A multi-level investigation of factors predicting the health of adolescents attending a faith-based school system in Australia

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Declarations

Statement of Original Authorship

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As I sit here and write, waiting for an editorial review of this thesis, I also wait for pathology results after just undergoing lengthy surgery for a recent cancer diagnosis. It is surreal given the aim and objectives of this thesis and its connection to rising rates of chronic disease, including cancer. May knowledge increase in all areas of preventing and treating this global scourge.

List of publications included as part of the thesis

This thesis is presented as a series of five papers. At the time of submission, five papers were published in peer review journals.

Craig, B. A., Morton, D. P., Morey, P. J., Kent, L. M., Gane, A. B., Butler, T. L., … Price, K. R. (2018). The association between self-rated health and social environments, health behaviours and health outcomes: a structural equation analysis. *BMC Public Health*, *18*, 440. https://doi.org/10.1186/s12889-018-5323-y

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Glossary of Common Abbreviations

ABS	Australian Bureau of Statistics
ACEs	Adverse childhood experiences
ACS	Alcohol consumption status
AIHW	Australian Institute of Health and Welfare
ANOVA	Analysis of variance
BMI	Body mass index
BST	Bioecological Systems Theory
CFD	Childhood family dynamics
CFI	Comparative fit index
CMIN	Chi-square statistic
CMIN/DF	Relative X^2
EFA	Exploratory factor analysis
IFI	Incremental fit index
MHS	Mental health status
NCD	Non-communicable disease
NFI	Normed fit index
NHMRC	National Health and Medical Research Council
RFI	Relative fit index
RMSEA	Root mean square error of approximation
SEM	Structural equation modeling
SF-36	Short-Form 36 Health Survey
SRH	Self-rated health
TLI	Tucker Lewis index

TPB	Theory of Planned Behaviour
TPD	Theory of Psychosocial development
TRA	Theory of Reasoned Action
WHO	World Health Organisation
X^2	Chi-square

Definition of Terms

Adolescent

An adolescent is person in the process of developing from a child to an adult. The World Health Organisation identifies this as a period from the ages of 10 to 19 years of age ('Adolescent development', 2014) This study refers to secondary school adolescents between the ages of 12 to 17 years of age.

Determinants of Health

Determinants of health are factors that interact with each other in various combinations to raise or lower an adolescent's health (AIHW, 2004).

Health Behaviour

A health behaviour is an action taken by a person that positively or negatively affects their health. Health behaviour reflects a person's health beliefs (Mosby, 2012). Common health behaviours include physical activity, dietary choices, alcohol, tobacco consumption and illicit substance use.

Protective Factor

Determinants of health that affect health in a positive way (WHO, 2014c).

Risk Factor

Health determinants that affect health in a negative way (WHO, 2014c).

Structural Equation Modelling

Put simply, Structural Equation Modelling is a multivariate statistical technique that allows for the analysis of a series of dependence relationships among independent and dependant variables simultaneously, either observed or latent (Ho, 2013, p. 284).

Abstract

Adolescent health is a major worldwide concern and is central to a number of current global health challenges. There is growing awareness that the factors influencing adolescent health are multi-dimensional and encompass a broad network of interrelated determinants. Although studies have explored the influence of selected determinants on adolescent health, few have explored the relative importance of the various determinants and the relationships that exist between them. Using Structural Equation Modelling (SEM), this thesis empirically investigates the complex network of factors that concomitantly predict health behaviours and health outcomes in adolescents. The thesis centres on data collected from a comprehensive health and lifestyle survey administered to 1734 adolescents (mean age = 14.5 ± 1.6 years; 54% males) attending 21 Seventh-day Adventist (Adventist) schools in Australia. The research findings are presented as a coherent series of five studies for publication in peer reviewed journals.

Study 1 focused on the self-rated health (SRH) status of the adolescents and investigated the association of a multitude of determinants including personal demographics; background factors such as childhood family dynamics (CFD) and adverse childhood experiences (ACEs); and selected health behaviours and health measures. The findings of Study 1 confirmed the complex relationship between these determinants and highlighted their respective relationships. Particularly noteworthy in this study was the relative high degree of association of mental health, body mass index (BMI) and ACEs on SRH. The findings from Study 1 formed the basis for Studies 2 to 5 which more extensively explored particular aspects of the model developed in Study 1.

