SCHOOL-BASED PHYSICAL ACTIVITY PROGRAMS FOR ADOLESCENT WELLNESS IMPROVEMENT: AN INVESTIGATION OF THE ASSOCIATION BETWEEN WELLNESS AND PHYSICAL ACTIVITY

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Keywords

Accelerometer, adolescent, calorimetry, direct observation, doubly labelled water, exercise, Five Factor Wellness Inventory; health, health promotion, high school, Index of Cultural Socio-Education Advantage, Indivisible Self Model of Wellness, institution, International Physical Activity Questionnaire for Adolescents, middle school, pedometer, physical activity, quality of life, reliability, school, secondary school, systematic review, wellbeing, wellness, youth.

Abstract

Preventative health has now become the focus of contemporary healthcare, with physical activity identified as a key factor in determining an individual's health and functioning. A youth focus among health promotion initiatives has emerged, with schools offering a unique research setting due to distinct methodological circumstances. Levels of physical inactivity among young populations are a serious concern both in Australia and globally. The benefits of youth physical activity engagement are well documented. Evidence exists indicating that these benefits extend well beyond the expected physiological effects. Despite this growing body of literature, associations between physical activity and the potential benefits for improvements in youth wellness are yet to be established. Paradoxically, despite the many physiological and psychological benefits of youth physical activity engagement, many youth wellness interventions fail to include a physical activity component. The effects of increases in physical activity may not be directly represented in merely the exercise or physical domains of adolescents' wellness. Rather, due to potential interrelatedness between various aspects of wellness, changes in behaviours representing domains of the wellness paradigm may also influence co-existing wellness domains. Therefore, the inclusion of physical activity in wellness interventions aimed at youth may not only be justified on the basis of influencing physical wellness, but potentially some non-physical aspects of wellness.

The overarching purposes of this thesis are twofold. First, to add to the growing body of literature detailing the numerous benefits of increased engagement in physical activity, with potential impacts on wellness as a key incentive for school-based physical activity promotion; and second, to increase the evidence foundation and inform planning for future large scale evaluative research regarding the inclusion of physical activity as a major component of youth wellness interventions. The thesis therefore has six aims: (1) to evaluate contemporary approaches for physical activity measurement among youth; (2) to review processes for physical activity research in Australian school settings; (3) to establish an operational understanding of wellness from the perspective of its use within educational institutions; (4) to examine the contemporary state of wellness assessment of adolescents, including a review of

current measurement techniques, established validity and reliability, and considerations for instrument selection; (5) to examine the test-retest reliability of the Five Factor Wellness Inventory (5F-Wel) when self-completed by adolescents; and (6) to explore the associations between self-reported wellness and physical activity among adolescents, and consider the practical implications. As a result of this thesis, seven manuscripts have been prepared and submitted to peer-reviewed journals, 6 of which are either published or in press, and the remaining manuscript under review.

In order to make conclusions about youth physical activity, it must be accurately measured using techniques that are contextually appropriate, logistically feasible, and provide data that can be used to address the research aims. Chapter 2 considers contemporary approaches to measuring youth physical activity. From this literature in the field of youth physical activity measurement, it is clear that there will always be a trade-off between accuracy and available resources when choosing the best approach to measuring physical activity amongst youth. Unfortunately, cost and logistical challenges may prohibit the use of 'gold standard' physical activity measurement approaches such as doubly labelled water. However, other objective methods such as heart rate monitoring, accelerometry, pedometry, indirect calorimetry, or a combination of measures have the potential to capture the duration and intensity of physical activity, but do not capture information about the type or context of this activity. Self-reported measures can capture the type and context of physical activity and have a practical advantage over other approaches due to their relative ease of administration and low cost. These practical advantages may come at the expense of precision due to dependence on recall of detailed historical activity information. However, this compromise is likely to be justified amongst large samples if the purpose of physical activity evaluation does not require a high degree of measurement precision for each individual. The International Physical Activity Questionnaire for Adolescents (IPAQ-A) was selected for use in this program of research following the review of literature. Although the IPAQ-A is a relatively new instrument for measuring physical activity in youth, on face value and given the international popularity of the adult version, it was deemed an acceptable selection. It was logistically feasible given the large sample size that was to be targeted, its low cost, and a single data collection time-point. It also enabled the collection of

contextual information such as physical activity performed over the four domains of leisure, school, transport, and home.

Chapter 3 reviews the research processes undertaken when conducting physical activity-based studies within school settings, and provides this information in the form of pragmatic guidance for conducting school-based physical activity research. It was found that those wishing to investigate school-based physical activity must overcome several obstacles in an endeavour to complete successful research investigations. Careful planning and consideration must be undertaken prior to the commencement of, and during the research process, due to the complex nature of school settings and research processes that exist in the Australian context. Improving the research capacity among teachers, including enhanced knowledge of research practices, could lead the way to truly collaborative approaches, beneficial to all parties. This may ultimately lead to the prevention of barriers which potentially avert school participation in research studies, and avoid disruption to staff and students during the research process. Advancing the relationship between schools and research institutions may lead to increased collaboration, with mutual benefits.

An operational understanding of wellness from the perspective of its use within educational institutions is provided in Chapter 4. While it is inevitable that cross-over exists between similar constructs, wellness does have distinctly identifiable features. Wellness is both holistic and multi-dimensional, with these dimensions being inter-related. The manipulation of one dimension may have an indirect influence on other dimensions. Wellness is determined, however, not in terms of its individual dimensions but as an integrated whole. Wellness focuses on lifestyle behaviours. While the effectiveness of lifestyle choices can be 'measured' through assessments of wellbeing, quality of life or physiological measures (e.g. blood pressure), wellness is an integrated construct determined by behaviours which facilitate the journey towards optimal states on multiple dimensions. The purpose and practical application of wellness is about undertaking positive lifestyle behaviours which enable an individual to achieve a higher order of functioning. Wellness in this context is therefore about actions or processes, rather than outcomes. Wellness recognises the interrelatedness between the person and their environment where each influences the other. Both intention and context make wellness programs and campaigns unique from those of related constructs. In summary, wellness is concerned with people

making appropriate lifestyle choices, with a focus upon a range of positive outcomes across dimensions.

Chapter 5 provides a review of the variety of wellness measurement instruments currently in use among adolescent samples. In addition, the empirical data supporting the validity and reliability of those instruments are examined. Adolescent wellness is an important indicator of current and future health and lifestyle habits. Instruments for evaluating wellness are particularly useful for those seeking to influence lifestyle behaviours among youth populations, including within health and educational settings. There are a number of tools available to measure wellness, each with its own focus, depending on the definition or model from which it was developed. This may cause debate regarding the appropriateness of some instruments for evaluating wellness. However, in the absence of a 'gold standard' definition, substantial variability across measurement approaches is inevitable. The majority of wellness evaluation approaches used within adolescent populations have less than ideal validation. A 'gold standard' definition could lead to the standardisation of a theoretical model against which wellness instruments could be validated. Progress toward developing a consensus for a definition of wellness during an international meeting of experts in the field would be a worthwhile undertaking. The absence of peer-reviewed studies reporting psychometric testing for wellness evaluation instruments for adolescents is of concern given their growing popularity, and highlights a priority area for future research in this field. Following the review of available instruments in use among adolescents, the 5F-Wel was selected for use in this program of research. The 5F-Wel was selected as it has been one of the most widely-used instruments among adolescents, it is empirically based, a youth-specific version of the instrument is available, and it provides a multi-dimensional detailed evaluation of the various components of the participant's wellness. Consequently, this allowed for an adequate exploration of the associations between self-reported wellness and physical activity among adolescents, and consideration of practical implications.

Test-retest reliability analysis of the 5F-Wel among adolescent males and females is conducted within Chapter 6. Thirty-five male and 46 female adolescents self-completed the 5F-Wel on two separate occasions, seven days apart. Limits of agreement, intraclass correlation coefficients, and paired t-tests were calculated to

investigate agreement, and whether systematic differences existed between administrations. The 5F-Wel generally had fair to excellent levels of agreement between assessments for both genders. The intraclass correlation coefficients, mean differences, paired t-tests and limits of agreement between assessments suggested there was only a small amount of random error, indicating that any disagreement was small in magnitude, and not systematic (i.e. not consistently higher or lower at either assessment). This is congruent with what one might expect from a reliable wellness instrument when assessments were carried out one week apart. The subscales with the closest agreement between assessments were Spirituality for both genders (intraclass correlation coefficient of .93 and .82 for males and females respectively) and also Leisure for females (intraclass correlation coefficient of .82). The subscales with the lowest intraclass correlation coefficient were Leisure (.48), and gender identity (.45) for males and females respectively. Future research priorities include investigating reliability of the 5F-Wel among socioeconomically or educationally disadvantaged students, and across alternative modes of administration; such as computer and telephone administration. These studies were the first investigations of reliability for the 5F-Wel instrument amongst adolescents, and supported the reliability of the instrument for administration among adolescent males and females. These findings suggest that the 5F-Wel instrument is suitable for use amongst adolescents and supports its use in research and professional contexts.

The associations between self-reported physical activity and wellness among adolescents are explored in Chapter 7. The investigation included a total of 493 adolescents (165 males and 328 females) aged between 12 and 15 years. Participants were recruited from six secondary schools of varying socio-economic status within a metropolitan area. Students were administered the 5F-Wel and the IPAQ-A to assess wellness and physical activity respectively. To address the primary aim of the study, three logistic regressions were undertaken. The first examined the associations between participants who were sufficiently physically active (dependent variable) and the 17 dimensions of wellness assessed with the 5F-Wel (independent variables). The second examined the associations between self-reported physical activity and the five higher-order factors from the 5F-Wel, and the third examined the association between self-reported physical activity and the total wellness summary score. Data indicated that significant associations between physical activity and wellness existed.

Self-reported physical activity was shown to be positively associated with a total of four dimensions including friendship, gender identity, spirituality and exercise; the higher order factor physical self and total wellness, and negatively associated with the dimensions self-care, self-worth, love and cultural identity. This study suggests that relationships exist between self-reported physical activity and various elements of wellness. Future research should utilize controlled trials of physical activity and wellness to establish causal links among youth populations. Understanding the nature of these relationships, including causality, has implications for the justification of youth physical activity promotion interventions, and the development of youth physical activity engagement programs.

This thesis provides evidence supporting the notion that the benefits of physical activity among youth are likely to extend beyond the prevention of chronic disease. Positive associations between physical activity and wellness add to the growing evidence base emphasizing the potential value of youth physical activity engagement and promotion interventions, beyond the many established physiological and psychological benefits of increased physical activity. This has implications for those seeking to justify youth physical activity promotion interventions, as well as those providing ongoing funding or allocation of resources for youth physical activity engagement programs, such as policy-makers and various government bodies. The findings from this program of research also suggest that, due to potential interrelatedness between various aspects of wellness, changes in physical activity may also influence co-existing wellness domains. These findings add to the body of literature supporting the potential inclusion of physical activity as a component within youth wellness programs. This may have implications for those seeking to instigate wellness interventions or programs among youth samples, and may warrant the inclusion of physical activity within such programs. These may include school administrators, counsellors, nurses, social workers, health and physical education teachers and chaplains, as well as medical practitioners.

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List of Abbreviations

Australian Institute of Health and Welfare	AIHW
Confidence interval	CI
Department of Health and Ageing	DOHA
Five Factor Wellness Inventory	5F-Wel
Gross Domestic Product	GDP
Health-related quality of life	HRQOL
Index of Community Socio-Education Advantage	ICSEA
Indivisible Self Model of Wellness	IS-Wel
International Physical Activity Questionnaire	IPAQ
International Physical Activity Questionnaire for Adolescents	IPAQ-A
Intraclass correlation coefficient	ICC
Limits of agreement	LOA
Quality of life	QOL
Socio-Economic Indexes for Areas	SEIFA
Standard deviation	SD
Statistical Package for the Social Sciences	SPSS
Wellness Evaluation of Lifestyle	WEL
Wheel of Wellness	WOW
World Health Organization	WHO

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. 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.

Signature: 

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Thesis Research Outputs

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Rachele, J. N., Cuddihy, T. F., McPhail, S.M. & Washington, T.L. (2013). Averting uncertainty: a practical guide to physical activity research in Australian schools. *Australian Journal of Teacher Education, 38*(9), 76-93.

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Conference presentations (oral)

Rachele, J. N., Cuddihy, T. F., Washington, T. L. & McPhail, S. M. (2014). Physical activity promotion as a school priority: what do parents think? *International Association for Physical Education in Higher Education World Conference*, Auckland, New Zealand.

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Rachele, J. N., Cuddihy, T. F., Washington, T. L. & McPhail, S. M. (2013). Australian adolescent perceptions of parental support: can it predict self-esteem among high and low SES groups. *International Congress of Pediatrics*, Melbourne, Australia.

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Related Research Outputs

Peer-reviewed journal articles

Barwais, F., Washington, T. L., Cuddihy, T. F. & Rachele, J. N. (2013) Variations in "free-living" standing, lying and sitting duration among sedentary adults in different BMI categories. *Journal of Sport and Health Science 2*(4) 249-256.

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Conference papers

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Chapter 1: Introduction

This Chapter provides an introduction to physical activity, its rates and recommendations for youth and adults, and the various benefits of being physically active. It also provides a brief background on the construct of wellness, its measurement techniques among adolescents, and issues surrounding its definition. This is followed by an outline of the aims and structure of the thesis.

1.1 BACKGROUND

1.1.1 Physical activity

Physical activity is defined as any bodily movement produced by skeletal muscle that results in energy expenditure above resting (Caspersen, Powell, & Christenson, 1985). Energy expenditure varies continuously from low to high, and is positively correlated with physical fitness (Caspersen, et al., 1985). Both ecological and economic models indicate that physical activity occurs across at least four life domains; leisure, occupation, transport, and home (Pratt, Macera, Sallis, O'Donnell, & Frank, 2004; Sallis et al., 2006). It is important that physical activity be differentiated from the term 'exercise'. Exercise is defined as a specific type of physical activity that is planned, structured, and repetitive bodily movement done to improve or maintain one of more components of fitness (Caspersen, et al., 1985; Trost, 2001). Exercise is therefore a form of physical activity. Physical activity recommendations are often in the form of type, frequency, duration, intensity, and volume.

Table 1.1

World Health Organization Definitions used for Physical Activity Recommendations

Term	Definition
Type	The mode of participation in physical activity. The type of physical activity can take many forms: aerobic, strength, flexibility, balance.
Duration	The length of time in which an activity or exercise is performed. Duration is generally expressed in minutes.
Frequency	The number of times an exercise or activity is performed. Frequency is generally expressed in sessions, episodes, or bouts per week.
Intensity	The rate at which the activity is being performed or the magnitude of the effort required to perform an activity or exercise.
Volume	Aerobic exercise exposures can be characterized by an interaction between bout intensity, frequency, duration, and longevity of the programme. The product of these characteristics can be thought of as volume.

Moderate-intensity physical activity	On an absolute scale, moderate intensity refers to activity that is performed at 3.0–5.9 times the intensity of rest. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0–10.
Vigorous-intensity physical activity	On an absolute scale, vigorous intensity refers to activity that is performed at 6.0 or more times the intensity of rest for adults and typically 7.0 or more times for children and youth. On a scale relative to an individual's personal capacity, vigorous intensity physical activity is usually a 7 or 8 on a scale of 0–10.
Aerobic activity	Aerobic activity, also called endurance activity, improves cardiorespiratory fitness. Examples of aerobic activity include: brisk walking, running, bicycling, jumping rope, and swimming.

(World Health Organization, 2010)

1.1.2 Benefits of physical activity

Regular physical activity is effective for the primary and secondary prevention of several chronic diseases including cardiovascular disease, type 2 diabetes mellitus, some forms of cancer, hypertension, obesity, and depression (Warburton, Nicol, & Bredin, 2006). It also strengthens the musculoskeletal system, reducing the incidence of osteoporosis and the risk of falls and fractures. Overall, individuals who are engaged in physical activity are less likely to die prematurely than sedentary subjects (Australian Institute of Health and Welfare, 2010; Bauman, 2004; US Department of Health and Human Services, 1996). A recent systematic review of longitudinal studies of the long-term health benefits of physical activity revealed that physical activity has long-term (>5 years) relationships with decreases in rates of weight gain, obesity, coronary heart disease, type 2 diabetes mellitus, Alzheimer's disease and dementia (Reiner, Niermann, Jekauc, & Woll, 2013). Among Australians, coronary heart disease remains the single leading cause of death (Australia Bureau of Statistics, 2013). Physical activity has been shown not only to aid in the prevention of cardiovascular events, but also improve recovery following cardiovascular events, while reducing the likelihood of further events (Briffa et al., 2006). In Australia, physical inactivity is second only to tobacco smoking as the modifiable risk factor most associated with burden of disease (Begg et al., 2007).

1.1.3 Physical activity recommendations

The following tables provide physical activity recommendations from both the Australian Government Department of Health and Ageing (DOHA), and the World Health Organization (WHO) for adults (18 years of age and older) and youth (12-17 and 5-17 years of age for DOHA and WHO respectively).

Table 1.2

Adult Recommendations for Physical Activity

Organisation	Recommendations
Australian Government Department of Health and Ageing	There are four steps for better health for Australian adults. Together, steps 1-3 recommend the minimum amount of physical activity you need to do to enhance your health. They are not intended for high-level fitness, sports training or weight loss. To achieve best results, try to carry out all three steps and combine an active lifestyle with healthy eating. Step 4 is for those who are able, and wish, to achieve greater health and fitness benefits. **Step 1 – Think of movement as an opportunity, not an inconvenience** Where any form of movement of the body is seen as an opportunity for improving health, not as a time-wasting inconvenience. **Step 2- Be active every day in as many ways as you can** Make a habit of walking or cycling instead of using the car, or do things yourself instead of using labour-saving machines. **Step 3 – Put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days.** You can accumulate your 30 minutes (or more) throughout the day by combining a few shorter sessions of activity of around 10 to 15 minutes each. **Step 4 – If you can, also enjoy some regular, vigorous activity for extra health and fitness** This step does not replace Steps 1-3. Rather it adds an extra level for those who are able, and wish, to achieve greater health and fitness benefits. (Department of Health and Ageing, 2005)

World Health Organization	1. Adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity. 2. Aerobic activity should be performed in bouts of at least 10 minutes duration. 3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity. 4. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week. (World Health Organization, 2010)

Table 1.3

Youth Recommendations for Physical Activity

Organisation	Recommendations
Australian Government Department of Health and Ageing	At least 60 minutes of physical activity every day is recommended. This can be built up throughout the day with a variety of activities. Physical activity should be done at moderate to vigorous intensity. There are heaps of fun ways to do it: Moderate activities like brisk walking, bike riding with friends, skateboarding and dancing. Vigorous activities such as football, netball, soccer, running, swimming laps or training for sport. Vigorous activities are those that make you "huff and puff". For additional health benefits, try to include 20 minutes or more of vigorous activity at least three to four days a week. Try to be active in as many ways as possible. Variety is important in providing a range of fun experiences and challenges and provides an opportunity to learn new skills. Make the most of each activity in your day. For example, you can walk the dog and replace short car trips with a walk or bike ride. (Department of Health and Ageing, 2004)
World Health Organization	1. Children and youth aged 5–17 should accumulate at least 60 minutes of moderate-to-vigorous intensity physical activity daily. 2. Amounts of physical activity greater than 60 minutes provide additional health benefits. 3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week. (World Health Organization, 2010)

1.1.4 Prevalence of physical inactivity in Australian adults

Prior to determining whether an individual is sufficiently active to achieve health benefits, the term 'sufficiently active' must first be defined. In the context of the Australian National Physical Activity Guidelines for Adults, sufficiently active

has been defined as exercising for 150 minutes or more, over at least five sessions in a one-week period, where the number of days doing physical activity is used as a proxy for the number of sessions (Department of Health and Ageing, 2005). According to results from the 2007-08 National Health Survey, 62% of adults did not meet the recommended amount of physical activity. This amount also increased with age, with 76% of people aged over 75 years not meeting guidelines, compared with 57% of people aged 18-34 years (Australian Bureau of Statistics, 2011). The trend of increases in physical inactivity was also apparent as the socioeconomic status of the population decreased, and as the region in which people resided became more remote (Australian Institute of Health and Welfare, 2012b).

1.1.5 Costs of physical inactivity

Expenditure on health in Australia has increased from $72.2 billion in 1999–2000 to $121.4 billion in 2009–10. At the same time, Australia's gross domestic product (GDP) increased from $951.0 billion to $1,284.8 billion. This means that health expenditure as a proportion of GDP has increased from 7.9% in 1999–00 to 9.4% of GDP in 2009–10. The $121.4 billion spent on health goods and services during 2009–10 averaged $5,479 per Australian (Australian Institute of Health and Welfare, 2011). Governments funded 69.9% of total health expenditure during this time, having increased from 69.3% in 2008-09, and 62.2% in 1999-2000 (Australian Institute of Health and Welfare, 2011). In 2003, the proportion of disease burden in Australia attributed to physical inactivity was approximately 6.7% (Begg, et al., 2007). Of the total health cost attributed to treating coronary heart disease, breast cancer, colon cancer, stroke, depression, type 2 diabetes mellitus, and falls, it has been estimated that 17% can be attributed to physical inactivity, equating to approximately $1.5 billion in 2006-07. The largest components of these costs were associated with falls ($469 million) and coronary heart disease ($372 million) (Econtech, 2007). The total economic cost (factoring in the costs of healthcare, losses in productivity and mortality) of physical inactivity in Australia in 2008 was estimated to be $13.8 billion.

1.1.6 Benefits of physical activity in youth

The majority of the ill-effects of physical inactivity, such as the onset of chronic disease, may not manifest until adulthood (Reiner, et al., 2013). There are, however, numerous other reasons for youth to be engaged in regular physical

activity. A recent systematic review has shown youth (5-17 years of age) physical activity to be associated with a variety of health benefits including improvements in high-density lipoproteins, self-concept, academic performance, bone strength, and fitness; and decreases in adiposity, triglycerides, hypertension, anxiety symptoms, and depression symptoms (Janssen & LeBlanc, 2010). Additionally, dose-response relations from observational studies indicated that the greater amount of physical activity that was engaged in by youth, the greater the health benefits. Likewise for intensity, substantive health benefits can be achieved for physical activity at moderate intensities, with greater benefits provided for vigorous intensities (Janssen & LeBlanc, 2010). Additional outcomes that have previously been associated with physical activity among adolescents include nutrition (Storey et al., 2009), academic performance (Rasberry et al., 2011b; Trudeau & Shephard, 2010), depressive symptoms (Aman, Sophie, Maria, Teri, & John, 2009; Motl, Birnbaum, Kubik, & Dishman, 2004; Rothon et al., 2010), stress (Twisk, 2001), risk-taking behaviours (Geckil & Dundar, 2011), and self-esteem (Ekeland, Heian, & Hagen, 2005; Ekeland, Heian, Hagen, Abbott, & Nordheim, 2005; Twisk, 2001). Physical activity has also been shown to be more effective than cognitive-behavioural therapy amongst adolescent females in reducing the pursuit of thinness, change in body composition, frequency of bingeing, purging and laxative abuse (Sundgot-Borgen, Rosenvinge, Bahr, & Schneider, 2002).

1.1.7 Establishing physical activity habits

The process of ingraining positive physical activity patterns into the long-term lifestyle patterns of adults has proven to be a difficult enterprise (Muller-Riemenschneider, Reinhold, Nocon, & Willich, 2008). An individual's lifestyle is the sum of cumulative day to day choices. These choices are made in response to stimuli on a background palate of intrinsic and extrinsic factors that have lead to ingrained habitual patterns (Telama, Nupponen, & Pieron, 2005). Evidence has shown that lifestyle patterns developed during childhood and adolescence have a tendency to carry over into adulthood (Hallal, Victora, Azevedo, & Wells, 2006; Telama et al., 2013). There is growing support for the consensus that broad social-ecological approaches are needed to promote positive lifestyle behaviours (Booth et al., 2001). Social ecological models propose multiple dimensions of influence and hypothesise that self-regulation is difficult to establish without broader social and institutional

support (Dzewaltowski, 1997). It is a recurring theme throughout the literature, that a multi-faceted approach must be taken when promoting positive lifestyle behaviours to adolescents, which may include parents, teachers, school administrators, and members of the community (Booth, et al., 2001; Dobbins, DeCorby, Robeson, Husson, & Tirilis, 2009; Dolly & Heather, 2007; Faber, Pamela Hodges, & Paul, 2007).

1.1.8 Prevalence of physical inactivity in Australian youth

Physically inactive pursuits during childhood and adolescence, as well as poor physical fitness in adolescence, have both been associated with poor adult health outcomes (Hallal, et al., 2006). This is concerning, given the consistent findings of insufficient physical activity among youth populations and the high prevalence of recreational, educational and occupational activities which do not typically involve physical activity; particularly not at moderate or vigorous intensities (Eaton et al., 2012). According to recent data from the 2009-10 National Secondary Students' Diet and Activity survey, 85% of secondary school students from years 8-11 across 237 schools across Australia (n=12,188) reported not engaging in sufficient levels of physical activity to provide health benefits (Cancer Council Australia, 2011), according to the Department of Health and Ageing's physical activity recommendations for 12-18 year olds (2004). From a global perspective, according to the most recent report from the world's most comprehensive cross-national study, the Health Behaviour in School-Aged Children (HBSC) study, only 23% of 11 year olds reported at least one hour of moderate-to-vigorous physical activity per day, along with 19% of 13 year olds, and 15% of 15 year olds (Currie et al., 2012). This issue of youth physical inactivity has recently been termed 'Exercise-Deficit Disorder' (Avery, Rhodri, Damien, & Gregory, 2013; Faigenbaum, Chu, Paterno, & Myer, 2013; Faigenbaum & Myer, 2012; Faigenbaum, Stracciolini, & Myer, 2011; Faigenbaum, Gipson-Jones, & Myer, 2012). Exercise-Deficit Disorder describes a condition that should be identified and treated to prevent the progression of risk factors and pathological processes (Avery, et al., 2013)

1.1.9 Physical activity measurement approaches for youth

Quantifying physical activity levels in free-living children and adolescents can be an extremely difficult undertaking. Unlike other health behaviours, physical activity lacks a precise biological marker, with cardiorespiratory fitness a moderate

correlate at best (Trost, 2007). Nonetheless, because of the importance of early adoption of health behaviours, access to precise and user-friendly tools to measure physical activity amongst youth is critical for those looking to implement or evaluate interventions for increasing physical activity to address this key public health priority (Eaton et al., 2010). A wide range of methods have been used to measure physical activity in children and adolescents (Brown, Hume, & Chinapaw, 2009). Selection of an appropriate physical activity measure depends not only on the specific purpose of evaluating physical activity, but also the characteristics of the population and the specificity with which type, duration, frequency, and intensity are to be evaluated (Trost, 2007). Monitoring the physical activity levels of youth requires a valid measure that is age appropriate, easy to administer, and poses minimal participant burden (Trost, Marshall, Miller, Hurley, & Hunt, 2007).

1.1.10 Schools as settings for physical activity promotion

Although parents, community agencies, and healthcare providers share the responsibility for ensuring that young people are physically active, schools are uniquely positioned to address public health concerns (Pate et al., 2006). In most countries, school attendance is compulsory for all youth until they reach adolescence (National Center for Chronic Disease, Health, Centers for Disease, & Prevention, 1997). School-aged youth spend a significant amount of their time either in transit to and from school, or within school settings, performing a range of varying learning-based activities. Schools are already a place of learning, and contain the physical and personnel infrastructure to implement effective physical activity promotion interventions (Alibali & Nathan, 2010; Dobbins, et al., 2009; Rachele, Cuddihy, Washington, & McPhail, 2013b). They are environments where teachers and other school staff can act as facilitators in the delivery of physical activity promotion, with readily-available, pre-existing facilities in place such as the provision of sports equipment, and sporting fields. This rare set of circumstances allows governments to reach the entire youth population and provide a consistent and synchronised health message to youth of the benefits and rewards of regular physical activity.

1.1.11 Australian schools as research settings

Schools have often been targeted as important settings for health promotion strategies aimed at increasing youth physical activity levels (Cleland, Dwyer, Blizzard, & Venn, 2008). In 2004, the WHO specifically identified schools as a

target setting for the promotion of physical activity among youth in its Global Strategy on Diet, Physical Activity and Health (World Health Organization, 2004). Youth spend many hours each year in school, and their school experiences profoundly influence their development (Alibali & Nathan, 2010). Schools are an ideal setting for population-based physical activity measurement and interventions (Dobbins, et al., 2009). The demographics of samples obtained from schools are often diverse and differ substantially from those obtained via traditional methods of recruitment outside of the school environment (Alibali & Nathan, 2010). They also offer unique methodological circumstances, such as the ability to target students via pre-existing structures like curriculum (Dobbins, et al., 2009). Salient findings from school-based studies have the potential to inform school policy development.

Despite the benefits of the inclusion of schools within youth physical activity promotion initiatives, recruiting and retaining schools is an often challenging process for advocates of health and physical activity promotion (Rachele, Cuddihy, et al., 2013b). Numerous obstacles may need to be overcome including: perceived (or actual) increased burden caused by research participation, differing priorities between school administrators and teachers, administrators and teacher colleagues may be unwilling to disrupt classroom organisation or student learning experiences for research design considerations, a disinclination to withhold potentially innovative curricula from a portion of students to permit a 'control group' comparison, and a perception that the motivation and demands of research projects are incompatible with the ideology or operation of schools (Mathews, Moodie, Simmons, & Swinburn, 2010; Petosa & Goodman, 1991; Rachele, Cuddihy, et al., 2013b).

1.1.12 A brief history of wellness

Modern perspectives in the study of wellness began in parallel with the positive health movement which came about as a result of changes in the WHO definition of Health. In 1946 the WHO created a definition of health so that it reflected not just the absence of disease, but complete physical, psychological, and social wellbeing (World Health Organization, 1946). Currently, there are numerous theories and models claiming to represent wellness; however, they are all linked by a focus on lifestyle dimensions (Adams, Bezner, & Steinhardt, 1997; Coatsworth, Palen, Sharp, & Ferrer-Wreder, 2006; Crose, Nicholas, Gobble, & Frank, 1992; Depken, 1994; Greenberg, 1985; Hettler, 1980; Lafferty, 1979; Leafgren, 1990; Myers & Sweeney,

2004a; Renger et al., 2000; Witmer & Sweeney, 1992). Traditional views of wellness generally include those by Dunn (1977), who first defined wellness as a dynamic process maximising an individual's potential, and by Hettler (1980), who stated that wellness can be defined as an active process through which the individual becomes aware of and makes choices toward a more successful existence. Although the WHO does not intend its 2006 definition to be exhaustive or scientific, it defines wellness as

> "the optimal state of health of individuals and groups. There are two focal concerns: the realization of the fullest potential of an individual physically, psychologically, socially, spiritually and economically, and the fulfilment of one's role expectations in the family, community, place of worship, workplace and other settings" (Smith, Tang, & Nutbeam, 2006).

As suggested by the definitions above, the majority of theories (Adams, et al., 1997; Crose, et al., 1992; Depken, 1994; Greenberg, 1985; Hettler, 1980; Lafferty, 1979; Leafgren, 1990; Renger, et al., 2000), divide wellness into individually oriented and interrelated dimensions. In the main the dimensions are social wellness, emotional wellness, physical wellness, intellectual wellness, and spiritual wellness (Roscoe, 2009). Some theories also contain a psychological wellness dimension (Adams, et al., 1997). Models such as those by Crose, et al. (1992), Hettler (1980), Leafgren (1990), and Renger, et al. (2000) include dimensions where the individual is regarded as functioning within a specific salient context such as occupational (Crose, et al., 1992; Hettler, 1980; Leafgren, 1990), and environmental (Renger, et al., 2000) wellness. Several wellness models place particular importance on spirituality, and use this dimension as the core of their model (Eberst, 1984; Myers, Witmer, & Sweeney, 2000).

1.1.13 Lack of a precise definition for wellness

Despite the increased focus on wellness and wellness programs within educational settings, there is currently no consensus as to what wellness is. A review of the academic literature reveals confusion as theorists frequently use a range of health-related terms to describe each other. Similarly, studies purporting to investigate one construct often employ evaluative instruments designed to measure another. The Wheel of Wellness model (Sweeney & Witmer, 1991), for example, is said to have an established empirical link with enhanced quality of life and

wellbeing. Similarly, the Indivisible Self Model of Wellness (IS-Wel), developed from data collected from the Wellness Evaluation of Lifestyle (WEL) questionnaire (Myers, Sweeney, & Luecht, 2004), is claimed to represent a way of life oriented toward optimal health and wellbeing. Wellness is also said to embody a way of living designed to improve quality of life (Renger, et al., 2000), be a way of life oriented towards health and wellbeing (Myers, et al., 2004), and be strongly consonant with subjective wellbeing, life satisfaction and developmental assets (Coatsworth, et al., 2006).

This lack of a precise definition has wide-ranging implications. For example, to observe the effect interventions have on wellness, or to observe wellness in a sample cohort at a single time point or change over time, it is important that wellness be appropriately quantified. The diversity in the understanding of the construct of wellness, and the subsequent models which are developed, have resulted in the development of a variety of instruments for measuring wellness. The diversity of wellness instruments in use has implications for the comparability of studies.

1.1.14 Wellness measurement in adolescents

One population group for whom measuring wellness is particularly important is adolescents. Behaviours or cognitions performed during this time may set the pattern for long periods of adulthood, as many lifestyle choices are established during adolescence (Craigie, Lake, Kelly, Adamson, & Mathers, 2011; Hallal, et al., 2006; Trudeau, Laurencelle, & Shephard, 2004). Unhealthy habits and lifestyle choices established during adolescence can lead to disability and disease later in life. Therefore, adult mortality and morbidity could be reduced by improving health habits in adolescence.

Specific wellness dimensions often reflect specific lifestyle outcomes. For example, lifestyle outcomes including stress, self-esteem, self-worth, nutrition and physical activity are also represented as subscales or dimensions within various wellness model. Measures like the WEL (Myers, Sweeney, & Witmer, 1996) and the Five Factor Wellness Inventory (5F-Wel) (Myers & Sweeney, 1999) have been used in many recent empirical studies (Garrett, 1999; Garrett, Rivera, Dixon, & Myers, 2009; Myers & Bechtel, 2004; Myers, Willse, & Villalba, 2011b; Rayle & Myers, 2004; Tatar & Myers, 2010). Scores derived from wellness instruments have been used as both dependent and independent variables in the study of wellness among

youth in relation to diverse psychological constructs and demographic indices, and have been used across a variety of disciplines including clinical and non-clinical settings. For example: Garrett (1999) used the wellness scores of Native American youth to develop more effective counselling interventions; Myers, et al. (2011b) explored the extent to which wellness factors are predictive of self-esteem; Tatar and Myers (2010) examined cross-cultural differences in wellness between children in Israel and in the United States; Rayle (2005) examined the impact of mattering on adolescent wellness; Choate and Smith (2003) incorporated a wellness model into the existing curriculum design of a first-year college course, as a framework to address student needs; Watson and Lemon (2011) compared the wellness responses of adolescents receiving counselling services at a community mental health centre with a norm group; and Smith-Adcock, Webster, Leonard, and Walker (2008) examined a group counselling intervention developed to promote wellness among adolescent girls at risk of delinquency.

