssey’s™ categories Social Connectedness and Rest, Pleasure & Play. However the qualitative data indicated that participants experienced an impact on social health and well-being. This was to be expected given that the program was taught to the class as a group, which would in itself increase social interactions between participants.

Mr Iyengar clearly states in his book ‘Light on Life’ that Yoga aims for “nothing less than to attain the integrity of the oneness – oneness with ourselves and as a consequence, oneness with all that lies beyond ourselves” (43). Thus, a social component can be seen in Mr Iyengar’s approach to Yoga and the trend revealed in the results might underpin this. In contrast to other Yogis, Mr Iyengar declined to become a sannyasin or one who renounces worldly and family commitments to follow a spiritual path or teaching and to draw back from the world (53). Instead he has chosen to live the life of a normal householder, facing all the trials and tribulations of life and to pass on his Yoga practice to everyday people who live the common life.

4.2.6 Relationships between health and well-being variables

The lack of statistically significant correlations (p<0.01) found within and between the physical, mental, spiritual and social health parameters in the change over the eight week period in the Yoga group is probably due to the
high variability in the health status of the participants, the small sample size, and thus the low power of this test.

The responses of the participants to the open-ended question in the post intervention assessment suggest various relationships and interconnectedness of improvements in the different elements of health and well-being perceived by the participants of the Yoga group on an individual level. Some participants revealed connections between the physical and mental, some between the physical and spiritual components of health and others between physical and social elements. Some of the participants reported improvements in a combination of more than two elements of health and well-being.

According to Mr Iyengar, this can be explained by the way Yoga philosophy sees human beings with the interconnectedness of our different bodies (that is physical, energetic, mental, intellectual and soul bodies) to each other (43). This knowledge used to be part of the traditional knowledge in India. In contemporary practice it is possible to learn by observation how various movements stimulate diverse physical and physiological effects, and how these pathways also affect other parts of the bodies. Further, he states that Yoga was created with the intention to satisfy the usual human needs of physical and mental health, understanding and wisdom, and peace and freedom in an all-inclusive seamless whole (53).

More research is required using larger sample sizes to investigate the interconnectedness of the various components of health and well-being and how physical activity and Yoga affects these various elements.

4.3 Strengths and limitations

This study had two major strengths. Firstly that there were no exclusion criteria and therefore no artificial group of participants was created which occurs so often in research. The second strength was that of having a broad range of tests in order to assess various components of health. The qualitative data opened up the door for a deeper insight of the complexity of the interwovenness
of various health components, as these changes would have been impossible to detect with quantitative data collection methods only.

This study was mainly limited by the financial resources available. Immunoassay kits accounted for most of the monetary cost of this study, dictating, to some extent, the number of participants that could be assessed. To cater for the 19 participants in the Yoga group, it was necessary to teach four classes a week (with 9 or 10 people per class).

Increasing the sample size would have required the employment of one or more full-time Yoga teachers. In this study, there were insufficient financial resources available to employ either a certified Iyengar Yoga teacher to conduct the intervention or other health professionals to conduct the tests and to run the qualitative data collection. The fact that the principal researcher was the interventionist and responsible for collection of the qualitative data, increased the possibility of potential bias, as the participants of the Yoga group reported their experiences to “their” Yoga teacher. They were, however, strongly encouraged to report honestly and assured that any kind of feedback (no change, improvement or deterioration) would be welcomed.

A larger sample size would have increased the power of the statistical analyses, reducing the potential for type II errors. Increasing the sample size may have revealed correlations between class attendance or home practice with improvements in various health dimensions or correlations in changes of variables in the participants of the Yoga group after the intervention.

As the wait-list control group also undertook an 8 week Yoga program after post-intervention data were collected, this additionally restricted the length of time available for teaching the Yoga group. It was not anticipated the Yoga group would ‘teach’ the control group, therefore there was a possibility of contamination, although the control group, being a wait-list control group was aware of being provided with the same program after the post intervention data collection.
A longer intervention time may have had the potential to allow changes in more health parameters to become evident.

The reliability and validity of the measures used were not individually assessed and this may therefore be a further limitation of this study.

4.4 Conclusion

Whilst this was a relatively small study, the results suggest that an eight week Iyengar Yoga program has a significant positive impact on some aspects of health and well-being of physically inactive people aged 55 years and over. Participation in Iyengar Yoga resulted in improvements in overall muscle strength and flexibility, and in self-perceived physical and emotional well-being. Participation also resulted in positive trends in spiritual and social health and well-being in the elderly.

Participation in a short-term Iyengar Yoga program had no effect on respiratory function, blood pressure or immune function in the elderly. A longer term program or one aimed more specifically at improving these parameters might show different results.

Individuals varied in the aspects of holistic health in which they improved, showing Iyengar Yoga causes very personal and individual changes in some dimensions of health and well-being. In general, measurements of health were consistent with the findings from the Life’s Odyssey™ Questionnaire. The SF12 v2™, in contrast, did not support the other findings of this study. This may be because the survey is norm-based to a US population and not an Australian population. The interconnectedness of the various health components was apparent in the qualitative data. This underlines the interwoven nature of the different ‘bodies’ of health described in Yoga and well-being.

The findings of this research project are consistent with the ontology of Yoga, and Mr Iyengar’s interpretation of Yoga (43), with the first changes occurring on
the outer layer of the body (skin, bones, and muscles). The qualitative data revealed that health is more complex and interwoven than its various components and this relates to the definition of holistic health used in this thesis – an understanding of reality in its integrated totality whose characteristics cannot be broken down into its constituent parts (7).

4.5 Recommendations

Further research assessing the impact of Iyengar Yoga on holistic health in the aged is needed and warranted. The interdisciplinary approach employed here should be extended with more depth to the various components, over a longer period of time and with a much greater number of participants.

Future research could be conducted with a greater number of participants in order to improve the power of the statistical analyses.

The participants could be grouped according to their age and by their medical conditions in order to receive more detailed insights into the impact of Iyengar Yoga on these different groups. Grouping participants would also allow more specialised classes to be provided for the individuals in these groups.

Health professionals that are blinded to the intervention status of participants could be used to assess the health status of participants. This would minimise any potential bias arising from the interventionist also conducting the health assessments.

