Traversing Boundaries: A Study of Physical and Psychological Well-being amongst Late Adolescents

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Abstract
Crossing extensive theoretical and methodological terrain this study investigates the extent to which physical well-being predicts psychological well-being in a sample of adolescents. Participants were 705 young people (52% female) surveyed in their final year of high school (age mean=17, SD=0.96). The results suggest that the proposed measures are psychometrically sound, approximately normally distributed, reliable, and demonstrate good first-order fit. The first-order correlations suggest higher-order structures which fit the data well and concur with theoretical and methodological approaches in the literature. Hypotheses suggesting that physical health positively predicted psychological health and perceived life quality and satisfaction were supported using structural equation modeling. A key focus of this paper is to present the theoretical and methodological considerations of interdisciplinary health-related research. With the final year of schooling being a potential pressure on the physical and mental health of adolescents, this study is uniquely positioned at an important developmental and educational stage for which the issue of well-being in young people has a particular distinctiveness. The present research yields substantive and practical implications regarding the importance of multidimensional and integrative approaches to understanding and enhancing adolescent well-being.

Key Words
Psychological health, psychological well-being, physical health, physical well-being, adolescence, quality of life, satisfaction with life
Introduction

The conference theme ‘Researching across Boundaries’ is a unique chance to showcase cross-disciplinary research and its many advantages. Reflecting the theme of this conference, this study takes a trans-theoretical approach to the question of adolescent well-being. That is, it draws from different bodies of theory relating to well-being, juxtaposed upon a background of adolescent development. Cutting across research disciplines, the initial research question/s were broad: how might we define/measure adolescent well-being? In following these questions further, the study traversed once rigid theoretical domains that were limited by contentious dualisms, mechanisation and medicalisation characteristic of Western thought. Next, embracing a methodological approach that is normally criticised for its ‘rigidity’ this study utilised a number of analytical techniques for gaining an understanding of the subject. Prospectively, the applications of this study are also of significance to a diversity of stakeholders, including research communities, youth health advocates, psychologists, government representatives/policy makers, and of course the young people and families who are the beneficiaries of school and government initiatives.

Literature Review

Across time the study of well-being has been a subject of intense inquiry particularly across the fields of philosophy, psychology, health and education. The various epistemological and methodological approaches to understanding well-being have prompted the questions: What does it mean to be well? How might we draw together the insights of various research approaches to reach a clear definition of well-being? What is the difference between health and well-being? How might well-being be measured? How might these understandings change across different ages and stages of the lifespan?

The idea that the individual exists both physically and non-physically (and that these are somehow connected) can be traced throughout history. Hebrew Scriptures representing this dualism of body and mind can be found in the book of Genesis, inherent in the creation of the first living humans. Aboriginal Dreaming refers to the creation of beings from souls into their physical existence as animals, plants and humans. Early Greek philosophers such as Plato discussed the idea that the soul was an entity quite separate from one’s physical existence (see Plato’s Meno, see Scott, 2006). Aristotle proposed that eudaimonia or ‘human flourishing’ was the highest human good (Thomson, 1953). Roman poet Juvenal, in the first century A.D., proffered the Latin phrase “mens sana in corpore sano” – commonly translated as "a sound mind in a sound body". At the verge of the Enlightenment Rene Descartes not only distinguished between body and mind but discussed the causal relations between the two (Lafleur, 1960). These perspectives across history have foregrounded the importance of balance for the individual, whose multidimensional self also inherently seeks a sense of holism, agency and overall contentment.
In the mid 20th century Abraham Maslow proposed a hierarchy of human needs intended to explain human survival, development and motivation. This hierarchy ranged from basic physical health and safety needs, such as food, nourishment and protection through social-emotional needs such as love and companionship, through to self-actualisation – the state of ultimate peace, contentment and happiness – an ultimate life goal (Maslow, 1943). Maslow’s hierarchy reflected a philosophical perspective commonly taken up by various health-based research communities; that a healthy body is the basis for good mental health. In this broad sense Maslow’s theory lends itself to the study of well-being such that we may model the relationships between physical well-being and psychological well-being.

In the continued search to define well-being, some authors have commented that despite the vast usage of the term ‘well-being’, few explicit definitions of it actually exist (Fraillon, 2004; Ryff & Keyes, 1995). Fraillon (2004) attempts to clarify both what it is not (i.e. ‘health’, which implies basic physical and emotional needs), and what it involves, key characteristics such as economic, social and psychological well-being, multidimensional aspects of the person which culminate in a higher sense of accomplishment, self-actualisation and psychological contentment (Fraillon, 2004). In line with Fraillon, well-being in this study is complex and multidimensional. This study proposes that health refers to the manifest physical and emotional indicators, whereas well-being captures both these manifest health indicators but additionally refers to the subjective ratings, meaning-making artefacts that individuals use to make sense of their physical and psychological/spiritual existence (Fraillon, 2004; WHOQoL Group, 1994). The present research differentiates ‘well-being’ and ‘health’ as such for conceptual and organisational purposes; to distinguish between the ‘higher’, ‘overall’ levels (coined in this thesis ‘well-being’) and the ‘lower’ sub-categories that constitute the former (physical ‘health’, and psychological ‘health’).