Extending upon the observation in Study 1 of the significant influence of mental health status on the SRH of the adolescents, Study 2 examined the predictors of mental health in greater

detail. The model developed in Study 2 through SEM analyses revealed that CFD was the strongest predictor of the adolescents' mental health status, followed by having a sense of meaning and purpose, perceived social rejection and school academic performance. Multi-group analysis for gender found significant differences. The mental health of males was more greatly affected by physical activity, whereas the mental health of females was more greatly affected by sleep duration.

Another significant finding of Study 1 was the influence of BMI, a measure of overweight and obesity, on SRH and this formed the focus of Study 3. Compared to national norms, lower rates of overweight and obesity but higher rates of underweight were observed in the study, which was explained by the unique characteristics of the school system the study cohort was drawn from. BMI was lower among the young members of the cohort, as well as those who more regularly ate breakfast, consumed less soft drink and had a regular exercise program.

In Study 1, alcohol consumption was not significantly associated with self-rated health; however, a low rate of alcohol consumption was observed among the study cohort. Study 4, therefore, aimed to better understand the factors influencing alcohol consumption among this unique cohort. The findings of Study 4 indicated that adolescents' intentions to consume alcohol were the greatest predictor of alcohol consumption. Consistent with the Theory of Reasoned Action, intentions to consume alcohol was influenced by their attitudes towards alcohol consumption and subjective norms surrounding alcohol consumption.

Finally, Study 5 focused on the unique faith-based aspect of the cohort to ascertain the influence of religious affiliation on the various health behaviours and health outcomes examined in Studies 1–4. The study found that adolescents who identified themselves as Adventist (57% of the total cohort) reported significantly better health behaviours than the other Christian and non-religious adolescents. This was especially significant among older adolescents (16–18 years). However, these better health behaviours did not translate to improved health status.

The findings from this thesis provide for the first time, a comprehensive picture of the complex network of factors associated with the health outcomes of adolescents attending Adventist schools in Australia. The findings support the need for age and gender appropriate multi-component interventions and prevention initiatives to promote positive health outcomes in adolescents, with an emphasis on prioritising not only modifiable health behaviours but upstream factors such as CFD and ACEs.

Chapter 1: Overview

Background

Throughout many countries of the world, concerns continue to be raised regarding adolescent health (Bloom, Cohen, & Freeman, 2011; Catalano et al., 2012; Resnick & Bowes, 2007; Sawyer et al., 2012). These concerns have come about because adolescents are now central to a number of major ongoing challenges in global health (Patton, Ross, et al., 2014; Sawyer et al., 2012). Historically, adolescents are a group that existing health services worldwide have not served well (World Health Organisation [WHO], 2014d) leaving adolescent health lagging behind other areas such as childhood and adult health (North, 2009).

If orthodox measures alone are used to assess adolescent health, it would seem that adolescents are in good stead. Recent dramatic declines in adolescent death rates have been observed in many countries (United Nations, 2013b). Rising trends in non-communicable diseases (NCD) and poor mental health, however, are alarming. These paradoxes highlight the complexities in understanding the landscape of adolescent health (Australian Institute of Health and Welfare [AIHW], 2011d). What has become evident is an emergent understanding that adolescent health is multi-dimensional and complex, perhaps more complex than with any other age group. Resnik and Bowes (2007) highlighted the need to understand the multidisciplinary nature of adolescent health, describing it as an interplay between biopsychosocial and cultural factors. Over the past three decades, researchers have increasingly recognised that upstream social influences form powerful determinants for adolescent health (AIHW, 2013a; Patton et al., 2012; WHO, 2008) because of their influence on proximal health risk and protective behaviours. In 2008, the WHO Commission on Social Determinants of Health report (WHO, 2008) adopted a life-course framework which identified the conditions or circumstances in which people are born, grow, live and age, as determinants affecting present and future health. Such a framework represents the complex web through which multiple factors affect adolescent health.

Alarming trends in adolescent health have prompted studies to better understand the determinants of adolescent health in order to inform more effective approaches and strategies to deal with the growing issue. Despite the incipient view that adolescent health is multidimensional and complex, little research has considered multiple determinants concomitantly and therefore has only yielded partial or confounded information on the determinants of adolescent health (Mantzavinis, Pappas, Dimoliatis, & Ioannidis, 2005). Investigations need to adopt a broader approach and concomitantly assess the factors associated with the health of adolescents (Mantzavinis et al., 2005).