The qualitative component could be expanded in order to obtain more individual data which could reveal very individual effects of Yoga on health and could provide inspiration and direction for further research.

The length of the intervention could be increased depending on the resources available and whether participants would be willing and available to engage for a longer timeframe.
The population of the world is ageing and this is expected to put increasing pressure on health services and governments to provide for the care of this group. Through this study and others, Iyengar Yoga has been shown to improve various aspects of holistic health and well-being in the elderly. Making Iyengar Yoga programs available to the elderly could have a beneficial impact on their health, thus reducing their reliance on already over-burdened public health systems.
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Appendices

Ethics approval (original and extension)
Jodie Thomas
Secretary, Human Research Ethics Committee
June 20, 2007 Office of Research
S/07/118
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EXPEDITED ETHICS APPROVAL FOR RESEARCH PROJECT - Impact of a short-term
Iyengar Yoga program
on the holistic and well being health of physically inactive people aged 55 years and over
(Project
S/07/118)

On 20 June 2007, following review of the application for ethics approval of the research project,
Impact of a short-term Iyengar Yoga program on the holistic and well being health of physically inactive
people aged 55 years and over (Project S/07/118), the Chairperson of the Human Research Ethics Committee of the
University of the Sunshine Coast granted expedited ethics approval for the project.
The period of ethics approval is from 20 June 2007 to 19 February 2008.
Could you please note that the ethics approval number for the project is HREC: [S/07/118].
The conditions of approval for this project are that you:
1. conduct the research project strictly in accordance with the research proposal submitted and
granted ethics approval, including any amendments required to be made to the proposal by the Human
Research Ethics Committee (except as subsequently amended and approved by the Committee or approved by
delegated authority exercised by the Chairperson or a Sub-committee); and
2. inform the Human Research Ethics Committee immediately of anything which may warrant review of
ethics approval of the research project, including:
• serious or unexpected adverse effects on participants;
• proposed changes in the protocol;
• unforeseen events that might affect continued ethical acceptability of the project; and
(A written report of any adverse occurrence or unforeseen event that might affect the continued
ethical acceptability of the research project must be submitted to the Chairperson of the Human Research
Ethics Committee by no later than the next working day after recognition of an adverse occurrence/event.)
June 20, 2007
2
3. make no change to the project as approved in its entirety by the Committee, including any
wording in any document approved as part of the project, without the prior written approval of the Committee
for any change; and
4. provide the Committee with a written Annual Report on the research project on completion of the project
by 19 February 2008, using the proforma “Annual Report on Approved Research Project Involving
Humans”; and
5. if the research project is discontinued, advise the Committee in writing within 24 hours of the
discontinuation; and
6. comply with each and all of the above conditions of approval and any additional conditions or any
modification of conditions which may be made subsequently by the Human Research Ethics Committee.
The Human Research Ethics Committee will review the Chairperson’s grant of approval and the conditions of approval at its next meeting and should there be any variation of the conditions of approval you will be informed as soon as practicable.

You are advised that failure to comply with the conditions of approval and the National Statement on Ethical Conduct in Research Involving Humans may result in withdrawal of approval for the Project. Should you require an extension of your period of ethics approval, please submit a written request for this purpose using the proforma “Annual Report on Approved Research Project Involving Humans”. The Annual Report on this activity will be due by no later than 19 February 2008. An electronic version of the proforma “Annual Report on Approved Research Project Involving Humans” may be accessed via the Staff or Student Drive or Intranet in the Human Ethics forms folder within the Research folder.

If you have any queries in relation to this matter or if you need any further information please contact me by e-mail at jthomas2@usc.edu.au or by telephone on (07) 5459 4574.

Yours sincerely

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EXPEDITED ETHICS APPROVAL FOR CHANGES TO RESEARCH PROJECT – Impact of short-term Iyengar Yoga program on the holistic health and wellbeing of physically inactive people aged 55 years and over (Project S/07/118)

This is to confirm email advice provided to Juliane on 21 August 2007 that on 21 August 2007, following review of the proposed changes to application, Impact of short-term Iyengar Yoga program on the holistic health and wellbeing of physically inactive people aged 55 years and over (Project S/07/118), the Chairperson of the Human Research Ethics Committee of the University of the Sunshine Coast granted expedited ethics approval for the project. The conditions of approval for this project remain the same, as previously outlined in a letter to you dated 19 June 2007.

You are advised that failure to comply with the conditions of approval and the National Statement on Ethical Conduct in Research Involving Humans may result in withdrawal of approval for the Project. If you have any queries in relation to this matter or if you need any further information please contact me by e-mail at jthomas2@usc.edu.au or by telephone on (07) 5459 4574.

Yours sincerely

Jodie Thomas
Research Project Information Sheet

Project Title
Impact of a short-term Iyengar Yoga program on the holistic and well being health of physically inactive people aged 55 years and over.

Ethics approval
This research has been approved by the Human Research Ethics Committee of the University of the Sunshine Coast (approval number: S/07/118).

Description and purpose of the research project
There has been limited research conducted on the effects of Iyengar yoga and the health and well being of older people. Therefore research is needed to look at the impact of Iyengar yoga has on holistic health whilst ageing. This research is innovative in that it will evaluate the effects of yoga on a range of health dimensions, including physical, mental, spiritual and social health and well being.

This research will assess the holistic health impacts of an 8 week Iyengar yoga program on a small group of physically inactive people aged 55 years and over. Research participants will be recruited from a Sunshine Coast retirement village and be new to Iyengar yoga. They will be randomly assigned to either a control group or an intervention group. The control group will be asked to continue their usual activities for the period of the project. The intervention group will participate in a twice-weekly 90-minute class and be asked to complete 15-20 minutes of home practice on at least three other days each week.

Data will be collected before and after the 8 week Iyengar program and compared to data from the control group to determine what changes have occurred over the period of the program. Data on physical health and wellbeing dimensions will collected by a range of physiological and musculoskeletal tests. Data on self reported physical, mental, spiritual and social health and well being will be collected by the SF12v2 Questionnaire and Life's Odyssey Questionnaire.