Wellness evaluation among adolescents has the potential to help identify those engaging in less than ideal lifestyle behaviours. Adolescents might be reluctant to initiate communication about potentially damaging risk-taking behaviours (Stephens, 2006) and might be unwilling or unable to effectively communicate the diagnostic indicators associated with early signs of mental illness (Derouin & Bravender, 2004). In these situations a wellness assessment tool can prove useful for those seeking to assist youth populations in establishing positive lifestyle behaviours, implement early health interventions or mitigate other health risks (Haddad, Owies, & Mansour, 2009). Therefore, effective measurement of wellness has application in the fields of healthcare, education, and counselling. Evaluating wellness can assist in the implementation and evaluation of wellness-related interventions among adolescents, particularly those interventions that aim to promote positive lifestyle behaviours.

One particularly popular instrument for measuring the broad aspects of wellness amongst adolescents is the 5F-Wel (Myers, et al., 2011b; Tatar & Myers, 2010). In combination with its predecessor, the WEL (designed to measure the Wheel of Wellness (WOW) model of wellness) (Myers, Sweeney, & Witmer, 2001, 2004), it has been an extensively used instrument amongst adolescents (Chang & Myers, 2003; Garrett, 1999; Garrett, et al., 2009; Myers & Bechtel, 2004; Rayle, 2005; Rayle & Myers, 2004; Smith-Adcock, et al., 2008). The 5F-Wel instrument is

designed to measure the IS-Wel wellness model. This is an empirically based model, developed from a factor analysis of WEL data (Myers & Sweeney, 2004a). Both the IS-Wel and WOW are grounded in Adlerian counselling theory (Adler, 1954) that emphasises the indivisibility of the self. This is what Adler defined as holism, and is based on a single, higher order wellness factor that includes all wellness components (Myers, et al., 2011b). The 5F-Wel was developed to assess the factors included in the IS-Wel.

1.1.15 School-based physical activity promotion interventions for improving wellness

The role of schools in the development of its students extends beyond simply the delivery of curriculum. Schools focus on developing whole persona and well-rounded citizens who depict lifestyle behaviours that complement modern society (Standish, 1995). These lifestyle behaviours are congruent with those presented in most wellness models (Rachele, Cuddihy, Washington, Barwais, & McPhail, 2013). Potential associations between youth physical activity and wellness scores could emphasise the value of school-based physical activity promotion interventions, beyond the many established physiological and psychological benefits of increased physical activity.

Potential interrelatedness between various aspects of wellness may lead to increasing physical activity not only being directly represented in the exercise domain of adolescents' wellness, but also influencing co-existing wellness dimensions. Despite this, many wellness interventions aimed at youth fail to incorporate a physical activity component. For example, Smith-Adcock, et al. (2008) examined a group counselling intervention developed to promote wellness among adolescent girls at risk of delinquency. Additional benefits for these adolescents may have been generated from the inclusion of appropriate physical activity promotion as part of the wellness intervention. Similarly, Choate and Smith (2003) incorporated a wellness model into the existing curriculum design of a first-year college course and examined changes in student wellness. Results indicated that students significantly ($p<.01$) increased their total wellness. The wellness outcomes for students may have been enhanced by the inclusion of effective physical activity promotion.

1.2 THESIS AIMS

The purpose of this thesis is twofold: 1) to add to the body of literature detailing the numerous benefits of increased engagement in physical activity, with impacts on wellness as a key incentive for school-based physical activity promotion, and 2) to increase the evidence for including physical activity as a major component of future youth wellness interventions.

The thesis therefore has six aims:

1. To evaluate contemporary approaches for physical activity measurement among youth.
2. To review processes for physical activity research in Australian school settings.
3. To establish an operational understanding of wellness from the perspective of its use within educational institutions.
4. To examine the contemporary state of wellness assessment of adolescents, including a review of current measurement techniques, established validity and reliability, and considerations for instrument selection.
5. To examine the test-retest reliability of the 5F-Wel when self-completed among adolescents.
6. To explore the associations between self-reported wellness and physical activity among adolescents, and consider practical implications.

1.3 SIGNIFICANCE, SCOPE AND CONTRIBUTION TO THE FIELD

The findings from this program of research have significance and practical implications on several fronts. The second Chapter provides a comprehensive overview of contemporary physical activity measurement approaches among youth populations. Given the number of available options for those seeking to assess youth physical activity, the Chapter provides a guide which considers the context and setting where measurement is to be undertaken, as well as making a selection which addresses the purposes for measuring youth physical activity.

In most countries, school attendance is compulsory for all youth until they reach adolescence. School-aged youth spend a significant amount of their time either

in transit to and from school, or within school settings, performing a range of varying learning-based activities. Schools contain the physical and personnel infrastructure to implement effective health and wellness promotion programs. It is an environment where teachers and other school staff can act as facilitators in the delivery of such programs, with readily-available, pre-existing facilities in place, such as the provision of sports equipment and sporting fields. The demographics of samples obtained from schools are often diverse and differing substantially from those obtained via traditional methods of recruitment outside of the school environment. Schools therefore offer a unique research setting due to distinct methodological circumstances. However, school-based researchers face several obstacles in their endeavour to complete successful research investigations; they are often confronted with complex research designs and methodological procedures that are not easily amenable to school contexts. Chapter Three provides a practical guide for teachers (both teacher educators and teaching practitioners) and researchers seeking to conduct physical activity-based research in Australian school settings. The guide provides a focus on the research enabling process, which has been divided into six phases: preparation; design; outcome measures; procedures; participants; and feedback.

While a number of definitions for wellness have been proposed, there has been no single recognised or 'gold standard' definition which is currently in use in the field. It is beyond the scope of this program of research to propose a definition. Moreover, adding a further definition of wellness to the numerous existing ones may prove counterproductive. Rather, this thesis aims to increase understanding for the use of the term wellness, differentiating it from other related terms such as health, quality of life, and wellbeing, while also discerning the use of wellness within certain contexts or settings. For the purpose of this thesis, the context is for improving wellness and promoting physical activity within young and otherwise healthy populations, and the setting is within educational institutions, specifically schools. This thesis also suggests that to obtain a comprehensive and agreed upon definition of wellness, an international meeting of experts in the field would be a worthwhile undertaking. This method has proved successful in a number of past examples, most notably at the International Health Conference in New York in 1946, where the Constitution of the World Health Organization was presented. This search for

consensus led to the definition of health including the words "complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (World Health Organization, 1946).

Wellness evaluation among adolescents has the potential to help identify those engaging in less than ideal lifestyle behaviours. Adolescents might be reluctant to initiate communication about potentially damaging risk-taking behaviours (Stephens, 2006) and might be unwilling or unable to effectively communicate the diagnostic indicators associated with the early signs of mental illness (Derouin & Bravender, 2004). In such situations a wellness assessment tool may prove useful for those seeking to assist youth populations in establishing positive lifestyle behaviours, implement early health interventions or mitigating other health risks (Haddad, et al., 2009). Therefore, effective measurement of wellness has application in the fields of healthcare, education, and counselling. Evaluating wellness may assist in the implementation and evaluation of wellness-related interventions among adolescents, particularly those interventions that aim to promote positive lifestyle behaviours. The contemporary state of wellness assessment of adolescents was reviewed, including instruments currently in use, or which have been used in the past, as well as their established validity and reliability. Considerations for instrument selection have also been detailed.

This review of wellness literature revealed that validity and reliability studies of wellness instruments were scarce, and this was considered to be a significant gap in the body of literature regarding wellness assessment, particularly among youth. The most commonly used wellness instrument which was empirically based, in addition to having an age-appropriate version, the 5F-Wel, was selected to be trialled in a reliability analysis among youth. This study was the first, to our knowledge, to complete a reliability analysis of this instrument among youth or adult samples. The instrument was found to have acceptable reliability, and was recommended for use among youth in a variety of settings. These findings have implications for those seeking to undertake wellness evaluation among youth samples, including counsellors, nurses, social workers, health and physical education teachers, chaplains, and school administrators.

The seventh Chapter of this thesis examines the association between self-reported physical activity and wellness. The findings suggest that relationships exist

between self-reported physical activity and various elements of wellness. However, causality within this relationship cannot be confirmed from cross-sectional data alone. It was considered beyond the scope of this program of research to establish causality between self-reported wellness and physical activity. The findings from this final study have significant contributions to research for both the youth physical activity and wellness fields. First, the findings add to the growing body of literature supporting the notion that the benefits of physical activity among adolescents are likely to extend beyond the prevention of chronic disease. Positive associations between physical activity and wellness emphasize the potential value of youth physical activity engagement and promotion interventions, in addition to the many established physiological and psychological benefits of increased physical activity. Potential interrelatedness between various aspects of wellness may lead to increasing physical activity not only being directly represented in the exercise domain of adolescents' wellness, but also influencing co-existing wellness dimensions. This has implications for those seeking to justify youth physical activity promotion interventions, as well as those providing ongoing funding or allocation of resources for youth physical activity engagement programs, such as policy-makers and various government bodies. The second is for those seeking to instigate wellness interventions or programs among youth samples. These findings add to the body of literature supporting the potential inclusion of physical activity as a component within youth wellness programs. Those who may be implicated include school administrators, and those likely to be school-based such as counsellors, nurses, social workers, health and physical education teachers and chaplains, as well as medical practitioners. As a result of these findings, the inclusion of physical activity in youth wellness interventions is justified not only on the basis of influencing physical wellness, but potentially some non-physical aspects of wellness.

1.4 STRUCTURE OF THE THESIS

This program of work includes a combination of background literature, chapters which are based on published or under review journal articles, and their resultant conclusions. Repetition may therefore occur throughout the thesis. This repetition is necessary to allow the chapters to be read as standalone articles, and neatly demonstrate the contribution given to literature at each stage of the PhD program. In such instances, edits have been made to ensure language and formatting

consistency throughout the thesis, and additional information is included where necessary. The PhD program was a result of an emergent process, where the development of ideas and theoretical positions was based on previous chapters. As a result, independent chapters are linked and demonstrate progression.

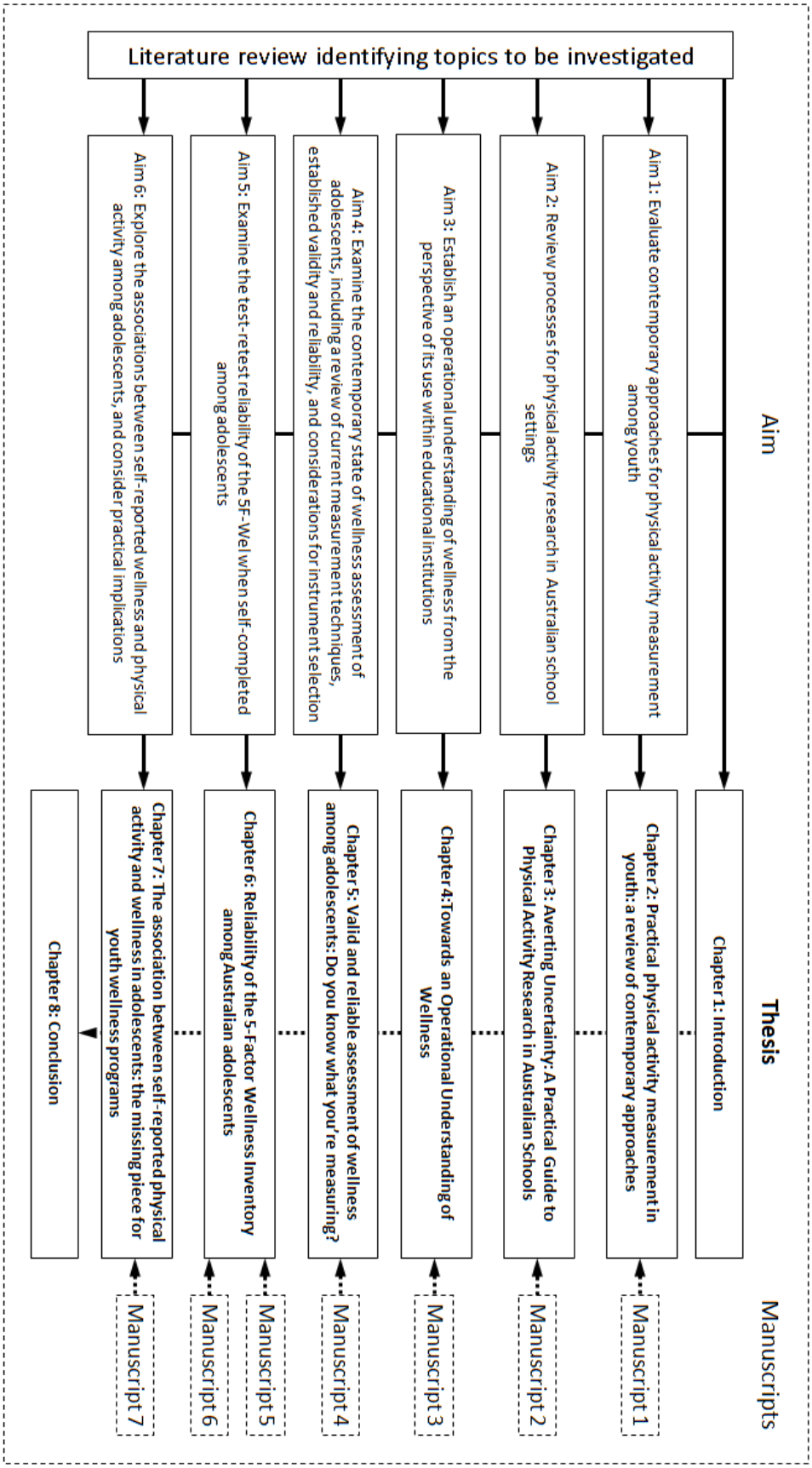

Figure 1.1. Structure and overview of the program of research

Chapter 2: Practical physical activity measurement in youth: a review of contemporary approaches

In order to make conclusions about youth physical activity, it must be accurately measured using techniques that are contextually appropriate, logistically feasible, and provide data that can be used to address the research question. This Chapter reviews contemporary approaches to measuring youth physical activity.

This Chapter is based on the following peer-reviewed journal article:

Rachele, J. N., McPhail, S. M., Washington, T. L. & Cuddihy, T. F. (2012). Practical physical activity measurement in youth: A review of contemporary approaches. *World Journal of Pediatrics, 8*(3), 207-216.

2.1 ABSTRACT

The accurate evaluation of physical activity levels amongst youth is critical for quantifying physical activity behaviours and evaluating the effect of physical activity interventions. The purpose of this review is to evaluate contemporary approaches to physical activity evaluation amongst youth. Literature from a range of sources was reviewed and synthesized to provide an overview of contemporary approaches for measuring youth physical activity. Five broad categories are described: self-report, instrumental movement detection, biological approaches, direct observation, and combined methods. Emerging technologies and priorities for future research are also identified. There will always be a trade-off between accuracy and available resources when choosing the best approach for measuring physical activity amongst youth. Unfortunately, cost and logistical challenges may prohibit the use of 'gold standard' physical activity measurement approaches such as doubly labelled water. Other objective methods such as heart rate monitoring, accelerometry, pedometry, indirect calorimetry, or a combination of measures have the potential to better capture the duration and intensity of physical activity, while self-reported measures are useful for capturing the type and context of activity.

2.2 BACKGROUND

The accurate evaluation of physical activity levels amongst youth is critical for quantifying physical activity behaviours and evaluating the effect of physical activity interventions (Kohl, Fulton, & Caspersen, 2000). Accurate physical activity measures are a necessity in studies designed to document the frequency and distribution of physical activity in defined population groups, determine the volume and intensity of physical activity required to influence specific health parameters, identify the psychosocial and environmental factors that influence physical activity behaviour in youth, monitor secular trends in behaviour, and to evaluate the effectiveness of interventions to increase habitual physical activity (Kohl, et al., 2000; Trost, 2001; Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005). This review focuses on physical activity evaluation approaches amongst youth aged 6-18 years. Quantifying physical activity levels in free-living children and adolescents can be an extremely difficult undertaking. Unlike other health behaviours, physical activity lacks a precise biological marker, with cardiorespiratory fitness a moderate correlate at best (Trost, 2007). Nonetheless, access to precise and user-friendly tools to measure physical activity amongst youth is critical for those looking to implement or evaluate interventions for increasing physical activity to address this key public health priority (Eaton, et al., 2010). Selection of an appropriate physical activity measure depends not only on the specific purpose of evaluating physical activity, but also the characteristics of the population and the specificity with which type, duration, frequency, and intensity are to be evaluated (Trost, 2007). Monitoring the physical activity levels of youth requires a valid measure that is age appropriate, easy to administer, and poses minimal participant burden (Trost, et al., 2007). A wide range of methods have been used to measure physical activity in children and adolescents (Brown, et al., 2009).

There is currently no ‘gold standard’ approach for measuring all aspects of physical activity (energy expenditure, duration, intensity, context, etc). Therefore, the choice of validation standard is an important consideration for studies of physical activity assessment modalities (Kohl, et al., 2000). The doubly labelled water technique represents an unobtrusive and non-invasive means to measure total daily energy expenditure in free-living children and adolescents (Welk, Corbin, & Dale, 2000). When combined with the measurement of resting energy expenditure, the

doubly labelled water technique can be used to estimate energy expenditure related to physical activity, and has been considered to be the 'gold standard' and most valid and reliable criterion for the determination of energy expenditure under free-living conditions (Ekelund et al., 2001; Schoeller et al., 1986; Trost, 2007; Welk, et al., 2000). The doubly labelled water method is based on the kinetics of 2 stable isotopes of water, $2H_2O$ (deuterium-labelled water) and $H_2{}^{18}O$ (oxygen-18-labeled water). Deuterium-labelled water is lost from the body through the usual routes of water loss (urine, sweat, evaporative losses). Oxygen-18-labeled water is lost from the body at a slightly faster rate because this isotope is also lost via carbon dioxide production in addition to all routes of water loss (Trost, 2007). The difference in the rate of loss between the 2 isotopes is therefore a function of the rate of carbon dioxide production, which is a reflection of the rate of energy production over time (Goran, 1994).

Despite the accuracy of this biological measurement approach, there are limitations associated with the doubly labelled water technique. These limitations include excessive cost, difficulty in obtaining the stable isotopes of water, inability to assess activity patterns or partition the energy expenditure associated with physical activity, participant burden, and the logistics related to multiple urine collections and laboratory visits (Kohl, et al., 2000; Trost, 2001; Welk, et al., 2000). For this reason, doubly labelled water is primarily used in well-resourced research activities rather than health promotion or initiatives led at a school level (Arvidsson, Slinde, & Hulthen, 2005; Corder et al., 2009; Ekelund, et al., 2001; Sjoberg et al., 2003). Additionally, the doubly labelled water technique fails to capture the duration and intensity of physical activity, and cannot provide information regarding the type or context of physical activity behaviour. It is for these reasons that a number of other approaches have been developed for measuring physical activity amongst youth populations. These can be broadly grouped into five categories: self-report, instrumental movement detection, biological approaches, direct observation, and combined methods.

2.3 SELF-REPORT METHODS

Self-report measures of physical activity are methods whereby participants either record or recall their activity over a given time frame. Recall time frames from as little as 1 day (Moore et al., 2008; Ridley, Olds, & Hill, 2006; Weston, Petosa, &

Pate, 1997) to as much as 1 year (Aaron et al., 1995; Koo & Rohan, 1999; Treuth, Hou, Young, & Maynard, 2005) have been reported amongst youth. Self-report measures are commonly used in epidemiological research and surveillance studies (Eaton, et al., 2010). They have a practical advantage over other approaches for studies with large sample sizes and restrictive budgets due to their relative ease of administration and low cost (Sallis, 1991). However, given that the reliability and validity of self-reported data are dependent on recall of prior activity, there may be some compromise on the accuracy of these results (Chinapaw, Mokkink, van Poppel, van Mechelen, & Terwee, 2010). Numerous questionnaires have been developed for varying populations, including youth, with considerable differences in length, type of activities reported and recall period used (Brown, et al., 2009; Chinapaw, et al., 2010). Due to the diversity in available questionnaires, it is not necessarily an easy task for researchers, educators and health professionals to determine which instrument is most suitable for their purpose. Three examples of widely used self-report instruments requiring differing recall timeframes include the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003), the Physical Activity Diary (Bouchard et al., 1983), and the Previous Day Physical Activity Recall (PDPAR) (Weston, et al., 1997).

2.3.1 International Physical Activity Questionnaire (IPAQ)

The IPAQ was designed by a multinational working group, for use as a universal instrument in epidemiological studies (Craig, et al., 2003). It is a self-report instrument that records the duration of physical activity for a habitual or past week. The short-version (9 items) is a dimension-based instrument, structured to capture 4 forms of physical activity, being vigorous, moderate, walking, and sitting (Craig, et al., 2003). The long-version (31 items) collects detailed information within the domains of household and yard work, occupational, self-powered transport, leisure-time, and sedentary activity (Craig, et al., 2003). The IPAQ has been used widely with mixed results in adolescents (Guedes, Lopes, & Guedes, 2005; Lachat et al., 2008; Mikaelsson, Eliasson, Lysholm, Nyberg, & Michaelson, 2011; Rangul, Holmen, Kurtze, Cuypers, & Midthjell, 2008). Rangul, et al. (2008) administered the short version of the IPAQ twice amongst youth samples (8-12 days apart) to measure reliability. Interclass correlations ranging between .10-.62 were reported between assessments across the various domains. Overall, findings from that study indicated

moderate test-retest reliability. However, criterion validity was not strong amongst adolescents with predominantly weak Spearman's correlation coefficients between the physical activity intensity reported in the IPAQ and VO2 Peak (r = .02-.32), total energy expenditure (r = -.02-.24), and physical activity level (r = .01- .43) measured using an ActiReg activity monitor (an instrument that uses combined recordings of body position and motion to calculate energy expenditure and physical activity) over 7 consecutive days. Studies are yet to be conducted, validating energy expenditure derived from the IPAQ against the doubly labelled water technique, or examining the responsiveness of these instruments amongst youth samples. The International Physical Activity Questionnaire for Adolescents (IPAQ-A) was developed from the IPAQ (long version) for use in adolescents. This adapted version also measures physical activity over the previous 7 days (Hagstromer et al., 2008). Questions about physical activity at work were replaced by physical activity at school, and it includes only 1 question about physical activity in the garden or at home (the IPAQ contains 3 questions in this area) (Hagstromer, et al., 2008).

Ottevaere et al. (2011) tested the IPAQ-A against an accelerometer and a non-wear activity diary, and found that the correlation coefficient between the IPAQ-A and accelerometer data increased when non-wear activity diary data were included (Ottevaere, et al., 2011). Hagstromer, et al. (2008) divided their sample into 2 groups of 12-14 year olds and 15- 17 year olds, and administered both the IPAQ-A and accelerometers. Significant associations between the IPAQ-A and accelerometers amongst the older age group were observed for time spent walking, moderate and vigorous activities, as well as for total physical activity (r = .17-.30) (Hagstromer, et al., 2008). However, these associations were not significant amongst the younger group (Hagstromer, et al., 2008). These results indicate the need for more validations of the IPAQ-A using enhanced criterion measures (such as doubly labelled water) to further determine its appropriateness for measuring adolescent physical activity. Additionally, the reliability and responsiveness of the IPAQ-A amongst self-reporting youth have yet to be investigated and remain a priority for future research. In spite of this need for further validation, the IPAQ-A may well be a logical choice over the IPAQ (long or short adult version) for use amongst older youth given the common-sense nature and face validity of the modifications and the less than optimal

reliability and criterion validity reported for adult versions of the IPAQ administered amongst youth (Guedes, et al., 2005; Rangul, et al., 2008).

2.3.2 Physical activity diary

Keeping a regular physical activity diary for a set period of time is one approach that may overcome possible shortcomings of instruments requiring a retrospective recall of physical activity performed over a 7-day period (such as the IPAQ). A common method for physical activity diaries was first reported by Bouchard, et al. (1983). Bouchard's 3-day activity record was designed to estimate energy expenditure. The three-day summary includes any two weekdays and one day from a weekend, providing a more frequent recording of daily activities. Each day is divided into 96 periods of 15 minutes each. For each 15-minute period, energy expenditure is qualified on a scale from 1 to 9. Approximate median energy cost for each of the nine categories in kcal/kg per 15 minutes is applied to compute daily energy expenditure for each individual (Bouchard, et al., 1983). The Bouchard physical activity diary has been shown to have moderate correlations (r = .33- .35) with accelerometers (Martínez-Gómez et al., 2010). However, there have not been validation studies using doubly labelled water as a criterion measure amongst youth samples. Additionally, reliability and responsiveness of the Bouchard diary are also yet to be investigated amongst youth samples. Physical activity diaries have the potential to provide valuable information regarding the amount and context of youth physical activity. However, they have not been as widely used in physical activity research as other approaches (Chinapaw, et al., 2010). Hofferth et al. (2008) found that diary estimates of the amount of time spent in active pursuits had a moderate yet significant association with moderate to vigorous physical activity measured by accelerometer counts (r = .37). The authors concluded that while self-reported physical activity diaries have merits, accelerometer measured physical activity levels are likely to be a more accurate indication of actual physical activity undertaken. Physical activity diaries are inexpensive and may have some accuracy advantages over instruments requiring a long recall (Sallis, 1991). However, they are considered less accurate than accelerometer data and the participant burden required to frequently record in the diary may result in some missing data amongst youth populations, or in certain contexts where frequent diary reporting may not be feasible.

2.3.3 Previous Day Physical Activity Recall (PDPAR)

An example of a self-report method for youth that has found middle ground between week long recall and frequent physical activity diary entries is the Previous Day Physical Activity Recall (PDPAR). The PDPAR is a self-report instrument designed specifically for the cognitive abilities of children and adolescents (Weston, et al., 1997). To help children and adolescents recall their past behaviour more accurately, the previous day is divided into 30-minute time blocks that, in turn, are grouped into broader time periods such as morning, lunchtime, afternoon, and evening (Weston, et al., 1997). The list of activities appearing in the PDPAR can also be modified to accommodate the activity interests and cultural norms of different population groups (Trost, 2007). Significant favourable findings of inter-rater reliability (r = .99) and test-retest reliability (r = .99) have been reported for the PDPAR. Similarly, indicators of criterion validity with step count (pedometer) and measurement of body movement (accelerometer) are favourable (r = .88 and r = .77, respectively). The association between PDPAR and mean percentage heart rate reserve for 30 minute intervals has been reported as higher across subjects (r = .53) than within subjects (mean r = .32) (Weston, et al., 1997). This suggests that participants could recall with accuracy the mode and intensity of their activity, but not necessarily the correct 30-minute block. A three-day version of the PDPAR, known as the 3-Day Physical Activity Recall (3DPAR), is now also used widely (Goulart et al., 2001; Lee & Trost, 2005; McMurray et al., 2004; Pate, Ross, Dowda, Trost, & Sirard, 2003). The flexibility of the PDPAR and 3DPAR has contributed to their use in numerous observational and intervention studies (Anderson, Hagstromer, & Yngve, 2005; Engelbrecht, Pienaar, & Coetzee, 2002; Goulart, et al., 2001; Hurter & Pienaar, 2007; Lee & Trost, 2005; McMurray, et al., 2004; McMurray et al., 2008; Pate, Ross, et al., 2003; Pate et al., 1999; Pate et al., 1997; Schofield, Schofield, & Mummery, 2005; Schofield, Mummery, Schofield, & Walmsely, 2002; Trost, et al., 2007; Trost, Ward, McGraw, & Pate, 1999; Welk, Dzewaltowski, & Hill, 2004). Several studies have reported favourable validity, reliability, and responsiveness in physical activity behaviour (Pate et al., 2003; Pate et al., 2005) across a number of regions (Anderson, et al., 2005; Goulart, et al., 2001; Lee & Trost, 2005; Trost, et al., 2007; Weston, et al., 1997). However, energy expenditure derived from either of these instruments has not been validated against the doubly labelled water technique. Recalling physical activity is a complex cognitive task requiring retrieval of

information about historical activity events, intensity and duration. The accuracy of this recollection may be questionable in some cases, particularly if the recall time is lengthy. Youth have a physical activity pattern that is much more variable and intermittent than that of adults (Baquet, Stratton, Van Praagh, & Berthoin, 2007), and they are less likely to make accurate self-report assessments due to developmental differences, especially in the ability to think abstractly and recall detailed activity information (Going et al., 1999; Sallis, 1991). Self-report methods may be subject to considerable recall bias, and caution must be exercised when attempting to use self-report instruments in children aged 10 years or younger (Kohl, et al., 2000). It may help to include a practice administration in an effort to help familiarise youth with the survey procedures. Furthermore, multiple administrations of the instrument may be needed to obtain reliable estimates, due to the substantial intra-individual day-to-day variability in youth physical activity behaviour (Trost, et al., 2007). Although available evidence indicates that self-report methods provide acceptable estimates of relative physical activity behaviour in older groups of children, where possible more sophisticated measures of physical activity and sedentary behaviour should be used, such as accelerometers, or direct observation (Trost, et al., 2007).

2.4 INSTRUMENTAL MOVEMENT DETECTION METHODS

Instrumental measures with real time data storage capabilities offer a distinct advantage over self-report methods, in that they provide reliable information on patterns of physical activity within a given day or over several days (Trost, Pate, Freedson, Sallis, & Wendell, 2000). While measuring physical activity in children and adolescents, it may be helpful to include an objective measurement tool to avoid dependency on recollection of previous activity information (Cuddihy, Pangrazi, & Tomson, 2005). There has been an increased focus on the development, validation, and application of new tools to objectively monitor physical activity behaviours over the past two decades. As a result, there has been a rapid increase in both the number and type of objective physical activity assessment instruments (Chen & Bassett, 2005). The wide range and availability of movement detection instruments to measure physical activity may lead to difficulty in selecting the most suitable instrument for the desired context of activity measurement (Tudor-Locke & McClain, 2009). Instrument selection may be complicated for those who study youth physical activity due to: (1) the challenges associated with detecting the typically

short and sporadic nature of children's physical activity patterns (Baquet, et al., 2007); (2) the range of developmental maturity/age among potential participants; and (3) inherent curiosity regarding wearable technologies and the associated potential for reactivity to monitoring. As a result, researchers and practitioners at times may make under-informed choices with regard to instrument selection (Tudor-Locke & McClain, 2009). Two widely used physical activity measurement instruments that are commercially available to researchers, practitioners, and consumers are accelerometers and pedometers (Chen & Bassett, 2005).

2.4.1 Accelerometers

Accelerometers are devices that measure body movements in terms of acceleration, which can then be used to estimate the intensity and duration of physical activity over time. Most contemporary accelerometers comprise piezoelectric sensors that detect acceleration(s) in one, two or three orthogonal planes (anteroposterior, mediolateral, and vertical). Processed data can be recorded to internal memory and then downloaded to computer based software for further analysis (Chen & Bassett, 2005). The raw outputs of physical activity monitoring accelerometers are known as counts. Counts can be produced in a number of ways: (1) as a digital counter which accrues the number of times the signal crosses a preset threshold, (2) via an algorithm to establish the maximum value for a selected period (otherwise known as an epoch) to represent the count for that time window, or (3) an area under the curve (integration or average) algorithm (Chen & Bassett, 2005). Regression analysis can then be implemented to establish ranges of accelerometer counts (cut-points) corresponding to predefined intensity levels (Freedson, Pober, & Janz, 2005). Three examples of widely used accelerometer intensity cut-points for youth are those by Puyau, Adolph, Vohra, and Butte (2002), Freedson, et al. (2005), and Ekelund et al. (2007). Accelerometry-based motion sensors have become one of the most commonly used methods for assessing physical activity in free-living individuals (Trost, 2001). They can be used to evaluate the frequency, intensity, and duration of physical activity over specified time intervals such as days or weeks (Welk, et al., 2000). Their small size, robust design features, and relatively modest cost make them particularly attractive to investigators quantifying activity behaviour in children and adolescents (Welk, et al., 2000). They may also present less burden to participants relative to other measures (such as heart rate monitors with electrodes

and chest straps). Evidence has shown that 7 days of wearing time are required for accelerometer data to have acceptable reliability (Trost, et al., 2000). Monitoring must also be performed continuously over this period of time, as it is important to ensure that both weekdays and weekends are included (Trost, et al., 2000). Accelerometer data have been shown to have a significant moderate association with doubly labelled water (r = .39) (Ekelund, et al., 2001), and a strong positive and significant association with oxygen uptake (as a criterion measure of physical activity) in simulated free-living conditions both indoors and outdoors (r = .77) (Sun, Schmidt, & Teo-Koh, 2008). Accelerometers have also shown to be responsive to different levels of intensity when tested amongst youth samples in laboratory settings (Puyau, Adolph, Vohra, Zakeri, & Butte, 2004). There are several recognized limitations of accelerometers. This includes their inability to account for the increased energy cost associated with walking up stairs or an incline, accurately measure activities such as cycling, lifting, or carrying objects (Freedson, et al., 2005; Trost, 2001; Welk, et al., 2000), and differentiate well between sitting and standing (Marshall, Rachele, Marshall, Lai, & Jones, 2010). However, it has been proposed that the contribution of these activities to the overall physical activity in free-living youth is small. Additionally, the outputs from accelerometers can vary, based on the equations used to interpret accelerometer data, and the subsequent cut-point values (Anderson, et al., 2005). This lack of standardization continues to plague physical activity research, particularly amongst youth samples (Kim, Beets, & Welk, 2012). Consequently, numerous studies using accelerometers have analysed their data providing options for a number of different cut-points (Anderson, et al., 2005; Mota et al., 2007; Ottevaere, et al., 2011). Because of these limitations, accelerometers may underestimate total or physical activity energy expenditure in comparison to doubly labelled water (Ekelund, et al., 2001).

2.4.2 Pedometers

Pedometers offer a simple and low cost estimate of total volume of physical activity which is measured as the number of steps taken (Tudor-Locke & McClain, 2009). The electronic circuitry within a pedometer accumulates steps and displays this information on a digital screen. The majority of pedometer instruments currently available detect steps using a horizontal, spring-suspended lever arm which moves up and down with vertical accelerations of the hip (Bassett & Strath, 2002). An event

(step) is recorded when a sufficiently forceful (above the sensitivity threshold of the specific pedometer) vertical hip acceleration deflects the lever arm to complete an electronic circuit (Bassett & Strath, 2002). Recently, piezoelectric pedometers have emerged within the commercial market. Briefly, this mechanism consists of a horizontal suspended beam and a piezoelectric crystal which directly measures vertical accelerations (similar to that of most accelerometers), recording a step if detected above manufacturer-defined sensitivity thresholds (Schneider, Crouter, Lukajic, & Bassett, 2003; Tudor-Locke & McClain, 2009). There is some consensus among researchers that a cumulative record of steps over the course of the day is a suitable and effective gross indicator of the physical activity of youth (Cuddihy, et al., 2005; Trost, 2007). Favourable findings in support of pedometer usage as a valid and reliable tool for assessing youth in free-living conditions have been reported (Kilanowski, Consalvi, & Epstein, 1999). Physical activity energy expenditure calculated from pedometers has a moderate correlation (r = .81) with energy expenditure calculated from the doubly labelled water method (Ramirez-Marrero, Smith, Sherman, & Kirby, 2005) and has demonstrated responsiveness to changes in physical activity amongst youth samples (Duncan, Schofield, Duncan, & Hinckson, 2007). Pedometers have similar limitations to accelerometers in that they are quite insensitive to some forms of movements. The primary limitation however, when making comparisons between the two, is that pedometers are unable to record the magnitude of the movement. This means that any movement above a given threshold is counted as a step regardless of whether it occurs during walking, running, or jumping (Kohl, et al., 2000; Trost, 2001). This is not the case with accelerometers, which can detect not only when that movement occurred, but also the intensity and duration of movement. Pedometers are generally not designed to detect specific intensity categories (e.g. time in moderate to vigorous physical activity) and therefore are not an appropriate choice for end users whose specific research questions are focused on these parameters. With this in mind, pedometer manufacturers are beginning to offer additional features intended to provide estimates of activity time (e.g. accumulated time of stepping) and also time in moderate to vigorous physical activity (e.g. time accumulated above a specified stepping cadence) (Tudor-Locke & McClain, 2009). However, further high-quality research is required before the assertion of validity and reliability of these pedometers for assessing physical activity intensity amongst children and adolescents

can be made. A key feature of accelerometer-based activity monitors is their real-time storage capabilities. However, most pedometers used in schools and health promotion programs do not possess real time storage capacity, and must rely on the participant's ability to record information at specific times (commonly at the end of each day) (Trost, 2007).