Previously the notion of well-being has been shaped by the medical model. Western views of health, the “...absence of one or more of the ‘five Ds’ – death, disease, discomfort, disability and dissatisfaction”– has largely infiltrated both professional and commonplace understandings of what it means to be well (Edlin & Golanty, 2009). So for the most part, clinical symptoms and disease-specific instrumentation have guided well-being research – with conditions, the therapies, and/or treatments being the major foci. However, research movements in positive psychology (Maslow, 1954; Seligman & Csikszentmihalyi, 2000), subjective well-being (Diener, 2000; Diener, Suh, Lucas, & Smith, 1999; Layard, 2010; Schwarz & Strack, 1999), and satisfaction with life (Diener, Emmons, Larsen, & Griffin, 1985; Diener & Chan, 2011) have provided different perspectives on the theory and measurement of health and well-being, where the individual is at the centre of the research. Thus a holistic and integrated picture of the complex nature of well-being can be appreciated.
More recent theoretical approaches differentiate several distinct aspects of well-being. The multidimensionality of well-being has been taken up in the research approaches of the World Health Organisation, which recognises the physical, mental, spiritual, independence, environment and social dimensions of well-being (WHOQoL Group, 1994; Murphy, Herrman, Hawthorn, Pinzone, & Evert, 2000). The WHO also recommends comprehensive, contextually appropriate and culturally sensitive measures of well-being, subjectively rated to account for relative salience of health-related quality of life domains (Murphy, Herrman, Hawthorn, Pinzone, & Evert, 2000). To this end, the international development and testing of the WHOQOL-100 instrument across various contexts has played a prominent role in shaping current models of health and well-being. For example, the social, emotional, spiritual, mental and physical well-being of Australian students have been identified but it has also been suggested that balance is necessary for ongoing growth and resilience (Masters, 2004). Indeed, ‘the whole is greater than just the sum of its parts’ when it comes to well-being (DEEWR, 2008: 6).

The present study explores the links between physical and psychological well-being during adolescence. Late adolescence is a relatively understudied group in well-being research (see e.g., Bize, Johnson, & Plotnikoff, 2007). Adolescence is an important stage of a young person’s life because it is a transitional period to the adult years. It is a time when longer-term adult attitudes and orientations to physical and psychological wellbeing are being established (Arnett, 2004; Smith & Biddle, 2008), when young people confront various life challenges associated with developmental changes (Erickson, 1968), and when young people are beginning the transition from school to further education or employment (Martin, Liem, Coffey et al., 2010). This study presents a snapshot of well-being at this critical time-point in late adolescence.

Well-being, in this study, is constituted by several multidimensional indicators of physical and psychological well-being. This approach encompasses and integrates an array of physical and psychological well-being indicators. In particular, the present research examines physical well-being via physical activity (based on a measure of the time spent on physical activity per week) and physical health indicators (including sleep and rest, energy/fatigue, absence of bodily pain/discomfort, and optimal daily performance) and operationalizes psychological well-being via psychological health measures (positive affect, negative affect, self-esteem, cognitive capacity), a sense of meaning and purpose in life, as well as perceived life quality and satisfaction. Thus the current study tests the relationships between the various multidimensional physical and psychological factors in one analytic model (see Figure 1). Drawing on the confluence of construct diversity, the focus on a critical life stage, and the applied and methodological insights gleaned from other more typical designs that are relatively narrow in measurement, design or sampling (see e.g., Berger & Tobar, 2007; Landers & Arent, 2007), the current study offers some unique contributions to the overall pool of research on well-being (see Research Impact).
Physical Well-being

Physical well-being is defined and operationalised in this study via two constructs: physical activity and physical health. Herein, physical activity is a conceptually related but distinct construct from physical health. Physical activity refers to all forms of individuals’ movement involving muscle contraction and increases in energy expenditure as indicated by frequency and intensity of the activity (Australian Institute of Health and Welfare [AIHW], 2003; Berger & Tobar, 2007). This definition reflects a health-enhancement model of physical activity (e.g., Kesaniemi, Danforth, Jensen, Kopelman, Lefebvre, & Reeder, 2001) which proposes a relationship between increased physical activity and better physical health and physiological functioning. This health-enhancement approach is taken up by countries such as the United States in promoting the role of physical activity in enhancing cardiovascular capacity, weight control, and sleep quality (U. S. Department of Health and Human Services, 2000; WHO, 2003; Youngstedt, O’Connor, & Dishman, 1997). But physical activity does not only interact with other physical health factors. Physical activity has been linked with lowered depression, anxiety, stress, mood disorders, and sleep disorders (AIHW, 2002; Dubbert, 2002; Jorm, Christensen, Griffiths, & Rodgers 2002; Salmon, Breman, Fotheringham, Ball, & Finch, 2000; Trost, 2005). Recent studies on adolescent populations have also examined the longitudinal effects of physical activity behaviors (Martin et al., 2010; Parker, Martin, Martinez, Marsh, & Jackson, 2010). While physical activity could be operationalised as part of physical health, its prominence in the literature both conceptually and empirically (see e.g., Berger & Tobar, 2007; Biddle et al., 2000; Biddle & Mutrie, 2001; Landers & Arent, 2007; Smith & Biddle, 2008), justifies this as a prominent indicator of well-being, distinct from other health-based factors.

Physical Health

Physical health is defined herein as individuals’ physical capacity allowing them to engage in a wide range of daily work and social activities, reflecting the World Health Organization’s view of health-related quality of life (WHOQOL Group, 1998). The WHO highlights key health indicators such as sleep and rest, maximization of energy and minimization of fatigue, absence of bodily pain and discomfort, and optimal performance of everyday activities as vital to one’s adaptive daily functioning and overall life quality (WHOQOL Group, 1995, 1998). Thus, physical health can be seen as a multidimensional construct, which influences the everyday personal and social life, work life, overall satisfaction, and ultimately psychological well-being of the person (Beyond Blue, 2004; Carless & Fox, 2003; Martinez, Martin, & Dowson, 2006; Seymour, 2003).