The expected contribution of this study will be to the fields of public health, health promotion and ageing. This research will provide evidence and new knowledge about the effectiveness of yoga as a physical activity strategy on a range of health indicators for improving the holistic health of physically inactive people aged 55 years and over. The research will also contribute to theories about ageing and holistic health, and will have the potential to impact on health promotion and aged care practice.
Who can participate?
- People who are 55 years of age and above; and
- People who currently do less than an average of 30 minutes of physical activity or exercise each day; and
- People who are interested and willing to participate for 8 weeks in twice weekly yoga classes of 90 minutes each plus 15-20 minutes of home practice for 3 further days; and
- People who are prepared to participate before and after the 8 week Iyengar Yoga program in some non-invasive tests for physical health indicators and to complete some questionnaires about holistic health and wellbeing; and
- People who agree to sign the consent form for this research project and the Australian Iyengar Yoga Association disclaimer form.

Benefits from this research for participants
Participants should experience a wide range of benefits in their health and well being, including improvements in musculoskeletal, physiological, mental, spiritual and social components, when becoming part of this research program. Before engaging in this research project, participants will be at a low level of physical activity, and therefore have the opportunity, through participation in this research, to change their activity pattern and could possibly continue either with Iyengar Yoga or feel encouraged to engage in other physical activities.

Potential benefits for others
This research has the potential to obtain new knowledge in the field of public health and health promotion. It will contribute knowledge about the effectiveness of short-term, low impact, physical activity on a range of physical health indicators and on mental, spiritual and social health and wellbeing.
It will also reveal the interconnectedness of several parts and systems of our bodies and various components of health and wellbeing and will contribute to theories about holistic healthy ageing. This research project will have the potential to impact on health promotion and aged care practice. It will allow further insight into changes/improvements in holistic health and wellbeing in older people after participating for 8 weeks in a low impact, physical activity program. The method being used here is an ancient one, yoga, which claims to maintain, and if needed, to restore health and wellbeing in committed participants.

Risks of participation
The researcher believes there are very few elements of this research that might cause long-term physical, emotional, mental, social or cultural pain, discomfort or stress; or constitute a risk to physical, emotional or mental health. The researcher also believes that none of the procedures or research elements will adversely affect you or anyone else, including those conducting the project. Participating in this research may be beneficial to both you and the wider community by contributing to future community planning, better public health policies and health services. Counselling will be made available to any participant who considers this is necessary as a result of participating in this research. Participants will be able to contact a counsellor independently without having to direct their concerns through the researcher. If you feel the need to contact a counsellor as a result of participating in this project, please contact Lifeline on 131114.
Voluntary participation
Participation in this research project is entirely voluntary. After being informed about the testing procedure and what to expect in the yoga classes, potential participants will need to give their consent by signing the relevant form called ‘Consent to Participate in Research’ and the form of the Australian BKS Iyengar Yoga Association of responsibility, which are attached to the Research Project Information Sheet. Signing the consent form means that you have been fully informed about the course of actions in this project relevant to you, and signing the form of the Australian BKS Iyengar Yoga Association implies that you, in turn, will inform the yoga teacher of any medical condition and you will listen and follow the instructions and if needed will ask for further clarification.

Participants, who wish to withdraw for any reason from the study, can do so at any stage of the research project, without the need to provide an explanation. In case of withdrawal of participation, information and collected data, already provided, will be excluded from the analysis, unless you provide permission to do so.

Participants’ privacy
This particular research project will only be possible with the willingness of people aged 55 years and above to engage in this short-term Iyengar Yoga program. All aspects of this study will comply with the National Health and Medical Research Committee Guidelines for research involving humans. As researchers and as humans, we will certainly respect the privacy and the well being of all participants in this research project.

Participation in this program will include collection of name, gender, age and contact details. Once, data collection is completed, all personal details will be replaced by codes by the researcher; therefore test records and questionnaires will not include your name, when being analysed. The investigators will ensure that all personal information remains confidential. All participants have the right to see any personal information obtained during this study.

It is possible that the de-identified data, attained from this study project, will be included in publications in health promotion, gerontology, and yoga journals, also in presentations at seminars/conferences related to the issues of this study. The principal researcher will present the results at a seminar at the University of the Sunshine Coast as a part of her Master of Science program. She will also provide individual participants with their personal results, if requested.

Contact for further information
If you have any complaints about the way this research project is being conducted you can either raise them with the Chief Investigator or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: (c/- The Academic Administration Officer, Teaching and Research Services, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 5459 4574; facsimile (07) 5459 4727; email humanethics@usc.edu.au.
Researchers involved in the project
The research on this project is being conducted by Juliane Vogler under the supervision of experienced Public Health scientists, Ms Lily O’Hara and Ms Jane Gregg, and an experienced immunologist, Dr Fiona Burnell.

Student and Principal Researcher
Juliane Vogler, BSc (Sport and Exercise Science); Certified Iyengar Yoga teacher
Master of Science student, Faculty of Science, Health and Education, University of the Sunshine Coast
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Expertise: Juliane Vogler is a trained and certified Iyengar Yoga teacher and experienced in instructing older people and people with special needs. Also, she studied three semesters of Physiotherapy and completed, at the University of the Sunshine Coast, her studies, with a Bachelor of Science (Sports and Exercise Science)/ Exercise Prescription for Health and Rehabilitation degree.

Supervisors
Ms Lily O’Hara: BSc Qld., GDHlthProm Curtin, MPublicHlth Qld.
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Lily O’Hara, Jane Gregg, Fiona Burnell and Juliane Vogler and the University of the Sunshine Coast, appreciate your participation in the research project.
Privacy Record Form

Privacy Record

Project Title: Impact of a short-term Iyengar Yoga program on the holistic health and wellbeing of physically inactive people aged 55 years and over

1. Nature of the records of personal information kept by the research team
The personal information to be kept will include:
- gender and age of the participants
- name of participants, which will be removed and replaced by codes from all records, when data collection is completed
- address of participants who request individual results
- test results for physical health indicators
- completed questionnaires

All personal information will be kept in a locked cabinet in the office of the Principal Supervisor of the Principal Investigator (PI), along with hard and soft copies of the coding system to be used for de-identifying data. The PI will ensure that a participant cannot be identified from other records and possible publications or presentations of the research results.

2. Purpose for which each type of record is kept
- Records of age and gender will be kept, so these can be correlated with the data collected from the tests for physical health indicators and the questionnaire.
- A record sheet of names and allocated codes, and addresses will be kept in order to provide information to individual participants about their results.