Despite the challenges in adolescent health, some opportunities present themselves. Addressing adolescent health may provide a potential triple dividend: with benefits now, later in adult life and for the next generation of children (Patton et al., 2016). Further, the period of adolescence may also provide a second opportunity to reduce or reverse early-life disadvantages (WHO, 2014b). Indeed, addressing adolescent health provides a foundation for future health globally (Sawyer et al., 2012).

Of interest to this thesis is the faith-based Seventh-day Adventist (Adventist) population which has been the subject of extensive health research. Adventists tend to experience good health characterised by significantly lower rates of many chronic diseases, total mortality, and better mental health (Beezhold, Johnston, & Daigle, 2010; Ellison & Levin, 1998; Grant et al., 2008; Willett, 1999). Although Adventist adults have been studied since 1960, there has been limited research on Adventist Australian adolescents and their health. In Australia, the Adventist church has an extensive education system, that caters for both Adventist and non-Adventist students while espousing the health practices of the church. In 2012, the

Adventist Church in Australia commissioned a survey to be administered in Adventist schools (n = 21) across Australia to examine the health and wellbeing of students. Data from this survey was accessed for this thesis.

Research Aim and Objectives

The aim of this thesis was to further understand the complex network of factors that predict health behaviours and health outcomes in adolescents, with a particular focus on adolescents attending Adventist schools in Australia. Of special interest were the factors predicting self-rated health, mental health, body mass index (BMI) and alcohol consumption, as well as the influence of religious affiliation on health behaviours and outcomes.

To fulfil the aim of this thesis, five studies were completed with the following objectives:

1. To investigate the complex network of factors that predict the self-rated health of adolescents attending Adventist schools in Australia.
2. To explore the complex network of factors that predict the mental health of adolescents attending Adventist schools in Australia.
3. To examine the complex network of factors that predict the BMI of adolescents attending Adventist schools in Australia.
4. To explore the predictors of alcohol consumption of adolescents attending Adventist schools in Australia.
5. To investigate the influence of religious affiliation on the health behaviours and health status of adolescents attending Adventist schools in Australia.

The thesis contributes to the body of knowledge relating to adolescent health by providing a more comprehensive picture of the determinants of adolescent health. In turn, this better understanding may inform strategies for optimising health outcomes for adolescents.

Structure and Overview of the Thesis

The thesis draws off data collected from a comprehensive health and lifestyle survey that was administered to adolescents (n = 1734) attending 21 Adventist schools in Australia in 2012. The publication potential was vast; however, for this thesis, a coherent series of five publications were assembled to address the aim and objectives of the thesis. The thesis structure is presented as follows:

Chapters 1–3 set the context of and the methodology for the thesis. Chapter 1 provides a contextual overview and background for the thesis and presents the thesis aim and objectives. Chapter 2 provides a review of literature relevant to the thesis and the underpinning theories and frameworks guiding the thesis. Chapter 3 outlines the study design, instruments used, and the specific analysis procedures employed in the studies in the thesis.

Chapter's 4–8 present the results of the thesis and are arranged as a coherent series of five papers that have been published in peer-review academic journals. Chapter 4 presents the first of the five papers developed for publication (Study 1). In Study 1, a complex model was developed showing a multitude of factors that are concomitantly associated with the self-rated health status of adolescents attending Adventist schools in Australia. According to the model, two important predictors of adolescent self-rated health status were their mental health status and body mass index (BMI). These findings provided the basis for Study 2 (Chapter 5) which more extensively explored predictors of adolescent mental health status, and Study 3 (Chapter 6) which more extensively explored the contributors of BMI. An interesting observation of Study 1 was that alcohol consumption was not significantly associated with self-rated health status. Further analysis indicated that rates of alcohol consumption were low among this cohort compared to national norms and therefore Study 4 (Chapter 7) examined the factors that predicted alcohol consumption status among the study cohort. Study 5 (Chapter 8) more fully explored the unique faith-based aspect of the study cohort by examining the influence of religious affiliation on the health behaviours and health outcomes of the adolescents. Chapters 4–8 are presented in the style of the journal to which the papers were submitted and for consistency are written in Australian English. References for chapters 4–8 are combined and included at the end of the thesis.