Pain and discomfort are relevant to a model of physical (and psychological) well-being for a variety of reasons, including: their direct effect on self-assessed perceptions of quality of life, affective dimensions of one’s life (such as anger, frustration, worry, uncertainty), effects on daily activity and productivity, sleep patterns, appetite and eating behaviours, enjoyment of social life,
general mental health (Boyle & Hamel-Lambert, 2001; Mason, Skevington and Osborn, 2004; Weydert, Ball & Davis, 2003). Research has also indicated the array of benefits of adequate sleep and rest on young people’s physical growth and general health, day to day energy, concentration, recovery from illness, achievement, personal safety, emotional stability (Beyond Blue, 2004; Giannotti, Cortesi, Sebastiani & Ottaviano 2002; O’Malley & O’Malley, 2008). Correspondingly, the energy requirements of adolescents and the effects of energy and fatigue on weight, daily activities, recovery from illness and discomfort, and other physical and psychological factors such as physiological and cognitive development are significant issues that highlight the interconnectedness of various aspects of well-being. With regards to optimal performance, young people’s daily lives are typically filled with activities, engagements and commitments perhaps more in this generation than ever before, leading to consequences for physical and psychological well-being such as stress, moodiness, attention and concentration difficulties (Arnett, 2004; Smith & Biddle, 2008). The factors presented here are theorized as part of a physical health factor that is then analysed for its effects on other factors in the model, such that an accurate view of the relationships between physical and psychological well-being can be formulated and measured over time.

Psychological Well-being

This research takes a multifaceted view of psychological well-being, comprising several dimensions: (a) quality of life, (b) satisfaction with life, (c) sense of purpose and (d) psychological health.

Quality and Satisfaction with Life

Psychological well-being can be measured in part by the person’s ratings of their quality of and satisfaction with life. Quality of life is defined herein as “individuals’ perceptions 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” (WHOQOL Group, 1995, p. 1405). Satisfaction with life is defined herein as individuals’ ratings of their satisfaction with life as derived from conscious judgments of their life conditions relative to their aspirations or ideals (Diener, Emmons, Larsen, & Griffin, 1985; Pavot & Diener, 1993, 2008). Life quality and satisfaction have been conceptualized in this study as two distinct constructs since while there are conceptual synergies, they nevertheless emanated from different research traditions (Pavot & Diener, 2008; WHOQOL Group, 1995, 1998). The inclusion of these two constructs in one analytic model provides important information about their relationship and relative contributions to other well-being constructs. Previous research has shown that individuals who are happier and more satisfied with their lives are more optimistic, have higher self-esteem (Diener et al., 1999, 2009), have broadened cognitive capacity and resources (Fredrickson, 2001, 2009), and have greater senses of life purpose and
meaning (King, Hicks, Krull, & Gaiso, 2006; Steger & Kashdan, 2007).

**Sense of Purpose**

The present research features the role of self and the individual’s investment in personal futures as fundamental to psychological well-being. This reflects Erikson’s (1968) position, which held that adolescence is a pivotal developmental stage characterized by the person’s search for and focus on life purposes. It is also consistent with the notion of human ‘flourishing’ found in further literature (e.g., Baumeister, 1991; Diener, Kesebir, & Tov, 2009; Ryff, 1989a, 1989b; Ryff & Keyes, 1995; Seligman, 2002; Steger, Kashdan, Sullivan, & Lorentz, 2008). This is particularly relevant to the present sample of young people who are emerging into adulthood and for whom psychological well-being is likely to be closely linked with their sense of directedness in life. The two traditional approaches to studying psychological well-being are the hedonic approach (Diener, Lucas, & Scollon, 2006) characterized by positive affects such as happiness and enjoyment and the eudaimonic approach (Ryff, 1989a, 1989b; Ryff & Singer, 1998, 2008; Waterman, 1993) which relates to purposeful and meaningful engagement with life to realize one’s potential and self-actualization. This distinction is reflected herein, since psychological health and sense of life purpose are identified as two conceptually different but related constituents of psychological well-being (Ryff, 1989a, 1989b; Steptoe, O’Donnell, Marmot, & Wardle, 2008).

**Psychological Health**

Herein, psychological health is defined as a state of mental wellness allowing individuals to realize their potential, to cope with their life demands, to work productively, and to make contributions to society (WHO, 2005). The WHO incorporates a number of distinct components in its definition of psychological health, for instance, the presence of positive feelings, the absence of negative feelings, and the possession of a positive sense of one’s self (self-esteem) and of adaptive cognitive functioning including one’s capacity to think, learn, memorize, and concentrate in daily activities (WHOQOL Group, 1995, 1998). The present review of the literature condones the construct validity of this structure of psychological health. For example, Bradburn (1969) presented influential research suggesting not only that positive and negative affect are fundamental to psychological health but also that the positive and negative valences balance the person’s overall sense of psychological well-being (see also Keyes, Shmotkin, & Ryff, 2002). Research also suggests that self-esteem is a key indicator of healthy psychological functioning, vital to a multidimensional model of psychological well-being (Ryff, 1989a, 1989b; Ryff & Singer, 1998, 2008). Further literature highlights links between self-esteem, positive affect, negative affect (negatively), and enhanced mental capacity (Fredrickson, 2001, 2009; Schimmack & Diener, 2003; White, Kendrick, & Yardley, 2009).

The above research provides empirical support for the inclusion of four related but separate
indicators of psychological well-being: psychological health, a sense of meaning and purpose in life, life quality and satisfaction.

Interconnectedness of Physical and Psychological Well-being

There is ample evidence of the extensive benefits of physical activity: in enhancing positive affect and reduction of negative affect (Berger & Tobar, 2007; Biddle et al., 2000; Dishman, Washburn, & Heath, 2004; Mutrie, 2000; Penedo & Dahn, 2005; White et al., 2009), enhancing cognitive functioning including reaction time, memory, and reasoning (Colcombe & Kramer, 2003; Landers & Arent, 2007; Sibley & Etnier, 2003), and enhancing self-esteem (Ekeland, Heian, Hagen, Abbot, & Nordheim, 2004; Fox, 2000; Spence, McGannon, & Poon, 2005). It is widely believed that the processes underlying these interactions between physical activity and psychological well-being are physiological in nature, for instance the stimulating effect of physical activity on the secretion of hormones (e.g., endorphin) and the activation of neurotransmitters (e.g., norepinephrine, serotonin) regulating mood and cognitive functioning (see Landers & Arent, 2007).