3. Classes of individuals about whom records are kept
Participants will be individuals 55 years of age or above and currently at a low level of physical activity. The records kept may include those belonging to Indigenous Australians.

4. Period for which each type of record is kept
Records will be kept for further 5 years from the date of publication of the final report.

5. Persons who are entitled to have access to the personal information contained in the records
Participants of this research project will be able to have access to any record, created or obtained from this research project, which is in the possession or control of the research team, and that contains personal information. Apart from the participants, only the PI and her Principal Supervisor will have access to identifiable personal information. Other members of the research team will have access to de-identified data only.

6. Conditions under which they are entitled to have access
As indicated in the Research Project Information Sheet, all participants have the right to see personal information during the study. The PI and her Principal Supervisor will access data, when required in order to contact participants or prepare tables of de-identified data.

7. Steps that should be taken by persons wishing to obtain access to that information
Participants can access their personal information at any time by contacting the PI on the details provided on the Research Project Information Sheet. The PI and her Principal Supervisor will not disclose a participant’s personal information to any other party without the prior written consent of the participant.
Consent to Participate in Research

Project Title: Impact of a short-term Iyengar Yoga program on the holistic health and well being physically inactive people aged 55 years and over.

Brief description of research project
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Data will be collected before and after the 8 week Iyengar program and compared to data from the control group to determine what changes have occurred over the period of the program. Data on physical health and wellbeing dimensions will collected by a range of physiological and musculoskeletal tests. Data on self reported physical, mental, spiritual and social health and well being will be collected by the SF12v2 Questionnaire and Life’s Odyssey Questionnaire.

Freedom of Consent
I have read and understood the Research Project Information Sheet, which outlines the research aims, methods, and privacy aspects of this research project. I understand that:

• My participation in this particular research study is entirely voluntary
• I can withdraw from participating in this study at any time and I do not have to provide any reason for my withdrawal
• In case of withdrawal, at any time, from the research study data or information obtained during the research project concerning my person, either attained through the tests for physical health indicators or the questionnaire, will not be used, unless permission from myself is approved
• I am entitled to see, at any time, my personal data
• Any personal information provided by myself or obtained through tests or questionnaires will be kept confidential, and only de-identified data will be used for possible publications or presentations with regard to this research.

I understand the content of the Research Project Information Sheet and the Consent to Participate in Research for the research project mentioned above. I understand that the research will be conducted as explained in the Research Project Information Sheet. I am aware of being able to withdraw from this research project, at any time, without any obligation to provide a reason for my action. Any questions in regards to his research project have been answered to my satisfaction.

Herewith, I agree to participate under the conditions, mentioned above, in this research study.

_______________________      ___/___/___
Participant in research                   Date

_______________________      ___/___/___
_______________________      ___/___/___
Principal Researcher                     Date                  Independent witness              Date
Life’s Odyssey™ Questionnaire

Instructions

This questionnaire consists of a series of statements designed to measure your current state of health. Beliefs, attitudes and behaviours that affect your happiness and well being will also be assessed. Next to each statement you will find a scoring scale. The left side of the scale, or a score of 1, corresponds to the response ‘strongly disagree’ or ‘rarely true for me’. The right side of the scale, or a score of 5, corresponds to the response ‘strongly agree’ or ‘usually true for me’.

Circle the number on the scale that best reflects how you feel about each statement. Please ensure that you circle a specific number. Do not place a mark along the lines between the numbers.

It is very important to remember the following:

• Respond to all items according to your present life situation.
• Try not to judge your responses: there are no right or wrong answers.
• Try not to compare yourself with others. Indicate the responses that best describe you.
Life and Health Attitudes
Circle the number on the scale that best reflects how you feel about each statement.

1. I anticipate that positive things will happen in my future.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

2. I am generally healthy.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

3. My thoughts and beliefs determine the direction of my life.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

4. I feel I am emotionally healthy.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

5. I expect life to challenge me with stressful events.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

6. I trust in my ability to work through difficult situations.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

7. I feel I am in good physical health.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

8. When I am sick, I am the most significant influence in my own healing.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

9. I have strong resistance to physical illness.
   
   Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me

10. I am the person with the greatest ability to change my life circumstances.
    
    Strongly disagree/ Rarely true for me 1-------2-------3-------4-------5  Strongly agree/ Usually true for me
Social Connectedness
Circle the number on the scale that best reflects how you feel about each statement.

1. I have friendships that are rewarding for me.
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

2. I feel close to one or more members of my extended family (children, grandchildren, parents, siblings, aunts, uncles, nieces, nephews).
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

3. I have close, loving relationships with the children in my life (biological, step and adopted children, children of friends or family, grandchildren).
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

4. I receive the kind of physical affection and touch that I desire (hugs, massages, back rubs, close holding).
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

5. I am presently involved in a close, intimate love relationship (or have been in the past five years).
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

6. I feel sexually content and fulfilled.
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

7. I am generally accepting and non-judgmental of people who are different than myself.
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

8. I am free of loneliness of isolation.
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

9. I feel valued and respected in my work (paid or volunteer work), study or social relationships.
   
   | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |

10. I contribute time and/or money to humanitarian or community causes that are important to me.
    
    | Strongly disagree/ Rarely true for me | 1 | 2 | 3 | 4 | 5 | Strongly agree/ Usually true for me |
Emotional Wellbeing
Circle the number on the scale that best reflects how you feel about each statement.

1. I am able to express my feelings to others (joy, anger, fear, happiness, love, sadness, hurt).
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

2. I know crying is important and I can cry when I feel the need.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

3. I am able to get my emotional needs met in relationships.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

4. I am comfortable asking others for help.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

5. I can set limits and say no to family and friends without feeling guilty.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

6. My home and family environment supports my emotional well being.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

7. I can set limits and say no to requests for my time without feeling guilty.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

8. My work, study and/or social environments support my emotional well being.
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

9. I am currently free of emotional problems (depression, anxiety, panic attacks, phobias, eating disorders).
   Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me

10. I can usually cope with the stress and difficulties in my life without relying on addictive or compulsive behaviours (overeating, excessive drinking, smoking, drug use, excessive work).
    Strongly disagree/ Rarely true for me 1 2 3 4 5  Strongly agree/ Usually true for me
Physical Wellbeing
Circle the number on the scale that best reflects how you feel about each statement.