2.5 BIOLOGICAL METHODS

Biological measures rely on the detection of physiological processes associated with physical activity. This may be detected through the use of an instrument worn on the body (such as a heart rate monitor), or through as series of biological tests (such as doubly labelled water). Additionally, calorimetry is also a popular biological approach to measuring physical activity (and energy expenditure) amongst youth. The amount of physical activity undertaken over a set period of time can be extrapolated from the changes observed in the biological markers of interest.

2.5.1 Calorimetry

Direct calorimetry provides accurate assessments of energy expenditure via the amount of heat produced by participants. However, direct calorimetry requires that participants be sequestered in special chambers, making its use expensive and limiting participants to specific tasks. This makes the use of direct calorimetry impractical for studies of larger samples or for measuring free-living physical activity (LaPorte, Montoye, & Caspersen, 1985). Open-circuit indirect calorimetry measures energy expenditure from oxygen consumption and carbon dioxide production. Indirect calorimetry is used extensively and considered an accurate and valid measure of short-term energy expenditure during rest and exercise (LaPorte, et al., 1985; Sirard & Pate, 2001). It is the most common criterion measure in laboratory-based studies, with doubly labelled water the most common in field-based studies (Freedson, et al., 2005; Trost, Pate, & McIver, 2005). Measurement of physical activity by means of indirect calorimetry requires that the participant wears a face mask or a mouthpiece with nose clip, and a container for the collection of expired air (LaPorte, et al., 1985). Due to the non-portable nature of the gas analysis equipment required, this method is impractical for studies of free-living conditions as they may alter or inhibit normal physical activity patterns (Chinapaw, et al., 2010; LaPorte, et al., 1985; Sirard & Pate, 2001).

2.5.2 Heart rate monitors

Heart rate monitors provide an objective indicator of the physiological effect of physical activity. The devices are relatively inexpensive and can provide multiple-day storage capacity for minute-by-minute heart rates, which have made them a feasible method for assessing physical activity in children and adolescents (Nichols, Davis, McCord, Schmidt, & Slezak, 2009). Heart rate monitoring remains an attractive approach to assessing physical activity because of the linear relationship between heart rate and energy expenditure during steady-state exercise (Eston, Rowlands, & Ingledew, 1998; Livingstone et al., 1992). It has also received favourable findings when compared to the doubly labelled water technique (Livingstone, et al., 1992). However, there are a number of problems associated with this method. First, it is widely recognized that factors such as age, body size, emotional stress, cardiorespiratory fitness, and proportion of muscle mass used influence the relationship between heart rate and the volume of oxygen consumed (used to assess energy expenditure during physical activities) (Reis, van den Tillaar, & Marques, 2011; Welk, et al., 2000). Second, heart rate response tends to lag momentarily behind changes in movement and tends to remain elevated after the cessation of movement. This may mask the sporadic and intermittent activity patterns of children and adolescents (McGrath & Hinckson, 2009), affecting the precision and responsiveness of the instrument. Third, a large percentage of a child's day may be spent performing relatively stationary activities (such as school-based activities like sitting in a classroom). For these reasons heart rate monitoring may be of limited use in assessing total daily physical activity.

These issues may contribute to considerable error when heart rate monitors are used for extended periods of monitoring (Welk, et al., 2000). However, techniques have been devised to address some limitations of heart rate monitoring. This primarily includes the use of heart rate indices that control for individual differences in resting heart rate and individualized heart rate to VO2 calibration curves (Kohl, et al., 2000; Trost, 2001). In an effort to improve the precision of heart rate-derived estimates of free-living energy expenditure, several investigators have used a combination of heart rate monitoring and accelerometry (Kohl, et al., 2000). Treuth, Adolph, and Butte (1998) tested the validity of this approach in children by comparing energy expenditure estimated by a combination of heart rate monitoring

and accelerometry to energy expenditure measured by whole-room calorimetry. Given the small magnitude of error, the authors concluded that the combination of heart rate monitoring and accelerometry provided an acceptable method for estimating energy expenditure not only for groups of youth but for individuals as well. However, increased burden placed on participants from wearing more than one device must also be taken into consideration.

2.6 DIRECT OBSERVATION

The final broad non-combination approach to measuring physical activity is direct observation. This involves witnessing physical activity behaviour while generally recording it on a coding form or through a handheld computer device to give an instantaneous rating of a child's physical activity level (McKenzie, Marshall, Sallis, & Conway, 2000). Direct observation has been used in a variety of naturalistic settings such as in home and school settings (Belton & Donncha, 2010; Fairclough & Stratton, 2006; Sallis et al., 2003; Sleap, 1996). It is especially useful for studies of young children who have not yet developed the cognitive ability to accurately recall detailed information (Anderssen, Jacobs, Aas, & Jakobsen, 1995). Additionally, direct observation itself has been considered as an appropriate criterion measure for the measurement of youth physical activity (Sirard & Pate, 2001). Relative to other methods, direct observation has a number of important advantages. Observational procedures are flexible and allow researchers to quantify physical activity in relation to actual context or environment such as behavioural cues, availability of equipment, and presence of significant others (McKenzie, 1991). Given its inherent flexibility, observation of physical activity can be used as either a process or outcome measure, and can therefore be useful to both researchers and practitioners. Direct observation has been shown to be a valid and reliable approach to measuring physical activity in children. McKenzie (2002) reviewed 9 different protocols for observing physical activity behaviour in children, with 8 of the 9 protocols having strong evidence of concurrent validity using accelerometry, heart rate monitoring, or energy expenditure assessed by indirect calorimetry as criterion measures. Additionally, inter-observer reliability was strong with reported kappa values greater than .90. Direct observation has several limitations. It can be very expensive (labour intensive), and therefore may be impractical for studies requiring long periods of observation or using large populations. However, direct observation remains a useful approach when

participants are confined to a defined space (e.g. classroom, school playground or gymnasium, home, or practice field) (McKenzie, 1991). Direct observation may be particularly useful when the influence of physical and social environments on youth activity behaviour is under investigation.

2.7 COMBINATION METHODS

Researchers looking to obtain accurate physical activity data may benefit from combining multiple approaches. Ottevaere, et al. (2011) found a slightly stronger association between the IPAQ-A and accelerometer counts of physical activity when the accelerometer data were enhanced in combination with a non-wear activity diary. Going, et al. (1999) used tri-axial accelerometers to measure the amount of activity, while using a specifically designed 24 hour physical activity recall questionnaire for assessing the frequency and type of activities in school children. Haerens, De Bourdeaudhuij, Maes, Cardon, and Deforche (2007) used a questionnaire in a total sample, while using accelerometers in a subsample to measure physical activity amongst adolescents to evaluate the effects of a physical activity intervention. Instruments incorporating combination measures of physical activity are also being made commercially available. One such device that integrates motion sensor data with a variety of heat-related sensors to estimate the energy cost of free-living activity is the SenseWear Armband (Calabro, Welk, & Eisenmann, 2009; Chen & Bassett, 2005). It contains a series of sensors measuring accelerometry, heat flux, galvanic skin response, skin temperature, and near-body ambient temperature (Chen & Bassett, 2005), and has recently been shown to yield accurate assessments of energy expenditure in youth when compared with the doubly labelled water method (Arvidsson, Slinde, & Hulthén, 2009).

2.8 EMERGING TECHNOLOGIES

Other devices have been developed that have the potential to measure youth physical activity, while also being used as health promotion tools. The Gruve tri-axial accelerometer is a clip-on physical activity monitor whereby data are synchronized with the internet to measure the wearer's caloric intake and personal progress. The individual's progress is indicated by a changing LED colour light at the top of the device. If the wearer's physical activity progress is below the set pre-determined goal, the monitor will vibrate as a reminder (Naditz, 2009). The Gruve

monitor has been shown to reliably distinguish between sedentary and walking activity in laboratory conditions (Manohar, Koepp, Mc Crady-Spitzer, & Levine, 2010). Another similar monitor is the Directlife tri-axial accelerometer (based on the Tracmor) (Bonomi, Plasqui, Goris, & Westerterp, 2009; Plasqui & Westerterp, 2007). Directlife is lightweight (12 g), waterproof up to 30m depth, has a battery life of 3 weeks and an internal memory that can store data for up to 22 weeks (Bonomi, Plasqui, Goris, & Westerterp, 2010). The monitor also contains an indicator bar of light-emitting diodes showing the achievement of the day in terms of amount of physical activity as determined by pre-set goals. While the Directlife monitor has been shown to accurately assess energy expenditure when compared to doubly labelled water in adult populations (Bonomi, et al., 2009), these devices are relatively untested amongst youth in free living conditions, and further validation is a priority for future research. Priorities for future research also include investigations reporting on practical information relating to the feasibility, not just the scientific validity or reliability of physical activity measurement approaches. For example, the ability to mail out physical activity measurement instruments to participants in remote locations would increase the feasibility of remote physical activity instrumental monitoring. However, the expected rate of instrument or data loss is currently unknown and is likely dependent on several factors (none of which have been investigated). The advancement of instrumental measurement approaches and their continued migration into commercial devices marketed for public and research usage, intensifies the need for researchers (independent of commercial entities) to validate these devices.

2.9 CONCLUSION

There will always be a trade-off between accuracy and available resources when choosing the best approach to measuring physical activity amongst youth. Unfortunately, cost and logistical challenges may prohibit the use of ‘gold standard’ physical activity measurement approaches such as doubly labelled water. However, other objective methods such as heart rate monitoring, accelerometry, pedometry, indirect calorimetry, or a combination of measures have the potential to capture the duration and intensity of physical activity, but do not capture information about the type or context of this activity. Self-reported measures can capture the type and context of physical activity and have a practical advantage over other approaches due

to their relative ease of administration and low cost. These practical advantages may come at the expense of precision due to dependence on recall of detailed historical activity information. However, this compromise is likely to be justified amongst large samples if the purpose of physical activity evaluation does not require a high degree of measurement precision for each individual.

The International Physical Activity Questionnaire for Adolescents (IPAQ-A) was selected for use in this program of research (Appendix A). Although the IPAQ-A is a relatively new instrument for measuring physical activity in youth, on face value and given the international popularity of the adult version, it was deemed an acceptable selection. It was logistically feasible given the large sample size that was to be targeted, low cost (only printing costs required), and a single data collection time-point (as opposed to a diary instrument). It also enabled the collection of contextual information such as physical activity performed over the four domains of leisure, school, transport, and home.

Chapter 3: Averting Uncertainty: A Practical Guide to Physical Activity Research in Australian Schools

Schools offer a unique research setting due to distinct methodological circumstances. However, school-based researchers face several obstacles in their endeavour to complete successful research investigations. This Chapter reviews the research processes undertaken when conducting physical activity-based studies within school settings. For the purpose of this discussion, the research process framework has been divided into six phases: preparation; design; outcome measures; procedures; participants; and feedback.

This Chapter is based on the following peer-reviewed journal article:

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3.1 ABSTRACT

Preventative health has become central to contemporary healthcare, identifying youth physical activity as a key factor in determining health and functioning. Schools offer a unique setting for physical activity research due to distinct methodological circumstances. However, school-based researchers face several obstacles in their endeavour to complete successful research investigations. They are often confronted with complex research designs and methodological procedures that are not easily amenable to school contexts. The purpose of this Chapter is to provide a practical guide for teachers (both teacher educators and teaching practitioners) seeking to conduct physical activity-based research in Australian school settings, as well as discuss research practices. The research enabling process has been divided into six phases: preparation; design; outcome measures; procedures; participants; and feedback. Careful planning and consideration must be undertaken prior to the commencement of, and during the research process, due to the complex nature of school settings and research processes that exist in the Australian context.

3.2 BACKGROUND

Preventative health has now become the focus of contemporary healthcare, with physical activity identified as a key factor in determining an individual's health and functioning (Australian Institute of Health and Welfare, 2010; World Health Organization, 2004). The focus of these health promotion initiatives has now turned to youth. This is in light of a number of investigations which have found adolescent physical activity to increase the likelihood of maintaining physical activity and other positive health-related lifestyle behaviours throughout adulthood (Guo & Chumlea, 1999; Hallal, et al., 2006; Muller-Riemenschneider, et al., 2008; Parsons, Power, Logan, & Summerbell, 1999; Wright, Parker, Lamont, & Craft, 2001). Insufficient amounts of youth physical activity in particular and its potential consequences later in life has been identified as an area of concern for the Australian Federal Government over the past decade (Australian Institute of Health and Welfare, 2004, 2006, 2008, 2010, 2012a). According to recent data from the 2009-10 National Secondary Students' Diet and Activity Survey, 85% of secondary school students from years 8-11 reported not engaging in sufficient levels of physical activity necessary to provide health benefits (Cancer Council Australia, 2011), in accordance with the Department of Health and Ageing's physical activity recommendations for 12-18 year olds (Department of Health and Ageing, 2004).

Schools have often been targeted as important settings for health promotion strategies aimed at increasing youth physical activity levels (Cleland, et al., 2008). In 2004, the World Health Organization specifically identified schools as a target setting for the promotion of physical activity among youth in its Global Strategy on Diet, Physical Activity and Health (World Health Organization, 2004). Youth spend many hours each year in school, and their school experiences profoundly influence their development (Alibali & Nathan, 2010). Therefore, they are an ideal setting for population-based physical activity measurement and interventions (Dobbins, et al., 2009). The demographics of samples obtained from schools are often diverse and differing substantially from those obtained via traditional methods of recruitment outside of the school environment (Alibali & Nathan, 2010). They also offer unique methodological circumstances, such as the ability to target students via pre-existing structures like curriculum (Dobbins, et al., 2009). Salient findings from school-based studies have the potential to inform school policy development. On this front, current

practising teachers should be aware that the introduction of a new national curriculum may correspond with increased studies being conducted within school settings, evaluating content, process and implementation procedures of the new curriculum. This is likely to include studies involving health promotion, which is a key theme found throughout the most recent "Shape of the Australian Curriculum: Health and Physical Education" document (Australian Curriculum Assessment and Reporting Authority, 2012b). In this context, school-based research may be conducted by those within government, not-for-profit, university or school organisations; or by a combination of researchers from more than one organisation type.

Several key obstacles must be overcome to enable successful research in Australian schools. These obstacles may be complex and difficult to navigate for those within, or external to school organisations. A recurrent theme for school-based physical activity intervention studies is the recruitment of teaching staff within the school as collaborators and project facilitators (Dobbins, et al., 2009). This role is often crucial to the success or failure of such programs. Therefore, improving research capacity among teachers, including enhanced knowledge of research practices, could lead the way to truly collaborative approaches, beneficial to all parties.

Teachers' engagement in school-based physical activity research is consistent with their contemporary role in school organisations. Teachers acting as researchers into their own practices, and practices within their schools, is long established (Babkie & Provost, 2004; Iliško, Ignatjeva, & Mičule, 2010). Australian education departments have described ongoing review of relevant research and literature as the key to achieving a critical awareness of significant issues and existing findings in an area of research (Department of Education and Early Childhood, 2006). This also has implications for teacher education. Appropriate teacher education strategies can empower teachers through researching their own practice, enabling teachers to become more aware of the complexities of the school environment, and for teacher research to be a self-reflection of their own professional practice (Gray & Campbell-Evans, 2002). Teachers involved in the physical education field or the general health and wellbeing of student populations will likely engage with school-based physical activity research. This engagement may come in the form of contributions to school-

based research activities that are being undertaken, or in the consumption of research findings to inform practice and policy.

Due to the need for programs that promote physical activity among Australian youth, and the complex nature of research within Australian school settings, a user-friendly guide to inform those seeking to conduct research and those facilitating research practices in Australian schools is warranted. The purpose of this Chapter is to provide a practical guide for those seeking to engage with research being undertaken in Australian school settings. For the purpose of this discussion, the research process framework has been divided into six phases: preparation; design; outcome measures; procedures; participants; and feedback.

3.3 PREPARATION

The preparation phase of the research process comprises two significant obstacles. These obstacles must be addressed prior to the commencement of any data collection. These undertakings include collaborating with schools, and gaining ethical approval to conduct the research.

3.3.1 Collaborating with schools

Successful plans for recruiting and retaining school engagement often extend beyond research considerations and necessitate addressing the political, economic, educational, and organisational needs of the school setting (Petosa & Goodman, 1991). Petosa and Goodman (1991) present a taxonomy of decision-making procedures characteristic of school districts. The taxonomy provides a framework for designing effective recruitment and retention strategies. It divides the decision-making procedures of school districts into five distinct phases being: legitimacy; information seeking; expressions of limitations; expressions of engagement; and commitment. Olds and Symons (1990) published a set of recommendations based on field experience. They suggested investigators submit proposals that are procedurally and philosophically sound, and emphasise to schools the tangible benefits of participation.

There are at least five exigent scenarios that investigators may face in order to build successful collaborations to conduct research within school organisations. First, although administrators may express interest in the potential outcomes of a proposed project, they may be unwilling to disrupt the operation of their schools to conduct the

project (Petosa & Goodman, 1991). Second, administrators may be willing to agree to their schools involvement; however, some teachers or school-based research liaisons may be non-participatory (either actively or passively). This non-participation may be due to perceived (or actual) increased burden caused by research participation, differing priorities between school administrators and teachers, or other elements of administrator-teacher dynamics that may be intrinsic to the culture of a school. Third, administrators and teacher colleagues may be unwilling to disrupt classroom organisation or student learning experiences for research design considerations (Petosa & Goodman, 1991). This may include a disinclination to withhold potentially innovative curricula from a portion of students to permit a 'control group' comparison. Fourth, administrators or teachers may perceive the motivation and demands of research projects to be incompatible with the ideology or operation of schools (Petosa & Goodman, 1991). Fifth, there may be a perception within schools that adequate structures already exist that stifles the introduction of new policy initiatives around physical activity (including physical activity research) (Mathews, et al., 2010).

In many cases, there is likely to be a trade off between study design rigour and practical considerations for the school involved in the research. While some elements of 'ideal' study design may need to be compromised, investigators must ensure that a degraded research plan does not ultimately undermine the future wider practical application of the research findings (Petosa & Goodman, 1991). On the other hand, if schools refuse to participate, a systematic bias may be created whereby sample populations from 'co-operative schools' evident in the research literature are not representative of the actual population (Petosa & Goodman, 1991). It has wisely been suggested that investigators must endeavour to maintain positive relationships with teachers and school administrators, who are key to the research process (Alibali & Nathan, 2010). This is likely to involve patience, non-disruption to the curriculum (wherever possible), flexibility to accommodate school structures and requirements, and use of outcome measures and feedback mechanisms that benefit faculty, administration, and students. It is important to understand and emphasise the spirit of mutual partnership, whereby practitioners are active researchers. Discussions with school staff prior to commencement of the project may be beneficial. Opportunities

may be identified for staff professional development or school improvement which can be tailored for in the design phase.

3.3.2 Ethical approval

School-based physical activity research must adhere to regulatory guidelines for the ethical conduct of human research. At a minimum, this will usually involve a review and approval of the planned research protocol by a local human research ethical review board or designated individual. Most peer-reviewed scientific journals will no longer publish reports of human research that have not received relevant local ethical approvals. Multiple ethical approvals may be required prior to the commencement of data collection. First, it may be necessary to complete institutional ethics applications. For university-based researchers conducting research within schools, this will usually require a letter of collaborative agreement from a suitable representative at the school where the research will be undertaken to accompany their application for ethical approval. Ethical requirements for government schools may differ depending on the size of the project, and the number of schools participating. For example, in the state of Queensland, if one school is participating, approval is only required from the corresponding school principal. If several schools in a single Department of Education and Training (DET) region are participating, approval must be obtained from the regional director. If schools in more than one DET region are participating, approval is required from the Central Office (Department of Education and Training, 2005).

Local processes for ethical approval also differ for schools governed by religious bodies. For example in Brisbane, Queensland, all applications to conduct research in diocesan catholic schools are coordinated centrally through the relevant archdiocese executive director's office. All applications to conduct research in religious institute schools (independent Catholic schools administered by religious orders) must be addressed separately and directed specifically to the principals of these schools (Catholic Education Archdiocese of Brisbane, 2010). Applications are considered by the relevant Catholic Education Research Committee, which typically meet on a monthly basis. Once the application has been reviewed and accepted, a letter of approval to approach the principal(s) at the respective school(s) nominated will be sent to the principal(s) notifying them of the researcher's proposed approach. It is a condition of approval that upon completion of the research, the researcher will

provide Brisbane Catholic Education with a copy of the research findings, provide the schools in which the research was conducted with a summary of the research findings, and give permission for Brisbane Catholic Education to disseminate the reports to its personnel (Catholic Education Archdiocese of Brisbane, 2010).

The specific processes (including application forms) for attaining ethical approval are subject to variability between institutions, states, and education systems throughout Australia and internationally. However, the fundamental tasks involved in completing ethical applications remain much the same. Applications for ethical approval commonly require description of the study aims, methods, and descriptions of how common potential ethical concerns (including privacy and confidentiality) have been addressed. The key considerations of ethical review boards are also somewhat consistent across institutions; namely beneficence, respect and justice are central values (National Health and Medical Research Council, 2007). This not only includes the merit and integrity of the research or whether the benefits of the research outweigh any potential risks, but also the manner with which research is to be conducted and ensuring sufficient protections are in place for vulnerable persons (National Health and Medical Research Council, 2007). In this regard, children in schools are likely to be considered vulnerable persons. Therefore, investigators need to consider the nature of dependent relationships between teachers and students to ensure that consent is not granted as a deference to the investigator's perceived position of power, or to someone else's wishes (National Health and Medical Research Council, 2007). Individuals should only be included if their participation is voluntary (National Health and Medical Research Council, 2007).

School-based research involving children as participants raises some specific ethical concerns regarding the provision of informed consent. These concerns centre around children's and young persons' capacity to understand what the research entails, and therefore whether their consent to participate is sufficient (National Health and Medical Research Council, 2007). The National Statement on Ethical Conduct in Human Research details four levels of maturity (National Health and Medical Research Council, 2007). First, infants, who are unlikely to be involved in school-based research, are unable to take part in discussion about the research. Second, young children who are able to understand some relevant information and take part in limited discussion about the research, but require parental (or guardian)

consent. Third, young people of developing maturity, who are able to understand the relevant information but whose relative immaturity means that they remain vulnerable, meaning that their consent is required, but is not sufficient to authorise research without concurrent parental (or guardian) consent; and, young people who are mature enough to understand and consent, and are not vulnerable through immaturity in ways that warrant additional consent from a parent (or guardian) (National Health and Medical Research Council, 2007). It is not possible to attach fixed ages to each level, as they may vary from child to child. Participants should be engaged in discussion at their level about the research and its likely outcomes.

3.4 DESIGN

A key consideration for any research activity is the study design. The same overarching principles of research design that govern research in most contexts also apply to school-based research. There is an almost limitless range of possible research design variations that may be implemented. However, research design selection for any specific project should be informed by a range of factors. Some common factors include the research question or study aims, available resources (funding, equipment, support, and time), the nature of the sample, institutional restrictions and ethical considerations. Study types may be divided into two broad categories: observational studies and intervention studies (dos Santos Silva, 1999).

Observational studies are those investigations that do not include an intervention being allocated to participants as part of the research protocol (dos Santos Silva, 1999). School-based observational studies may draw inferences about students, teachers, parents, organisational structures or processes and other topics of relevance in schools. Observational studies may also involve drawing some inferences about the effectiveness of interventions or changes in curriculum activities that occurred (but were not assigned to participants as part of the research protocol). However, observational studies of this nature could only postulate causal links in the absence of a control group for comparison purposes. Where the aim of a research investigation is to evaluate the effect of an intervention, an intervention study design would be more appropriate.

Intervention studies generally aim to evaluate the effect of an intervention on a specific group of participants (dos Santos Silva, 1999). Randomised controlled trials

are often considered the 'gold standard' for intervention studies, and this holds true for school-based physical activity research (Dobbins, et al., 2009). While randomised trials are a rigorous way to evaluate the effectiveness of an intervention, they are not always pragmatic in school settings. For this reason a range of other quasi-experimental designs are often used (Dobbins, et al., 2009). Quasi-experimental designs generally do not involve the random allocation of participants to an intervention or control group. This approach may be more palatable to school organisations who do not want to withhold potentially innovative and effective interventions on the basis of random allocation.

A recent Cochrane systematic review that included both randomised trials and quasi-experimental designs summarised the current evidence of effectiveness for school-based interventions in promoting physical activity and fitness in children (Dobbins, et al., 2009). It was found that school-based interventions can have positive impacts on physical activity, television viewing, Vo2max, and blood cholesterol. However, existing studies have not demonstrated an effect on leisure time physical activity rates, systolic and diastolic blood pressure, body mass index, and pulse rate. At a minimum, a combination of printed educational materials and changes to the school curriculum that promote physical activity can result in positive effects. The authors concluded that, given that there are no harmful effects and that there is some evidence of positive effects on lifestyle behaviours and physical health status measures, ongoing physical activity promotion in schools are recommended (Dobbins, et al., 2009). It was also recommended that school-based interventions be tailored to the developmental level of participants and foster positive attitudes toward physical activity (Dobbins, et al., 2009). Given these findings, there is much room for innovation, evaluation and refinement of school-based physical activity interventions.

There is growing support for the notion that broad social-ecological approaches are needed to promote positive lifestyle behaviours (Booth, et al., 2001). Social ecological models propose multiple dimensions of influence and hypothesise that self-regulation is difficult to establish without broader social and institutional support (Dzewaltowski, 1997). It is a recurring theme throughout the literature that a multi-faceted approach must be taken when promoting youth positive lifestyle behaviours. This approach includes the utilisation of associated groups such as parents, teachers,

school administrators, and members of the community (Booth, et al., 2001; Dobbins, et al., 2009; Faber, et al., 2007). Past notable strategies to increase student physical activity in school settings include: changes to curriculum (Eliakim et al., 1996; McKenzie, Sallis, Faucette, Roby, & Kolody, 1993; McKenzie, Sallis, Kolody, & Faucette, 1997), provision of equipment (Verstraete, Cardon, De Clercq, & De Bourdeaudhuij, 2006), training for teachers (McKenzie, et al., 1997), educational materials for teachers (Carrel et al., 2005; Eliakim, et al., 1996), targeting of parents (Burke et al., 1998), community-based strategies (Bush et al., 1989; Ewart, Young, & Hagberg, 1998), mass media involvement (Lionis et al., 1991; Owen, Bauman, Booth, Oldenburg, & Magnus, 1995); and the use of counsellors and other health professionals (Graf et al., 2005).

An additional recurrent theme for school-based physical activity intervention studies is the use of teaching staff within the school as project facilitators. To increase the potential success of these types of studies: (1) it is important for classroom teachers and other school personnel to recognise that developing healthy and active students is ideally a school-wide effort and whole school responsibility, reinforced within the school environment (Cale, 2000; Faber, et al., 2007); (2) physical educators should model healthy and active behaviours (Dobbins, et al., 2009; Faber, et al., 2007); (3) classroom teachers should embed physical activities and health knowledge into a range of cross-curricular subjects inside the classroom; and (4) teachers in the school should be informed about the goals and benefits of the program, and about the benefits of physical activity breaks and of integrating health knowledge into other subjects (Faber, et al., 2007). This concept of integration already exists in Australia, with cross-curriculum priorities present in the new Australian Curriculum. However, health (or physical activity) promotion is not currently one of these priorities. At the time of writing, the priorities stand as “Aboriginal and Torres Strait Islander histories and cultures”, “Asia and Australia’s engagement with Asia”, and “Sustainability” (Australian Curriculum Assessment and Reporting Authority, 2011).

3.4.1 School Selection

Some key considerations that need to be made regarding school selection prior to collecting data include whether the school is single or mixed gender, in a rural or urban setting, private or public, as well as the socio-economic composition of the

school and the area in which it resides. One particularly useful tool to judge the SES background of a school is the Australian Curriculum, Assessment and Reporting Authority's (ACARA's) Index of Community Socio-Education Advantage (ICSEA). Briefly, ICSEA is a scale that enables meaningful comparisons to be made across schools. It has been designed specifically for the ACARA's My School website for identifying schools serving similar student populations. The variables used in calculating a value on the ICSEA scale include student-level data on the occupation and education level of parents/carers, and/or socio-economic characteristics of the areas where students live; whether a school is in a metropolitan, regional or remote area; the proportion of students from a language background other than English and the proportion of Indigenous students enrolled at the school (Australian Curriculum Assessment and Reporting Authority, 2012a).

The ICSEA method may have practical advantages over traditional methods for determining SES in Australia, such as the Socio-Economic Indexes for Areas (SEIFA). These indexes are compiled at the Census Collection District (CD) level, and may be used to rank CDs according to the general socio-economic wellbeing of residents (Adhikari, 2006). This use of ICSEA prevents artificial misrepresentations whereby a student from a high SES family, or living in a highly ranked CD, is attending a school in a low SES ranked neighbourhood (CD). Identifying the SES background of youth is critical, and may have implications for a number of factors related to physical activity, such as participation in studies (Nickelson et al., 2011), and barriers to being physically active (Humbert et al., 2006).

3.5 OUTCOME MEASURES

Most studies include a range of demographic variables, as well as both primary and secondary outcomes. In the context of school-based physical activity research, demographic variables may be collected from students, parents, teachers or administrators. Some variables, such as date of birth, height and weight (BMI), and ethnic background (Aboriginal and/or Torres Strait Islander), may be relevant to all groups. However, some demographic variables are likely to be specific to adults, such as smoker status, marital status, and level of education. Variables of relevance to teacher participants may include teaching experience, formal qualifications and teaching areas.

Primary outcome measures often represent the outcome of greatest potential therapeutic benefit relevant to the research aim, and hence the outcome of greatest importance to the study at hand. Secondary outcome measures may provide information on additional effects (such as side-effects, or tolerability), that are relevant to address the research aim and are of secondary importance (Sedgwick, 2010). While specific primary and secondary outcomes may vary substantially depending on the research question at hand, one construct that is likely to be measured in almost all school-based physical activity research is physical activity.

Instruments that measure the prevalence of physical activity have long been used as a part of school-based research, both as tools to facilitate physical activity, and to evaluate effectiveness (Dobbins, et al., 2009). Its accurate assessment is critically important when examining the relationship between physical activity and health (e.g. cardiovascular disease risk factors, fatness, and aerobic fitness) (Ekelund, et al., 2001). Physical activity assessments can also provide valuable information to children and parents, and may also provide a meaningful outcome for school administrators and teachers (Welk, 2008). Monitoring the physical activity levels of youth requires a valid measure that is age appropriate, easy to administer, and which poses minimal participant burden (Trost, et al., 2007). A wide range of methods have been used to measure physical activity in children and adolescents. These can be broadly grouped as direct observation, self-report and instrumental categories.

3.5.1 Direct observation

Direct observation of physical activity levels may be used to examine physical activity levels within specific contexts and direct observation (Belton & Donncha, 2010; Fairclough & Stratton, 2006; Kohl, et al., 2000; Pate, 1993; Sallis, et al., 2003; Sleap, 1996; Trost, 2007). This may include observation and recording of the types and duration of physical activity undertaken by students during their lunch break, or other context specific occasions. An advantage of direct observation is the ability to record the type of physical activity undertaken. However, key disadvantages of direct observation is that it is labour intensive, lacks scalability and can be difficult to quantify the intensity of physical activity being undertaken among individuals within an observed group.

3.5.2 Self-report physical activity measurement

Self-report measures have a practical advantage over other approaches for studies with large sample sizes and restrictive budgets due to their relative ease of administration (in comparison to instrumental measurement or interview techniques) and low cost (Chinapaw, et al., 2010). However, this may come with some compromise on the reliability and validity of self-reported data which is dependent on recall of prior activity (Chinapaw, et al., 2010). It is not an easy task for investigators to determine which instrument is most suitable for their purpose due to the diversity in available questionnaires (Chinapaw, et al., 2010). Some examples of self-report instruments which have been widely used in school settings include the Previous Day Physical Activity Recall (PDPAR) (McMurray, et al., 2008; Saunders et al., 1997; Trost, et al., 2007; Trost, et al., 1999; Welk, et al., 2004; Weston, et al., 1997; Yngve, Anderson, & Hagstromer, 2005), and the Bouchard 3-day Activity Record (Bratteby, Sandhagen, Lotborn, & Samuelson, 1997; Bratteby, Sandhagen, & Samuelson, 2005; Henry, Webster-Gandy, & Elia, 1999).

Youth have a physical activity pattern that is much more variable and intermittent than that of adults (Baquet, et al., 2007), and they are less likely to make accurate self-report assessments than adults due to developmental differences, especially in the ability to think abstractly and report detailed recall (Going, et al., 1999; Sallis, 1991). It may help to include a practice administration in an effort to help familiarise youth with the survey procedures and assess validity using multiple administrations of the instrument (Trost, et al., 2007). Where possible, more sophisticated measures of physical activity and sedentary behaviour should be used, such as accelerometers, time-use diaries, or direct observation (Trost, et al., 2000).

3.5.3 Instrumental physical activity measurement

Instrumental measures with real time data storage capabilities offer a distinct advantage over self-report methods in that they provide reliable information on patterns of physical activity within a given day or over several days (Trost, et al., 2000). It is often helpful to include an objective measurement tool to avoid dependency on recollection and the reading of questionnaires while measuring physical activity in children and adolescents (Cuddihy, et al., 2005). There has been a rapid increase in both the number and type of objective physical activity assessment

instruments, including pedometers and accelerometers, which are commercially available to researchers, practitioners, and consumers (Chen & Bassett, 2005).

The increase in the availability of instruments to measure physical activity has led to investigators being often overwhelmed and confused when attempting to select the one which is most appropriate for their purposes (Tudor-Locke & McClain, 2009). As a result, researchers and practitioners at times make under-informed choices with regard to instrument selection (Tudor-Locke & McClain, 2009). Some popular instrumental approaches which have been used frequently in school settings include accelerometers (Baquet, et al., 2007; Cooper, Page, Foster, & Qahwaji, 2003; Corder, et al., 2009; Haerens, et al., 2007; Maia, Ferreira, Lopes, & Vasques, 2007; McMurray, et al., 2008; Mota, et al., 2007; Pate, Saunders, et al., 2003; Trost, et al., 2000; Trost, et al., 1999; Tudor-Locke, 2004; Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009; Welk, et al., 2004; Weston, et al., 1997; Wickel et al., 2007; Yngve, et al., 2005), pedometers (Lee & Trost, 2005; Scruggs, Mungen, & Oh, 2010a, 2010b; Trost, et al., 2007; Weston, et al., 1997), doubly labelled water (Arvidsson, et al., 2005; Corder, et al., 2009; Ekelund, et al., 2001; Sjoberg, et al., 2003) and heart rate monitors (Belton & Donncha, 2010; Watson, Beveridge, & Scruggs, 2003; Weston, et al., 1997).

Distribution and collection of physical activity measurement instruments may be problematic for physical activity researchers working with both youth and adults. However, schools provide a structured environment with fixed routine interaction points that can be utilised to facilitate the distribution and collection of instruments. This may alleviate the need to expend resources mailing and collecting instruments for physical activity measurement (Keyserling et al., 2008; Price, Tucker, Griffin, & Holman, 2008; Robinson et al., 2008; Sanchez et al., 2008; Sloane, Demark-Wahnefried, Snyder, Kraus, & Lobach, 2009). One potential drawback from physical activity measurement instruments is that they may introduce a strong focus on the desired outcome, at the expense of less focus being attributed to the underlying behaviour that is being promoted (physical activity) (Welk, 2008).