The connections between physical health indicators and psychological well-being indicators have also been discussed (Emmons, 2005; Jenkins, McCulloch, Friedli, & Parker, 2002; Plante & Rodin, 1990; Shields & Shoostari, 2001). For instance, individuals reporting chronic physical pain and fatigue also report lower general mental health status (e.g., Nagyova, Stewart, Macejova, Van Dijk, & Van den Heuvel, 2005; Penny, Purves, Smith, Chambers, & Smith, 1999) and/or psychological distress (Van Damme, Crombez, Van Houdenhove, Mariman, & Michielsen, 2006). In other examples, previous research has shown that the quality and duration of sleep are connected with both hedonic and eudaimonic psychological well-being (Ryff, Singer, & Love, 2004; Steptoe et al., 2008), and that optimal sleepers (between 6 and 8.5 hours of sleep/night) evidenced lower levels of depression and anxiety and higher levels of other psychological well-being indicators such as personal growth, self-acceptance, and purpose of life (Fuligni & Hardway, 2006; Hamilton, Nelson, Stevens, & Kitzman, 2007; Ryff et al., 2004).

There are also interconnections between physical well-being and life quality and satisfaction. For example the role of physical health and activity in enhanced life satisfaction and optimism, along with self-directedness has been discussed in the literature (see Berger & Tobar, 2007; Landers & Arent, 2007). Further studies have also evidenced the connections between physical well-being and perceived life quality and satisfaction (Ginis, Jetha, Mack, & Hetz, 2010; Sawatzky et al., 2010; Waters, Davis, Nicolas, Wake, & Lo, 2008; Waters, Salmon, Wake, Wright, & Hesketh, 2001). One such noteworthy study is Waters et al. (2008) who discovered that individuals’ negative quality of life ratings decreased as the number of physical health issues increased. Relatedly, poor physical health has also been shown to predict low satisfaction with life (Zullig, Valois, Huebner, & Drane, 2005). Other notable studies are Gibson (2005) and Schwimmer,
Burwinkle, and Varni (2003) who demonstrated the influence of various health concerns common in children and adolescents, such as obesity and headaches, upon young people’s quality of life ratings.

**Research Impact**

The research impact of this study is two-fold in nature: it builds on current conceptualisations of adolescent well-being and it also offers methodological advantages beyond previous approaches. Regarding the conceptual issues, this study combines physical activity and key physical health indicators to generate a unique physical well-being construct. Current physical well-being measures tend to utilise either generalised health factors, physical activity factors without any indications of other physical health factors, or a sound range of health indicators, but with limited definitions and/or measures of what some factors, such as ‘sleep’ or ‘daily activity’, might include (see e.g. Steptoe et al., 2008; Hamilton et al., 2007). One advantage of this study is this physical well-being factor which captures key health indicators and physical activity in a general population of young people.

Another conceptual advantage of this study is that it examines the role of physical health factors interacting on a wider array of psychological factors than previously researched. These psychological well-being factors range from specific psychological health measures to broader life markers. In past research, psychological well-being has been measured via a single global indicator (Nagyova et al., 2005) or combined with a physical health indicator to create a single item score for well-being (Sawatzky, Ratner, Johnson, Kopec, & Zumbo, 2010; Lyubbomirsky, King, & Diener, 2005). The current approach not only offers a more comprehensive view of psychological well-being but also a deeper understanding of the relative salience of physical factors in psychological well-being.

There are considerable methodological advantages to this study. While research on adolescent well-being is now burgeoning, there has previously been an abundance of literature on well-being in general adult populations (see Bize et al., for a review), particularly adults with physical vulnerabilities such as chronic fatigue symptoms (Van Damme et al., 2006), spinal cord injury (Ginis, Jetha, Mack, & Hetz, 2010), and rheumatoid arthritis (Nagyova et al., 2005). A vast majority of these studies used cross-sectional designs (e.g., Jurakić, Pedišić, & Greblo, 2010; see also Ginis et al., 2010 for a review) and analyses of simple correlations (e.g., Penny et al., 1999) or multiple regression (e.g., Jurakić et al., 2010; Nagyova et al., 2005).

The current issues are examined at a critical developmental stage, where young people are on the cusp of major growth and life transition. This time-point is a notably difficult period to capture in social research due to the demands of the end of secondary schooling. However because this is a pivotal life stage, and because it brings with it the various issues specific to adolescent well-
being, this research is not only justifiable but necessary and beneficial to the wider fields of health and well-being research. The analyses of both first and higher order variables in a predictive model by way of sophisticated statistical techniques offers in-depth meaning and salience to our understandings of the interaction of physical and psychological well-being in young people.

Method

The main purpose of this research is to examine the hypothesized effect of physical well-being on psychological well-being. The data from this study contributes to a larger longitudinal project, funded by the Australian Research Council. The longitudinal data have been used to explore the trans-theoretical model of change, (in)stability in physical activity motivation, flow and self-concept between school and post-school transitions, and a range of methodological questions associated with longitudinal research (e.g., Martin, 2010; Martin et al., 2010; Parker et al., 2010). The research questions and processes involved in the present investigation and the interplay of these unique factors at this time point have not previously been examined.