1. I am physically fit.
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

2. I am pleased with the way my body looks.
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

3. I can tell the difference between physical and emotional hunger.
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

4. I do not repeatedly diet to maintain or lose weight.
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

5. More than my diet consists of fresh foods (foods that are not packaged, processed or highly refined).
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

6. I participate three times a week or more in physical activity that I enjoy.
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

7. I do not exercise several times a day or when I am sick or injured.
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

8. My life is relatively free of injuries or accidents (breaks, bruises, cuts, falls, sprains, strains).
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

9. I rarely experience physical symptoms of stress (chest pains, headaches, back pains, neck pains, digestive upsets).
   Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me

10. I am free of serious physical health problems (cancer, heart disease, high blood pressure, high cholesterol, diabetes, digestive illness, arthritis, severe allergies, asthma, chronic back pain).
    Strongly disagree/ Rarely true for me 1-----2-----3-----4-----5  Strongly agree/ Usually true for me
Rest, Pleasure & Play
Circle the number on the scale that best reflects how you feel about each statement.

1. I can take off time from work, study or home responsibilities without feeling guilty.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

2. I find ways to nurture myself (buying presents or toys, listening to music, going out to eat or to movie, taking time to do nothing).
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

3. I take fun vacations.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

4. My home environment supports my need for quality leisure time and sleep.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

5. I get adequate restful sleep.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

6. Laughter and humour are often part of my life.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

7. I take time to develop and enjoy my creative talents and abilities.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

8. I have adequate free time to enjoy silence or time alone.
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

9. I seek out opportunities to feel connected with nature (enjoying gardening, hiking, fishing, hunting, beaches, parks or outdoor sports).
   - Strongly disagree/ Rarely true for me: 1
   - Rarely true for me: 2
   - Usually true for me: 5
   - Strongly agree/ Usually true for me: 5

10. I like to be around pets and animals.
    - Strongly disagree/ Rarely true for me: 1
     - Rarely true for me: 2
     - Usually true for me: 5
     - Strongly agree/ Usually true for me: 5
Purpose & Meaning
Circle the number on the scale that best reflects how you feel about each statement.

1. I have a sense of purpose and direction in my life.
   
   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

2. I am a spiritual person who feels connected to a higher power, the universe or nature.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

3. I practice meditation, prayer or personal reflection.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

4. My life is interesting and gratifying.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

5. There is little difference between my current life and the life I would like to lead.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

6. The struggles I experience during difficult times add meaning to my life.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

7. My personal and professional relationships support my beliefs and values.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

8. My work (paid or unpaid) is rewarding and meaningful.

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

9. I participate in a variety of intellectual stimulating activities (reading, conversation with others, learning experiences).

   Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me

10. I have enough energy for each new day.

    Strongly disagree/ Rarely true for me 1--------2--------3--------4--------5 Strongly agree/ Usually true for me
**Self care**
Circle the number on the scale that best reflects how you feel about each statement.

1. **I am in control of my financial resources.**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

2. **I manage my money in a way that allows me to comfortably meet my basic living needs.**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

3. **I am assertive with my healthcare providers (by asking questions, getting additional information, obtaining second opinions).**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

4. **When appropriate, I use self care strategies before calling of seeing a healthcare provider (extra sleep, home remedies, a wait and see approach, self care resource books).**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

5. **If I am not receiving the quality of attention and treatment I deserve, I change healthcare providers.**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

6. **I get medical and dental check-ups as part of my preventive self care.**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

7. **When I take prescription medications I educate myself about the drug, its side effects, and its interaction with other medications.**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

8. **I am aware of my physical and emotional symptoms of stress, and I respond with self care strategies (relaxation, meditation, appropriate life changes).**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

9. **I practice preventive health and safety behaviours (safe sex, driving without drinking, first aid certification, use of sunscreen, seat belts, smoke detectors).**
   - Strongly disagree/ Rarely true for me: 1
   - Usually true for me: 5

10. **I am concerned about environmental issue and I participate in conservation activities (recycling, energy conservation, purchase of environmentally friendly products).**
    - Strongly disagree/ Rarely true for me: 1
    - Usually true for me: 5
SF 12 v2™ Health Survey

Your Health and Wellbeing
These questions ask for your views about your health and how well you are able to do your usual activities. For each of the following questions, please tick or cross the one box that best describes your answer.

1. **In general, would you say your health is:**
   - excellent □
   - very good □
   - good □
   - fair □
   - poor □

2. **The following questions are about activities you might do during a typical day. Does your health now limit you in these activities?**
   - Moderate activities such as moving table, pushing a vacuum cleaner, bowling or playing golf
     - yes, limited a lot □
     - yes, limited a little □
     - no, not limited at all □
   - Climbing several flights of stairs
     - yes, limited a lot □
     - yes, limited a little □
     - no, not limited at all □

3. **During the past 4 weeks, how much of your time have you had any of the following problems with your work of other regular daily activities as a result of your physical health?**
   - Accomplished less than you would like
     - all of time □
     - most of the time □
     - some of the time □
     - a little of the time □
     - none of the time □
   - Were limited in the kind of work or other activities
     - all of time □
     - most of the time □
     - some of the time □
     - a little of the time □
     - none of the time □

4. **During the past, how much of the time have you had any of the following problems with your work (paid or unpaid) or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?**
   - Accomplished less than you would like
     - all of time □
     - most of the time □
     - some of the time □
     - a little of the time □
     - none of the time □
   - Did work or other activities less carefully than usual
     - all of time □
     - most of the time □
     - some of the time □
     - a little of the time □
     - none of the time □

Please turn over – only a few questions to go!
During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and house work)?

not at all □ a little bit □ moderately □ quite a bit □ extremely □

5. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks.....