There is almost always a trade-off between practicality and accuracy when quantitatively measuring physical activity. Unfortunately, cost and logistical challenges may prohibit the use of ‘gold standard’ physical activity measurement approaches such as doubly labelled water. However, other objective methods such as

heart rate monitoring, accelerometry, pedometry, indirect calorimetry, or a combination of measures have the potential to capture the duration and intensity of physical activity, but do not capture information about the type or context of this activity. Self-reported measures can capture the type and context of physical activity and have a practical advantage over other approaches due to their relative ease of administration and low cost. These practical advantages may come at the expense of precision due to dependence on recall of detailed historical activity information. However, this compromise is likely to be justified among large samples if the purpose of physical activity evaluation does not require a high degree of measurement precision for each individual (Rachele, McPhail, Washington, & Cuddihy, 2012).

3.6 PARTICIPANTS

3.6.1 Recruitment

Information regarding recruiting child participants for school-based research is limited (Pincus & Friedman, 2004). Popular strategies for promoting the recruitment of participants within school settings include the use of flyers (Park, Hong, Lee, & Kang, 2007), school newsletters (Kipping, Jago, & Lawlor, 2012; Park, et al., 2007), special presentations (Reed, Warburton, Macdonald, Naylor, & McKay, 2008) and announcements at full school and year level assemblies (McLaughlin, 2006; Pate, et al., 2005). However, the comparative effectiveness of these approaches is currently unknown, and multiple approaches run in parallel may be the best way to disseminate information about the study being conducted (Jamner, Spruijt-Metz, Bassin, & Cooper, 2004).

Unless a waiver of consent has been granted as part of the ethical approval process, potential research participants have the right to decide whether or not they would like to participate in the research. It is common for studies that utilise a large number of aggregated de-identifiable routinely collected data to be granted a waiver of consent during the ethical review process. However, in all other circumstances participants must provide informed consent as part of the recruitment process. This frequently occurs through the use of participant information sheets and written consent forms, which are central to the recruitment process. Potential participants may choose to decline participation (or withdraw from the study at any time) for any

reason. These reasons may include being burdened by data collection requirements; having difficulty reading questionnaires or completing assessments; disclosing information about sensitive topics; invasiveness of measurements; and confidentially concerns (Rice, Bunker, Kang, Howell, & Weaver, 2007). If the study is being conducted during class time, the investigators must consider what activities non-participating students might perform while their peers are completing the study, and will that activity disadvantage study participants or non-participants. For example, non-participating students may be given a relative advantage if completing homework or assessment tasks while their peers take part in the research investigation.

3.6.2 Retention

The retention of participants can often determine the success of studies, particularly studies with longitudinal designs and longer term follow-up assessments. Participants who dropout can produce bias, affecting study findings and interpretation (Frank, Nader, Zive, Broyles, & Brennan, 2003). Investigators should be alert to personal issues, beliefs, and attitudes of potential participants (Frank, et al., 2003). The retention rate of participants is likely to be enhanced by ensuring participants are informed about the tasks they will be expected to complete during the study. Common important tasks that participants should be informed about include the number and timing of re-assessments, the nature of interventions they may receive, and the length of the study. Factors affecting participant retention among school children are likely to include family non-participation, research environment, incentives, knowledge of condition, community outreach, gender, and ethnicity (Frank, et al., 2003). Several strategies can be used to maximise retention of participants during the implementation of a study. Examples include reminders about upcoming re-assessments, integrating re-assessments into school scheduling, providing multiple opportunities to complete re-assessments, and ensuring that assessments are not long and burdensome.

3.6.3 Incentives

The issue of incentives should be considered early in the design of the research proposal, with attention to developmental age, ethical considerations, purpose of the research, and burden to the child and family. Decisions about payment or reimbursement in kind should take into account the customs and practices of the

community in which the research is being conducted (National Health and Medical Research Council, 2007). Furthermore, the potential for loss of intrinsic motivation that may be exhibited through the use of extrinsic rewards should also be considered by participating schools (Kohn, 1998). Prior discussion with relevant school staff is advised as to 'what' and 'how much', or whether incentives are to be included at all during the research process, and should be reflective of the burden undertaken (Rice, et al., 2007). Payment that is disproportionate to the time involved, or any other inducement that is likely to encourage participants to take risks is ethically unacceptable (National Health and Medical Research Council, 2007).

3.7 FEEDBACK

Context specific feedback provided directly to school administrators or teachers is an important mechanism through which investigators can maximise the benefit that participating schools receive from the research. This is not only an important altruistic objective of school-based research, but also improves the likelihood of school participation in a research study, and emphasises the partnership of mutual benefit between school and researcher. In return for their teachers' and students' time and services, feedback must be meaningful for participants (Petosa & Goodman, 1991). In this sense, discussions with appropriate school staff prior to the commencement of the project may be beneficial, and opportunities may be identified for staff professional development or school improvement. The most valid and sincere form of feedback that is appealing to schools that choose to participate will generally come in the form of study results. Results should be returned to schools in a format that is meaningful to school administrators, and provides the school with relevant information about its population. Therefore, research publications acquired from the data collected at the school may not always be the best form of feedback that researchers can provide. Alternative feedback could be provided in the form of lay-language reports which focus on specific outcomes of interest to the school, or customised presentations to school staff and administrators.

3.8 CONCLUSION

Those wishing to investigate school-based physical activity face several obstacles in their endeavour to complete successful research investigations. Careful planning and consideration must be undertaken prior to the commencement of, and

during, the research process, due to the complex nature of school settings and research processes that exist in the Australian context. Improving the research capacity among teachers, including enhanced knowledge of research practices, could lead the way to truly collaborative approaches, beneficial to all parties. This may ultimately lead to the prevention of barriers which are potentially averting schools from participating in research studies, and avoid disruption to staff and students during the research process. Advancing the relationship between schools and research institutions may lead to increased collaboration, with mutual benefits.

Chapter 4: Towards an Operational Understanding of Wellness

Perhaps the greatest overarching issue facing the field of wellness is the lack of consensus on a definition. An agreed upon definition, or at least an agreed upon understanding of the construct is needed in order to facilitate the comparison of research findings, program implementation and evaluation. This Chapter aims to provide an operational understanding of wellness from the perspective of its use within educational institutions.

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4.1 ABSTRACT

Despite the increased focus on wellness and wellness programs there is still no consensus as to what wellness is. In this paper, we suggest an operational understanding of wellness and show how wellness differs from health, quality of life and wellbeing. Academic literature on the subject of health, wellness, wellbeing and quality of life reveals some confusion as theorists and researchers frequently describe each of these constructs in a similar manner. It is proposed that the context and target population in which the term wellness is used are critical for our understanding of the construct. While it is inevitable that cross-over exists between similar constructs, wellness does have distinctly identifiable features. These include, being both holistic and multidimensional, being focused on lifestyle behaviours, being about actions or processes, recognising the interrelatedness between person and environment, and being unique in goal and context.

4.2 BACKGROUND

Wellness is receiving substantial attention, particularly regarding intervention programs designed to facilitate the adoption of positive lifestyle behaviours among youth within educational settings (Hettler, 1980; Miller, Martens, & Gilman, 2008; Smith-Adcock, et al., 2008). Wellness programs and services run within educational institutions have proven to be particularly popular as enjoyable and accessible programs where participants can learn about and practice healthy living. For example: Smith-Adcock, et al. (2008) examined a group counselling intervention developed to promote wellness among adolescent girls at risk of delinquency, Choate and Smith (2003) infused a wellness model into the curriculum design of a first-year college course and examined changes in student wellness, and Benjamins and Whitman (2010) required schools to form wellness councils, write wellness policies, and implement policy changes or activities in five key areas being health education, physical education, school environment, family involvement, and staff wellness.

Despite the increased focus on wellness and wellness programs within educational settings, there is currently no consensus as to what wellness is. As a result, studies that assume a wellness focus are often hard to differentiate from studies that pertain to related constructs such as health, quality of life and wellbeing. A review of the academic literature highlights a variety of interpretations as theorists frequently use a range of related constructs to describe each other. Similarly, studies purporting to investigate one construct often use instruments designed to measure another. The Wheel of Wellness Model (Sweeney & Witmer, 1991), for example, is said to have an established empirical link with enhanced quality of life and wellbeing. Similarly, the Indivisible Self Model of Wellness, developed from data collected from the Wellness Evaluation of Lifestyle questionnaire (Myers, et al., 2004), is claimed to represent a way of life oriented toward optimal health and wellbeing. Wellness is also said to: embody a way of living designed to improve quality of life (Renger, et al., 2000), be a way of life oriented towards health and wellbeing (Myers, et al., 2004), and be strongly consonant with subjective wellbeing, life satisfaction and developmental assets (Coatsworth, et al., 2006).

Due to this lack of consensus, wellness studies and programs often employ vastly different outcome measures, making comparisons between studies a difficult undertaking. Consensus could facilitate an agreed upon theoretical model against

which wellness instruments could be validated, thus providing a clear basis for the evaluation of wellness research and interventions. Current definitions of wellness are often difficult to separate from related constructs health, quality of life and wellbeing, and therefore more consideration of these differences need to be discussed. This Chapter outlines an understanding of wellness by comparing the construct to health, quality of life and wellbeing and suggests how to best utilise this understanding to develop effective wellness programs within education settings.

4.3 DISCUSSION

4.3.1 Wellness: A brief history

Modern perspectives in the study of wellness began in parallel with the positive health movement which came about as a result of the World Health Organization's (WHO) definition of Health. In 1946 the WHO created a definition of health that reflected not just the absence of disease, but complete physical, psychological, and social wellbeing (World Health Organization, 1946). Currently, there are numerous theories and models claiming to represent wellness; however, they are all linked by a focus on lifestyle dimensions (Adams, et al., 1997; Coatsworth, et al., 2006; Crose, et al., 1992; Depken, 1994; Greenberg, 1985; Hettler, 1980; Lafferty, 1979; Leafgren, 1990; Myers & Sweeney, 2004a; Renger, et al., 2000; Witmer & Sweeney, 1992). Traditional views of wellness generally include those by Dunn (1977), who first defined wellness as a dynamic process maximizing an individual's potential, and by Hettler (1980), who stated that wellness can be defined as an active process through which the individual becomes aware of and makes choices toward a more successful existence. Although the WHO does not intend its 2006 definition to be exhaustive or scientific, it defines wellness as

> "the optimal state of health of individuals and groups. There are two focal concerns: the realization of the fullest potential of an individual physically, psychologically, socially, spiritually and economically, and the fulfilment of one's role expectations in the family, community, place of worship, workplace and other settings" (Smith, et al., 2006).

From a scientific perspective, Roscoe (2009) undertook what she considered the first of many steps to clarify the wellness construct. Notably, Roscoe's findings suggested that wellness studies: 1) had minimal empirical exploration of the structure and dimensions of wellness, 2) were predominantly informed by conceptual untested

theories, and 3) did not investigate the nature of wellness, rather they explore properties of the instruments. Roscoe proposed the need for an integrated definition of the construct.

As suggested by the above definitions, the majority of theories (Adams, et al., 1997; Crose, et al., 1992; Depken, 1994; Greenberg, 1985; Hettler, 1980; Lafferty, 1979; Leafgren, 1990; Renger, et al., 2000) divide wellness into individually oriented and interrelated dimensions. In the main the dimensions are social wellness, emotional wellness, physical wellness, intellectual wellness, and spiritual wellness (Roscoe, 2009). Some also contain a psychological wellness dimension (Adams, et al., 1997). Models such as those by Crose, et al. (1992), Hettler (1980), Leafgren (1990), and Renger, et al. (2000) include dimensions where the individual is regarded as functioning within a specific salient context, such as occupational wellness (Crose, et al., 1992; Hettler, 1980; Leafgren, 1990) or environmental wellness (Renger, et al., 2000). Many wellness models place particular importance on spirituality, and use this dimension as the core of their model (Eberst, 1984; Myers, et al., 2000).

In the following sections we briefly synthesise definitions of health, quality of life and wellbeing with the aim of determining an understanding of wellness.

4.3.2 Health

Differentiation between the definitions of wellness and health has previously been identified as problematic (Mackey, 2000). Traditionally, health has been conceptualised and evaluated from an illness perspective (Breslow, 1972). When a person is deemed to have good health, it invariably means that the person is not suffering from any identifiable disease. Furthermore, an improvement in that person's health is traditionally understood to mean that the disease is less severe (Breslow, 1972). This pathogenic approach to health focuses on the origins and causes of disease (Becker, Glascoff, & Felts, 2010), and likely arose from the fact that the predominant health problem facing society, and in particular medicine, was overcoming infectious disease (Breslow, 1972). This model has been highly productive in the advancement of medical sciences, preventing and curing diseases and prolonging life. It does not, however, allow for optimal functioning beyond lack of illness, and for the journey towards optimal functioning. A salutogenic perspective to health provides an alternative framework to approach modern health. Briefly, salutogensesis focuses on the origins or causes of health, while also focusing on

moving toward higher level health, or optimization (Becker, et al., 2010). While the starting point of a pathogenic approach to health is to solve a particular disease or problem, the starting point of a salutogenic approach to health is an already healthy individual, with a focus on that individual reaching a higher potential. The difference between these two complementary perspectives on health is that the endpoint of a pathogenic approach is the freedom from illness (hence the problem is solved), whereas the endpoint of a salutogenic approach is an individual reaching their fullest potential (Becker, et al., 2010). A salutogenic approach may therefore be more conducive to wellness theories.

Both the WHO and the Australian Government Department of Health (Deparment of Health, 2013; World Health Organization, 1946) define health to be a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity. The Australian Bureau of Statistics (2001) divides health into two major dimensions being physical health, and mental health. Physical health is said to relate to the functioning of the physical body, while mental health is said to relate to people's emotions, thoughts and behaviours. This definition of health also proposes that these two dimensions interact with one another. For example, a person's physical health can influence their mental state. These modern definitions of health allow for healthcare systems to create environments that can enhance the health potential of the Australian population.

4.3.3 Quality of life

Quality of life has been described as elusive, approachable at varying levels of generality from the assessment of societal or community wellbeing, to the specific evaluation of the situations of individuals or groups (Felce & Perry, 1995). These societal and individualistic perspectives have intensified the diversity of both operational definitions of quality of life, and applicable theoretical models or academic orientations (Felce & Perry, 1995). The field of medicine adapted quality of life and created health-related quality of life. This term focuses on an individual's functional health status, usually with reference to illness or recovery from a disease. This includes evaluation of symptoms, physical function, cognitive performance, psychological condition, emotional status, and adaptation to disease (Gupta & Kant, 2009). Both quality of life and health-related quality of life have gained in popularity

in recent times due to their application in quantifying the status of an individual, especially in healthcare settings.

Measurement tools have been developed to measure these concepts. Such tools are being used by healthcare services to analyse the effectiveness of interventions, treatment decisions, and new medical technologies (Bravo Vergel & Sculpher, 2008). Cost-effectiveness is determined by quality-adjusted life years (QALY), and increase in life expectancy (Bravo Vergel & Sculpher, 2008). Briefly, QALY is a composite measure of outcome for use in healthcare economic evaluation studies, with measured or judged health-related quality of life weights for health states (on a 0-1 scale) used to adjust survival times (Weinstein & Stason, 1977). By plotting the health-related quality of life weight (also called utility score) for each healthcare intervention against the year in which the health outcome is obtained, a profile can be constructed comparing the consequences of one intervention to another (Bravo Vergel & Sculpher, 2008). The advantage of using the QALY measure is that it can simultaneously capture and aggregate gains in terms of both morbidity (health-related quality of life) and mortality (quantity) (Bravo Vergel & Sculpher, 2008).

Quality of life focuses on conditions that impact upon the functional status of the individual but typically does not allow for life fulfilment, but rather directs attention to the ability to complete physical tasks, activities of daily living and the avoidance of non-communicable diseases.

4.3.4 Wellbeing

Two central perspectives of wellbeing have been distinguished; hedonic and eudaimonic (Ryan & Deci, 2001). While these perspectives overlap, they are founded on different philosophical orientations regarding human needs and desires. The hedonic perspective is that wellbeing consists of pleasure or happiness, with these emotions being viewed as the essential goal of human life (Ryan & Deci, 2001). Wellbeing is therefore achieved by increasing happiness through striving for pleasurable moments and approaching stimuli that increase positive affect (Lundqvist, 2011). In contrast, the eudaimonic tradition considers wellbeing as the extent to which an individual develops their potential congruent with their values and engagements (Ryan & Deci, 2001; Ryff, 2004). These two traditional views of wellbeing are founded on distinct views of human nature and of what constitutes a good society (Ryan & Deci, 2001). They pose different questions concerning how

developmental and social processes relate to wellbeing, and prescribe different approaches to the enterprise of living (Ryan & Deci, 2001). However, evidence from a number of investigators has indicated that wellbeing is probably best conceived as a multidimensional phenomenon that includes aspects of both the hedonic and eudaimonic conceptions (Ryan & Deci, 2001). In more recent shifts in the definition of wellbeing, Seligman (2011) argues for greater focus on relationships, and accomplishment, while Jayawickreme, Forgeard, and Seligman (2012) additionally include positive emotion, engagement and meaning.

As with quality of life, the term wellbeing is sometimes further qualified, giving rise to terms such as psychological wellbeing and subjective wellbeing. Psychological wellbeing is deemed a multidimensional construct encompassing six outcomes: autonomy, personal growth, self-acceptance, life purpose, mastery, and positive relatedness (Ryff & Keyes, 1995). These six dimensions define psychological wellbeing both theoretically and operationally. It is suggested that high level emotional and physical health are promoted through the attainment of these six outcomes (Ryff & Singer, 1998).

Subjective wellbeing consists of three components: life satisfaction, the presence of positive mood, and the absence of negative mood, together often summarized as happiness (Ryan & Deci, 2001). These conceptual underpinnings of subjective wellbeing limit its use to the hedonic context. There has been much debate regarding the validity of measures of subjective wellbeing to define psychological wellness (Ryff & Singer, 1998). Three possibilities can be identified: 1) the hedonic view and subjective wellbeing could be used as an indicator of wellbeing; 2) subjective wellbeing could be an operational definition of wellbeing, while still endorsing the eudaimonic view of what fosters subjective wellbeing; and 3) the measure of subjective wellbeing as an indicator of wellbeing could be rejected, while arguing against hedonic principles as the vehicle to produce wellbeing (Ryan & Deci, 2001).

In all of the perspectives considered, however, wellbeing is considered an outcome measure. There is little room for independent or process variables where manipulation of particular dimensions can affect whole individual changes.

4.4 AN OPERATIONAL UNDERSTANDING OF WELLNESS

There are currently a number of wellness models which place individuals on a uni-dimensional scale where the individual is either on, or in-between, ill-health-wellness (Travis, 1977). These perspectives on wellness do not allow for an individual who is temporarily ill (e.g. has a cold) or who has permanent disability in one dimension, but is still 'well' with regards to other lifestyle dimensions as part of many multidimensional wellness models. Such an individual would not be accurately placed on a uni-dimensional scale of ill-health-wellness. If a person is receiving treatment requiring hospitalisation for a life threatening disease, can they still be considered well if they are living their potential in other dimensions? Although they are likely to have poor physical wellness due to illness, they may, for example, have increased spiritual, social, emotional, and intellectual wellness due to additional visits from family and friends in conjunction with extra time to learn and reflect. A multi-faceted model of wellness would more accurately portray the lifestyle of this person. This emphasises the uniqueness of the wellness construct from wellbeing, quality of life, and health.

From this perspective wellness is more than a salutogenic concept; it can be conceptualised as a holistic multi-dimensional construct where a person is perceived in terms of their journey towards being the best that they can be, within the environment in which they are situated. The multi-dimensional characteristics of wellness propose that human beings are at once spiritual, physical, social, intellectual, cognitive, and emotional beings. From this perspective, wellness promotion is about identifying and making the best of individual positive and negative constraints as a means to continuing the wellness journey. Wellness differs from health, quality of life and wellbeing in that wellness is interested in the development of individual lifestyle behaviours that *promote* the attainment of optimum functioning and fulfilment.

Wellness interventions may be analogously conceptualised in the context of driving a car. The goal of wellness interventions is not to simply prevent the onset of various diseases and conditions by moving away from negative outcomes and always 'looking in the rear view mirror'. In contrast, a wellness journey encompasses moving towards an ideal state where the driver is looking forward. This is not to say that positive health outcomes which are a consequence of good health practices

should be ignored, but the primary focus is moving towards optimal states on a range of dimensions rather than only avoiding or diminishing illness. The setting where wellness is applied is therefore of importance. The clinical context is one where clients may present with some perceived illness, disease or distress, with the goal of eliminating, minimising or managing that condition. Outside of healthcare environments, target populations are generally not defined by illness. Rather, the emphasis is on improvement that is not defined by health or illness status. One such context which comprises of predominantly healthy populations is within educational institutions, particularly schools. This may be the case due to the fact that the implications of poor health behaviours (e.g. the onset of chronic disease) often do not manifest until adulthood (Reiner, et al., 2013), and the predominant population within school settings are young people. Therefore, educational institutions provide a setting, and a context (as defined by its population) where wellness interventions can be of relative significance.

4.5 SUMMARY

While it is inevitable that cross-over exists between similar constructs, wellness does have distinctly identifiable features. Wellness is both holistic and multi-dimensional, with these dimensions being inter-related. The manipulation of one dimension has a reciprocal influence on other dimensions. Wellness is determined, however, not in terms of its individual dimensions but as an integrated whole. Wellness focuses on lifestyle behaviours. While the effectiveness of lifestyle choices can be 'measured' through assessments of wellbeing, quality of life or physiological measures (e.g. blood pressure), wellness is an integrated construct determined by behaviours which facilitate the journey towards optimal states on multiple dimensions. The purpose and practical application of wellness is undertaking positive lifestyle behaviours which enable an individual to achieve a higher order of functioning. Wellness in this context is therefore about actions or processes, rather than outcomes. Wellness recognises the interrelatedness between the person and their environment where one influences the other. Both intention and context make wellness programs and campaigns unique from those of related constructs. In summary, wellness is concerned with people making appropriate lifestyle choices, with a focus upon a range of positive outcomes across dimensions.

Chapter 5: Valid and reliable assessment of wellness among adolescents: Do you know what you're measuring?

Once an operational understanding of wellness in an institutional context has been established, an understanding of the current wellness assessment techniques in use may assist with the selection of an appropriate wellness measurement instrument. This Chapter reviews the variety of wellness measurement instruments currently in use among adolescent samples, and considers the empirical data supporting the validity and reliability of those instruments.

This Chapter is based on the following peer-reviewed journal article:

Rachele, J. N., Cuddihy, T. F., Washington, T. L., Barwais, F. & McPhail, S. (2013) Valid and reliable assessment of wellness among adolescents: do you know what you're measuring? *International Journal of Wellbeing, 3*(2), 162-172

5.1 ABSTRACT

Measuring wellness among adolescents is an emerging trend among professionals and researchers endeavouring to influence youth as they establish lifestyle patterns in this critical period of life. This discussion highlights instruments used to measure adolescents' wellness, and considers the empirical data supporting the validity and reliability of those instruments. In summary, adolescents' wellness is an important indicator of future health and lifestyle habits. There are a number of tools available to measure wellness, each with its own focus, depending on the definition or model from which it was developed. This may cause debate regarding the appropriateness of some instruments for evaluating wellness. The majority of wellness evaluation approaches used with adolescent populations have less than ideal validation. A 'gold standard' definition could lead to the standardisation of a theoretical model against which wellness instruments could be validated. The absence of peer-reviewed studies reporting psychometric testing for wellness evaluation instruments used with adolescents is of concern given their growing popularity and highlights a priority area for future research in this field.

5.2 BACKGROUND

'Wellness' is often considered the endpoint of physical, mental or social interventions. Wellness has been described as a dynamic process maximizing an individual's potential (Dunn, 1977); a way of life orientated toward optimal health and wellbeing in which body, mind, and spirit are integrated by an individual to live more fully within the human and natural community (Myers, et al., 2000); and a construct reflecting the process of enhancing life quality by integrating and balancing one's physical, mental, and spiritual wellbeing (Harari, Waehler, & Rogers, 2005). Although the World Health Organization (WHO) does not intend its definition to be exhaustive or scientific in nature, it defines wellness as

> "the optimal state of health of individuals and groups. There are two focal concerns: the realization of the fullest potential of an individual physically, psychologically, socially, spiritually and economically, and the fulfilment of one's role expectations in the family, community, place of worship, workplace and other settings" (Smith, et al., 2006).

To this end, wellness focuses on lifestyle behaviours which contribute toward individuals living to their fullest potential, and is determined not just in terms of its individual dimensions, but as an integrated whole. Wellbeing on the other hand, has been described as the balance-point between an individual's resource pool and the challenges faced, whereby stable wellbeing is when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge (Dodge, Daly, Huyton, & Sanders, 2012). Wellness also differs from other health-related concepts, such as health, which traditionally focuses on the individual in relation to illness status (Breslow, 1972), and quality of life, which has been defined as individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (Power et al., 1998). To observe the effect interventions have on wellness, or to observe wellness in a sample cohort at a single time point or change over time, it is important that wellness can be quantified. The advancement of wellness theories, such as early definitions provided by Dunn (1977), towards more advanced theories comprising multiple levels of dimensions and subscales such as the Indivisible Self model of wellness

(Myers & Sweeney, 2004a), has resulted in the development of a variety of instruments for measuring wellness.

One population group for whom measuring wellness is particularly important is adolescents. Behaviours or cognitions performed during this time may set the pattern for long periods of adulthood, as many lifestyle choices are established during adolescence (Craigie, et al., 2011; Hallal, et al., 2006; Trudeau, et al., 2004). Unhealthy habits and lifestyle choices established during adolescence can lead to disability and disease later in life. Therefore, adult mortality and morbidity could be reduced by improving health habits in adolescence. Specific wellness dimensions often reflect specific lifestyle outcomes. For example, lifestyle outcomes including stress, self-esteem, self-worth, nutrition and physical activity are also represented as subscales or dimensions within wellness models (Table 5.1 below). Measures like the Wellness Evaluation of Lifestyle (WEL) (Myers, et al., 1996) and the Five Factor Wellness Inventory (5F-Wel) (Myers & Sweeney, 1999) have been used in many recent empirical studies (Garrett, 1999; Garrett, et al., 2009; Myers & Bechtel, 2004; Myers, et al., 2011b; Rayle & Myers, 2004; Tatar & Myers, 2010). Scores derived from wellness instruments have been used as both dependent and independent variables to study wellness among youth in relation to diverse psychological constructs and demographic indices; and used across a variety of disciplines including clinical and non-clinical settings. For example, Garrett (1999) used the wellness scores of Native American youth to develop more effective counselling interventions; Myers, et al. (2011b) explored the extent to which wellness factors are predictive of self-esteem; Tatar and Myers (2010) examined cross-cultural differences in wellness between children in Israel and in the United States; Rayle (2005) examined the impact of mattering on adolescent wellness; Choate and Smith (2003) infused a wellness model into the curriculum design of a first-year college course, as a framework to address student needs; Watson and Lemon (2011) compared the wellness responses of adolescents receiving counselling services at a community mental health centre with a norm group; and Smith-Adcock, et al. (2008) examined a group counselling intervention developed to promote wellness among adolescent girls at risk of delinquency.

Wellness evaluation among adolescents has the potential to help identify those engaging in less than ideal lifestyle behaviours. Adolescents might be reluctant to

initiate communication about potentially damaging risk-taking behaviours (Stephens, 2006) and might be unwilling or unable to effectively communicate the diagnostic indicators associated with early signs of mental illness (Derouin & Bravender, 2004). In these situations a wellness assessment tool can prove useful for those seeking to assist youth populations in establishing positive lifestyle behaviours, implement early health interventions or mitigate other health risks (Haddad, et al., 2009). Therefore, effective measurement of wellness has application in the fields of healthcare, education, and counselling. Evaluating wellness can assist in the implementation and evaluation of wellness-related interventions among adolescents, particularly those interventions that aim to promote positive lifestyle behaviours. The purpose of this discussion is to examine the contemporary state of wellness assessment of adolescents to help inform professionals and researchers regarding instrument selection, and identify priorities for future research in this field.

Table 5.1

The Dimensions Included in each of the Multidimensional Wellness Instruments.

Instrument and Model	Dimensions
Wellness Evaluation of Lifestyle* (97-131 items), founded on Wheel of Wellness model	Spirituality; self-direction; sense of worth; sense of control; realistic beliefs; emotional awareness and coping; intellectual stimulation, problem solving and creativity; sense of humour; nutrition; exercise; self-care; stress management; gender identity; cultural identity; work; leisure; friendship; love; total wellness; and perceived wellness.
Five Factor Wellness Inventory* (90-97 items), founded on The Indivisible Self model	Essential Self (spirituality, gender identity, cultural identity, self-care), Social Self (friendship, love), Creative Self (thinking, emotions, control, work, humour), Physical Self (exercise, nutrition), and Coping Self (leisure, stress management, self-worth, realistic beliefs),.
Perceived Wellness Survey* (36 items), founded on the Perceived Wellness Model	Physical, spiritual, psychological, social, emotional, and intellectual.
Life Assessment Questionnaire (100 items), founded on Hettler's dimensions of wellness	Social, spiritual, physical, intellectual, emotional, and occupational.
Testwell* (100 items), founded on Hettler's dimensions of wellness	Social, spiritual, physical, intellectual, emotional, and occupational.
Optimal Living Profile (135 items), founded on the Total Person Concept	Emotional, spiritual, physical, social, intellectual, and environmental.
Salutogenic Wellness Promotion Scale (25 items), founded in salutogenesis	Social, spiritual, intellectual, vocational, physical, emotional, environmental
Wellness Inventory (120 items), founded on the Wellness Energy System	Self-responsibility and love, breathing, sensing, eating, moving, feeling, thinking, playing and working, communication, sex, finding meaning, and transcending.
Holistic Wellness Assessment (285 items), model not described	Self-regard, self-awareness and responsibility, sustainability, relational, risk prevention, spirituality, physical, health maintenance.

Adolescent Wellness Appraisal* (55 items), model not described	Self-care and health history; health habits and knowledge; safety and violence; nutrition habits; drugs, alcohol and tobacco; quality of life; and both school and out of school activities.
Juvenile Health and Wellness Survey* (104 items) , model not described	General health, mental health, risk-taking behaviour, socio-demographic information, and healthcare habits.
Perceived Wellness Profile* (75 items) , model not described	Physical activity, participation in strength and stretching exercises, perceived energy level, perceptions of present body weight, and smoking and alcohol use among adolescents.
Wellness Factor of the Laffrey Health Conception Scale* (21 items) , model not described	Eudaimonistic (wellbeing and humanness), role performance, and adaptive health.
Adolescent Wellness Inventory* (11 items), model not described	Social relationships, intellectual development, emotional wellness, physical wellness, and spiritual wellness
Adolescent Wellness Survey* (63 items), model not described	Physical, psychological, spiritual, and social
Child and Adolescent Wellness Scale* (100 items), model not described	Adaptability, connectedness, conscientiousness, emotional self-regulation, empathy, initiative, mindfulness, optimism, self-efficacy, and social competence.

*A version of this instrument has been designed or modified specifically for administration to youth.

5.3 METHODS

5.3.1 Data sources and searches

A search of the CINAHL, EMBASE, Google Scholar, MEDLINE, ProQuest Education Journals, ProQuest Psychology Journals, ProQuest Science Journals, ProQuest Social Science Journals, PsycINFO, PubMed, and ScienceDirect electronic databases were performed with no time restrictions for date of publication or language. Search terms included wellness and common variants of adolescent. To be as inclusive as possible, a large number of terms were included in the search string, with Medical Subject Headings (MeSH) used to expand the search term "adolescent". These additional terms were: adolescents, adolescence, teen, teens, teenager, teenagers, and youth. Searches were conducted during September 2013.

5.3.2 Study Selection

Two study inclusion criteria were used to identify relevant studies. First, only empirical studies from peer-reviewed scholarly journals were included. Second, the study must have included participants aged between 12 and 17 years. Articles from non-scholarly journals and non-peer reviewed sources were excluded, as were letters to the editor, and articles that did not use an instrument to measure wellness (e.g. qualitative interviews).

All articles identified with the search strategy were evaluated independently for inclusion by at least two members of the research team. An additional member of the research team was available to arbitrate any disagreement as to whether an article should be included or excluded. However, there were no such disagreements. A conventional four step process was used to exclude non-relevant articles by first reviewing titles, then abstracts, then full text. Additionally, a manual review of reference lists from included articles was performed to include relevant articles (outlined in Figure 5.1) (Brown, et al., 2009; Chinapaw, et al., 2010) .

5.3.3 Data Extraction and Quality Assessment.

The authors decided against using a standardised criteria (such as the Consensus-Based Standards for the selection of Health Measurement Instruments (COSMIN) checklist (Terwee et al., 2011)) list for quality assessment due to the heterogeneity of study designs, contexts and lack of description of instrument measurement properties amongst adolescents. Instead, once an article was included, information relevant to each report, including publication year, number of participants, sample age, sex, description, setting, and wellness instrument were extracted and tabulated to assist in data synthesis (see Table 5.2 for summary of this information).

5.3.4 Data synthesis and analysis

Similarly, it was deemed inappropriate to perform a meta-analysis of data due to the heterogeneity in study design, participant samples, and instruments used. Studies were arranged into categories based on the type of instrument used, and year of publication. Theoretical underpinnings and dimensions described for multi-dimensional instruments were summarised and tabulated (Table 5.1). Additionally,

studies reporting elements of validity and reliability were summarised and tabulated (Table 5.3).