Participants

705 Australian adolescents were surveyed in Year 12, their final year of high school. Participants were drawn from six schools in two capital cities on Australia's east coast. Three schools were co-educational, two were single-sex boys’ schools, and one was a single-sex girls’ school. 53% of respondents completed Year 12 in NSW schools, and 47% completed Year 12 in Queensland schools. Therefore, participants were drawn from an array of systemic and independent sectors; representing a heterogeneous profile, albeit a convenience sample. Females represented 52% of the sample and students from ESB represented 93% of the sample. The mean age of participants was 17 years ($SD = .96$).

Measures

Physical well-being

Physical activity. Individuals’ participation and engagement in physical activity was measured via the Active Australia Survey (AIHW, 2003). This is an 8-item instrument which ascertains the number of times respondents walked continuously for a minimum of 10 minutes, did vigorous or heavy work that made them breathe harder (e.g., gardening, house cleaning), completed moderate physical activity (e.g., gentle swimming, social tennis, golf), and vigorous physical activity (e.g., jogging, cycling, aerobics, competitive tennis) in the week prior to the survey (in minutes). The Active Australia Survey manual (AIHW, 2003) includes an algorithm that calculates the total number of minutes that the person has engaged in physical activity in the past week, ranging between zero and 1680.
**Physical health.** The World Health Organization Quality of Life instrument was used to measure physical health (WHOQOL-100; see WHOQOL Group, 1998). This instrument contains four 4-item subscales which tap into the different areas of physical health: (1) *energy and fatigue* which measures the extent to which individuals’ levels of energy and fatigue affect their everyday life (e.g., How much are you bothered by fatigue?); (2) *sleep and rest* which measures the extent to which individuals have adequate sleep and rest to carry out everyday tasks (e.g., Do you have any difficulties with sleeping?); (3) *pain and discomfort* measures the extent to which individuals experience pain or discomfort in their everyday life (e.g., To what extent do you feel that physical pain prevents you from doing what you need to do?); and (4) *activities of daily living* measures the extent to which individuals feel physically strong and able to carry out daily activities (e.g., How well are you able to carry out your daily activities?). The WHOQOL-100 uses a two-week recall period, and individuals respond to the WHOQOL-100 items along 5-point response scales ranging from 1 (never; or not at all; or very poor; or very dissatisfied) to 5 (an extreme amount; or extremely; or completely; or very satisfied; or very good; or always).

**Psychological well-being**

*Quality of life.* The WHOQOL-100 was also used to assess perceived quality of life (WHOQOL Group, 1998). The 4-item Quality of Life subscale of measures one’s evaluation of his/her quality of life (e.g., How would you rate your overall quality of life?). Individuals respond to a 5-point scale ranging from 1 (very poor) to 5 (very good).

*Satisfaction with life.* The 5-item Satisfaction With Life Scale is used in this study to measure perceived satisfaction with life (SWLS; Diener et al., 1985; Pavot & Diener, 1993, 2008). The SWLS assesses individuals’ judgements of their overall satisfaction with life and fulfilment with their life in general (e.g., In most ways my life is close to my ideal). This is different from the WHOQOL-100 quality of life measure that refers to individuals’ present state, condition, or life circumstance in the past two weeks. Individuals are asked to rate their responses along a 7-point response scale ranging from 1 (strongly disagree) to 7 (strongly agree). The SWLS is one of the most widely used measures of subjective well-being and has shown strong internal reliability (α ≥ .80; see Diener et al., 1985; Pavot & Diener 1993, 2008).

*Meaning and purpose.* The WHOQOL-100 instrument was used in this study to measure individuals’ sense of life meaning and purpose (WHOQOL Group, 1998). Respondents refer to a 4-item subscale to examine the extent to which they feel a sense of meaning and purpose in their life (e.g., To what extent do you feel your life to be meaningful?). Items are rated along 5-point response scales ranging from 1 (not at all) to 5 (an extreme amount) using a two-week recall period.

*Psychological health.* Psychological health was measured in this study using three 4-item subscales from the WHOQOL-100 (WHOQOL Group, 1998) and a 5-item general self-esteem
measure from the Self-Description Questionnaire II (SDQ-II; Marsh, 1990). These subscales include the affective and cognitive components of psychological well-being: (1) *positive affect* which measures the extent to which individuals experience positive feelings and emotions (e.g., How much do you experience positive feelings in your life?); (2) *negative affect* which measures the extent to which individuals experience negative feelings and emotions (e.g., How often do you have negative feelings, such as blue mood, despair, anxiety, depression?); (3) *thinking, learning, memory, and concentration* which measures the extent to which individuals are able to focus on their daily activities (e.g., How well are you able to concentrate?); and (4) *general self-esteem* which measures the extent to which individuals evaluate themselves favorably and perceive that they are in charge of their own lives (e.g., Overall, I have a lot to be proud of). The SDQ is held to be one of the most validated self-concept measures available for use with adolescents (Byrne, 1996). Respondents were asked to rate their affect and cognition responses along 5-point response scales, while the self-esteem items from the SDQ were rated on a 7-point response scale ranging from 1 (strongly disagree) to 7 (strongly agree).

**Procedure**

This study received full ethics approval by the University of Sydney. Surveys were administered at school with the assistance of class teachers. The teachers had been given specific administration guidelines so as to ensure consistency in the administration and completion of surveys. Teachers read the instructions aloud and then answered any queries from students. In the early stages of the process, the teachers read aloud the first items and the rating scales to guide students with completing the remainder of the survey independently. The survey took an average of 30 minutes to complete, and were then collected, sealed in a large envelope, and returned to the school office. All packages were boxed at the school office then couriered directly to the University. Upon arrival the boxes and envelopes were checked to ensure they had all arrived in good order. Because the survey was administered during class/school time, so data were relatively easy to collect and response rates were close to 100%.