- Have you felt calm and peaceful
  - all of time □ most of the time □ some of the time □ a little of the time □ none of the time □
- Did you have a lot of energy
  - all of time □ most of the time □ some of the time □ a little of the time □ none of the time □
- Have you felt downhearted and depressed
  - all of time □ most of the time □ some of the time □ a little of the time □ none of the time □

6. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

- all of time □ most of the time □ some of the time □ a little of the time □ none of the time □

Thank you for completing these questions.
Operating Procedure for Musculoskeletal Assessment

Project Title: Impact of a short-term Iyengar Yoga program on the holistic health and wellbeing of physically inactive people aged 55 years and over

Health and Safety at the University of the Sunshine Coast
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Purpose of the Test
The tests will be used by a student in the frame of her Master’s research project in order to determine, before and after the 8 week Iyengar Yoga program, muscular strength of particular muscle groups and active joint range of motions in major joints, in the participants of this research project.

Manual Muscle Testing (MMT)
MMT was designed to measure muscle strength, which develops tension against resistance. Gravity plays an integral role in this testing procedure and therefore a strong link to activities of daily life become obvious. For each muscle/ muscle group being tested a specific positioning of the person being tested and the tester is described in order to appropriately test, to prevent substitution by other muscles and to eliminate risk for the person being tested. The proximal joint segment is stabilized by either using a firm testing surface, positioning of the person being tested, and/or manual holds of the examiner. Additional confirmation to test the intended muscle/muscle group is achieved by palpation of the relevant muscle/muscle group.

Participants of this research project will be tested for Grades 3, 3+, 4, and 5.

Grade 3 - movement through complete test range in a gravity-eliminated position
Grade 3  movement through complete test range against gravity
Grade 3+ movement through complete test range against gravity and additional minimum resistance
Grade 4  movement through complete test range against gravity and additional moderate resistance
Grade 5  movement through complete test range against gravity and additional maximum resistance

Muscle strength test will be applied to the participants of this research project for:
- hip flexion and hip abduction
- knee extension
- shoulder flexion and shoulder abduction
- trunk rotation and trunk extension

Possible risks associated with the test
The participants being tested will be asked to continue with normal breathing when resistance is applied and will be under constant observation during the testing procedure. No risk factors stimulated by manual muscle testing were found in the literature by the author.
Hip flexion

Figure 4–3 Arrow indicates direction of movement

Figure 4–4 Arrow indicates direction of resistance

Hip abduction

Figure 4–28 Arrow indicates direction of movement

Figure 4–29 Arrow indicates direction of resistance

Knee extension

Figure 4–83 Arrow indicates direction of movement

Figure 4–84 Arrow indicates direction of resistance

Shoulder flexion
Shoulder abduction

Trunk rotation
Gravity resisted

Gravity eliminated

Trunk extension
Assessment of active range of motion

For the measurements to determine active range of motion a universal goniometer, a most common device for measuring joint angles in clinical environment, is used. The neutral zero method is used, therefore the goniometer is placed preferably lateral at the joint; the stationary arm lies parallel to the longitudinal axis of the proximal joint segment, whereas the moveable arm of the goniometer lies and then moves parallel to the moving distal segment of the joint.

Active range of motion will be determined for:
Hip flexion, hip extension, hip abduction
Trunk rotation (measured from the top in °from zero position)

A general scan for the range of motion in joints of the upper extremity 'placing hands behind the back' will be undertaken, as this includes scapular, shoulder and elbow movements in a complex way and reveals the flexibility of the entire shoulder girdle.

Possible risks associated with the test
As only active range of motion will be assessed, the participants perform every movement by themselves in their personal range of ability. The examiner only measures the range of motion. No risk factors stimulated by manual muscle testing were found in the literature by the author.

Hip flexion

Figure 6-11. Start position: hip flexion.

Figure 6-12. End position: hip flexion.
Hip extension

Figure 6-15. Start position: hip extension.

Figure 6-16. End position: hip extension.

Hip abduction

Trunk rotation

Figure 2-74. Start position: trunk rotation.

Figure 2-75. End position: trunk rotation.

Degree of rotation will be measured with the goniometer from the top.
General scan upper extremity

Measured will be the distance between the fingertips of the middle fingers to each other in centimetres.

**Exclusion Criteria**
There are no criteria to exclude participants from the measurements.

**References**

1. University of the Sunshine Coast Health and Safety Policy
   http://www.usc.edu.au/University/AbouttheUniversity/Governance/Policies/Campus/Health.htm


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Purpose of the Test
Measuring a subject’s blood pressure is used to find out how well their heart is sending blood through their body. The test involves a soft device that wraps around the arm, to see how fast and heavy the blood is flowing.

Indirect measurement of arterial blood pressure
In this procedure, a Sphygmomanometer will be utilised to measure blood pressure indirectly. The brachial artery in the upper-arm will be enclosed with a pressurised cuff. This will compress the arm, causing the artery to occlude when the cuff pressure is greater than systolic blood pressure. As the cuff pressure is slowly decreased blood will begin to flow through the artery. This release of blood through the occluded artery can be detected through the use of a stethoscope.

Possible Risks Associated with the Test
Potential risks involved with the procedure:
- There may be some pain or discomfort associated with the pressurised cuff around the participant’s upper-arm;
- There is potential risk for nerve or capillary damage (e.g. bruising) from misuse of the blood pressure cuff. Likewise there is some risk of the participant fainting due to discomfort if the cuff is left pressurised for long periods of time (misuse of the blood pressure cuff);
- There is a risk that excessive constriction of the arm may cause slight elevation of the participant’s blood pressure (misuse of the blood pressure cuff);
- There is risk of harm for subjects participating in the activity if they have hypertension.*

* Hypertension is defined as a resting BP equal to or above 140/90 (Kaplan, 1997; Levick, 2000).

Exclusion Criteria
The following subjects should be excluded from acting as volunteers for this procedure:
- any subject suffering from lymphoedema
- any subject who has smoked cigarettes before testing
any subject who has engaged in **vigorous exercise** before testing
any subject who is feeling "**unwell**"
any subject who has **cardiovascular disease**
any subject who has **diabetes**
any subject suffering from a **neurological disorder**
any subject who records an **abnormal pulse rate** during the pulse rate measurement.
* Abnormal pulse rate is defined as a resting pulse rate < 50 beats per minute or > 95 beats per minute (Martini & Welch, 2001).
any subject who is known to be or shows during the course of testing to be **hypertensive** (elevated resting blood pressure).
* Defined as having a diastolic pressure reading equal to or above 85 mmHg, or a systolic pressure reading equal to or above 140 mmHg.