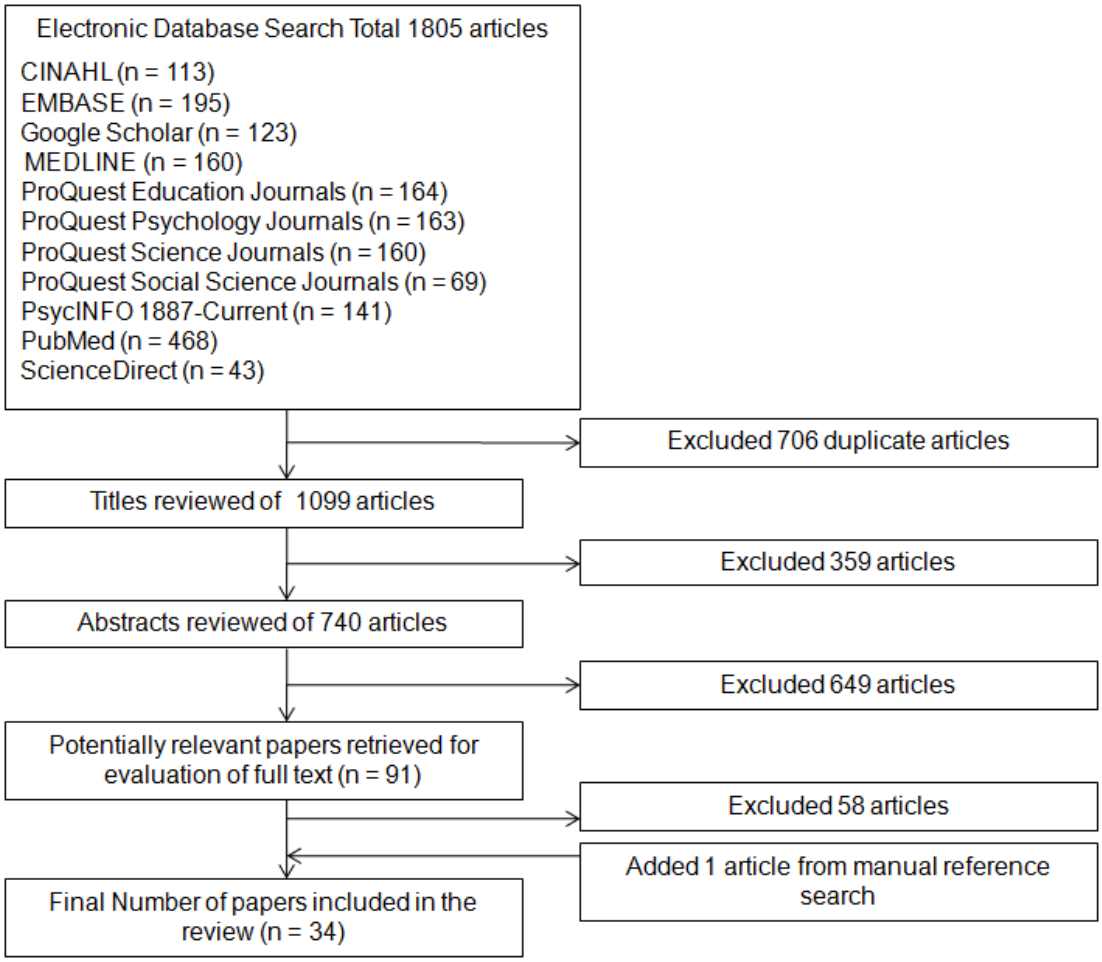

Figure 5.1. Summary of results and articles excluded after each phase of study selection

5.4 RESULTS

Following the initial search of databases, a total of 1805 articles were identified (Figure 5.1) using the search terms. After the manual removal of duplicate articles, a total of 1099 studies remained. These titles were reviewed, and a further 359 articles were excluded, leaving 740 remaining studies. After abstract analysis, a further 649 articles were removed, and 91 potentially relevant articles were identified and the full texts were retrieved for evaluation. A further 58 articles were then excluded, and 1 article was retrieved following a manual reference search, leaving 34 articles to be included in the review.

A summary of included studies is presented in Table 5.2. The earliest study was published in 1984 (Papenfuss & Beier), and the most recent in 2013 (Shimada,

Hess, & Nelson). Twenty-five of 34 studies recruited adolescent participants from school settings. Of the 19 studies that reported the mean age of participants, three reported mean ages of above 17 years. Six studies used wellness measurement techniques to evaluate the effectiveness of programs or interventions.

Overall, 20 instruments were used across the 34 studies. Demographic information from a number of studies indicated that data were derived from the same sample, leaving 31 separate samples. The Wellness Evaluation of Lifestyle was the most widely used instrument, totalling seven studies identified. The other techniques reported in multiple investigations include the Five Factor Wellness Inventory (4 studies), Adolescent Wellness Appraisal (2 studies), Juvenile Wellness and Health Survey (4 studies), Perceived Wellness Survey (2 studies), Wellness Factor of the Laffrey Health Conception Scale (3 studies), and analogue measures or scales (4 studies). A questionnaire adapted from the Personal Wellness Profile was reported in a single study amongst adolescents, as were the Wellness Assessment Scale of the Chinese Positive Youth Development Scale, the Attitudinal Inventory of Wellness and Wellness Behaviour Inventory, Adolescent Wellness Inventory, the Adolescent Wellness Survey, and the Child and Adolescent Wellness Scale. Similarly, indicators from the Positive and Negative Affect Schedule and Satisfaction with Life Scale, and Developmental Assets Checklist were used in a single study. Additionally, two studies used customised surveys to evaluate wellness amongst adolescents. The dimensions included in multi-dimensional wellness instruments are presented in Table 5.1.

Nine studies reported elements of validity or reliability (or both) amongst adolescents for one of the wellness instruments. The findings from these investigations are summarised in Table 5.3. A wide variety of analysis approaches were used across the nine studies. Two studies employed principal component analysis or factor analysis to investigate construct validity or internal consistency (Myers, et al., 2011b; Yarcheski, Mahon, & Yarcheski, 2005). One study compared two language versions of the same instrument (although employed tests of effect size rather than conventional agreement statistics). No studies used agreement statistics to evaluate test-retest reliability or mode of administration reliability (e.g. interviewer administered versus self-completion). Three studies investigated content validity (Spurr, Bally, Ogenchuk, & Walker, 2012; Sussman, Dent, Stacy, & Burton, 1995;

Yarcheski, et al., 2005). No studies investigated concurrent validity of two wellness measurement approaches. Minimally important difference was not estimated for any of the wellness instruments used amongst adolescents included in this review.

Table 5.2

Summary of Revised Studies

Wellness Instrument	Country	Year	N (% male)	Sample Description	Years of Age (Range, Mean (SD))	Setting
Wellness Evaluation of Lifestyle	USA	2004 (Myers & Bechtel, 2004)	179 (83.8)	First year cadets	Range 17-23 Mean 19.4 (6.4) Mode 19	Military facility
	USA	2008 (Smith-Adcock, et al., 2008)	8 (0)	Females from a school for at-risk students	Range 6-18	Alternative school
	USA	1999 (Garrett, 1999)	155	High school students	Grades 9-12	High school
	USA	2009 (Garrett, et al., 2009)	121	High school students	Grades 9-12	High school
	USA	2004 (Rayle & Myers, 2004), 2005 (Rayle, 2005)	462 (49.5)	High school students	Range 14-19 Mean 16.24 (1.25)	High school
Wellness Evaluation of Lifestyle (Korean)	USA	2003 (Chang & Myers)	6	Adolescents from Korean churches		Home
Five Factor Wellness Inventory	USA	2011 (Myers, Willse, & Villalba)	140 (45.7)	High school students	Range 15-17	High school
	Israel	2010 (Tatar & Myers)	240 (50)	Middle school students	Range 12-18 Mean 14.4 (1.8)	Middle school

	USA		629 (49.1)	Middle school students	Range 13-17 Mean 15.76 (0.93)	Middle school
	USA	2011 (Watson & Lemon)	114 (48.2)	Help-seeking adolescents	Range 12-19 Mean 14.24 (1.59)	Community mental health centre
	USA	2008 (Hartwig Moorhead, Green, McQuistion, & Ozimek, 2008)	1 (100)	Adolescent with Aspergers' Disorder	13	Middle school
Perceived Wellness Survey	USA	2000 (Adams, Bezner, Drabbs, Zambarano, & Steinhardt)	112 (19)	Undergrad-uate students	Range 16-58 Mean 23.2 (5.4)	University
	Australia	2006 (Schembri, Reece, & Wade)	378 (52.4)	Secondary school students	Range 11-18 Mean 13.34 (1.14)	Secondary school
Personal Wellness Profile	Australia	1997 (Savage & Holcomb)	220 (65)	High school students	Mean 13.2 Grades 7-9	High school
	USA		820 (29)	High school students	Mean 13.9 Grades 7-9	High school
Positive and Negative Affect Schedule, Satisfaction with Life Scale, Developme ntal Assets Checklist	USA	2006 (Coatsworth, et al.)	115 (36)	High school students	Mean 16.4 (1.15)	High school

Adolescent Wellness Appraisal (Arabic)	Jordan	2009 (Haddad, et al.)	530 (50.8)	High school students	Grade 7-8	High school
Adolescent Wellness Appraisal	USA	1997 (Muscari, Phillips, & Bears)	709 (51.1)	High school students	Range 15-18	High school
Attitudinal Inventory of Wellness and Wellness Behaviour Inventory	USA	1984 (Papenfuss & Beier)	150 (38)	High school students	Range 14-16	High school
Wellness Factor of the Laffrey Health Conception Scale	USA	2010 (Yarcheski, Mahon, Yarcheski, & Hanks)	144 (49.6)	Middle school students	Range 12-14 Mean 12.5 (0.36)	Middle school
	USA	2005 (Yarcheski, et al.)	230 (46.1)	Middle school students	Range 12-14 Mean 12.6 (0.69)	Middle school
	USA	2005 (Mahon, Yarcheski, & Yarcheski)	151 (44)	Middle school students	Mean 12.6 (0.56)	Middle school
Global Wellness Score	England	2004 (Viner et al.)	56 (37)	Children & adolescents with chronic fatigue	Range 9-17 Mean 14.2 (0.2)	Hospital

4-point Likert Scale of General Wellness	USA	2005 (Bishop, Hudson, Hilton, & Wilde)	19	Adolescents with cystic fibrosis, Placebo n=9 (60% male) buffered reduced glutathione (GSH) n=10 (67% male)	Range 6-19 Placebo 12.9 (4.9) GSH 13.3 (4.1)	Community -based clinical trial
Wellness Assessment Scale of the Chinese Positive Youth Developme nt Scale	Hong Kong	2006 (Shek et al.)	426 (58.8)	Adolescents		Multiple sources
20cm analogue measure of wellness	USA	2009 (Kilgus, Pumariega, & Rea); (Kilgus, Pumariega, & Seidel)	32 (75)	Cocaine-dependant adolescents	Range 14-17 Mean 16	Hospital
Customised Surveys	USA	1996 (Ansuini, Fiddler-Woite, & Woite)	200 (50)	700 participants (200 adolescent), 50% male	Range 9-73 (adolescents 9-19)	School (for adolescents)
	USA	1995 (Sussman, et al.)	3674 (47)	Middle school students	Grade 7	Middle school

Juvenile Wellness and Health Survey	USA	1998 (Steiner, Pavelski, Pitts, & McQuivey), 2000 (Steiner, McQuivey, Pavelski, Pitts, & Kraemer), 2002 (Steiner, Erickson, Hernandez, & Pavelski)	1755 (52.1)	High school students	Mean 15.9 (1.16)	High school
	USA	2003 (Pyle, McQuivey, Brassington, & Steiner)	770 (53.1)	High school students	Mean 15.9	High school
Adolescent Wellness Inventory	USA	2012 (Ashley, Ennis, & Owusu-Ansah, 2012)	109 (33)	Middle and high school students	Grades 6-8	Middle and high school
Adolescent Wellness Survey	Canada	2012 (Spurr, et al., 2012)	280 (54)	High school students	Range 16-20 Grade 11	High school
Child and Adolescent Wellness Scale (Japanese)	Japan	2013 (Shimada, et al., 2013)	322 (51)	Middle school students	Range 12-15 Grades 7-8	Middle school

Table 5.3

Studies reporting elements of the validity or reliability of wellness measurement approaches amongst adolescents.

Instrument	Assessment	Summary of validity or reliability components reported.
Arabic version of the Adolescent Wellness Appraisal (Haddad, et al., 2009)	Content Validity	Content validity was assessed by experts in the areas of adolescent and children's health, leading to the modification of 2 questions.
	Reliability	No specific coefficient of determination was reported.
Wellness Behaviour Inventory (Papenfuss & Beier, 1984)	Content Validity	Readability and content validity was assessed by a five-member jury.
		Evaluated statements as per the system developed by Gilmore (1974).
	Reliability	Reliability was determined using pre-test score values of the control group.
		Hoyt's analysis of variance was used to calculate a favourable reliability coefficient of .8226.
Wellness Factor of the Laffrey Health Conception Scale (Yarcheski, et al., 2005)	Construct Validity	Principal component analysis was undertaken (Wellness factor coefficient alpha was .96).
		Construct validity was assessed receiving modest results via correlations between relevant variables.
		Social support was assessed via the Personal Resource Questionnaire (r=.53).
		Self esteem was assessed via the Rosenberg Self-Esteem Scale (r=.49).
		Positive health practices was assessed via the Revised Personal Lifestyle Questionnaire (r=.55).

Juvenile Health and Wellness Survey (Steiner, et al., 1998)	Concurrent Validity	Concurrent validity was tested via 8 questions from the Coping Response Inventory – Youth Form. Items divided into Approach Coping and Avoidance Coping. Approach Coping had a weak negative association with high risk behaviours, sexual risks, mental health, and health problems (r=.04-.21), while no significant association with general health problems was evident. Avoidance Coping had a weak positive association with all 5 factors (r=.12-.18)
Sussman's customised survey (Sussman, et al., 1995)	Construct Validity	Construct validity completed via a second-order factor analysis on the full set of construct indices to determine those with high factor loadings for a 'Wellness' factor. The indices with highest factor loadings for the wellness factor were self-esteem (.72), and sense of coherence (.69).
Wellness Assessment Scale of the Chinese Positive Youth Development Scale (Shek, et al., 2006)	Concurrent Validity	The strength of association between the subscale and summary score of Chinese Positive Youth Development Scale was investigated. A modest correlation of r=.58 was reported.
Korean version of the WEL (Chang & Myers, 2003)	Reliability	Reliability was examined via testing effect sizes between the English and Korean versions of the instrument, using pooled standard deviation of results. Of the 19 subscales of the WEL, 4 had effect sizes considered to be large.(Cohen. J, 1988)
Adolescent Wellness Inventory (Ashley, et al., 2012)	Validity	The Adolescent Wellness Inventory was correlated (p<.001) with the previously validated Family Member Well-Being Index (Mccubbin & Thompson, 1987).
Adolescent Wellness Survey (Spurr, et al.,	Internal consistency reliability	Internal consistency analyses found that all but one (Emotional wellness = .59) of the five dimensions have reliability coefficients at .72 or higher (Sharkey, 1999).

2012)	Content validity	Feedback was requested by health and education experts on the items of the survey. The survey and scales were refined, and the language was clarified based on the experts' suggestions (Sharkey, 1999; Spurr, et al., 2012).
	Face validity	Face validity was examined through the pilot test and the administration of the survey. The items were developed with the intention of being transparent, relevant, and easy to understand, and the pilot test allowed respondents to write comments on the individual items and on the survey as a whole (Spurr, et al., 2012).
	Internal consistency reliability	Cronbach's alpha coefficient was used to investigate the internal reliability of the 63 survey items on the four dimensions of wellness, Individual scales were developed for each of the four developmental dimensions (physical, psychological, social, and spiritual). The physical developmental scale was further divided into sub-scales to increase the correlations between the items. The first subscale (substance use) included items on the rates of substance use, and the second subscale (health) integrated items related to body weight, physical activity, and nutrition. Their coefficients were .65 and .67, respectively. The coefficients ranged from .86 to .92 for the three developmental dimensions (psychological, spiritual, and social) and provided evidence of internal reliability. The total coefficient for the four developmental dimensions was .92 and provided support for the wellness construct of this study (Spurr, et al., 2012).

5.5 WELLNESS INSTRUMENTS

A number of wellness instruments have been used in adolescent samples. These include instruments such as the WEL (Chang & Myers, 2003; Garrett, 1999; Garrett, et al., 2009; Myers & Bechtel, 2004; Rayle, 2005; Rayle & Myers, 2004; Smith-Adcock, et al., 2008), 5F-Wel (Hartwig Moorhead, et al., 2008; Myers, et al., 2011b; Tatar & Myers, 2010; Watson & Lemon, 2011), Adolescent Wellness Appraisal (AWA) (Haddad, et al., 2009; Muscari, et al., 1997), Juvenile Wellness and Health Survey (JWHS) (Pyle, et al., 2003; Steiner, et al., 2002; Steiner, et al.,

2000; Steiner, et al., 1998), Perceived Wellness Survey (PWS) (Adams, et al., 1997; Schembri, et al., 2006), Wellness Factor of the Laffrey Health Conception Scale (Mahon, et al., 2005; Yarcheski, et al., 2005; Yarcheski, et al., 2010), the Personal Wellness Profile (Savage & Holcomb, 1997), the Adolescent Wellness Inventory (Ashley, et al., 2012), the Adolescent Wellness Survey (Spurr, et al., 2012), and the Child and Adolescent Wellness Scale (Shimada, et al., 2013). Additional measurement techniques include the use of analogue measures or scales (Bishop, et al., 2005; Kilgus & Pumariega, 1994; Kilgus, Pumariega, & Rea, 2009; Kilgus, Pumariega, & Seidel, 2009), customised surveys (Ansuini, et al., 1996; Sussman, et al., 1995), and adapted techniques such as the indicators from the Positive and Negative Affect Schedule and Satisfaction with Life Scale, and Developmental Assets Checklist (Coatsworth, et al., 2006). Wellness instruments that have been used in peer-reviewed studies among adult populations, but not adolescent populations, include the Life Assessment Questionnaire (National Wellness Institute, 1983), Optimal Living Profile (Renger, et al., 2000), Wellness Inventory (Travis, 1981), Holistic Wellness Assessment (Brown & Applegate, 2012), TestWell (National Wellness Institute, 1992) and the Salutogenic Wellness Promotion Scale, which was designed to measure health potential (Becker, Whetstone, Glascoff, & Moore, 2008; Becker et al., 2009; Lourance Razzaq Enad Al et al., 2013).

Two common types of measures are employed to measure wellness; uni-dimensional and multidimensional measures. Uni-dimensional wellness measures employ a general overall wellness rating item such as a Likert scale or visual analogue scale. Historically, this approach has been used among healthcare populations when assessing the effects of treatments (Bishop, et al., 2005; Kilgus & Pumariega, 1994; Kilgus, Pumariega, & Rea, 2009; Kilgus, Pumariega, & Seidel, 2009). Uni-dimensional wellness measures provide a single overall wellness score and are likely to have low respondent and administrator burden (due to less administration time, ease of completion, and cost). However, these measures do not allow for detailed evaluation of each dimension of wellness, and may not capture intricate changes required for evaluation of multi-faceted wellness interventions.

Some multidimensional measures report their foundation in underpinning wellness models, including the WEL (Chang & Myers, 2003; Garrett, 1999; Garrett, et al., 2009; Myers & Bechtel, 2004; Rayle, 2005; Rayle & Myers, 2004; Smith-

Adcock, et al., 2008), 5F-Wel (Hartwig Moorhead, et al., 2008; Myers, et al., 2011b; Tatar & Myers, 2010; Watson & Lemon, 2011), PWS (Adams, et al., 2000; Schembri, et al., 2006), and the AWA (Haddad, et al., 2009; Muscari, et al., 1997). A summary of the dimensions included in these instruments, and their foundational models, is presented in Table 5.1 (above). Other multidimensional measures do not report a foundational wellness model. There are some similarities and differences in dimensions between wellness instruments. The differences between instruments may allow the administrator to select an instrument that captures wellness dimensions most pertinent to their purpose for measuring wellness. However, this comes with the disadvantage that the comparisons that can be made across measures of wellness comprised of differing dimensions are limited. Multidimensional wellness measures have an advantage over uni-dimensional measures in capturing detailed information about an individual or group. While these instruments provide multidimensional assessments of wellness, they are also likely to carry a higher respondent and administrator burden due to their length and structure compared to uni-dimensional wellness measurement.

5.6 VALIDITY AND RELIABILITY ISSUES

Perhaps the most critical issue for adolescent wellness measurement, and one common in many developing fields, is the scarcity of peer-reviewed empirical work regarding foundational validity and reliability of measurements of wellness in adolescents. Rudimentary investigations of validity and reliability of the instruments used to measure wellness in adolescents are lacking (or have produced less than ideal results) for many self-reported outcomes (Chang & Myers, 2003; Shek, et al., 2006; Steiner, et al., 2000; Yarcheski, et al., 2005). This is not surprising given that some instruments have been used in only a single peer-reviewed investigation of wellness among adolescents (Bishop, et al., 2005; Coatsworth, et al., 2006; Copeland, Nelson, & Traughber, 2010; Papenfuss & Beier, 1984; Shek, et al., 2006; Viner, et al., 2004). It is also problematic to evaluate the rigour of non peer-reviewed reports of validity and reliability that are included in user manuals for wellness instruments, such as for the WEL and 5F-Wel instruments (Myers & Sweeney, 2004b, 2005b). Therefore, it is difficult to draw firm conclusions regarding the reliability or validity of those particular instruments.

Another point for consideration is that the construct validity of wellness instruments will always be dependent on their foundational definition of wellness. This may cause debate regarding the appropriateness of some instruments for evaluating wellness while substantial variability exists across wellness definitions, models and instruments for measuring wellness. However, in the absence of a 'gold standard' definition, these debates are perhaps inevitable. For example, Coatsworth, et al. (2006) considered "subjective wellbeing/life satisfaction and developmental assets" as key constructs within wellness and therefore assessed wellness with the Positive and Negative Affect Schedule, Satisfaction with Life Scale, and the Developmental Assets Checklist. Others might consider this measurement approach inappropriate if their own foundational definition of wellness is not congruent with Coatsworth's definition (Adams, et al., 1997; Myers & Sweeney, 2004a). Disagreements about what a wellness definition should include are just one of a number of barriers to consensus. Additional barriers may include the history of different priorities for assessment, religious and cultural differences, and the customary use of models or instruments within certain disciplines.

In addition to discrepancies between definitions of wellness, the latent factors being evaluated by each instrument might not always match the wellness model underpinning that instrument or might not use items with sound psychometric properties. For example, the PWS is based on the multidimensional Perceived Wellness Model. However, factor analysis of empirical data suggests the PWS does not measure the discrete dimensions in the Perceived Wellness Model, but instead represents a single latent variable (wellness) (Adams, et al., 1997; Harari, et al., 2005). Adams, et al. (1997) concluded this did not suggest wellness is a uni-dimensional phenomenon, but dimensions are closely related by their perceptual nature rather than differentiated by content. Other instruments have been developed and used with adolescents without description of their theoretical underpinnings, and with minimal or no psychometric testing (Ansuini, et al., 1996). The absence of peer-reviewed studies reporting psychometric testing for instruments used in adolescent populations is of concern and, as is common in many developing fields, highlights a priority area for future research.

The advancement of valid and reliable outcome measures to evaluate wellness in adolescents is not limited to conventional investigations to establish reliability and

validity. Addressing some of the more complex issues surrounding the evaluation of change in this subjective construct (such as the response shift phenomenon (McPhail, Comans, & Haines, 2010; McPhail & Haines, 2010a; McPhail & Haines, 2010b)) as well as the validity of proxy reporting (McPhail, Beller, & Haines, 2008), estimating values for minimal importance difference (Hays, Farivar, & Liu, 2005) and cross-cultural adaptations of instruments (Chang & Myers, 2003) are priorities for future research. However, perhaps the greatest overarching threat to rigorous evaluation of wellness is the lack of consensus regarding its definition (Roscoe, 2009).

A 'gold standard' definition could lead to the standardisation of a theoretical model against which wellness instruments could be validated. While there is clearly no panacea in this regard, the World Health Organization's description of wellness provides a useful starting point (Smith, et al., 2006). It could be argued that variation between instruments may allow for choices which more accurately represent the purpose of the measurement. However, similarities between wellness models (Table 5.1) indicate that one model (or possibly an amalgamation of models) may be appropriate, and lead to harmonisation of assessment. While efforts have been made to increase the understanding of the use of the wellness construct within specific contexts or settings (Chapman, Lesch, & Baun, 2007; Roscoe, 2009; Swarbrick, Murphy, Zechner, Spagnolo, & Gill, 2011), progress toward developing a consensus for a definition of wellness during an international meeting of experts in the field would be a worthwhile undertaking. This method has proved successful in a number of examples in the past, most notably at the International Health Conference in New York in 1946, where the Constitution of the WHO was presented. This search for consensus led to the definition of health including the words "complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (World Health Organization, 1946).

5.7 INSTRUMENT SELECTION

A number of factors influence professionals and researchers when they select an instrument to evaluate wellness. The most appropriate wellness measurement technique is likely to be dependent on the administrator's purpose for measuring wellness. If the purpose is to measure lifestyle wellness so that it can be enhanced, then a multidimensional measure is more likely to permit a detailed evaluation of various components of wellness. This may allow for wellness programs (whether

they are intended for individual or group treatment purposes) to be tailored to those wellness dimensions with the greatest relevance. This also provides the option of the respondent being referred to an appropriate practitioner within that domain for specialised treatment. If a less detailed evaluation of wellness is required, or if an instrument with low participant and administrator burden is necessary, then a uni-dimensional question such as a Likert scale of general wellness may be more appropriate. There might also be a case for selecting a shorter multidimensional wellness measure that provides more detail than a uni-dimensional measure, but which is associated with less participant burden than longer multidimensional instruments. Shorter multidimensional instruments have proven to be very successful in measuring other related constructs including wellbeing (Keyes, 2002; Tennant et al., 2007) and health-related quality of life (Jenkinson & Layte, 1997; Rabin & Charro, 2001; Wille et al., 2010).

When wellness in youth is assessed, there might also be benefit in selecting an instrument that has been modified so as to be age appropriate. Age-adjusted instruments include modified versions of the WEL (WEL-G, at a 7th grade reading level), PWS (PWS – Youth) or 5F-Wel (5F-Wel-T, at a 6th grade reading level), whereas other instruments have been designed specifically for youth (AWA and JWHS). Additionally, accessibility of wellness evaluation instruments is another factor that is likely to contribute to the popularity of some instruments. Questionnaires such as the WEL and 5F-Wel can be accessed online through the host company Mind Garden Inc (Mind Garden Inc, 2010a, 2010b). However, access to some instruments with a stronger empirical foundation often comes at financial cost. At the time of writing it is not uncommon for the fee paid to copyright holders of some instruments for evaluating wellness to range between $1 and $4 per administration for some instruments, while other instruments do not have associated fees.

5.8 SUMMARY

Adolescent wellness is an important indicator of current and future health and lifestyle habits. Instruments for evaluating wellness are particularly useful for those seeking to influence lifestyle behaviours among youth populations, including health and educational settings. There are a number of tools available to measure wellness, each with its own focus, depending on the definition or model from which it was

developed. This may cause debate regarding the appropriateness of some instruments for evaluating wellness. However, in the absence of a 'gold standard' definition, substantial variability across measurement approaches is inevitable. The majority of wellness evaluation approaches used with adolescent populations have less than ideal validation. A 'gold standard' definition could lead to the standardisation of a theoretical model against which wellness instruments could be validated. Progress toward developing a consensus for a definition of wellness during an international meeting of experts in the field would be a worthwhile undertaking. The absence of peer-reviewed studies reporting psychometric testing for wellness evaluation instruments for adolescents is of concern given their growing popularity and highlights a priority area for future research in this field.

Following this review of available instruments in use among adolescents, the 5F-Wel was selected for use in this program of research (Appendix B). The 5F-Wel was selected as it has been one of the most widely-used instruments among adolescents, it is empirically based, a youth-specific version of the instrument is available, and it provides a multi-dimensional detailed evaluation of the various components of the participant's wellness. This allowed us to adequately explore the associations between self-reported wellness and physical activity among adolescents, and consider practical implications.

Chapter 6: Reliability of the Five Factor Wellness Inventory among Australian adolescents

The Five Factor Wellness Inventory was identified as one of the most commonly-used wellness assessment instruments, with youth-specific versions. However, no youth-specific reliability analysis of the instrument exists in peer-reviewed literature. This Chapter details a test-retest reliability analysis of the Five Factor Wellness Inventory among adolescent males and females. Due to articulation from a Research Masters to a Doctor of Philosophy degree, experiments were completed and manuscripts were submitted at different time-points in the candidature. The following Chapter is an amalgamation of those two manuscripts.

This Chapter is based on the following peer-reviewed journal articles:

Rachele, J. N., Cuddihy, T. F., Washington, T.L. & McPhail, S. (2014). *Reliability of a wellness inventory among adolescent females aged 12-14 years.* Manuscript submitted for publication.

Rachele, J. N., Cuddihy, T. F., Washington, T.L.& McPhail, S. (2013). Reliability of the Five Factor Wellness Inventory among male adolescents. *Journal of Individual Psychology, 69*(2) 118-132

6.1 ABSTRACT

The effective measurement of wellness in adolescents can assist researchers and practitioners in determining lifestyle behaviours in which they are lacking. Behaviour change interventions can then be designed which directly aid in the promotion of these areas. Measuring adolescent wellness can assist researchers and practitioners in determining lifestyle behaviours in which adolescents are deficient. The Five Factor Wellness Inventory (designed to measure the Indivisible Self model of wellness) is a popular instrument for measuring the broad aspects of wellness amongst adolescents. The instrument comprises 97 items contributing to 17 subscales, 5 dimension scores, 4 context scores, total wellness score, and a life satisfaction index. This investigation examines the test-retest reliability of 5F-Wel amongst adolescents. Thirty-five male and 46 female adolescents self-completed the 5F-Wel on two separate occasions, seven days apart. Limits of agreement, intraclass correlation coefficients, and paired t-tests were calculated to investigate agreement, and whether systematic differences existed between administrations. The findings indicate the 5F-Wel is reliable for use amongst adolescent males and females and support its use in research and professional contexts.

6.2 BACKGROUND

The concept of wellness is an important construct that offers a point of difference to other health-related concepts. Wellness has been described as a dynamic process maximizing an individual's potential (Dunn, 1977), and an active process through which the individual becomes aware of and makes choices toward a more successful existence (Hettler, 1980). Wellness can be conceptualized as a multi-dimensional holistic notion, focusing on the individual's journey to being the best that they can be, within the environment where they are situated (Rachele, Cuddihy, Washington, Barwais, et al., 2013). Its focus on positive behaviours leading toward this outcome is an important point differentiating it from other constructs that may primarily focus on the prevention or treatment of disease or disability. Wellness aims to promote behaviours which facilitate the life journey and is about actions or processes rather than outcomes. Given the importance of establishing positive lifestyle behaviours during adolescence, interventions to improve these behaviours during this critical stage of life are worthy of investigation. To this end, measuring adolescent wellness can assist researchers and practitioners in determining lifestyle behaviours in which adolescents are deficient. Behaviour change interventions can then be designed which directly aid in the promotion of these areas.

The complexity of male psychology and social constructions of masculinity make it challenging to deliver effective and consistent care to adolescent males (Bell & Ginsburg, 2003). An appropriate objective assessment may provide a useful starting point for adolescent males who feel uncomfortable discussing behaviours indicative of wellness deficits (Westwood & Pinzon, 2008). Adolescent males are less likely to seek healthcare than their female counterparts (Westwood & Pinzon, 2008). This is particularly true for emotional or mental health related problems, as young males may consider this to be perceived as weakness. Clinical visits from adolescent males are often brief, and usually due to an acute illness, injury, or a physical complaint (Westwood & Pinzon, 2008). They are more likely to binge drink alcohol and also drive a vehicle while intoxicated (Elster & Marcell, 2003), carry a weapon, become involved (and injured) in a physical fight, and use marijuana (Eaton, et al., 2012). To prevent sustained engagement in risk-taking behaviours, it may be beneficial for healthcare professionals to identify adolescent males engaging

in these types of behaviours early in order to intervene (DuRant, Smith, Kreiter, & Krowchuk, 1999).

Adequate wellness assessment among adolescent females is also of critical importance. When compared to their male counterparts, adolescent females are more likely to be bullied on school property, and electronically; be forced to have sexual intercourse; feel sad or hopeless; seriously consider suicide; make a suicide plan; attempt suicide; have alcohol given to them; use an inhalant; not eat for ≥24 hours to lose weight or to keep from gaining weight; and vomit or take laxatives to lose weight or to keep from gaining weight (Eaton, et al., 2012). Consequently, the use of this tool may have particular relevance to adolescent females.

Measuring the wellness of adolescents can assist researchers and practitioners in determining lifestyle behaviours in which adolescents are deficient. Behaviour change interventions can then be designed which directly aid in the promotion of these areas. Wellness instruments may be used both as educative self-assessment tools to identify at-risk elements of an individual's life, and as a tool to facilitate the counselling process. Smith-Adcock et al. (2008) examined the use of group intervention counselling intertwined with wellness concepts (using the Wheel of Wellness model (Sweeney & Witmer, 1991)) for adolescent females at risk of deliquency. Findings indicated that the wellness intervention helped the participants broarden their ideas about wellness and to set personal wellness goals.

Numerous theories and models have been created to represent wellness, all of which encompass a diverse range of lifestyle dimensions. One such model of wellness that has been developed, largely based on the psychology of Alfred Adler, is the Wheel of Wellness (Sweeney & Witmer, 1991), and subsequent Indivisible Self Model of Wellness (IS-Wel). Wellness assessment instruments derived from these theories allow researchers and practitioners to apply these concepts in a variety contexts and settings. The Five Factor Wellness Inventory (5F-Wel) is a popular instrument for measuring the broad aspects of wellness amongst adolescents (Hartwig Moorhead, et al., 2008; Myers, et al., 2011b; Tatar & Myers, 2010; Watson & Lemon, 2011). In combination with its predecessor, the Wellness Evaluation of Lifestyle (Myers, et al., 2001, 2004), it has been an extensively used instrument amongst adolescents (Chang & Myers, 2003; Garrett, 1999; Garrett, et al., 2009; Myers & Bechtel, 2004; Rayle, 2005; Rayle & Myers, 2004; Smith-Adcock, et al.,

2008; Watson & Lemon, 2011). The 5F-Wel instrument is designed to measure the IS-Wel wellness model. This is an empirically based model, developed from a factor analysis of Wellness Evaluation of Lifestyle data (Myers & Sweeney, 2004a). The IS-Wel is grounded in Adlerian counselling theory (Adler, 1954) that emphasizes the indivisibility of the self. This is what Adler defined as holism, and is based on a single, higher order wellness factor that includes all wellness components (Myers, et al., 2011b). The 5F-Wel was developed to assess the factors included in the IS-Wel.

Although the 5F-Wel has been used amongst adolescents, there has been no empirical investigation regarding its reliability in adolescent populations. A lack of reliability of instruments for measuring wellness in adolescent populations has been highlighted as a concern in previous research (Rachele, Cuddihy, Washington, Barwais, et al., 2013). Prior studies involving the 5F-Wel have reported factor analysis for the five second-order factors (dimensions of self) (Hattie, Myers, & Sweeney, 2004), and internal consistency (Myers & Sweeney, 2005a) of the instrument within adult populations. However, there have been no previous peer-reviewed investigations of test-retest reliability of the instrument amongst adult or adolescent populations. It is important that reliability of the 5F-Wel is established amongst adolescents to support its use in observing wellness in a cohort at a single time point, change over time or the effect of positive behaviour-based interventions on wellness. The aim of this investigation was to examine the test-retest reliability of the 5F-Wel instrument when self-completed by adolescents.

6.3 METHODS

6.3.1 Design

Participants self-completed the 5F-Wel on two separate occasions (test-retest), with seven days between assessments.

6.3.2 Participants and setting

This investigation included 35 male and 48 female adolescents aged between 12 and 14 years. Participants were from two same-sex private secondary schools in metropolitan Brisbane, Australia.

6.3.3 Instrument

The 5F-Wel-T version (the 5F-Wel modified to a 6th grade reading level) is a 97 item questionnaire which includes attitudinal and behavioural statements (e.g. "I eat a healthy diet"). Respondents rate their agreement with the statement using a 4-point Likert scale ranging from strongly agree (1) to strongly disagree (4) (Myers, et al., 2011b). The instrument takes approximately 15 minutes to complete. The 97 questions are grouped to contribute to 17 subscales, 4 context scores and an overall life satisfaction index (Myers, et al., 2011b). Mean item ratings for each subscale are computed and modified using a linear transformation to make the scales comparable, with each having a range from 25-100 (Myers, et al., 2011b). The 17 subscales can be grouped into 5 dimensions that comprise total wellness (creative, coping, social, essential and physical) (Myers, et al., 2011b). An illustration of the relationship between subscales, dimensions, and overall wellness are presented in Figure 6.1. Detailed definitions of dimensions and subscales and information on theory development have previously been described (Myers & Sweeney, 2004a).