**Statistical Analyses**

*Confirmatory factor analysis (CFA) and structural equation modeling (SEM).* The main analyses involved in this study were confirmatory factor analysis (CFA) and structural equation modeling (SEM). LISREL 8.80 was used to conduct these analyses (Jöreskog & Sörbom, 2006). The process begins where the researcher proposes an *a priori* factor structure of the measures (in CFA) or hypothesizes a model that describes the structural relationships of latent factors (in SEM). Next, tests are conducted to determine the validity of a result based on the fit of the hypothesized factor structure or structural relationships by showing that: (a) the solution is well defined, (b) the
A range of goodness-of-fit indices were used to assess the fit of the data to alternative models in CFA and SEM. In line with views on establishing model fit (e.g., Marsh, Hau, & Wen, 2004), the Comparative Fit Index (CFI), the Non-Normed Fit Index (NNFI), the Root Mean Square Error of Approximation (RMSEA), the $\chi^2$ test statistic, and an evaluation of parameter estimates were used in the present research to determine model fit. The RMSEA index is less affected by sample size than the $\chi^2$ test statistic and values at or less than .08 and .05 are taken to reflect acceptable and excellent fit respectively (see Marsh, Balla, & Hau, 1996; Yuan, 2005). The NNFI and CFI vary along a 0-to-1 continuum in which values at or greater than .90 and .95 are, respectively, generally acceptable and excellent fit to the data (McDonald & Marsh, 1990). While the NNFI and RMSEA contain penalties for a lack of parsimony, the CFI contains no penalty for a lack of parsimony so improved fit due to the introduction of additional parameters may reflect capitalization on chance (Yuan, 2005).

**Multicollinearity and higher-order factor analysis.** In addition to examining the fit of the model to the data, the researcher must also examine parameter estimates (MacCallum & Austin, 2000). Evidently, there are numerous constructs that have the potential to be highly correlated in this study, such as the four indicators of physical well-being (energy/fatigue, sleep/rest, pain/discomfort, and daily activities). Therefore the potential problems of multicollinearity and suppression effects in SEM analyses must be considered (Grewal, Cote, & Baumgartner, 2004; Maassen & Bakker, 2001; Tabachnick & Fidell, 2007). To avoid possible suppression effects, and due to the large number of observed variables involved in this study, physical health was treated as a higher-order factor and the scale scores of energy/fatigue, sleep/rest, pain/discomfort, and daily activities as its manifest variables or indicators. Similarly, psychological health was treated as a higher-order factor and the scale scores of positive affect, negative affect, cognitive capacity, and self-esteem as its indicators.

**Modification indices.** With SEM, it is possible that several different models can fit the data equally well (or even better) and that alternative theoretical models can also be feasible (MacCallum, Roznowski, & Necowitz, 1992). In order to search for possible additional parameters (i.e., modifying covariance structure) modification indices (MI; see Jöreskog & Sörbom, 2006; MacCallum et al., 1992) and the expected parameter change (EPC) statistic (Saris, Satorra, & Sörbom, 1987) can be examined. The model modification process used in this study is a forward search (see Chou & Bentler, 1993; Kaplan, 1990) where both the MI and EPC are inspected and fixed parameters in the existing model are freed and successively re-estimated. In this study,
additional parameters were freed if MI indicated a large estimated change and these parameters were conceptually or substantively defensible (MacCallum et al., 1992).

**Results**

There are distinct processes used in the present study to assess the measurement properties of the instruments and the hypothesised model. Firstly descriptive statistics were reported in relation to each measure. Next confirmatory factor analyses (CFAs) were conducted for each of the subscales and for the entire instrumentation. Then multi-group tests were run to determine the invariance of the factor structure across key groups of respondents. This was followed by multiple-indicator multiple-cause (MIMIC) modeling to establish the influence of demographic and interaction factors on key variables. Finally structural equation modeling (SEM) was conducted to test the hypothesized process model.

**Descriptive and Psychometric Statistics**

In every study both the context and sample are unique so construct validity (reliability, factor structure, distributional properties) of key factors must be established, despite the validation of these constructs in other previous research. The distributional properties of the data were assessed using means, standard deviations, skewness and kurtosis. The results demonstrate that each factor is approximately normally distributed (see Table 2, Appendix). Cronbach’s alpha was used to test the reliability of each factor; and as can be seen, the acceptable Cronbach’s alphas demonstrate that each factor is reliable (with the minor exception of cognitive capacity).

**Confirmatory Factor Analyses**

**First-order CFA**

CFA was used to assess the first-order factor structure and its fit to the data. To recap, physical well-being comprised the first-order factors: physical activity, pain and discomfort, sleep and rest, energy and fatigue and daily activities. Psychological well-being comprised the first-order factors: life satisfaction, quality of life, positive affect, negative affect, cognition, self-esteem, and meaning and purpose. The CFA demonstrated that this model yielded a good fit ($\chi^2 = 4,126.57; df = 969; CFI = .96; NNFI = .95; RMSEA = .07$). Factor loadings are presented in Table 3 (Appendix).

The first step in exploring common higher-order factors involves inspecting the correlations from the first-order CFA (see Table 4, Appendix). The first-order CFA reveals that many of the psychological well-being variables are highly correlated. For example (a) positive affect and (reversed) negative affect, (b) positive affect and cognition, (c) positive affect and self-esteem, and (d) cognition and negative affect all yield significant correlations ($r = .60, r = .52, r = .66, r = .51$ respectively; $p<0.001$). Significant correlations are also shown between (e) cognition and self-
esteem, and (f) negative affect and self-esteem \( (r = .64, r = .53 \text{ respectively}; p<0.001) \). In line with the literature, these relatively strong correlations suggest that a common psychological well-being factor exists. Similarly, there are a number of first-order correlations that suggest that a common physical well-being factor exists. For instance, (g) energy/fatigue and sleep/rest yielded \( r = .61 \) \( (p<0.001) \), (i) (reversed) pain/discomfort and daily activities yielded \( r = .54 \) \( (p<0.001) \), (j) daily activities and sleep/rest yielded \( r = .56 \) \( (p<0.001) \), and (k) daily activities and energy/fatigue yielded \( r = .87 \) \( (p<0.001) \).