**Procedure:**

**Auscultation Method (Korotkoff Method)**

1. Subject seated for at least 5 minutes with their back and feet supported. The participant’s elbow should be slightly flexed. It is expected that the subject has **not** just ingested foods or drugs that alter the heart function, e.g. caffeine, nicotine, or alcohol. The subject should wait at least one hour after exercise to get a resting blood pressure measurement.

2. Wrap the deflated cuff snugly around a bare arm, above the elbow and support the arm at the level of the heart; align the cuff with the brachial artery. The rubber tubing attached to the black rubber bulb should hang distally from the cuff.

3. Place the stethoscope ear pieces in your ears, and lightly place the stethoscope bell below the antecubital space over the brachial artery. Excess pressure results in falsely low diastolic blood pressure readings.

4. Quickly inflate the cuff pressure to 200 mm Hg or 20 mm Hg beyond the point at which the radial pulse is no longer palpable.

5. Slowly release the pressure at a rate equal to 2-3 mm Hg/sec. Note the pressure reading of the first Korotkoff sound. This is the systolic pressure.

6. Continue releasing the cuff pressure slowly, noting when the sound becomes muffled (4th phase diastolic BP) and when the sound disappears (5th phase diastolic BP). The 5th Korotkoff sound is the measurement used for the diastolic pressure. Make a note of this pressure reading.

7. The blood pressure is generally written as 120/80 mm Hg, with the systolic score written first. Occasionally, the 5th Korotkoff sound never disappears completely or it may finally diminish at a very low pressure. An accepted way to record the BP when the pressure between Korotkoff 4 and 5 is greater than 10 mm Hg is to mark it as SBP/IV/V, for example 120/75/20 mm Hg.

8. Use the average of at least two readings unless the first two differ by more than 5mmHg, in which case obtain additional readings. To permit blood to be released
Blood pressure
120 Systolic
70 Diastolic

Arm Pressure in cuff
120 or over; no sounds audible

Rubber cuff inflated with air

Brachial artery closed

Brachial artery

Pressure in cuff
below 120, but above 70

Sounds audible in stethoscope

Pressure in cuff
below 70; no sounds audible

Figure 5.4: Procedure for the indirect measurement of blood pressure (Marieb, 1996)

measurements in the same arm.

9. Decontaminate all non-disposable equipment and surfaces after sampling.
10. Following each test, the stethoscope and cuff should be sprayed with 1% Vircon solution, rinsed and dried.

References

- Centre for Healthy Activities, Sport and Exercise Laboratory Standards Assistance Scheme Accreditation Manual, (2004), University of the Sunshine Coast.

Document Control

This SOP was officially approved by the HREC on 22/03/05 (Ethics Approval number: S/05/63)
Any changes must be re-submitted for approval by the HREC. Original document held by Dr Fiona Burnell.
Spirometry

Health and Safety at the University of the Sunshine Coast

The University of the Sunshine Coast requires workplace health and safety to be an integral part of all its activities. The University is committed to the prevention of illness or injury due to work carried out by any student, member of staff or any other person on campus or other related workplace, and everyone has an obligation to ensure that all work under their care or control is carried out in a safe and efficient manner.

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Purpose of the Test

Spirometry is a rapid, non-invasive painless test that is commonly performed to assess pulmonary (lung) function. A spirometer measures the flow both in and out of the lungs, and serves as a useful indicator for lung diseases or abnormalities. The participant breathes into a tube attached to the spirometer, which then calculates the amount of air the lungs can hold and the rate at which that air can be inhaled and exhaled. The results of the test are compared with those of healthy individuals of similar height and age, and of the same sex and race. The test is useful in determining the cause of any shortness of breath, for example restrictive or obstructive conditions that may limit the expansion or capacity of the lungs, thus adversely affecting levels of physical activity.

Possible Risks Associated with the Test

While the risks are minimal for most participants, because the test involves forced and rapid breathing, some people may experience temporary shortness of breath or syncope. Care should be taken to avoid harm from falling, and the participant should be closely monitored at all times. Falls will be avoided by having the participant complete the test in a seated position. The test will be terminated immediately under any of the following circumstances:
- at the request of the participant
- if the participant shows any signs of pallor or cyanosis (pale or bluish colouring) around the lips or nose

Study participants may be a source of infectious diseases that are transmissible to other participants or operators via their saliva. Hence there is a small risk of cross contamination during spirometric procedures.
Potential sources of contact with saliva during spirometric testing include mouthpieces, noseclips and respiratory tubing, and direct contact with saliva. The risks can be minimised by adherence to the guidelines provided in the CHASE Pre-approved SOP 3: "Collection and Handling of Human Saliva". The critical procedures to be adhered to are summarised in the following steps:

- Participants will be asked if they currently have, or have had within the past three days:
  - A cold or flu
  - Chest infection
  - Viral infection
- Operators should wash their hands before and after testing each participant
- Operators should wear disposable gloves throughout the test and when handling used mouthpieces and tubing
- Only disposable mouthpieces will be utilised and these will be placed in biohazard bags for appropriate disposal
- Participants are to handle their own mouthpieces and dispose of them in the biohazard bags
- A clean noseclip will be used for each participant
- Noseclips will be sprayed with 1% Vircon solution

Exclusion Criteria
Any participants with a recent history of surgery (particularly to the eye, thorax or abdomen), who have a serious heart disease, have recently had a heart attack, or who are currently experiencing chest pain will be excluded from undertaking this test. Participants will be excluded on the basis of prevention of cross-contamination if they answered yes to currently having, or having had within the past three days:

- A cold or flu
- Chest infection
- Viral infection

Results of this test will be evaluated and may serve to identify at-risk individuals. Hence it may be used as an exclusion criteria for subsequent performance testing.