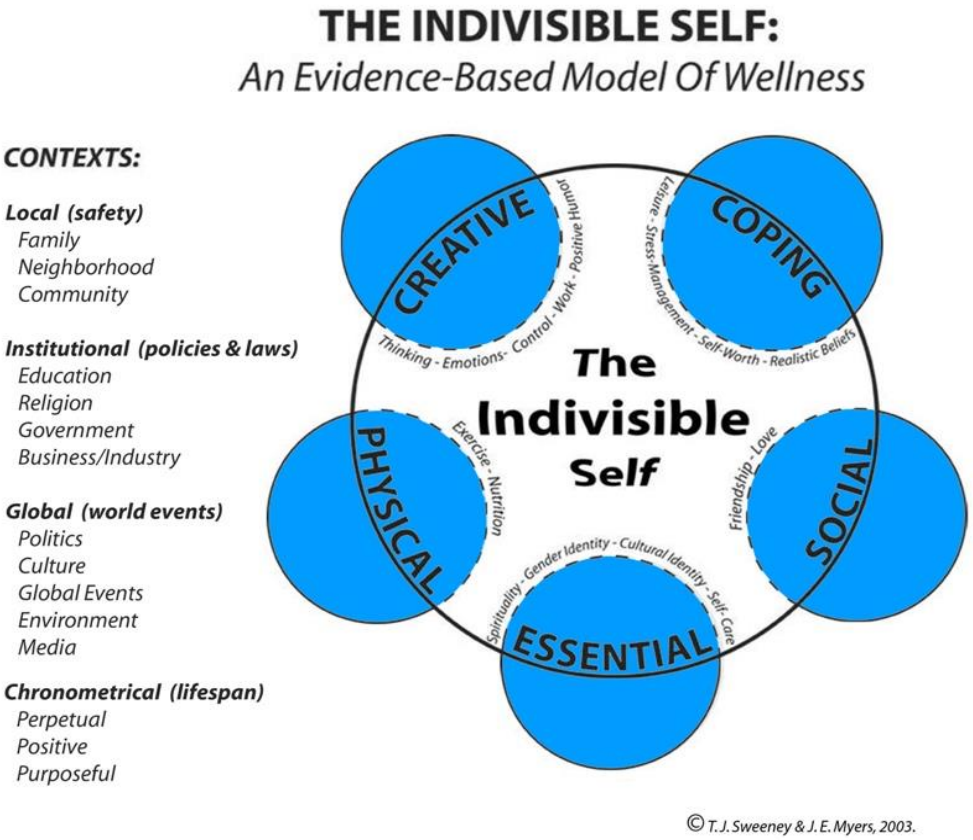

*Figure 6.1.*The Indivisible Self Model of Wellness

6.3.4 Procedure

Participants completed their initial 5F-Wel report during class time, at their school. Participants then completed the 5F-Wel seven days later in the same scheduled class. A seven day period was chosen to decrease the chance of participants recalling their response from the previous administration while also minimizing the chance of substantial life changes between assessments (McPhail et al., 2009). This study was approved by the Human Research Ethics Committee of the Queensland University of Technology (Appendix C). Examples of participant information and consent forms can be found in Appendix D and Appendix E.

6.3.5 Data Analysis

Data analysis was completed using the Statistical Package for the Social Sciences (SPSS). Limits of agreement and intraclass correlation coefficients with 95% confidence intervals (CI) were calculated to investigate agreement between the two assessments for each of the 17 subscale scores, 5 dimension scores, 4 context scores, life satisfaction index and total wellness score of the 5F-Wel. Limits of agreement represent a reference interval (also known as a 'normal range') for the test-retest differences expected for 95% of individuals in a population. These reference intervals are used to make probability statements for expected values using the known relationship between the standard deviation and centiles of a normally distributed population (Atkinson & Nevill, 2000). Intraclass correlation coefficient is a measure of agreement expressed as a coefficient between 0 and 1, where a higher value represents stronger concordance. Although criterion levels for intraclass correlation coefficients have been described as "hopelessly arbitrary" (de Mast, 2007), values <.40 are commonly described as "poor to fair", .40 to .75 as "fair to good" and >.75 as "excellent" (Fleiss, 1986).

Paired t-tests were employed to examine whether systematic differences between the two administrations existed for each subscale score. Bonferroni corrections for multiple comparisons were used to adjust t-test alpha to .002 to mitigate the chance of Type 1 error (Cabin & Mitchell, 2000). Therefore, p-values <.002 would indicate that a systematic difference exists. Bland-Altman plots (Bland & Altman, 1986) were also completed for total wellness and the 5 dimensions of wellness (Figure 6.2 and Figure 6.3) to analyse the agreement between the 2 assessments. This plot of difference against the mean allows the investigation of any

possible relationship between the measurement error and the true value (Bland & Altman, 1986).

6.4 RESULTS

6.4.1 Males

A total of 34 (97%) participants completed the 5F-Wel questionnaire at both assessments and were included in the analysis. One participant was absent from school for the second assessment and was excluded from all analyses. The mean age and standard deviation (SD) of participants was 13.6 (0.6) years. The mean (SD) scores for each of the 17 subscales, 5 dimensions and for total wellness at each 5F-Wel assessment are presented in Table 6.1. There were no significant differences between assessments for subscale, dimension or total wellness scores (p-value range .033 to 1.000). The mean (SD) score for the 5 contexts and life satisfaction index for the 5F-Wel are presented in Table 6.2. There were no significant differences for the 4 context scores and life satisfaction index (p-values range .284 to .711). This indicates no systematic differences between assessments were present.

Agreement statistics for each of the 17 subscales, 5 dimensions and total wellness at each 5F-Wel assessment are presented in Table 6.1. Intraclass correlation coefficients for the 17 subscales ranged from .48 (Leisure) to .93 (Spirituality). Intraclass correlation coefficients for the 5 dimension scores ranged from .73 (Social Self) to .91 (Essential Self). The limits of agreement were similar across subscales, dimensions and total score, and were consistently centred around zero with a range +/- 6.7-19.7 points (Table 6.1). Bland-Altman plots are presented for dimension scores and the total wellness score (Figure 6.2). There was only a small amount of variation in the limits of agreement and Bland-Altman plots across domains with no overall pattern of disagreement across domains evident.

Agreement statistics for each of the 4 context scores and life satisfaction index at each 5F-Wel assessment are presented in Table 6.2. Intraclass correlation coefficients for the 4 context scores ranged from .73 (Global Context) to .85 (Local Context). The limits of agreement were similar across contexts and the life satisfaction index, and were consistently centred around zero with a range +/- 11-28.2 points (Table 6.2).

Table 6.1

Intraclass correlation coefficient (ICC), mean (standard deviation) scores, and limits of agreement (LOA) for the dimensions and total wellness score Five Factor Wellness Inventory among males

Measure	ICC (95% CI)	Mean 1 (SD)	Mean 2 (SD)	Limits of agreement			p-value
				Lower LOA (95% CI)	Mean difference (95% CI)	Upper LOA (95% CI)	
Thinking	.86 (.74, .93)	79.7 (13.3)	82.2 (13.1)	-16.69 (-18.39, -14.99)	-2.5 (-4.20, -.80)	11.69 (9.99, 13.39)	.045
Emotions	.54 (.25, .74)	85.1 (10.1)	84.8 (10.1)	-19.39 (-21.75, -17.03)	.38 (-1.99, 2.74)	20.14 (17.78, 22.51)	.823
Control	.80 (.63, .90)	79.8 (13.1)	82.9 (12.5)	-19.73 (-21.71, -17.74)	-3.12 (-5.11, -1.14)	13.48 (11.50, 15.47)	.033
Work	.82 (.67, .91)	82.1 (11.4)	82.1 (11)	-13.63 (-15.26, -12.01)	0 (-1.63, 1.63)	13.63 (12.01, 15.26)	1.000
Positive Humor	(.65 (.40, .81)	83.3 (11)	85.5 (10.7)	-20.64 (-22.84, -18.43)	-2.21 (-4.41, -0.00)	16.22 (14.022, 18.43)	.166
Creative Self	.90 (.81, .95)	81.9 (9.8)	83.3 (9.6)	-10.20 (-11.25, -9.14)	-1.41 (-2.46, -0.36)	7.38 (6.33, 8.43)	.066
Leisure	.48 (.18, .70)	85.9 (8.3)	86.3 (9.1)	-18.44 (-20.60, -16.28)	-0.37 (-2.53, 1.80)	17.71 (15.55, 19.87)	.811
Stress Management	.86 (.73, .93)	80.0 (12.2)	82.4 (12.8)	-16.02 (-17.65, -14.39)	-2.39 (-4.02, -0.76)	11.24 (9.61, 12.87)	.046
Self-worth	.78 (.61, .89)	88.1 (9.2)	89.9 (10.9)	-15.26 (-16.86, -13.65)	-1.83 (-3.4, -0.23)	11.60 (9.99, 13.20)	.116
Realistic Beliefs	.80 (.64, .90)	56.0 (11.3)	54.4 (10.6)	-12.46 (-14.14, -10.77)	1.62 (-0.06, 3.30)	15.69 (14.01, 17.37)	.183
Coping Self	.75 (.56, .87)	78.3 (5)	79.1 (6.3)	-8.934 (-9.90, -7.96)	-0.82 (-1.79, 0.15)	7.29 (6.32, 8.26)	.241
Friendship	.66 (.42, .82)	86.6 (9.3)	87.8 (10.2)	-17.38 (-19.32, -15.44)	-1.18 (-3.11, 0.76)	15.03 (13.09, 16.97)	.396

Love	.75 (.55, .87)	88.6 (10.3)	89.7 (12)	-17.13 (-19.05, -15.22)	-1.1 (-3.02, 0.82)	14.93 (13.02, 16.85)	.423
Social Self	.73 (.53, .86)	87.7 (9.1)	88.8 (10.5)	-15.79 (-17.54, -14.04)	-1.13 (-2.88, 0.63)	13.54 (11.78, 15.29)	.370
Spirituality	.93 (.87, .97)	49.9 (23.4)	51.5 (23.6)	-19.24 (-21.34, -17.13)	-1.62 (-3.72, 0.49)	16.00 (13.90, 18.11)	.285
Gender Identity	.58 (.30, .76)	88.4 (9.2)	90.5 (9.3)	-19.34 (-21.41, -17.27)	-2.02 (-4.09, 0.05)	15.29 (13.23, 17.36)	.176
Cultural Identity	.75 (.56, .87)	82.7 (12.7)	83.1 (12.1)	-18.012 (-20.12, -15.90)	-0.37 (-2.48, 1.74)	17.28 (15.17, 19.39)	.807
Self-care	.62 (.35, .79)	94.7 (5.8)	92.9 (7.8)	-10.45 (-11.91, -8.99)	1.77 (0.31, 3.22)	13.98 (12.52, 15.44)	.097
Essential Self	.91 (.82, .95)	78.2 (8.4)	78.7 (9.5)	-8.43 (-9.38, -7.48)	-0.48 (-1.43, 0.48)	7.47 (6.52, 8.42)	.483
Exercise	.75 (.55, .87)	84.4 (12.8)	87.2 (11.2)	-20.14 (-22.21, -18.07)	-2.79 (-4.87, -0.72)	14.55 (-4.87, -0.72)	.065
Nutrition	.78 (.61, .89)	87.9 (11.2)	89.0 (11.4)	-16.21 (-18.01, -14.40)	-1.09 (-2.90, 0.71)	14.02 (12.21, 15.83)	.398
Physical Self	.75 (.55, .86)	85.0 (9.9)	87.1 (9.6)	-16.23 (-17.92, -14.54)	-2.11 (-3.80, -0.42)	12.01 (10.32, 13.69)	.086
Total Wellness	.88 (.78, .94)	81.8 (6.5)	82.9 (7.3)	-7.75 (-8.56, -6.94)	-1.01 (-1.81, -0.20)	5.731 (4.926, 6.54)	.086

Table 6.2

Intraclass correlation coefficient (ICC), mean (standard deviation) scores, and limits of agreement (LOA) for the context score and life satisfaction index of the Five Factor Wellness Inventory among males

Measure	ICC (95% CI)	Mean 1 (SD)	Mean 2 (SD)	Limits of agreement			p-value
				Lower LOA (95% CI)	Mean difference (95% CI)	Upper LOA (95% CI)	
Local Context	.85 (.71, .92)	91.8 (9.2)	91.3 (10.2)	-10.56 (-11.87, -9.24)	0.44 (-0.87, 1.76)	11.44 (10.12, 12.75)	.638
Institutional Context	.75 (.55, .87)	71.9 (12)	73.6 (12.9)	-19.69 (-21.85, -17.54)	-1.66 (-3.81, 0.50)	16.37 (14.22, 18.53)	.284
Global Context	.73 (.53, .86)	79.1 (9.2)	79.9 (14.2)	-19.67 (-23.04, -16.30)	8.54 (5.17, 11.91)	36.74 (33.37, 40.12)	.683
Chronometrical Context	.74 (.54, .86)	86.8 (12.3)	87.3 (10.7)	-17.48 (-19.51, -15.46)	-0.55 (-2.58, 1.47)	16.38 (14.35, 18.40)	.702
Life Satisfaction Index	.68 (.45, .83)	90.4 (13.8)	91.2 (14.9)	-24.06 (-26.85, -21.27)	-0.74 (-3.52, 2.05)	22.59 (19.80, 25.38)	.711

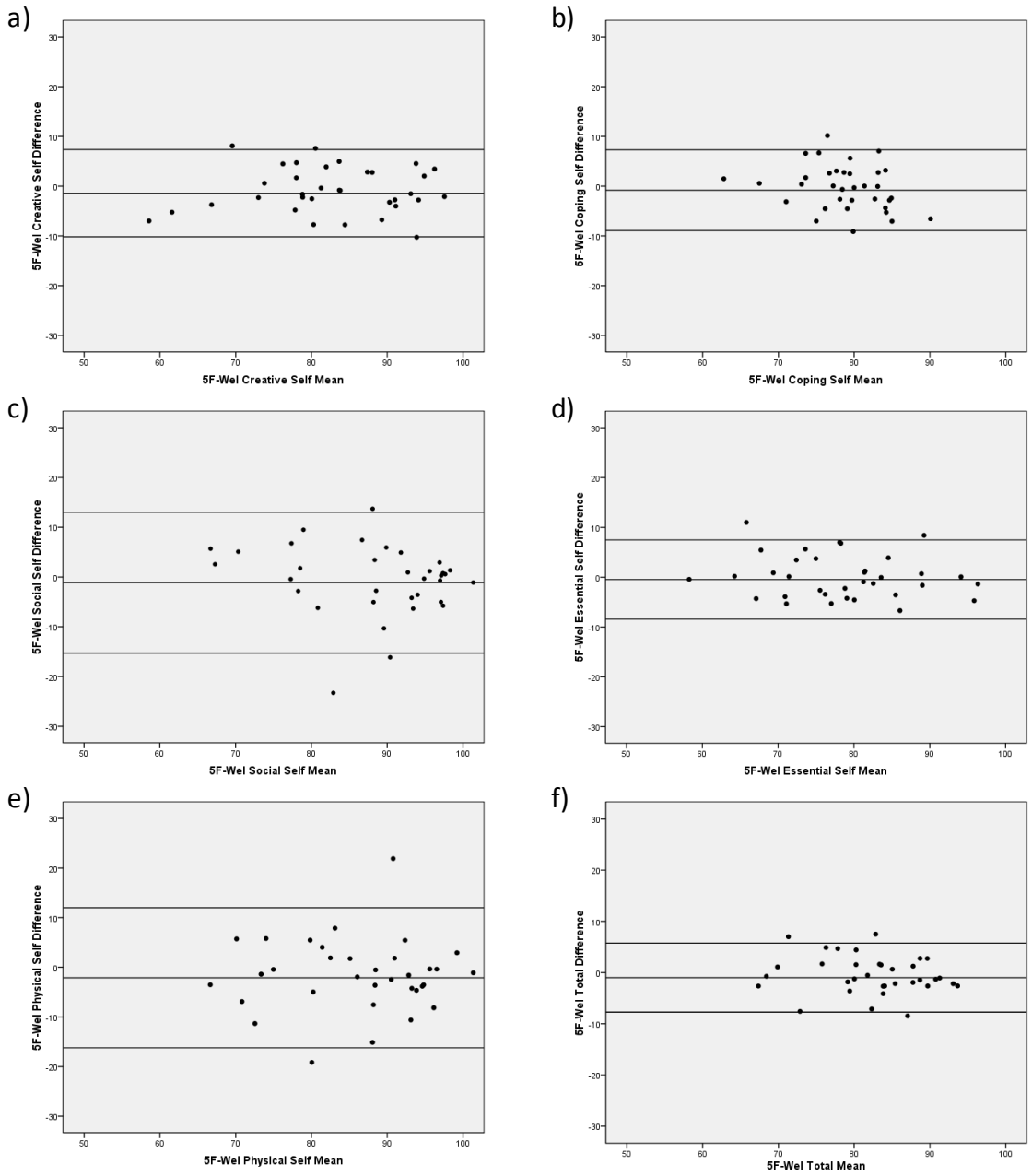

Figure 6.2. Bland-Altman plots for 5F-Wel dimensions including Creative Self (a), Coping Self (b), Social Self (c), Essential Self (d), and Physical Self (e), as well as the Total Wellness score (f) among males

6.4.2 Females

Overall, 46 (95.8%) had complete data sets and were included in the analysis. One participant had incomplete responses to the first assessment and another was absent from school for the second assessment. Both participants were excluded from all analyses. The mean age and standard deviation (SD) of participants was 13.26

(0.57) years. The mean (SD) scores for each of the 17 subscales, 5 dimensions and for total wellness at each 5F-Wel assessment are presented in Table 6.3. There were no significant differences between assessments for subscale, dimension or total wellness scores (p-value range .006 to .998). The mean (SD) score for the 5 contexts and life satisfaction index for the 5F-Wel are presented in Table 6.4. There were no significant differences for the 4 context scores and life satisfaction index (p-values range .005 to 1.000). This indicates no systematic differences between assessments were present.

Agreement statistics for each of the 17 subscales, 5 dimensions and total wellness at each 5F-Wel assessment are presented in Table 6.3. Intraclass correlation coefficients for the 17 subscales ranged from .45 (Gender Identity) to .82 (both Leisure and Spirituality). Intraclass correlation coefficients for the 5 dimension scores ranged from .70 (Social Self and Coping Self) to .81 (Essential Self). The limits of agreement were similar across subscales, dimensions and total score, and were consistently centred around zero with a range +/- 6.67-25.17 points (Table 6.3). Bland-Altman plots are presented for dimension scores and the total wellness score (Figure 6.3). There was only a small amount of variation in the limits of agreement and Bland-Altman plots across domains with no overall pattern of disagreement across domains evident.

Agreement statistics for each of the 4 context scores and life satisfaction index at each 5F-Wel assessment are presented in Table 6.4. Intraclass correlation coefficients for the 4 context scores ranged from .63 (Chronometrical Context) to .73 (Local Context). The limits of agreement were similar across contexts and the life satisfaction index, and were consistently centred around zero with a range +/- 15.49-35.28 points (Table 6.4).

Table 6.3

Intraclass correlation coefficient (ICC), mean (standard deviation) scores, and limits of agreement (LOA) for the dimensions and total wellness score Five Factor Wellness Inventory among females

Measure	ICC (95% CI)	Mean 1 (SD)	Mean 2 (SD)	Limits of agreement			p-value
				Lower LOA (95% CI)	Mean difference (95% CI)	Upper LOA (95% CI)	
Thinking	.64 (.44, .79)	75.7 (10.3)	76.1 (9.2)	-17.12 (-19.12, -15.13)	-0.43 (-2.43, 1.56)	16.25 (14.26, 18.25)	.721
Emotions	.58 (.36, .75)	83.6 (7.9)	84.3 (9.4)	-16.79 (-18.71, -14.86)	-.067 (-2.60, 1.25)	15.44 (13.51, 17.36)	.568
Control	.61 (.39, .76)	76.2 (9.8)	79.1 (10.6)	-21.13 (-23.32, -18.95)	-2.86 (-5.04, -0.68)	15.41 (13.23, 17.60)	.037
Work	.78 (.63, .87)	81.5 (9.4)	81.5 (10.3)	-13.35 (-14.94, -11.75)	-0.00 (-1.60, 1.60)	13.34 (11.75, 14.94)	.998
Positive Humor	.73 (.56, .84)	82.1 (11.5)	83.4 (9.8)	-17.41 (-19.33, -15.49)	-1.36 (-3.28, 0.56)	14.70 (12.78, 16.62)	.251
Creative Self	.77 (.62, .87)	79.8 (6.6)	80.7 (7.5)	-10.97 (-11.83, -9.51)	-0.95 (-2.11, 0.21)	8.77 (7.60, 9.93)	.184
Leisure	.82 (.69, .89)	83.0 (10.8)	83.2 (11.8)	-14.13 (-15.78, -12.47)	-0.27 (-1.92, 1.39)	13.59 (11.94, 15.25)	.792
Stress Management	.58 (.35, .74)	73.4 (13.4)	76.8 (11.7)	-26.82 (-29.62, -24.02)	-3.40 (-6.19, -0.60)	20.03 (17.23, 22.82)	.052
Self-worth	.62 (.40, .77)	79.6 (12.7)	81.0 (10.5)	-22.06 (-24.53, -19.58)	-1.35 (-3.83, 1.12)	19.35 (16.88, 21.83)	.373
Realistic Beliefs	.49 (.23, .68)	52.6 (8.7)	52.2 (8.9)	-17.70 (-19.57, -15.53)	0.43 (-1.73, 2.60)	18.57 (15.40, 20.74)	.743
Coping Self	.70 (.52, .82)	73.5 (6.2)	74.4 (6.6)	-10.95 (-12.15, -9.75)	-0.92 (-2.12, 0.28)	9.10 (7.91, 10.30)	.212
Friendship	.63 (.41, .77)	87.7 (10.0)	90.0 (8.9)	-18.95 (-20.95, -16.92)	-2.28 (-4.28, -0.29)	14.39 (12.40, 16.38)	.066
Love	.61 (.39, .77)	90.1 (7.9)	90.2 (8.7)	-14.92 (-16.69, -13.14)	-0.09 (-1.86, 1.69)	14.74 (12.97, 16.52)	.936
Social Self	.70 (.52, .82)	89.0 (8.1)	90.1 (8.1)	-13.83 (-15.36, -12.31)	-1.09 (-2.61, 0.43)	11.65 (10.13, 13.18)	.246

Spirituality	.82 (.70, .90)	61.1 (15.4)	64.0 (15.2)	-21.54 (-23.76, -19.31)	-2.93 (-5.16, -0.71)	15.67 (13.44, 17.89)	.035
Gender Identity	.45 (.19, .65)	83.3 (11.6)	85.9 (12.0)	-27.74 (-30.75, -24.73)	-2.58 (-5.58, 0.43)	22.59 (19.58, 25.60)	.166
Cultural Identity	.77 (.62, .87)	82.6 (11.2)	81.1 (11.6)	-14.14 (-16.01, -12.27)	4.49 (-0.38, 3.35)	17.12 (15.25, 18.98)	.197
Self-care	.65 (.45, .79)	93.5 (5.6)	95.2 (4.2)	-10.09 (-11.08, -9.09)	-1.74 (-2.74, -0.74)	6.61 (5.61, 7.61)	.006
Essential Self	.81 (.68, .89)	79.8 (7.5)	81.3 (7.2)	-10.77 (-11.87, -9.67)	-1.54 (-2.64, -0.44)	7.69 (6.58, 8.79)	.026
Exercise	.69 (.50, .82)	84.9 (11.4)	86.3 (11.2)	-19.40 (-21.55, -17.25)	-1.41 (-3.56, 0.74)	16.57 (14.42, 18.72)	.285
Nutrition	.76 (.60, .86)	84.0 (10.5)	86.6 (12.0)	-18.52 (-20.43, -16.62)	-2.58 (-4.49, -0.68)	13.36 (11.45, 15.26)	.031
Physical Self	.78 (.64, .87)	83.6 (10.2)	86.0 (10.9)	-16.56 (-18.26, -14.86)	-2.32 (-4.02, -0.61)	11.93 (10.23, 13.63)	.030
Total Wellness	.84 (.72, .91)	80.4 (5.6)	81.6 (5.9)	-7.92 (-7.82, -7.12)	-1.24 (-2.04, -0.45)	5.43 (4.64, 6.23)	.014

Table 6.4

Intraclass correlation coefficient (ICC), mean (standard deviation) scores, and limits of agreement (LOA) for the context score and life satisfaction index of the Five Factor Wellness Inventory among females

Measure	ICC (95% CI)	Mean 1 (SD)	Mean 2 (SD)	Limits of agreement			p-value
				Lower LOA (95% CI)	Mean difference (95% CI)	Upper LOA (95% CI)	
Local Context	.73 (.56, .84)	89.9 (10.6)	89.9 (12.3)	-17.12 (-19.16, -15.07)	0.00 (-2.05, 2.05)	17.12 (15.07, 19.16)	1.000
Institutional Context	.67 (.47, .80)	74.3 (9.5)	74.8 (9.4)	-16.09 (-17.97, -14.22)	-0.40 (-2.28, 1.47)	15.28 (13.41, 17.16)	.724
Global Context	.64 (.43, .78)	76.5 (15.6)	78.4 (13.9)	-27.51 (-30.56, -24.46)	-1.99 (-5.04, 1.06)	23.52 (20.47, 26.57)	.288
Chronometrical Context	.63 (.42, .78)	83.2 (9.4)	85.3 (11.0)	-19.97 (-22.10, -17.84)	-2.16 (-4.29, -0.03)	15.64 (13.51, 17.77)	.101
Life Satisfaction Index	.37 (.10, .60)	82.6 (17.4)	90.2 (13.4)	-42.88 (-47.10, -38.67)	-7.60 (-11.82, -3.39)	27.66 (23.45, 31.88)	.005

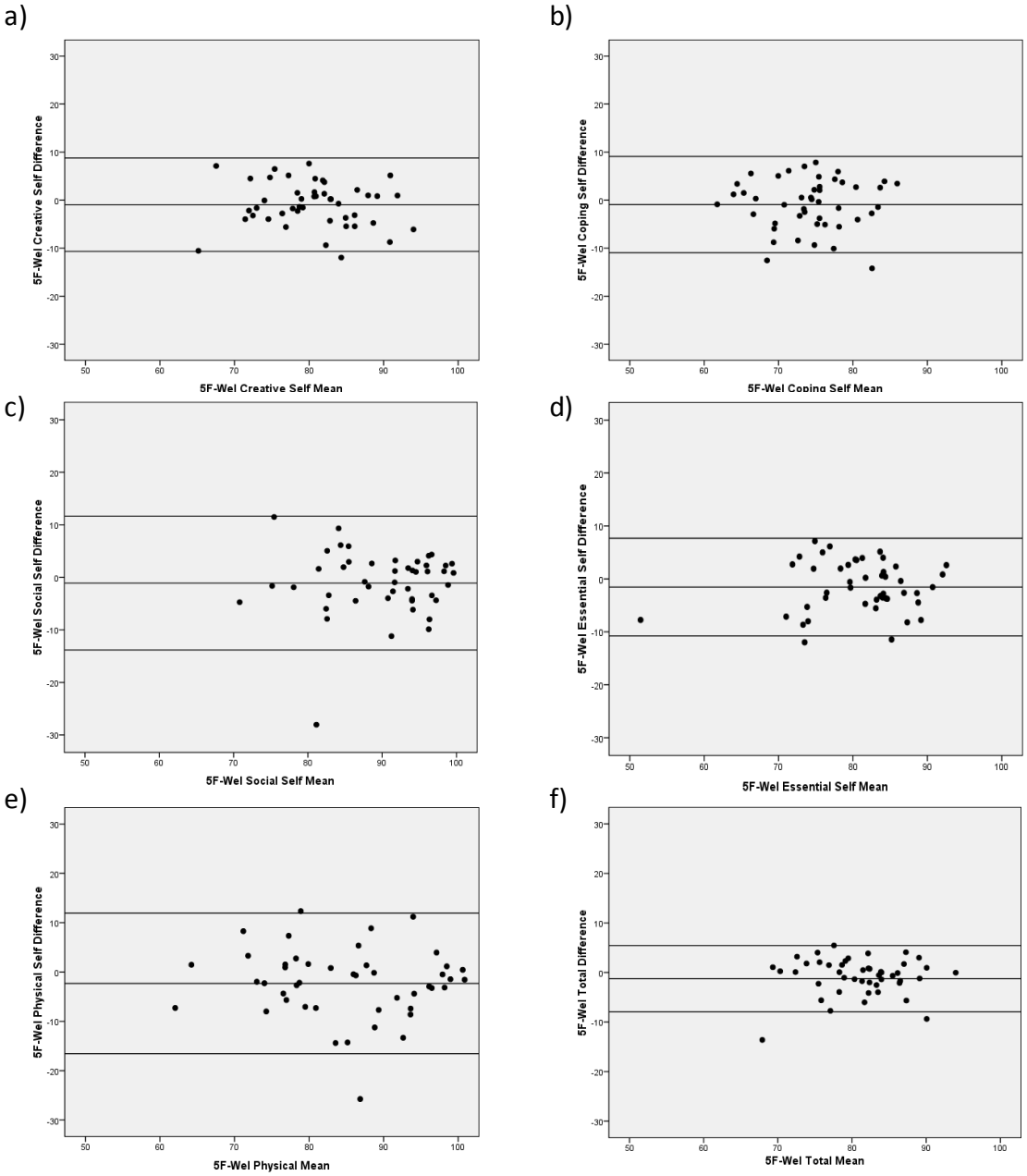

Figure 6.3. Bland-Altman plots for 5F-Wel dimensions including Creative Self (a), Coping Self (b), Social Self (c), Essential Self (d), and Physical Self (e), as well as the Total Wellness score (f) among females

6.5 DISCUSSION

The 5F-Wel generally had fair to excellent levels of agreement between assessments for both genders. The intraclass correlation coefficients, mean differences, paired t-tests and limits of agreement (Tables 6.1-6.4) between assessments suggested there was only a small amount of random error, indicating that any disagreement was small in magnitude, and not systematic (i.e. not

consistently higher or lower at either assessment).This is congruent with what one might expect from a reliable wellness instrument when assessments were carried out one week apart. This study is the first investigation of reliability for the 5F-Wel instrument amongst adolescents and suggests the instrument is reliable to be administered amongst adolescent males and females.

There was no overarching pattern of disagreement across the scores on the 17 subscales, 5 dimensions, total wellness score, 4 contexts and overall life satisfaction index. The subscales with the closest agreement between assessments were Spirituality for both genders (intraclass correlation coefficient of .93 and .82 for males and females respectively) and also Leisure for females (intraclass correlation coefficient of .82) (Tables 6.1-6.4). Most questions that contribute to the spirituality subscale involve attending church or undertaking religious activities. The high level of agreement for this subscale is not surprising given that participants in this sample are unlikely to change religious beliefs or spiritual practices between the two assessments. The subscales with the lowest intraclass correlation coefficient were Leisure (.48), and gender identity (.45) for males and females respectively. However, there was still moderate agreement in this subscale between the two assessments (Fleiss, 1986). Interestingly, Leisure, the subscale with the lowest intraclass correlation coefficient for males (.48), was also the subscale with the equal-highest intraclass correlation coefficient in females (.82). It is possible to speculate that adolescents currently in secondary schools are likely to be participating in forms of structured and organized activities (Mota & Esculcas, 2002). The time of school semester that data collection was undertaken (mid-semester for females and end of semester for males) may well explain the differences in reliability for this subscale between genders.

Reliable measures of wellness are important for observing the effect of interventions on wellness, to observe wellness in a sample cohort at a single time point or changes that may occur over time. This study has provided foundational empirical evidence that supports the reliability of this instrument in adolescents. This evidence is important to inform multi-dimensional wellness instrument selection for observational studies and intervention evaluation targeted at adolescents (Rachele, Cuddihy, Washington, Barwais, et al., 2013). Findings from this research support the use of the 5F-Wel for this purpose.

Comparisons of findings from this study to prior research are difficult given the scarcity of empirical work in this field. There have been no prior investigations of test-retest reliability of the 5F-Wel amongst adolescents. The level of reliability reported in this investigation compares favourably with intraclass correlation coefficients reported for other self-reported instruments amongst adolescents such as the International Physical Activity Questionnaire (.11 to .77) and World Health Organization, Health Behavior in Schoolchildren questionnaire (.59 to .66) (Rangul, et al., 2008). Additionally, the level of reliability observed in this investigation is also comparable to that observed when wellness instruments have been evaluated amongst adult populations (Brown, Geiselman, Copeland, Gordon, & Richard-Eaglin, 2008; Myers, et al., 2004).

A study of this nature has two potential limitations (McPhail, et al., 2009). First, there is the innate risk that a participant may have anticipated the purpose of the study, recalled their original answer and responded in the same way when completing the questionnaire for the second time. The second is the risk that a participant's life situation or attitudes to the assessment statements may have measurably changed between the two assessment points. We believe that this study was more at risk of the second limitation than the first as we allowed a seven day period between assessments. This, combined with the number of items (n=97) that a respondent would have had to remember correctly gave some protection against the memory-recall limitation. By doing so, however, our results were likely to be more conservative than what could be expected in real life. Hence, given the nature of our design, we argue that the results of this investigation provide evidence to support the use of the 5F-Wel among adolescent populations. This may comprise a number of settings including research environments, schools or community centres, and with practitioners such as school-based nurses, counsellors, and social workers.

There are also several factors that may limit the extrapolation and transferability of findings from this study. Data collection was undertaken in catholic (females) and non-denominational (males) private school in a developed nation where adolescents are likely to have a high level of literacy. It is unlikely that socioeconomically or educationally disadvantaged adolescents were represented in this sample and may not have responded in the same way as participants in this study. While this investigation provides important foundational empirical evidence

for use of the 5F-Wel instrument, there are several related research priorities. In addition to investigating the reliability of the 5F-Wel amongst socioeconomically or educationally disadvantaged adolescents, the reliability of the instrument across possible alternative modes of administration should also be a priority for future research. In this study the 5F-Wel was administered as a self-completed paper based questionnaire. Two alternative modes of administration worthy of investigation amongst adolescents include computer administration (such as via a web-based survey platform) and telephone administration. These two alternative modes of administration, if reliable, may facilitate 5F-Wel completion in professional and research contexts. Web-based administration may increase the feasibility of large scale investigations and offer a convenient alternative for computer savvy adolescents. Telephone administration may improve response rates for investigations where participants have not completed and returned the paper based version. However, for telephone reliability to be established, it may be prudent to first investigate whether the 5F-Wel questions elicit the same response when self-completed versus interviewer administered. It is foreseeable that an adolescent may not provide the same responses to an interviewer than when self-completing the instrument in relative privacy. Any discrepancy observed between interviewer administration and self-completion of the instrument may also influence an inter-mode reliability study investigating telephone administration of the 5F-Wel.

6.6 CONCLUSION

This study has been the first to investigate the reliability of the 5F-Wel instrument amongst adolescents. Overall, there was fair to excellent agreement across the first and second administrations of the instrument. These findings suggest the 5F-Wel instrument is reliable for use amongst adolescents and supports its use in research and professional contexts.

Following this study, the 5F-Wel was deemed acceptable for use in this program of research, and was therefore used to address the final aim of this study, to explore the associations between self-reported wellness and physical activity among adolescents, and consider practical implications.

Chapter 7: The association between self-reported physical activity and wellness in adolescents: The missing piece for youth wellness programs

After ascertaining an operational understanding of wellness, determining an appropriate physical activity measure to employ, and establishing acceptable reliability of the 5F-Wel, this Chapter explores the association between self-reported physical activity and wellness in adolescents. Practical implications and priorities for future research are discussed.