There are a number of correlations shown in these results that reflect questions underlying this study as to how physical and psychological well-being might be related. In addition to those high intra-set correlations that indicate higher-order factors, there are also some relatively strong inter-set correlations between the physical well-being factors and psychological well-being factors. Significant correlations are revealed between daily activities and most psychological well-being factors (positive affect, \( r = .58 \), negative affect, \( r = .64 \), cognition, \( r = .79 \) and self-esteem, \( r = .56 \): \( p<0.001 \) for all). Further correlations are found between pain and discomfort and (lower) negative affect \( (r = .55, p<0.001) \), sleep and rest and negative affect \( (r = .55, p<0.001) \), and sleep and rest and cognition \( (r = .49, p<0.001) \). As such, daily activities, energy and fatigue and sleep and rest are associated with cognition while physical pain and discomfort is associated with affect, and sleep and rest are linked with affect and cognition.

The results show a number of significant correlations between the physical well-being and psychological well-being factors and both quality of life and satisfaction with life. The strongest correlations with quality of life are: positive affect \( (r = .82, p<0.001) \), negative affect \( (r = .60, p<0.001) \), cognition \( (r = .58, p<0.001) \), self-esteem \( (r = .64, p<0.001) \), energy and fatigue \( (r = .58, p<0.001) \), and daily activities \( (r = .68, p<0.001) \). Indeed, the variables that correlate highest with quality of life also appear to correlate highest with satisfaction with life (see Table 3). As expected, there is a strong correlation between quality of life and satisfaction with life \( (r = .78, p<0.001) \). Supporting the test of convergent validity, these results show that the selected WHOQOL-100 facets function effectively both against their own ‘overall’ factor and another previously well-validated variable (SWL).

There are also variables that are not correlated in this study, and this provides us with further information that can be used to understand the relationships between physical and psychological well-being. For example, the physical activity factor behaved more reservedly than expected. Of both the physical and psychological well-being factors, the strongest correlate with physical activity was self-esteem at \( r = .24 \) \( (p<0.001) \). This result might indicate that physical activity is closely linked with one’s self-perception and evaluation, in line with the literature on body-image and the social benefits of physical activity. Another factor that held back more than expected was meaning and purpose which did not correlate with many of the physical factors but correlated...
with some psychological well-being factors. Meaning and purpose most strongly correlates with positive affect \( (r = .29, p<0.001) \), quality of life \( (r = .25, p<0.001) \), satisfaction with life \( (r = .27, p<0.001) \) and self-esteem \( (r = .24, p<0.001) \).

The SEM reported later sheds more light on these inter-set correlations between physical and psychological well-being.

**Higher-order CFA**

In line with the literature, grouping similar constructs into higher-order factors can counteract collinearity and enhance parsimony across variables. This approach also supports the theoretical basis of this study since it was expected that first-order factors would cluster into higher-order physical and psychological health factors. In particular it was expected that the first-order factors pain and discomfort, sleep and rest, energy and fatigue and daily activities would load onto one higher-order factor, ‘physical health’. It was also expected that the first-order factors positive affect, negative affect, cognition, and self-esteem would load onto another higher-order factor, ‘psychological health’. As described earlier, the first-order correlations (see also Table 3, Appendix) give some indication of this higher-order factor clustering.

Two higher-order physical and psychological health factors were estimated using higher-order CFA. Results revealed that the model fit the data very well \( (\chi^2 = 4,790.67; df = 1,012; CFI = .95; NNFI = .95; RMSEA = .07) \). Higher-order factor loadings and inter-scale correlations are presented in Table 5 (Appendix). The first-order factors pain and discomfort, sleep and rest, energy and fatigue and daily activities loaded on the ‘physical health’ higher-order factor \( (\beta = .52-.98; \text{mean} = .75) \). In addition, the first-order factors positive affect, negative affect, cognition, and self-esteem loaded on the ‘psychological health’ factor \( (\beta = .71-.83; \text{mean} = .76) \). Other results from this analysis are of relevance to the proposed predictive model to come, where higher-order physical factors that relate to psychological health factors show significant correlations: physical activity \( (r = .13, p<0.001 \text{ and } r = .22, p<0.001 \text{ respectively}) \) with quality of life \( (r = .68 \text{ and } r = .89, p<0.001 \text{ respectively}) \) and satisfaction with life \( (r = .55, \text{ and } r = .83, p<0.001 \text{ respectively}) \) and psychological health with meaning and purpose \( (r = .25, p<0.001) \).

**MIMIC Analyses**

Prior to assessing the substantive relationships between physical and psychological well-being, key demographic factors that are relevant to these constructs must be examined. Multiple Indicator Multiple Cause modelling (MIMIC – see Method) is used in this study to examine the extent to which gender, age, language background (non-English speaking background; NESB) – and their interactions: gender x age, gender x NESB, age x NESB – impact on the key first and higher-order factors.