Test Procedures

A. Hand held peak flow meter
   1. Familiarise the participant with the protocol and equipment
   2. Ensure a new and clean disposable mouthpiece is fitted for each participant
   3. Have the participant sitting comfortably, with back straight and both feet on the floor
   4. The participant should hold the peak flow meter level, so the indicator faces upwards
   5. Ensure that the marker is positioned on zero or ‘start’
   6. Place a clean nose clip on the participant and ask them to breath through their mouth
   7. Instruct them to take in as deep a breath as possible
   8. Ask the participant to place their lips tightly around the mouthpiece and then blow as hard and fast as they can
   9. Record their score
   10. Repeat steps 5-9 two more times
   11. Have the participant remove and dispose of the mouthpiece themself to minimise cross contamination

B. Full spirometry
1. Familiarise the participant with the protocol and equipment
2. Ensure a new and clean disposable mouthpiece is fitted for each participant
3. Enter the participant's details into the spirometer (de-identified number, age, gender, race)
4. The test may be administered either in a standing or seated position
5. The participant should be directed to:
   a. Stand or sit upright and relaxed.
   b. Grasp the cardboard tube with both hands and grip with their teeth and seal with their lips.
   c. Breathe normally until comfortable
   d. Then take a maximal inspiration followed by a maximal expiration that goes as fast and long as possible (aim for 6sec or the audible beep)
   e. Follow this with a normal inspiration
6. Repeat step 5 three (3) times
7. Have the participant remove and dispose of the mouthpiece themself to minimise cross contamination

**Reporting of Spirometry**

On completion of testing, the docket will be retrieved from the spirometer and the participant’s measurements recorded.

Normal spirometry results are based on the age, height, and gender of the person being tested and most are expressed as a percentage of a predicted value. Normal spirometry measurements include:

- **Tidal volume (TV)** - the volume breathed in and out during normal relaxed breathing
- **Vital capacity (VC)** - the total volume during a full inspiration and full expiration
- **Expiratory reserve volume (ERV)** - the volume breathed out that is in excess of tidal expiration
- **Inspiratory capacity (IC)** - the volume breathed in that is in excess of tidal inspiration
- **Forced Expiratory Volume in one second (FEV₁)**, the volume of air expelled in the first second of a forced expiration
- **Forced Vital Capacity (FVC)**, the maximum volume of air that can be forcibly and rapidly exhaled from a full inspiration

**References**

Infection control guidelines for the prevention of transmission of infectious diseases in the health care setting” (2004) National Health and Medical Research Council


**Document Control**

This SOP was officially approved by the HREC on 10/05/05
Any changes must be re-submitted for approval by the HREC. Original document held by Assoc. Prof.

Brendan Burkett.
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Purpose of the Test

Mucous membranes, which line the gastrointestinal, respiratory and genitourinary tracts, represent the most frequent portal of entry for common infectious agents, allergens and carcinogens. Saliva samples may be collected for a number of purposes, including assessment of levels of various biomarkers of health and/or disease. Analysis of saliva can provide a general indication of the state of the entire mucosal immune system for example. This, as well as their non-invasive nature, explains why assays utilising saliva, rather than serum or blood, are increasing in popularity with research scientists.

Possible Risks Associated with the Procedure

Sources of Infection

Co-workers or study participants may be a source of infectious diseases that are transmissible to researchers/technicians via blood, blood products or other body fluids (e.g., urine, saliva, tears, breast milk, cerebro-spinal fluid, amniotic fluid, semen, vaginal secretions etc). The potential health effects of acquiring such a disease will depend largely on the nature of the infective organism. These effects range from being asymptomatic through to life-threatening (e.g., HIV). Transmission of infectious diseases from researchers to participants is also possible.

Exclusion Criteria

If possible, depending on the aims of the project, exclude participants with known current infectious diseases.

Procedure

Standard Precautions

All human blood and body fluids are to be treated as potential sources of infection. Staff and students must adhere rigorously to the following precautions in order to minimise any exposure to infectious organisms contained in saliva.

Avoid contact with the saliva:

- Wear disposable gloves whenever contact with saliva is envisaged. If gloves are removed at any time for any purpose then these must be discarded into a biohazard bag and must
not be re-used. Gloves should be removed on completion of laboratory tasks, when using a telephone or when performing any other office work.

- Because of the risk of splashing or spraying, wear safety glasses, goggles or face shield.
- Wear a laboratory coat, preferably closed at the front. Laboratory coats should be removed when laboratory workers leave the ‘work area’, such as go to the toilet or at meal breaks.

Wash hands with water and soap or antiseptic:
- before and after patient/participant contact
- immediately that they are contaminated with saliva
- whenever gloves are removed
- before eating, drinking, or leaving the laboratory.

Decontaminate surfaces after procedures.

Dispose of contaminated linen and waste (swabs, gloves etc) as outlined below.

Report exposure incidents immediately to your supervisor so that the risk of disease transmission can be assessed.
- If saliva gets in the mouth, spit it out and rinse your mouth with water several times

Waste Disposal

Clinical and Biological Waste
This type of waste includes surgical dressings, cultures, biological tissues, needles and other sharps. Clinical wastes can be of human or animal origin. In general, clinical and biological waste must be decontaminated or sterilised before leaving the Faculty.

Saliva is classified as human tissue by the National Health and Medical Research Council, and as such should be disposed of by autoclaving and incineration.
- Place all saliva samples into Biohazard bag for later autoclaving by laboratory technicians, followed by collection and incineration by commercial contractors. The relevant bags have the internationally recognised biohazard symbol in black with a yellow background.

Spillage of Saliva Specimens

Minor spills- eg. spilled drops and splatters
1) Wear personal protection, ie. lab coat, safety glasses and disposable gloves.
2) Wipe up spilled drops or splatters of infectious material using absorbent gauze soaked in 0.5% sodium hypochlorite. Allow a few minutes for the disinfectant to work.

Major spills
1) Don't panic - assess the situation calmly.
2) Seal off the area to prevent people from walking through the spillage.
3) Wear personal protection, ie. lab coat, safety glasses and disposable gloves.
4) Pour 0.5% sodium hypochlorite solution around the spill allowing it to mix gradually. Do not pour directly onto spill, as this creates aerosols.
5) Take Vermiculite or sand and lay around the spill, gradually closing the circle allowing the material to absorb the entire spill.
6) Carefully gather up all debris absorbent material and place in infectious waste bag for removal to the incinerator.
7) If glass is broken, use forceps to pick up the large pieces. Small fragments may be picked up using thick wads of disposable cloth soaked in 0.5% sodium hypochlorite. Place broken glass and other sharp objects into infectious sharps to be autoclaved and incinerated. 
8) Re-swab area with more disinfectant and clean thoroughly by wiping up splatters on walls, cupboards and benches using gauze swabs soaked in 0.5% sodium hypochlorite as for minor spills.

References

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