This Chapter is based on the following peer-reviewed journal article:

Rachele, J. N., Cuddihy, T. F., Washington, T. S. & McPhail, S. (in press). The association between adolescent self-reported physical activity and wellness: The missing piece for youth wellness programs. *Journal of Adolescent Health*

7.1 ABSTRACT

Potential positive associations between youth physical activity and wellness scores could emphasize the value of youth physical activity engagement and promotion interventions, beyond the many established physiological and psychological benefits of increased physical activity. The purpose of this study was to explore the associations between adolescents' self-reported physical activity and wellness. This investigation included a total of 493 adolescents (165 males and 328 females) aged between 12 and 15 years. Participants were recruited from six secondary schools of varying socio-economic status within a metropolitan area. Students were administered the Five-Factor Wellness Inventory and the International Physical Activity Questionnaire for Adolescents to assess both wellness and physical activity respectively. Data indicated that significant associations between physical activity and wellness existed. Self-reported physical activity was shown to be positively associated with a total of 4 dimensions including friendship, gender identity, spirituality, exercise; the higher order factor physical self and total wellness, and negatively associated with self-care, self-worth, love and cultural identity. This study suggests that relationships exist between self-reported physical activity and various elements of wellness. Future research should utilize controlled trials of physical activity and wellness to establish causal links among youth populations. Understanding the nature of these relationships, including causality, has implications for the justification of youth physical activity promotion interventions, and the development of youth physical activity engagement programs.

7.2 BACKGROUND

Physically inactive pursuits during childhood and adolescence, as well as poor physical fitness in adolescence, have both been associated with poor adult health outcomes (Hallal, et al., 2006). This is concerning, given the consistent findings of insufficient physical activity among youth populations and the high prevalence of recreational, educational and occupational activities which do not involve physical activity; particularly not at moderate or vigorous intensities (Eaton, et al., 2012). The latest report from World Health Organization (WHO) on the Health Behavior in School-aged Children Study, with 11, 13 and 15 year old pupils in 35 countries of the WHO European Region and in North America, demonstrated that more than two thirds of young people did not report meeting the current recommendation for physical activity of 60 minutes per day at a moderate-to-vigorous intensity, on 5 or more days a week (Currie, et al., 2012).

The number and magnitude of youth physical activity promotion interventions have been increasing as the preventative focus of contemporary healthcare moves to target younger age groups. Regular physical activity in youth has various immediate benefits, including improved musculoskeletal health, mental health, growth and development (Warburton, et al., 2006). Recent systematic reviews have found that physical activity in adolescence had positive short-term effects on self-esteem (Ekeland, Heian, Hagen, et al., 2005), positive effects on academic performance (Rasberry et al., 2011a), and the potential to reduce depression (Brown, Pearson, Braithwaite, Brown, & Biddle, 2013). A prospective study including 4594 adolescents concluded that physical activity was inversely related to depressive symptoms in early adolescence (Motl, et al., 2004). The potential for physical activity interventions to provide benefits beyond physical health enhances the value of these interventions, and provides justification for further research investigating the relationships between physical activity and the wellness of youth from a holistic, rather than piecemeal, viewpoint.

Wellness has been described as focusing on lifestyle behaviours which contribute towards individuals living to their fullest potential, and is often portrayed as multidimensional, whereby these dimensions contribute to make an integrated whole (Rachele, Cuddihy, Washington, Barwais, et al., 2013). Although the lack of a ‘gold standard’ definition of wellness has been highlighted as an area of concern in

the field (Rachele, Cuddihy, Washington, Barwais, et al., 2013), several consistencies among wellness definitions and models have been identified. Wellness is often defined as being both holistic, and multidimensional, with these dimensions being inter-related (Rachele, Cuddihy, Washington, Barwais, et al., 2013; Roscoe, 2009). The majority of wellness models (Adams, et al., 1997; Crose, et al., 1992; Hettler, 1980; Leafgren, 1990; Renger, et al., 2000) contain each of the following five dimensions; social, emotional, physical, intellectual, and spiritual wellness. Additionally, some contain; psychological (Adams, et al., 1997), occupational (Crose, et al., 1992; Hettler, 1980; Leafgren, 1990), and environmental (Renger, et al., 2000) wellness dimensions. Wellness is therefore an integrated construct determined by behaviours which facilitate the journey towards optimal states on multiple dimensions. The wellness paradigm offers an important point of difference from related constructs. For example, wellbeing has been described as the balance-point between an individual's resource pool and the challenges faced, whereby stable wellbeing is when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge (Dodge, et al., 2012). Health-related quality of life focuses on an individual's functional health status, often with reference to illness or recovery from a disease, including evaluation of symptoms, physical function, cognitive performance, psychological condition, emotional status, and adaptation to disease (Gupta & Kant, 2009). The wellness construct may be particularly useful when conceptualizing the benefits (or otherwise) of positive lifestyle behaviours among youth; at a time before chronic diseases associated with negative behaviours have developed.

The Indivisible Self model of wellness (IS-Wel) is an empirically based model, developed from a factor analysis of Wellness Evaluation of Lifestyle data (Myers & Sweeney, 2004a), a previously developed instrument established to measure wellness. The IS-Wel is grounded in Adlerian counselling theory (Adler, 1954) that emphasizes the indivisibility of the self. This is what Adler defined as holism, and is based on a single, higher order wellness factor that includes all wellness components(Myers, et al., 2011b). The IS-Wel model is displayed in Figure 7.1 and is comprised of five higher order factors of the self (creative self, coping self, social self, essential self and physical self). The creative self higher order factor includes the dimensions of thinking, emotions, control, work and positive humor. The coping

self higher order factor includes the dimensions of leisure, stress management, self-worth and realistic beliefs. The social self higher order factor includes the dimensions of friendship and love. The essential self higher order factor includes the dimensions of spirituality, gender identity, cultural identity and self-care. While the physical self higher order factor contains the dimensions exercise and nutrition.

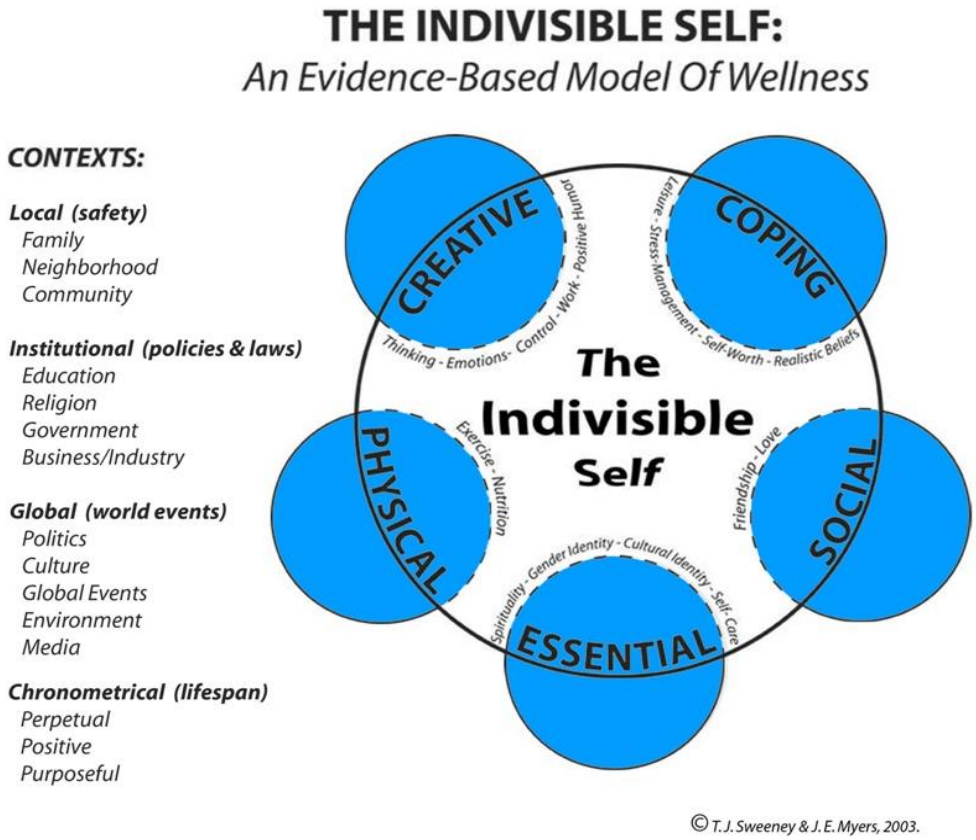

Figure 7.1.The Indivisible Self Model of Wellness, as measured by the Five-Factor Wellness Inventory, including the five higher order factors, and dimensions of which they are comprised

Positive associations between youth self-reported physical activity and wellness would add to the body of literature supporting the potential inclusion of physical activity as a component within youth wellness programs. Additionally, positive associations between physical activity and wellness would add to the growing evidence base emphasizing the potential value of youth physical activity engagement and promotion interventions, beyond the many established physiological and psychological benefits of increased physical activity. The purpose of this study was to explore the associations between adolescents' self-reported physical activity and wellness domains.

Existing literature indicates that some elements of wellness may be more strongly associated with self-reported physical activity than others. For example, positive associations may be present between physical activity and the IS-Wel dimensions of nutrition (Storey, et al., 2009), self-worth (Raudsepp, Liblik, & Hannus, 2002; Raudsepp, Neissaar, & Kull, 2013), self-care (Geckil & Dundar, 2011) friendship (de la Haye, Robins, Mohr, & Wilson, 2011; Macdonald-Wallis, Jago, Page, Brockman, & Thompson, 2011) thinking (Rasberry, et al., 2011a), and cultural identity (Renzaho, Swinburn, & Burns, 2008). It is also expected that the exercise subscale (described in the IS-Wel model as engagement in, and perceptions of exercise, and physical activity (Myers & Sweeney, 2005a)) may also be positively associated with self-reported physical activity levels. However, this relationship may have an element of circularity, given the content similarities between these two outcomes. Conversely, it is expected that self-reported physical activity may not be associated with a number of IS-Wel dimensions among youth; including realistic beliefs, work, positive humor, love, and emotions (Myers & Sweeney, 2005a).

7.3 METHODS

7.3.1 Participants

This investigation included a total of 493 adolescents (165 males and 328 females) aged between 12 and 15 years. Participants were recruited from six secondary schools in metropolitan Brisbane, Australia. Schools were categorized as either from low, medium, or high socioeconomic status (SES) backgrounds. Socioeconomic background was determined by the Australian Curriculum, Assessment and Reporting Authority's Index of Community Socio-Education Advantage (ICSEA). Briefly, ICSEA is a scale that enables meaningful comparisons to be made across schools in Australia. Variables used in calculating a value on the ICSEA scale include student-level data on the occupation and education level of parents/carers, and/or socio-economic characteristics of the areas where students live, whether a school is in a metropolitan, regional or remote area, the proportion of students from a language background other than English, as well as the proportion of Indigenous Australian students enrolled at the school (Australian Curriculum Assessment and Reporting Authority, 2012a; Rachele, Cuddihy, et al., 2013b). High SES participants were recruited from two non-denominational same-sex private schools. Mid SES participants were recruited from one same-sex and one co-ed

private school, and one public school. Low SES participants were recruited from one public school.

7.3.2 Instruments

Two instruments were used to measure self-reported wellness and physical activity among participants in this study.

Five Factor Wellness Inventory

The 5F-Wel T version (the 5F-Wel modified to a 6th grade reading level) is a 97 item questionnaire which includes attitudinal and behavioural statements (e.g. "I eat a healthy diet"). Respondents rate their agreement with each statement using a 4-point Likert scale ranging from strongly agree (1) to strongly disagree (4) (Myers, et al., 2011b). The 5F-Wel (T version) takes approximately 15 minutes to complete and has favourable evidence supporting its reliability as a self-reported measure of wellness among adolescents (Rachele, Cuddihy, Washington, & McPhail, 2013a). The 97 questions are grouped into 17 dimensions, within five higher order factors, four context scores, an overall life satisfaction index, and total wellness (Myers, et al., 2011b). Mean item scores for each subscale are computed and modified using a linear transformation to make the scales comparable, with each having a range from 25-100 (Myers, et al., 2011b). The 17 dimensions can be grouped into five higher order factors that comprise total wellness (creative, coping, social, essential and physical) (Myers, et al., 2011b). An illustration of the relationship between subscales, dimensions, and overall wellness are presented in Figure 7.1.

The Five-Factor Wellness Inventory (5F-Wel) T version (the 5F-Wel modified to a 6th grade reading level) was designed to measure factors on the IS-Wel Model of Wellness (Myers, et al., 2011b). The 5F-Wel-T is a 97 item questionnaire which includes attitudinal and behavioural statements (for example "I eat a healthy diet") where respondents rate their agreement with the statement using a 4-point Likert scale ranging from strongly agree to strongly disagree (Myers, et al., 2011b). These 97 items are grouped into 17 dimensions. Mean item ratings for each dimension are computed and modified using a linear transformation to make the dimension scales comparable, with each having a range from 25-100. The 17 dimensions are also grouped into five higher order factors consistent with the IS-Wel model of wellness. An illustration of the IS-Wel, as measured by the 5F-Wel, including the five higher

order factors and dimensions of which they are comprised is displayed in Figure 7.1. Responses to the questionnaire are also used to generate a total wellness score (Myers, et al., 2011b). The 5F-Wel-T takes approximately 15 minutes to complete and has favourable evidence supporting its reliability as a self-reported measure of wellness among adolescents (Rachele, McPhail, Cuddihy, & Washington, 2012), while validity has been demonstrated for a variety of 5F-Wel factors (Myers & Sweeney, 2005a).

International Physical Activity Questionnaire for Adolescents

The International Physical Activity Questionnaire for Adolescents (IPAQ-A), adapted from the International Physical Activity Questionnaire Long Version, was developed for use in adolescents (Hagstromer, et al., 2008). This adapted version also measures physical activity over the previous seven days, and covers four domains of physical activity being school-related physical activity, including activity during physical education classes and breaks; transportation; housework; and leisure time. In each of the four domains, the numbers of days per week and time periods per day spent walking, in moderate activity and in vigorous activity are recorded. Variations from the adult version include, questions about physical activity at work being replaced by physical activity at school, and including only one question about physical activity in the garden or at home (versus 3 in the standard IPAQ) (Hagstromer, et al., 2008). It has been reported that the minimum dose of physical activity per week in youth to gain health benefits is 420 minutes per week (one hour per day) at a moderate-to-vigorous intensity (Trost, 2005). Total time spent per week engaging in moderate-to-vigorous physical activity can be summed across each of the four domains, and computed to establish if participants are meeting physical activity recommendations (Department of Health and Ageing, 2004; World Health Organization, 2010). The IPAQ-A was used in this way for this investigation to identify those participants who were (and were not) meeting the minimum physical activity levels recommended for receiving health benefits.

7.3.3 Procedure

Questionnaires were distributed to students via teaching staff at their respective schools. Students were invited to complete the survey at home. Questionnaires included a participant information sheet for both parents and students detailing their involvement in the study. Questionnaires were then returned to teaching staff, and

collected by the principal researcher. This study was approved by the Human Research Ethics Committee of the Queensland University of Technology.

7.3.4 Data Analysis

Analyses were performed using the IBM Statistical Package for the Social Sciences (SPSS) version 21. Demographic information (age, gender and SES) was described using conventional descriptive statistics. Participants were categorized as either sufficiently or insufficiently physically active as determined by meeting physical activity guidelines of at least 420 minutes per week of moderate-to-vigorous physical activity, as recommended by the World Health Organization (World Health Organization, 2010) and Australian Federal Government Department of Health and Ageing (Department of Health and Ageing, 2004). Physical activity was categorized to ensure greater clinical meaningfulness of results (regarding which participants were sufficiently physically active for health benefits), as well as to enable comparisons with internationally published categorical data for youth physical activity (Currie, et al., 2012).

Previous investigations have indicated missing data from physical activity surveys among adolescents may not be missing at random; with adolescents from low SES backgrounds more likely to have incomplete data sets (Corder et al., 2011). This meant that simple listwise deletion of participants on the basis of missing data (missing in a systematic way) could negatively influence the robustness of the study findings. Therefore a logistic regression, with the presence of missing data as the dependent variable and participant characteristics (SES, gender, age, ethnicity, school status) as independent variables was used to determine which participant characteristics were associated with missing data. Those characteristics associated with missing data were then used to develop propensity weightings (propensity for missing physical activity data). This was to ensure that participants with complete data and possessing traits in common with participant's who had missing data, were given a greater weighting during analysis. To achieve this, propensity weightings were calculated from the probabilities of missing data generated from a logistic regression (with the presence of missing physical activity as the dependent variable, and those participant characteristics associated with missing data as independent variables). These propensity weightings were then used during analyses conducted to address the study aims.

To address the primary aim of the study three logistic regressions were undertaken. The first examined the associations between participants who were sufficiently physically active (dependent variable) and the 17 dimensions of wellness assessed with the 5F-Wel (independent variables). The second examined the associations between self-reported physical activity (dependent variable) and five higher-order factors from the 5F-Wel. The third examined the association between self-reported physical activity and the total wellness summary score. Potential confounding variables gender, SES and the interaction between gender and SES were also added to each of the logistic regressions. Simulations studies of logistic regressions indicate that a minimum of 10 outcome events per predictor variable are required to avoid poor modelling including coefficient bias, poor confidence interval coverage, and type 1 error (Peduzzi, Concato, Feinstein, & Holford, 1995; Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996). The largest regression model in this analysis contained 20 predictor values, requiring a sample of at least 200 participants. Multi-collinearity was assessed using variance inflation factors and tolerance statistics. Variance inflation factors below 10 (Bowerman, O'Connell, & Dickey, 1990; Field, 2009; Myers, 1990) and tolerance statistics above 0.2 (Field, 2009; Menard, 2002) were deemed acceptable for analysis. Additionally, Pearson Chi-Square was used to test for differences in physical activity between SES groups and genders.

7.4 RESULTS

A total of 324 (65.7%) participants (88 males and 236 females) had complete data and were included in the analysis. The average age (standard deviation) of participants was 13.7 (0.7) years. The number (%) of participants included were 38 (11.7%) from low SES backgrounds, 185 (57.1%) from mid SES backgrounds, and 101 (31.2%) from high SES backgrounds. The analyses of missing data revealed that SES background ($p<.001$) and gender ($p<.001$) indicated propensity for missing data and these variables were used to generate propensity weightings.

A total of 202 (58.6%) participants reported physical activity levels that exceeded guidelines. Within each SES group, the number (%) of participants who reported being sufficiently physically active were 19 (48.7%) for low SES participants, 124 (61.9%) for mid SES participants, and 59 (56.2%) for high SES participants. Differences in the proportion of participants in each group meeting the

physical activity guidelines was not statistically significant (χ^2 (2) = 4.169, p = .124). Within each gender, the number (%) of participants who reported being sufficiently physically active were 101 (61.96%) for male participants, and 185 (56.40%) for female participants. Differences in the proportion of participants in each group meeting the physical activity guidelines were not statistically significant (χ^2 (1) = 1.324, p = .250).

Each of the three regressions examining associations between physical activity and wellness produced significant results. Observed variance inflation factors and tolerance statistics were below 10 and above 0.2 respectively, indicating that multi-collinearity was not present among any of the 5F-Wel dimensions, higher order factors or total wellness. The first logistic regression (Table 7.1, χ^2 = 127.96; df = 20; p < .001) indicated that friendship (p = .003), gender identity (p = .026), love (p = .022), self-care (p = .001), self-worth (p = .002), spirituality (p = .014), cultural identity (p = .033) and exercise (p < .001) were all associated with meeting the physical activity guidelines. The second logistic regression (Table 7.2, χ^2 = 58.28; df = 8; p < .001) indicated that the physical self (p < .001) higher order factor was significantly associated with physical activity. The third logistic regression indicated that the total wellness summary score was associated with physical activity (Table 7.3, χ^2 = 10.98; df = 4; p = <.05).

Table 7.1

Logistic regression results between self-reported physical activity and wellness dimensions

Independent variable	β	SE	Wald	*p*-Value	Exp(β)
Control	.020	.014	1.912	.167	1.020
Emotions	-.002	.015	.016	.900	.998
Friendship	.052*	.017	9.120	.003	1.053
Gender identity	.029*	.013	4.924	.026	1.030
Leisure	-.016	.012	1.779	.182	.984
Love	-.033*	.015	5.242	.022	.967
Nutrition	.017	.011	2.484	.115	1.017
Realistic beliefs	.013	.011	1.434	.231	1.013
Self-care	-.039*	.012	11.060	.001	.962
Self-worth	-.039*	.012	9.771	.002	.962
Spirituality	.016*	.006	6.060	.014	1.016
Stress management	.008	.012	.423	.515	1.008
Thinking	.000	.014	.001	.981	1.000
Work	-.026	.017	2.407	.121	.974
Exercise	.067*	.010	41.094	.000	1.069
Positive humor	.004	.011	.156	.693	1.004
Cultural identity	-.024*	.011	4.522	.033	.976
SES	.258	.618	.174	.676	1.294
Gender	-.132	.740	.032	.859	.877
SES * Gender	-.181	.356	.259	.611	.834
	Model $\chi^2 = 127.96$ $p < .001$				
	Psuedo $R^2 = .325$				
	n = 324				

* p<.05

Table 7.2

Logistic regression results between self-reported physical activity and wellness higher order factors

Independent variable	β	SE	Wald	*p*-Value	Exp(β)
Creative self	.000	.018	.000	.983	1.000
Coping self	-.021	.020	1.104	.293	.980
Social self	-.004	.015	.083	.774	.996
Essential self	-.018	.013	1.938	.164	.982
Physical self	.070*	.011	41.682	.000	1.073
SES	.136	.562	.059	.808	1.146
Gender	-.397	.678	.344	.558	.672
SES * Gender	.049	.322	.023	.880	1.050
	Model $\chi^2 = 58.28$ $p < .001$				
	Psuedo $R^2 = .159$				
	n = 324				

* p<.05

Table 7.3

Logistic regression results between self-reported physical activity and total wellness

Independent variable	β	SE	Wald	*p*-Value	Exp(β)
Total wellness	.036*	.013	7.858	.005	1.037
SES	.182	.540	.114	.736	1.200
Gender	-.059	.646	.008	.928	.943
SES * Gender	-.139	.307	.205	.651	.870
	Model $\chi^2 = 10.98$ $p < .05$				
	Psuedo $R^2 = .032$				
	n = 324				

* p<.05

Note: the dependent variable in this analysis is meeting physical activity guidelines coded so that 0 = those who did not meet physical activity guidelines and 1 = those who did meet physical activity guidelines

7.5 DISCUSSION

Data from this investigation indicated that an association between physical activity and wellness exists. While directional causality cannot be established from this cross-sectional study, it is plausible that causality may not be unidirectional. Physical activity, may contribute to aspects of wellness; particularly physical wellness but potentially non-physical aspects of wellness too. On the other hand, it is also plausible that being 'well' in certain aspects of the wellness paradigm may contribute to a synergistic relationship of being able to lead a physically active lifestyle.

While there have not been previous investigations directly evaluating the association between physical activity and wellness among adolescents, findings from this investigation are consistent with previous reports that have indicated physical activity is associated with a number of psychological constructs and lifestyle behaviours that are represented within the IS-Wel model. Expected significant associations materialized between self-reported sufficient physical activity and wellness elements for the IS-Wel dimensions including friendship and exercise. Positive associations were also found for gender identity and spirituality.

Unexpectedly, negative associations were found for the IS-Wel dimensions self-care, self-worth, love and cultural identity. Furthermore, specific dimensions of wellness were not expected to be significantly associated with self-reported sufficient physical activity, and these transpired accordingly. These include the IS-Wel dimensions control, emotions, leisure, realistic beliefs, stress management, work, positive humor and love.

It was perhaps interesting to note that some expected significant associations between wellness dimensions and self-reported sufficient physical activity didn't materialize. These two IS-Wel dimensions were thinking and nutrition. It is possible that associations between self-reported sufficient physical activity and nutrition, or thinking, may not have been present in this sample. Alternatively, these particular dimensions of the IS-Wel may require further validation to ensure their appropriateness for administration among adolescent populations.

The results from this investigation have added to the growing body of literature supporting the notion that the benefits of physical activity among adolescents are likely to extend beyond the prevention of chronic disease. While this study suggests that relationships may exist between self-reported physical activity and elements of wellness among youth, causality within these relationships cannot be established from cross-sectional data alone. If a causal link between physical activity and a variety of wellness dimensions were to be subsequently demonstrated, the inclusion of physical activity in wellness interventions aimed at youth may be justified not only on the basis of influencing physical wellness, but potentially a variety of non-physical aspects of wellness. Currently many wellness interventions aimed at youth do not incorporate a physical activity component. For example, Smith-Adcock, et al. (2008) examined a group counselling intervention (1 hour per week for 8 weeks) developed to promote wellness among adolescent girls at risk of delinquency, who were attending an alternative school. Additional benefits for these adolescents may have been generated from the inclusion of appropriate physical activity promotion as part of the wellness intervention. Similarly, Choate and Smith (2003) infused a wellness model into the curriculum design of a first-year college course and examined changes in student wellness. It is plausible that the wellness outcomes for students may have been enhanced by the inclusion of effective physical activity promotion.

This study included a number of important limitations. First, it is noteworthy that the gender gap in youth reading proficiency exists in all 65 countries and economies that participated in the 2009 Organization for Economic Cooperation and Development's (OECD) Programme for International Student Assessment (PISA) tests (OECD, 2011). It is therefore likely that lower levels of reading proficiency among students from lower SES backgrounds and among males (in comparison to females) may have meant these students had a greater propensity to not return completed self-report questionnaires (and were initially underrepresented in the dataset). To overcome this potential shortcoming, propensity score weighting (for missing data) was employed in the analyses to ensure that students with similar attributes to those who had missing data were assigned a higher weighting within the models. The propensity score weighting meant that male individuals and those from low SES backgrounds would have been weighted more heavily (than for example, female individuals from high SES backgrounds) in the final models reported in this study. Second, while this study included different SES groups, and subsequent propensity weighting methods ensured representation of participants from all SES groups could be considered a strength, this investigation only included participants from a high income nation where participation in school education is compulsory for adolescents in this age group. Therefore these findings may not be applicable to youth from dissimilar societies. Third, this study only included participants aged 12 to 15 years, and consequently, the findings cannot be extrapolated beyond this age group. Further investigations in the 9 to 12 year and 15 to 17 year age groups would enhance the understanding of physical activity's relationship with wellness during continuing decline in physically activity levels among youth (Dumith, Gigante, Domingues, & Kohl, 2011; Nader, Bradley, Houts, McRitchie, & O'Brien, 2008). Finally, although the study design was suitable to address the research aim, an intervention trial would be required before any assertions of causality can be confirmed.

There are a number of important priorities for future research. Future research to inform understanding of the relationship between physical activity and wellness among youth populations is of considerable importance. This research may include randomized controlled trials examining, for example, the impact of physical activity on youth wellness (group 1) versus wellness alone (group 2). Furthermore, physical

activity levels generally begin to decline at 9 years of age, and continue until 15 years (Dumith, et al., 2011; Nader, et al., 2008). Indeed, this decline is sharper among youth from disadvantaged or low income communities and remains a priority for subsequent investigations (Borraccino et al., 2009; Drummond, Drummond, Dollman, & Abery, 2011). Other populations of interest include those living or attending schools in rural areas, or undergoing schooling in education systems in other geographical regions or dissimilar societies.

7.6 CONCLUSION

This study suggests that relationships exist between self-reported physical activity and various elements of wellness. Future research should utilize controlled trials of physical activity and wellness to establish causal links among youth populations. Understanding the nature of these relationships, including causality, has implications for the justification of youth physical activity promotion interventions, and the development of youth physical activity engagement programs.

Chapter 8: Conclusion

The following Chapter provides conclusions which respond to each of the research aims stated in Chapter 1. Research implications, study limitations, and recommendations for future research are also discussed. These are followed by final reflections of the overall program of research.

8.1 CONTEMPORARY APPROACHES TO PHYSICAL ACTIVITY EVALUATION AMONGST YOUTH

There will always be a trade-off between accuracy and available resources when choosing the best approach to measuring physical activity amongst youth. Unfortunately, cost and logistical challenges may prohibit the use of 'gold standard' physical activity measurement approaches such as doubly labelled water. However, other objective methods such as heart rate monitoring, accelerometry, pedometry, indirect calorimetry, or a combination of measures have the potential to capture the duration and intensity of physical activity, but do not capture information about the type or context of this activity. Self-reported measures can capture the type and context of physical activity and have a practical advantage over other approaches due to their relative ease of administration and low cost. These practical advantages may come at the expense of precision due to dependence on recall of detailed historical activity information. However, this compromise is likely to be justified amongst large samples if the purpose of physical activity evaluation does not require a high degree of measurement precision for each individual.

The International Physical Activity Questionnaire for Adolescents (IPAQ-A) was selected for use in this program of research. Although the IPAQ-A is a relatively new instrument for measuring physical activity in youth, on face value and given the international popularity of the adult version, it was deemed an acceptable selection. It was logistically feasible given the large sample size that was to be targeted, low cost (only printing costs required), and a single data collection time-point (as opposed to a diary instrument). It also enabled the collection of contextual information such as physical activity performed over the four domains of leisure, school, transport, and home.

8.2 PROCESSES FOR PHYSICAL ACTIVITY RESEARCH IN AUSTRALIAN SCHOOL SETTINGS

Those wishing to investigate school-based physical activity face several obstacles in their endeavour to complete successful research investigations. Careful planning and consideration must be undertaken prior to the commencement of, and during the research process, due to the complex nature of school settings and various constraints that exist within the Australian context. Improving the research capacity among teachers, including enhanced knowledge of research practices, could lead the

way to truly collaborative approaches, beneficial to all parties. This may ultimately lead to the prevention of barriers which are potentially averting schools from participating in research studies, and avoid disruption to staff and students during the research process. Advancing the relationship between schools and research institutions may lead to increased collaboration, with mutual benefits.

8.3 AN OPERATIONAL UNDERSTANDING OF WELLNESS

While it is inevitable that cross-over exists between similar constructs, wellness does have distinctly identifiable features. Wellness is both holistic and multi-dimensional, with these dimensions being inter-related. The manipulation of one dimension has a reciprocal influence on other dimensions. Wellness is determined, however, not in terms of its individual dimensions but as an integrated whole. Wellness focuses on lifestyle behaviours. While the effectiveness of lifestyle choices can be 'measured' through assessments of wellbeing, quality of life or physiological measures (e.g. blood pressure), wellness is an integrated construct determined by behaviours which facilitate the journey towards optimal states on multiple dimensions. The purpose and practical application of wellness is undertaking positive lifestyle behaviours which enable an individual to achieve a higher order of functioning. Wellness in this context is therefore about actions or processes, rather than outcomes. Wellness recognises the interrelatedness between the person and their environment where one influences the other. Both intention and context make wellness programs and campaigns unique from those of related constructs. In summary, wellness is concerned with people making appropriate lifestyle choices, with a focus upon a range of positive outcomes across dimensions.

8.4 THE STATE OF WELLNESS ASSESSMENT AMONG ADOLESCENTS

Adolescent wellness is an important indicator of future health and lifestyle habits. Instruments for evaluating wellness are particularly useful for those seeking to influence lifestyle behaviours among youth populations, including health and educational settings. There are a number of tools available to measure wellness, each with its own focus, depending on the definition or model from which it was developed. This may cause debate regarding the appropriateness of some instruments for evaluating wellness. However, in the absence of a 'gold standard' definition, substantial variability across measurement approaches is inevitable. The majority of

wellness evaluation approaches used with adolescent populations have less than ideal validation. A ‘gold standard’ definition could lead to the standardisation of a theoretical model against which wellness instruments could be validated. Progress toward developing a consensus for a definition of wellness during an international meeting of experts in the field would be a worthwhile undertaking. The absence of peer-reviewed studies reporting psychometric testing for wellness evaluation instruments for adolescents is of concern given their growing popularity and highlights a priority area for future research in this field.

Following this review of available instruments in use among adolescents, the Five Factor Wellness Inventory (5F-Wel) was selected for use in this program of research. The 5F-Wel was selected as it has been one of the most widely-used instruments among adolescents: it is empirically based; a youth-specific version of the instrument is available; and it provides a multi-dimensional detailed evaluation of the various components of the participant’s wellness. This allowed us to adequately explore the associations between self-reported wellness and physical activity among adolescents, and consider practical implications.

8.5 TEST-RETEST RELIABILITY OF THE FIVE FACTOR WELLNESS INVENTORY

The 5F-Wel generally had fair to excellent levels of agreement between assessments for both genders. The intraclass correlation coefficients, mean differences, paired t-tests and limits of agreement between assessments suggested there was only a small amount of random error, indicating that any disagreement was small in magnitude, and not systematic (i.e. not consistently higher or lower at either assessment). This is congruent with what one might expect from a reliable wellness instrument when assessments were carried out one week apart. This study is the first investigation of reliability for the 5F-Wel instrument amongst adolescents and suggests that the instrument is reliable to be administered amongst adolescent males and females. These findings suggest the 5F-Wel instrument is reliable for use amongst adolescents and supports its use in research and professional contexts.

8.6 ASSOCIATIONS BETWEEN SELF-REPORTED WELLNESS AND PHYSICAL ACTIVITY

This study indicated that significant associations between physical activity and wellness existed. Self-reported physical activity was shown to be positively associated with a total of four dimensions including friendship, gender identity, spirituality, exercise; the higher order factor physical self and total wellness, and negatively associated with self-care, self-worth, love and cultural identity. Future research should utilize controlled trials of physical activity and wellness to establish causal links among youth populations. Understanding the nature of these relationships, including causality, has implications for the justification of youth physical activity promotion interventions, and the development of youth physical activity engagement programs.

8.7 RESEARCH AND 'REAL WORLD' IMPLICATIONS

8.7.1 Youth physical activity measurement

The second Chapter provides a comprehensive overview of contemporary physical activity measurement approaches among youth populations. Given the number of available options for those seeking to assess youth physical activity, the Chapter provides a guide which considers the context and setting in which measurement is to be undertaken, as well as making a selection which addresses the purposes for measuring youth physical activity in the outset.

8.7.2 Conducting research in school settings

Schools offer a unique research setting due to distinct methodological circumstances. These features include: the compulsory nature of schooling, physical and personnel infrastructure available to researchers and practitioners, the demographics obtained from school settings, and the ability to infuse content into the curriculum. However, school-based researchers face several obstacles in their endeavour to complete successful research investigations; they are often confronted with complex research designs and methodological procedures that are not easily amenable to school contexts. Chapter Three provides a practical guide for teachers (both teacher educators and teaching practitioners) and researchers seeking to conduct physical activity-based research in Australian school settings, as well as a discussion about research practices. The research enabling process has been divided

into six phases: preparation; design; outcome measures; procedures; participants; and feedback.

8.7.3 For wellness researchers and practitioners

While a number of definitions for wellness have been proposed, there has been no single recognised or 'gold standard' definition which is currently in use in the field. This thesis increases understanding of the use of the term wellness, differentiating it from other related terms such as health, quality of life, and wellbeing, while also discerning the use of wellness within certain contexts, such as with young populations, and within schools or other institutional settings. This thesis also suggests an international meeting of experts in the field to facilitate the creation of a comprehensive and agreed upon definition of wellness.

The findings from this program of research also suggest that positive associations between youth self-reported physical activity and wellness exist, and due to potential interrelatedness between various aspects of wellness, changes in physical activity may also influence co-existing wellness domains. These findings add to the body of literature supporting the potential inclusion of physical activity as a component within youth wellness programs.