**First-order MIMIC Analysis**
As shown in Table 6, the first-order MIMIC model (demographic factors predicting the first-order factors) fit the data very well ($\chi^2 = 4,625.00$, df $= 1,179$, NNFI $= .95$, CFI $= .95$, RMSEA $= .06$). Results indicate that NESB is associated with physical well-being as students from English speaking backgrounds report higher on most aspects of physical health compared with those from Non-English-speaking backgrounds. In particular, there are differences regarding pain and discomfort, energy and fatigue and daily activities ($\beta = -.19$, $\beta = -.21$ and $\beta = -.33$, p<0.001, respectively). Correspondingly, ESB participants reported higher on positive affect, negative affect, cognition and self-esteem ($\beta = -.16$, $\beta = -.23$, $\beta = -.25$ and $\beta = -.27$, p<0.001 respectively), quality of life ($\beta = -.29$, p<0.001), and satisfaction with life ($\beta = -.22$, p<0.001). Results also suggest that gender is linked with physical and psychological well-being (see Table 5). Males report higher scores across all aspects of physical well-being ($\beta = -.25$, p<0.001, $\beta = -.12$, p<0.01, $\beta = -.17$, $\beta = -.45$ and $\beta = -.21$, p<0.001 on physical activity; pain and discomfort, sleep and rest, energy and fatigue and daily activities respectively), physical activity) and psychological well-being ($\beta = -.13$, p<0.001 on satisfaction with life; $\beta = -.11$, p<0.01 on quality of life; $\beta = -.11$, p<0.01 on positive affect; and $\beta = -.30$, $\beta = -.26$, $\beta = -.33$, p<0.001 on negative affect, cognition and self-esteem respectively). These results indicate that age has relatively little impact on physical and psychological well-being factors, most likely due to the narrow age range in the sample.

Higher-order MIMIC Analysis

The higher-order MIMIC model (demographic factors predicting each of the hypothesised higher-order factors) also presented a very good fit to the data ($\chi^2 = 5,539.76$, df $= 1,258$, NNFI $= .94$, CFI $= .95$, RMSEA $= .07$). The higher-order results of the MIMIC model (see Table 7) reflect the first-order MIMIC results. ESB is related to higher physical health ($\beta = -.27$, p<0.001), satisfaction with life ($\beta = -.22$, p<0.001), quality of life ($\beta = -.29$, p<0.001) and psychological health ($\beta = -.29$, p<0.001). Gender (male) is related to higher physical activity ($\beta = -.25$, p<0.001), lower physical health ($\beta = -.32$, p<0.001), lower satisfaction with life ($\beta = -.13$, p<0.001), lower quality of life ($\beta = -.11$, p<0.01) and lower psychological health ($\beta = -.31$, p<0.001). Similar to the first-order MIMIC results, age has relatively little impact on the higher-order variables.

Tests of Factor Invariance as a Function of Gender

Also prior to assessing the substantive relationships between physical and psychological well-being, group differences in factor structure must be assessed. CFA is used to determine whether—and how—the structure of a set of proposed factors stands with equal validity across the sample (see Marsh, 1993). Factor invariance across gender is tested here using seven multi-group CFAs (testing by age is not necessary given the results of the MIMIC analyses above). Table 8 depicts the various models estimated and the results accordingly. Examination of fit indices is necessary to determine the differences between these models. The CFI is typically the preferred criteria for assessing factor invariance, and it shows robustness to sample size (Cheung &
Rensvold, 2002; Tabachnick & Fidell, 2007). Generally accepted criteria state that a lack of invariance is demonstrated when there is a change of more than 0.01 in CFI. The current findings show that when successive elements of the factor structure are held invariant across gender, the fit indices are comparable (see Table 7). Hence the factor structure for males and females is generally similar, and there is no gender bias inherent in the data.

**Proposed Predictive Model**

This study hypothesises that physical well-being (physical activity and physical health) predicts psychological well-being (life satisfaction and quality, meaning and purpose, and psychological health).

This model is tested first using only the first-order factors. While two higher-order factors emerged from the literature review and the earlier results, there are further tests that will demonstrate that this is the case according to this set of data. The first-order model fit the data well ($\chi^2= 4126.57$ df = 969; CFI = .96; NNFI = .95; RMSEA = .068), however suppression effects due to multicollinearity were detected. Results show that while energy and fatigue and cognition are relatively strongly positively correlated ($r = .54$ – see Table 4), the predictive beta path shows a strong inverse relationship ($\beta = -.86$). Indeed, suppression effects were found between a number of correlates of energy and fatigue (e.g. positive affect, $r = .47$; $\beta = -.41$).

The expectation of higher-order physical and psychological well-being variables was therefore warranted. It was theorised that the higher-order ‘physical health’ factor consists of pain and discomfort, energy and fatigue, sleep and rest, and daily activities and the higher-order ‘psychological health’ factor consists of positive affect, negative affect, cognition and self-esteem. This higher-order SEM fit the data well ($\chi^2= 4790.67$; df = 1012; CFI = .95; NNFI = .95; RMSEA = .073). Furthermore, the higher-order SEM resolved the suppression effects (see standardised betas in Table 1 and Figure 1 below). Findings showed that physical activity predicts satisfaction with life ($\beta = .09$, $p<0.05$) and psychological health ($\beta = .12$, $p<0.001$); and physical health predicts satisfaction with life ($\beta = .54$, $p<0.001$), quality of life ($\beta = .67$, $p<0.001$) and psychological health ($\beta = .79$, $p<0.001$). Each of these paths supports the earlier hypotheses in relation to the various aspects of physical and psychological well-being. The meaning and purpose construct requires further exploration, but some reasons for this data are offered in the discussion to come.
Table 1

**Predictive Model: Beta Coefficients for Higher-order SEM**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Satisfaction With Life</th>
<th>Quality of Life</th>
<th>Meaning and Purpose</th>
<th>Psychological Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity</td>
<td>.09*</td>
<td>.05</td>
<td>.06</td>
<td>.12***</td>
</tr>
<tr>
<td>Physical Health</td>
<td>.54***</td>
<td>.67***</td>
<td>.06</td>
<td>.79***</td>
</tr>
</tbody>
</table>

Note. All path coefficients are standardised * p<0.05; ** p<0.01; *** p<0.001