8.7.4 Measuring youth wellness

Wellness assessment tools can prove useful for those seeking to assist youth populations in establishing positive lifestyle behaviours, implement early health interventions or mitigate other health risks. Evaluating wellness can assist in the implementation and evaluation of wellness-related interventions among adolescents, particularly those interventions that aim to promote positive lifestyle behaviours. The contemporary state of wellness assessment of adolescents was reviewed, including instruments currently in use, or which have been used in the past, as well as their established validity and reliability. Considerations for instrument selection have also been detailed. Validity and reliability of wellness instruments were scarce, and this was considered to be a considerable gap in the body of literature regarding wellness and wellness assessment. The most commonly used wellness instrument, which is empirically based and has an age-appropriate version, the Five Factor Wellness Inventory, was selected to be included in a reliability analyses among youth. This study was, to our knowledge, the first to complete a reliability analysis of this

instrument among youth or adult samples. The instrument was found to have acceptable reliability, and was recommended for use among youth in a variety of settings. These findings have implications for anyone seeking to undertake wellness evaluation among a youth sample. Some examples may include counsellors, nurses, social workers, chaplains, health and physical education teachers, and school administrators.

8.7.5 Physical activity promotion interventions

The findings from this program of research add to the growing body of literature suggesting that the benefits of physical activity among adolescents are likely to extend beyond the prevention of chronic disease. Potential interrelatedness between various aspects of wellness may lead to increasing physical activity not only being directly represented in the exercise domain of adolescents' wellness, but also influencing co-existing wellness dimensions.

There are numerous implications for youth physical activity promotion interventions as a result of these findings. For example, the findings from this program of research suggest that the benefits of physical activity may also extend to numerous areas of wellness beyond the physical domain. Schools and education systems in many developed nations often have an inherent responsibility to develop well-rounded citizens (The Ministerial Council for Education Early Childhood Development and Youth Affairs, 2008). Physical activity may significantly contribute to the development of such students through potential interrelatedness of wellness domains. These findings may have implications for school policy-makers, and local school decision makers when considering for example, the allocation of resources for youth physical activity promotion interventions. The implications for physical activity promotion are also likely to extend to any who have an interest in the wellness of young people. These may include, but are not limited to: medical practitioners of young people, parents, chaplains, community social workers, and counsellors.

8.7.6 Youth wellness interventions

The findings from this program of research have implications for those seeking to initiate wellness interventions or programs among youth samples. These may include counsellors, nurses (particularly school nurses), medical practitioners, social

workers, health and physical education teachers, and school chaplains. As a result of these findings, the inclusion of physical activity in wellness interventions aimed at youth is justified not only on the basis of influencing physical wellness, but potentially some non-physical aspects of wellness. For example, the inclusion of a brief self-reported physical activity assessment upon an adolescent's first visit to a youth counsellor may provide useful insights into the physical domain of the client's wellness. The youth counsellor, based on the results of such an assessment, could provide feedback, which may be as simple as advising that the client complete the minimum recommendations for youth physical activity (60 minutes of moderate-to-vigorous physical activity each day (Department of Health and Ageing, 2004). Such advice could form a part of the client's wellness intervention.

8.8 LIMITATIONS OF THE THESIS

8.8.1 General limitations

Data collection was undertaken in a developed nation where adolescents are likely to have a high level of literacy. Participants from countries that contain socioeconomically or educationally disadvantaged adolescents may not have responded in the same way as participants in this study.

It was deemed beyond the scope of this program of research to propose a new definition for wellness. Moreover, adding a further definition of wellness to the numerous existing ones may prove counterproductive. Rather, this thesis aimed to increase understanding for the use of the term wellness, differentiating it from other related terms such as health, quality of life, and wellbeing, while also discerning the use of wellness within certain contexts or settings. Should a new definition of wellness be developed, it was suggested that this be during an international meeting of experts in the field.

During the systematic review of wellness instruments, the decision was made against using a standardised criteria (such as the Consensus-Based Standards for the selection of Health Measurement Instruments (COSMIN) checklist (Terwee, et al., 2011)) for quality assessment due to the heterogeneity of study designs, contexts, and lack of description of instrument measurement properties amongst adolescents. Similarly, it was deemed inappropriate to perform a meta-analysis of data due to the heterogeneity in study design, participant samples, and instruments used.

8.8.2 Reliability analysis limitations

A study of this nature has two potential limitations (McPhail, et al., 2009). First, there is the innate risk that a participant may have anticipated the purpose of the study, recalled their original answer and responded in the same way when completing the questionnaire for the second time. The second is the risk that a participant's life situation or attitudes to the assessment statements may have measurably changed between the two assessment points. We believe that this study was more at risk of the second limitation than the first as we allowed a seven day period between assessments. This, combined with the number of items (n=97) that a respondent would have had to remember correctly gave some protection against the memory-recall limitation. By doing so, however, our results were likely to be more conservative than what could be expected in real life. Additionally, while it is noted that the findings from this study suggest that the 5F-Wel is reliable for administration among adolescent samples, this analysis did not address validity, and hence the psychometric properties are not fully confirmed.

8.8.3 Association between physical activity and wellness limitations

This study included a number of important limitations. First, it is noteworthy that the gender gap in youth reading proficiency exists in all 65 countries and economies that participated in the 2009 Organization for Economic Cooperation and Development's (OECD) Programme for International Student Assessment (PISA) tests (OECD, 2011). It is therefore likely that lower levels of reading proficiency among students from lower SES backgrounds and among males (in comparison to females) may have meant these students had a greater propensity to not return completed self-report questionnaires (and were initially underrepresented in the dataset). To overcome this potential shortcoming, propensity score weighting (for missing data) was employed in the analyses to ensure that students with similar attributes to those who had missing data were assigned a higher weighting within the models. The propensity score weighting meant that male individuals and those from low SES backgrounds would have been weighted more heavily (than for example, female individuals from high SES backgrounds) in the final models reported in this study. Second, while this study included different SES groups, and subsequent propensity weighting methods ensured representation of participants from all SES groups could be considered a strength, this investigation only included participants

from a high income nation where participation in school education is compulsory for adolescents in this age group. Therefore these findings may not be applicable to youth from dissimilar societies. Third, this study only included participants aged 12 to 15 years, and consequently, the findings cannot be extrapolated beyond this age group. Further investigations in the 9 to 12 year and 15 to 17 year age groups would enhance the understanding of physical activity's relationship with wellness during continuing decline in physically activity levels among youth (Dumith, et al., 2011; Nader, et al., 2008). Fourth, self-report methods were used to assess physical activity in this program of research. Youth are less likely to make accurate self-report assessments due to developmental differences, especially in the ability to think abstractly and recall detailed activity information (Going, et al., 1999; Sallis, 1991), and results may therefore be subject to some recall bias (Kohl, et al., 2000). However, it was beyond the scope of this program of research, and available resources to use objective physical activity measurements. And finally, although the study design was suitable to address the research aim, an intervention trial would be required before any assertions of causality can be confirmed.

8.9 RECOMMENDATIONS FOR FUTURE RESEARCH

8.9.1 5F-Wel reliability

While this investigation provides important foundational empirical evidence for use of the 5F-Wel instrument, there are several related research priorities. In addition to investigating the reliability of the 5F-Wel amongst socioeconomically or educationally disadvantaged adolescents, the reliability of the instrument across possible alternative modes of administration should also be a priority for future research. In this study the 5F-Wel was administered as a self-completed paper based questionnaire. Two alternative modes of administration worthy of investigation amongst adolescents include computer administration (such as via a web-based survey platform) and telephone administration. These two alternative modes of administration, if reliable, may facilitate 5F-Wel completion in professional and research contexts. Web-based administration may increase the feasibility of large scale investigations and offer a convenient alternative for computer savvy adolescents. Telephone administration may improve response rates for investigations where participants have not completed and returned the paper based version. However, for telephone reliability to be established, it may be prudent to first

investigate whether the 5F-Wel questions elicit the same response when self-completed versus interviewer administered. It is foreseeable that an adolescent may not provide the same responses to an interviewer than when self-completing the instrument in relative privacy. Any discrepancy observed between interviewer administration and self-completion of the instrument may also influence an inter-mode reliability study investigating telephone administration of the 5F-Wel.

8.9.2 Physical activity and wellness associations

There are a number of important priorities for future research. Future research to inform understanding of the relationship between physical activity and wellness among youth populations is of considerable importance. This research may include randomized controlled trials examining, for example, the impact of physical activity on youth wellness (group 1) versus wellness alone (group 2). Furthermore, physical activity levels generally begin to decline at 9 years of age, and continue until 15 years (Dumith, et al., 2011; Nader, et al., 2008). Indeed, this decline is sharper among youth from disadvantaged or low income communities and remains a priority for subsequent investigations (Borraccino, et al., 2009; Drummond, et al., 2011). Other populations of interest include those living or attending schools in rural areas, or undergoing schooling in education systems in other geographical regions or dissimilar societies.

8.10 FINAL REFLECTIONS

The field of wellness and wellness evaluation has a great deal of merit among healthy populations. These are likely to be populations classified as ‘apparently healthy’, meaning that they are not suffering from any identifiable illness or disease, but who are looking to obtain an overview of their lifestyle behaviours. This is where terms such as ‘optimal state’ and ‘fullest potential’ are useful descriptors for the goal of a wellness journey. However, it could be argued that ‘apparently healthy’ populations should not be the focus of wellness promotion measures, unlike supposed ‘priority’ or ‘at-risk’ populations, such as those at risk of chronic disease, or youths engaging in risky behaviours. This is why the context in which wellness is used is of importance to the value of the construct. Settings such as schools and workplaces where ‘apparently healthy’ populations are in abundance and the motivation to provide ongoing support to these participants exists is a scenario where

wellness can be applied. Furthermore, identifying aspects of one's lifestyle which are wellness deficient, according to a wellness evaluation measure, may prove useful as a diagnostic instrument for populations who perceive themselves to be 'apparently healthy'. Some might argue that if one perceives themselves to be 'apparently healthy', then what's the point of self-improvement endeavours and the subsequent allocation of the necessary resources? I would argue, what's the point of not trying to self-improve?

Wellness assessment instruments are often quite cumbersome, usually containing 100 or more items for detailed evaluations. Shorter questionnaires which are less burdensome would be beneficial for wellness assessments among larger populations. The endeavour to advance the use of pragmatic self-reported instruments in the fields of sociological and health-related research has trended towards questionnaires with fewer items and less respondent burden. For example, use of the World Health Organization Quality of Life (WHOQOL) 100 Item instrument was largely superseded by the World Health Organization Quality of Life Assessment-Bref (WHOQOL-BREF), which contains only 26 items (Harper & Power, 1998). Those wishing to derive a multi-attribute utility score from the Medical Outcomes Study (MOS) 36-Item Short Form Survey (SF36), may choose to instead use the SF-6D (6 items) or the SF12 (12 items) (Riddle, Lee, & Stratford, 2001). Of note, the Perceived Wellness Survey (Adams, et al., 1997) encouragingly has 36 items. It is also interesting to note in the results from the systematic literature review that there were numerous instruments that have been developed, and then used only once. Instrument development and validation should be an iterative process, whereby instrument performance is strengthened through modifications based on empirical data. Unfortunately, in this developing field of wellness measurement among adolescents, this has generally not occurred to date. It is our hope that future research can productively iterate on foundational work to produce sound measures (rather than continually develop other new measures without subsequent development). It may also prove useful for wellness measurement instruments to provide a more thorough assessment of physical activity. An example of a short physical activity recall instrument would be the International Physical Activity Questionnaire (short version). This questionnaire asks only 4 questions, obtaining information about physical activity performed in the categories of

vigorous, moderate, and walking, as well as a question about time spent sitting. A statement as to whether participants adhere to national physical activity recommendations (the minimum recommended physical activity to achieve health benefits), as these are founded on empirical evidence, could be of value to participants.

The International Physical Activity Questionnaire for Adolescents (IPAQ-A) was selected for use in this program of research (Appendix A). Although the IPAQ-A is a relatively new instrument for measuring physical activity in youth, on face value and given the international popularity of the adult version, it was deemed an acceptable selection. It was logistically feasible given the large sample size that was to be targeted, low cost (only printing costs required), and a single data collection time-point (as opposed to a diary instrument). It also enabled the collection of contextual information such as physical activity performed over the four domains of leisure, school, transport, and home. However, there were large amounts of incomplete datasets or 'missing data' from students using this instrument. The instrument has potential for improvements in formatting and wording.

This thesis has implications for those seeking to justify youth physical activity promotion interventions, as well as those providing ongoing funding or allocation for youth physical activity engagement programs, such as policy-makers and various government bodies. There are also implications for those seeking to initiate wellness interventions or programs among youth samples. These may include school administrators and those likely to be school-based such as counsellors, nurses, social workers, health and physical education teacher and chaplains, as well as medical practitioners.

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Appendices

Appendix A
International Physical Activity Questionnaire for Adolescents

International Physical Activity Questionnaire for Adolescents

Dear student,

The following questions are about all the **walking, vigorous and moderate physical activities** that you did **for at least 10 uninterrupted minutes in the last 7 days**.

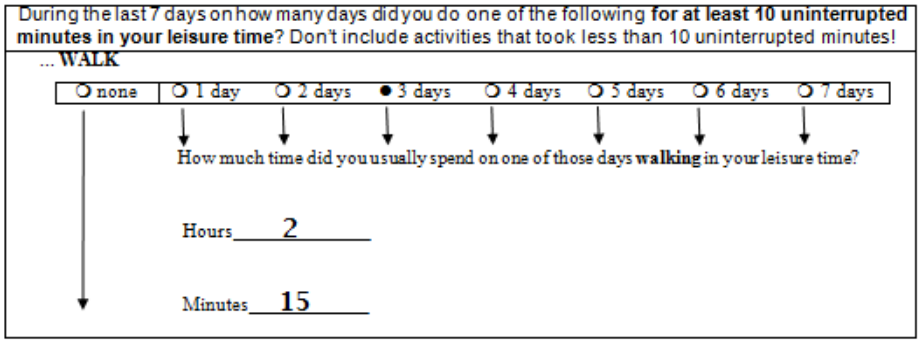
Please do not include those activities that took less than 10 minutes per occasion.

By the last 7 days we mean 5 school days and 2 weekend days.

The questions are divided into four groups and ask questions about

- physical activities you did during school time,
- physical activities you did in and around your home like housework and gardening
- physical activities you did to get to and from places,
- physical activities you did during leisure time (physical activities during play, sports, dancing, exercises and competition).

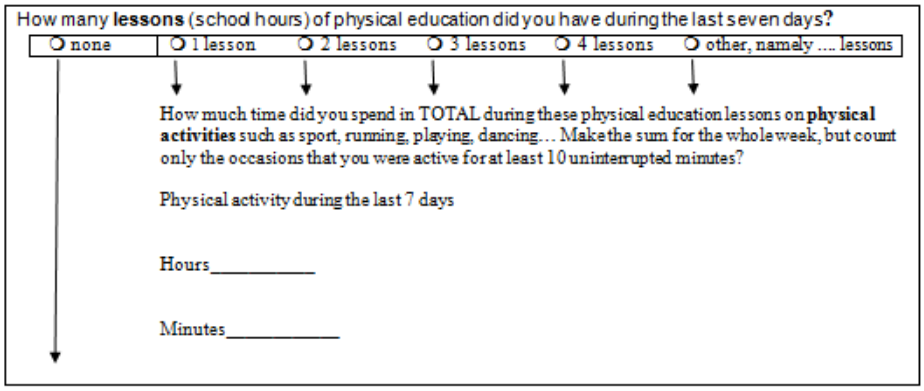
Sample



Part 1: SCHOOL-RELATED PHYSICAL ACTIVITY

Part 1 is about the physical activities that youhave been doing the last 7 days during school hours (during the lessons and during breaks). Transportation to and from school are NOT included.

A. During physical activity classes



B. During school breaks

During the last 7 days, on how many days did you do the following, during **breaks** at school, **for at least 10 uninterrupted minutes....**
Don't include activities that took less than 10 uninterrupted minutes.

... **WALK**

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days **walking**?

Hours_____

Minutes_____

... **VIGOROUS physical activity, that took hard physical effort and made you breathe much harder than normal,** like running…

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days doing **vigorous physical activities**?

Hours_____

Minutes_____

... **MODERATE physical activity, that took moderate physical effort and made you breathe somewhat harder than normal,** like dancing, …

❍ none	❍ 1 day	❍ 2 days	❍ 3 days	❍ 4 days	❍ 5 days

How much time did you usually spend during breaks at school on one of those days doing **moderate physical activities**?

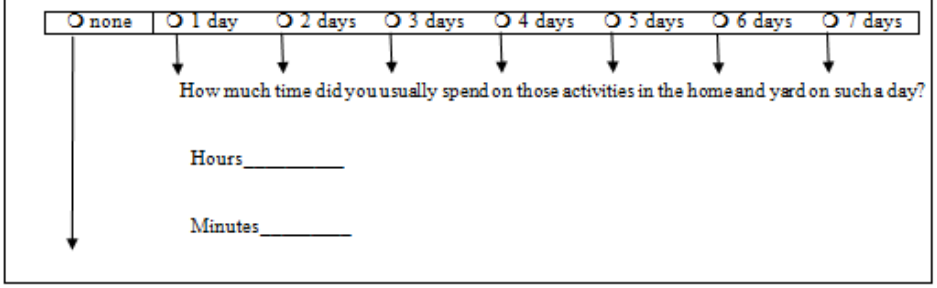
Hours_____

Minutes_____

Part 2: HOUSEWORK AND GARDENING

This second part is about physical activity that you might have been doing during the last 7 days in and around the house.

During the last 7 days, on how many days did you do for at least 10 uninterrupted minutes physical activities in the garden or at home that took at least moderate physical effort and made you breathe somewhat or much harder than normal like carrying heavy loads, scrubbing floors, sweeping... Don't include activities that took less than 10 uninterrupted minutes.



Part 3: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like school, stores, movies, and so on during the last 7 days.

During the **last 7 days**, on how many days did you **travel for at least 10 uninterrupted minutes ...** Don't include activities that took less than 10 uninterrupted minutes.

... **IN A MOTOR VEHICLE** like a train, bus, car, or tram?

❍ none ❍ 1 day ❍ 2 days ❍ 3 days ❍ 4 days ❍ 5 days ❍ 6 days ❍ 7 days

How much time did you usually spend on one of those days **travelling by motor vehicle**?

Hours_____

Minutes_____

... **WITH A BICYCLE?**

❍ none ❍ 1 day ❍ 2 days ❍ 3 days ❍ 4 days ❍ 5 days ❍ 6 days ❍ 7 days

How much time did you usually spend on one of those days **bicycling** from place to place?

Hours_____

Minutes_____

... **BY FOOT?**

❍ none ❍ 1 day ❍ 2 days ❍ 3 days ❍ 4 days ❍ 5 days ❍ 6 days ❍ 7 days

How much time did you usually spend **walking** from place to place on one of those days?

Hours_____

Minutes_____

Part 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned!!!

During the last 7 days on how many days did you do one of the following **for at least 10 uninterrupted minutes in your leisure time**? Don't include activities that took less than 10 uninterrupted minutes!

... **WALK**

○ none | ○ 1 day | ○ 2 days | ○ 3 days | ○ 4 days | ○ 5 days | ○ 6 days | ○ 7 days

How much time did you usually spend on one of those days **walking** in your leisure time?

Hours_____

Minutes_____

... **VIGOROUS** physical activities, **that took hard physical effort and made you breathe much harder than normal,** like aerobics, running, fast bicycling, or fast swimming …

○ none | ○ 1 day | ○ 2 days | ○ 3 days | ○ 4 days | ○ 5 days | ○ 6 days | ○ 7 days

How much time did you usually spend on one of those days **on vigorous physical activity** in your leisure time?

Hours_____

Minutes_____

... **MODERATE** physical activities, **that took moderate physical effort and made you breathe somewhat harder than normal,** like dancing, swimming at a regular pace, and doubles tennis …

○ none | ○ 1 day | ○ 2 days | ○ 3 days | ○ 4 days | ○ 5 days | ○ 6 days | ○ 7 days

How much time did you usually spend on one of those days **on moderate physical activity** in your leisure time?

Hours_____

Minutes_____

Appendix B
Five Factor Wellness Inventory

Five Factor Wel Inventory
Form T

The purpose of this inventory is to help you make healthy lifestyle choices. The items are statements that describe you. Answer each item in a way that is true for you **most of the time. Think about how you most often see yourself, feel or behave.** Answer all the items. Do not spend too much time on any one item. Your honest answers will make your scores more useful.

Mark only one answer for each item using this scale:

Strongly Agree	If it is true for you most or all of the time
Agree	If it is true for you some of the time
Disagree	If it is usually not true for you
Strongly Disagree	If it is almost or never true for you

EXAMPLE

	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
I like meeting new people.	**A**	✕	**C**	**D**

This appendix is not available in this version of the thesis. Please contact the publisher Mind Garden, Inc. for a copy of this instrument.

Appendix C
Ethics Approval

University Human Research Ethics Committee
HUMAN ETHICS APPROVAL CERTIFICATE
NHMRC Registered Committee Number EC00171

Date of Issue: 8/8/11 (supersedes all previously issued certificates)

Dear Mr Jerome Rachele

A UHREC should clearly communicate its decisions about a research proposal to the researcher and the final decision to approve or reject a proposal should be communicated to the researcher in writing. This Approval Certificate serves as your written notice that the proposal has met the requirements of the *National Statement on Research involving Human Participation* and has been approved on that basis. You are therefore authorised to commence activities as outlined in your proposal application, subject to any specific and standard conditions detailed in this document.

Within this Approval Certificate are:

* Project Details
* Participant Details
* Conditions of Approval (Specific and Standard)

Researchers should report to the UHREC, via the Research Ethics Coordinator, events that might affect continued ethical acceptability of the project, including, but not limited to:

(a) serious or unexpected adverse effects on participants; and
(b) proposed significant changes in the conduct, the participant profile or the risks of the proposed research.

Further information regarding your ongoing obligations regarding human based research can be found via the Research Ethics website http://www.research.qut.edu.au/ethics/ or by contacting the Research Ethics Coordinator on 07 3138 2091 or ethicscontact@qut.edu.au

If any details within this Approval Certificate are incorrect please advise the Research Ethics Unit within 10 days of receipt of this certificate.

Project Details

Category of Approval: Human non-HREC
Approved From: 8/08/2011 **Approved Until:** 8/08/2014 (subject to annual reports)
Approval Number: 1100000885
Project Title: The promotion of physical activity in secondary schools
Experiment Summary: Inform a future program aimed at increasing the physical activity of adolescents in a secondary school setting.

Investigator Details

Chief Investigator: Mr Jerome Rachele

Other Staff/Students:

Investigator Name	Type	Role
Dr Tom Cuddihy	Internal	Supervisor
Dr Tracy Washington	Internal	Supervisor
Dr Steven McPhail	External	Supervisor

Participant Details

Participants:
Approximately 140

Location/s of the Work:
Brisbane Grammar School

University Human Research Ethics Committee

HUMAN ETHICS APPROVAL CERTIFICATE

NHMRC Registered Committee Number EC00171

Date of Issue: 8/8/11 (supersedes all previously issued certificates)

Conditions of Approval

Specific Conditions of Approval:
No special conditions placed on approval by the UHREC. Standard conditions apply.

Standard Conditions of Approval:
The University's standard conditions of approval require the research team to:

1. Conduct the project in accordance with University policy, NHMRC / AVCC guidelines and regulations, and the provisions of any relevant State / Territory or Commonwealth regulations or legislation;

2. Respond to the requests and instructions of the University Human Research Ethics Committee (UHREC);

3. Advise the Research Ethics Coordinator immediately if any complaints are made, or expressions of concern are raised, in relation to the project;

4. Suspend or modify the project if the risks to participants are found to be disproportionate to the benefits, and immediately advise the Research Ethics Coordinator of this action;

5. Stop any involvement of any participant if continuation of the research may be harmful to that person, and immediately advise the Research Ethics Coordinator of this action;

6. Advise the Research Ethics Coordinator of any unforeseen development or events that might affect the continued ethical acceptability of the project;

7. Report on the progress of the approved project at least annually, or at intervals determined by the Committee;

8. (Where the research is publicly or privately funded) publish the results of the project is such a way to permit scrutiny and contribute to public knowledge; and

9. Ensure that the results of the research are made available to the participants.

Modifying your Ethical Clearance:
Requests for variations must be made via submission of a Request for Variation to Existing Clearance Form (http://www.research.qut.edu.au/ethics/forms/hum/var/var.jsp) to the Research Ethics Coordinator. Minor changes will be assessed on a case by case basis.

It generally takes 7-14 days to process and notify the Chief Investigator of the outcome of a request for a variation.

Major changes, depending upon the nature of your request, may require submission of a new application.

Audits:
All active ethical clearances are subject to random audit by the UHREC, which will include the review of the signed consent forms for participants, whether any modifications / variations to the project have been approved, and the data storage arrangements.

End of Document

Appendix D
Parent and Student Participant Information Sheet

Queensland University of Technology
Brisbane Australia

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT
– Parent and Child –

The promotion of physical activity in secondary schools

QUT Ethics Approval Number 1100000885

RESEARCH TEAM CONTACTS

Principal Researcher: Jerome Rachele – Research Student
Supervisor: Tom Cuddihy – Research Fellow

DESCRIPTION

This project is being undertaken as part of a Masters project for Jerome Rachele. The project is funded by the School of Human Movement Studies.

The purpose of this project is to collect data to inform a future program aimed at increasing the physical activity of adolescents in a secondary school setting. Previous research has demonstrated that unhealthy habits and lifestyle choices established during adolescence can lead to chronic diseases later in life, as even though the ill effects of these diseases manifest in adulthood, their development starts in childhood and adolescence. Sedentary behaviour during childhood and adolescence, as well as poor physical fitness in adolescence, have both been found to be associated with poor adult health outcomes. Therefore, adult mortality and morbidity could potentially be reduced by improving health habits in childhood and adolescence.

The research team requests your child's assistance by answering some questions regarding wellness, physical activity, and their thoughts and preferences for a future aimed at increasing the physical activity of adolescents in a secondary school setting. Your child may also be asked to wear a physical activity monitor for a period of 7 days, and complete a non-wear time activity diary. The activity monitor weighs approximately 27grams, and the size of a matchbox. The data obtained from this device will be used to test the accuracy of the International Physical Activity Questionnaire for Adolescents, and will be linked to student survey responses.

PARTICIPATION

Your child's participation in this project is voluntary. If your child agrees to participate, they can withdraw from participation during the project without comment or penalty. However, once their results have been submitted we will be unable to identify them and they will be unable to withdraw from the project. Your child's decision to participate will in no way impact upon their current or future relationship with QUT or with your school.

Your child's participation will involve completing a survey at their school, at the request of the school, that will take approximately 30-40 minutes of their time. The survey will include items from the International Physical Activity Questionnaire for Adolescents, Wellness Evaluation of Lifestyle, Self-Determination Scale, and questions regarding their preferences for a future physical activity intervention. Participation may also involve wearing an accelerometer for a period of 7 days.

EXPECTED BENEFITS

It is expected that this project will not directly benefit your child. However, the information from this study will provide us with knowledge to assist in the promotion of physical activity among secondary school students.

RISKS

There are no risks beyond normal day-to-day living associated with your child's participation in this project. There are no risks associated with wearing the physical activity monitor. Some class time will be utilized during data collection, for the completion of surveys and the administration of activity monitors. Brisbane Grammar School has provided permission for the study to be conducted during school time.

CONFIDENTIALITY

All comments and responses will be treated confidentially. It is our intent to publish the outcomes from this study, however, all data will be aggregated and not include self-identifying information, and your child's identity will remain confidential. Information recorded by researchers will be stored in a secure area for a period of 7 years following publication of results, after which time it will be confidentially destroyed. Only members of the research team will have access to this information while it is stored. Non-identifiable data collected in this project may be used as comparative data in future projects by the current researchers.

CONSENT TO PARTICIPATE

We would like to ask you to sign a written consent form (enclosed) to confirm your child's agreement to participate.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT

Please contact one of the research team members named above to have any questions answered or if you require further information.

Jerome Rachele – Research Student
School of Human Movement Studies – Faculty of Health – QUT
Phone 3138 5835
Email j.rachele@qut.edu.au

Tom Cuddihy – Research Fellow and Supervisor
Phone 3138 5826
Email t.cuddihy@qut.edu.au

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT

QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project. Please keep this sheet for your information.

Appendix E
Parent and Student Consent Form

Queensland University of Technology
Brisbane Australia

CONSENT FORM FOR QUT RESEARCH PROJECT
– Parent and Child –

The promotion of physical activity in secondary schools

QUT Ethics Approval Number 1100000885

RESEARCH TEAM CONTACTS

Jerome Rachele – Research Student
School of Human Movement Studies
Phone 3138 5835
Email j.rachele@qut.edu.au

Tom Cuddihy – Research Fellow
School of Human Movement Studies
Phone 3138 5826
Email t.cuddihy@qut.edu.au

STATEMENT OF CONSENT

By signing below, you are indicating that you:

- have read and understood the information document regarding this project
- have had any questions answered to your satisfaction
- understand that if you have any additional questions you can contact the research team
- understand that you are free to withdraw at any time, without comment or penalty
- understand that you can contact the Research Ethics Unit on 3138 5123 or email ethicscontact@qut.edu.au if you have concerns about the ethical conduct of the project
- have discussed the project with your child and what is required of them if participating
- agree for my child to participate in this project

Name .....

Signature .....

Date .....

STATEMENT OF CHILD CONSENT

Your parent or guardian has given their permission for you to be involved in this research project.
This form is to seek your consent to participate in the research.

By signing below, you are indicating that you:

- have read and understood the information about this project
- have discussed the project with your parent/guardian
- have had any questions answered to your satisfaction
- understand that if you have any additional questions you can contact the research team
- understand that you are free to withdraw at any time, without comment or penalty
- understand that you can contact the Research Ethics Unit on 3138 5123 or ethicscontact@qut.edu.au if you have concerns about the ethical conduct of the project
- agree to participate in the project

Name .....

Signature .....

Date .....

Please return this sheet to the investigator.

Appendix F
Parent Information Sheet

Queensland University of Technology
Brisbane Australia

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT
– Parent–

The promotion of physical activity in secondary schools

QUT Ethics Approval Number 1100000885

RESEARCH TEAM CONTACTS

Principal Researcher: Jerome Rachele – Research Student
Supervisor: Tom Cuddihy – Research Fellow

DESCRIPTION

This project is being undertaken as part of a Doctoral project for Jerome Rachele. The project is funded by the QUT School of Exercise and Nutrition Sciences.

The purpose of this project is to collect data to inform a future program aimed at increasing the physical activity of adolescents in a secondary school setting. Previous research has demonstrated that unhealthy habits and lifestyle choices established during adolescence can lead to chronic diseases later in life, as even though the ill effects of these diseases manifest in adulthood, their development starts in childhood and adolescence. Sedentary behaviour during childhood and adolescence, as well as poor physical fitness in adolescence, have both been found to be associated with poor adult health outcomes. Therefore, adult mortality and morbidity could potentially be reduced by improving health habits in childhood and adolescence.

The research team requests your, and your child's assistance by answering some questions regarding wellness, physical activity, and your thoughts and preferences for a future aimed program at increasing the physical activity of adolescents in a secondary school setting.

PARTICIPATION

Your and your child's participation in this project is voluntary, and if you and/or your child agrees to participate, either can withdraw from participation during the project without comment or penalty. However, once their results have been submitted we will be unable to identify them and they will be unable to withdraw from the project. Your child's decision to participate will in no way impact upon their current or future relationship with QUT or with your school.

Your child's participation will involve completing a survey that will take approximately 30-40 minutes of their time. The survey will include items from the International Physical Activity Questionnaire for Adolescents, Wellness Evaluation of Lifestyle, Self-Determination Scale, and questions regarding their preferences for a future physical activity promotion program.

Your participation will involve answering a brief questionnaire about your physical activity, and demographics, as well as your preferences for a future physical activity promotion program. Children are able to participate, regardless of parent participation.

EXPECTED BENEFITS

It is expected that this project will not directly benefit you or your child. However, the information from this study will provide us with knowledge to assist in the promotion of physical activity among secondary school students.

RISKS

There are no risks beyond normal day-to-day living associated with your child's participation in this project.

CONFIDENTIALITY

All comments and responses and will be treated confidentially. It is our intent to publish the outcomes from this study, however, all data will be aggregated and not include self-identifying information, and your child's identity will remain confidential. Information recorded by researchers will be stored in a secure area for a period of 7 years following publication of results, after which time it will be confidentially destroyed. Only members of the research team will have access to this information while it is stored. Non-identifiable data collected in this project may be used as comparative data in future projects by the current researchers. By completing the questionnaire you indicate that you give your consent for use of your responses as part of this research.

CONSENT TO PARTICIPATE

By completing the questionnaire you indicate that you give your consent for use of your responses as part of this research.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT

Please contact one of the research team members named above to have any questions answered or if you require further information.

Jerome Rachele – Research Student
School of Exercise and Nutrition Sciences – Faculty of Health – QUT
Phone 3138 5835
Email j.rachele@qut.edu.au

Tom Cuddihy – Research Fellow and Supervisor
Phone 3138 5826
Email t.cuddihy@qut.edu.au

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT

QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project.

Appendix G
Student Participant Information Sheet

Queensland University of Technology
Brisbane Australia

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT
–Child –

The promotion of physical activity in secondary schools

QUT Ethics Approval Number 1100000885

RESEARCH TEAM CONTACTS

Principal Researcher: Jerome Rachele – Research Student
Supervisor: Tom Cuddihy – Research Fellow

DESCRIPTION

This project is being undertaken as part of a Doctoral project for Jerome Rachele. The project is funded by the QUT School of Exercise and Nutrition Sciences.

The purpose of this project is to collect data to inform a future program aimed at increasing the physical activity of adolescents in a secondary school setting. Previous research has demonstrated that unhealthy habits and lifestyle choices established during adolescence can lead to chronic diseases later in life, as even though the ill effects of these diseases manifest in adulthood, their development starts in childhood and adolescence. Sedentary behaviour during childhood and adolescence, as well as poor physical fitness in adolescence, have both been found to be associated with poor adult health outcomes. Therefore, adult mortality and morbidity could potentially be reduced by improving health habits in childhood and adolescence.

The research team requests your assistance by answering some questions regarding wellness, physical activity, and your thoughts and preferences for a future aimed program at increasing the physical activity of adolescents in a secondary school setting.

PARTICIPATION

Your participation in this project is voluntary. If you agree to participate, you can withdraw from participation during the project without comment or penalty. However, once your results have been submitted we will be unable to identify them and you will be unable to withdraw from the project. Your decision to participate will in no way impact upon your current or future relationship with QUT or with your school.

Your participation will involve completing a survey that will take approximately 30-40 minutes of your time. The survey will include items from the International Physical Activity Questionnaire for Adolescents, Wellness Evaluation of Lifestyle, Self-Determination Scale, and questions regarding your preferences for a future physical activity promotion program.

Your participation will also involve answering a brief questionnaire about your physical activity, and demographics, as well as your preferences for a future physical activity promotion program.

EXPECTED BENEFITS

It is expected that this project will not directly benefit you. However, the information from this study will provide us with knowledge to assist in the promotion of physical activity among secondary school students.

RISKS

There are no risks beyond normal day-to-day living associated with your participation in this project.

CONFIDENTIALITY

All comments and responses will be treated confidentially. It is our intent to publish the outcomes from this study, however, all data will be aggregated and not include self-identifying information, and your identity will remain confidential. Information recorded by researchers will be stored in a secure area for a period of 7 years following publication of results, after which time it will be confidentially destroyed. Only members of the research team will have access to this information while it is stored. Non-identifiable data collected in this project may be used as comparative data in future projects by the current researchers. By completing the questionnaire you indicate that you give your consent for use of your responses as part of this research.

CONSENT TO PARTICIPATE

By completing the questionnaire you indicate that you give your consent for use of your responses as part of this research.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT

Please contact one of the research team members named above to have any questions answered or if you require further information.

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Thank you for helping with this research project.