Chapter 9 concludes with an overview of the thesis and synthesis of the study findings, highlighting how they address the research aim and objectives, as well as implications and recommendations for future research and current practice.

Chapter 2: Literature Review

Adolescent Health: A Global Concern

Adolescent health has received considerable global attention in recent decades. It has been the subject of a number reports (Fares et al., 2006; Interagency Youth Working Group, 2011; United Nations Children's Fund, 2011, 2012; WHO, 2013a) and milestone publications (Bustreo & Chestnov, 2013; The Lancet, 2007, 2012b), global goals and targets (United Nations, 2001b, 2002; United Nations Population Fund, 1994; WHO 2012), global public health conferences (World Health Summit, 2011), and recent United Nations and international initiatives and resolutions (Ministers of Youth, 2010; United Nations, 2013a; UNPF 2010). This global attention has come about because adolescents are now central to a number of major ongoing health challenges in many countries (Patton, Ross, et al., 2014; Sawyer et al., 2012).

Historically, adolescents are a group that existing health services worldwide have not served well globally (WHO, 2014d). Few attempts have been made to systematically measure adolescent health around the world, and at present, there are no internationally agreed set of determinants for measuring adolescent health (Patton et al., 2012). North (2009) claims this has obstructed accelerated health care action and has left adolescent health lagging behind other areas such as childhood and adult health—areas which have had good information systems underpinning their advancement (Bryce et al., 2008). Viner et al. (2012a) suggest that many of the determinants of adolescent health are not well understood and lie largely outside the traditional health service system. Deschamps (1997) describes the domain of adolescent health care as 'falling outside of biological paradigms, clinical medicine and its usual classifications, and (outside) the classic distinctions between physical and mental health, between medical and social aspects of health, and between curative and preventive care' (p. 37). The Youth and Health Risks report issued by the World Health Assembly (WHO, 2011) indicates that the global picture of research in adolescent health contains major gaps.

Adding to the lack of understanding encompassing adolescent health are extant myths that adolescents are healthy and do not need much attention, and that the major health problems facing adolescents are in the area of sexual and reproductive health (WHO, 2014d). Adolescence is often considered the healthiest time of life where health services are the lowest over the lifespan (*The End of Adolescence*, 2004). This view of adolescent health has contributed to adolescence attracting so little interest and investment in global health policy (Patton et al., 2016). Orthodox measures such as morbidity and life expectancy also fail to provide the full picture of adolescent health (Eckersley, 2007). Indeed it is remarkable that in recent decades there has been a dramatic decline in adolescent death rates in many countries (United Nations, 2013b), however using these measures alone underestimates the adverse trends in global chronic disease and mental health problems. Further, many of the behaviours and attitudes that largely determine adult health originate in childhood and adolescence (Eckersley, 2007), reinforcing the importance of the period of adolescence.

The health of adolescents in Australia is not unlike that of other developed countries. In 2007, the AIHW (2007) claimed that Australian children are generally much healthier than in previous generations, citing a 90% fall in death rates over the past hundred years and a halving over the previous two decades. Similar claims were reported in the 2011 report (AIHW, 2011) which also stated that adolescents enjoyed good health according to the national indicators presented in the report. While these results may be encouraging, the reporting of indicators such as life expectancy alone underestimate the importance of adverse trends, especially in chronic disease and mental health problems. Noteworthy, the 2014–15

ABS survey (2015) reported that over one third (37%) of young Australians aged 15–24 years rated their health as fair or poor. With regards to chronic disease, a 2008 report by the AIHW (2008c) indicated that young people in Australia have the highest growth rate of chronic disease prevalence of all population cohorts. With regards to mental health, the Australian Health 2018 report (AIHW, 2018) stated that poor mental health accounted for the highest burden of disease among young people. Among males, suicide and self-inflicted injuries were the highest contributors, and for females, anxiety and depressive disorders were the two leading causes of burden. A recent report (Erskine et al., 2015) indicated that 14% of young people aged 4–17 years had experienced a mental disorder in the twelve months prior to being surveyed. For young people aged 18–24 years, this figure rose to 27%. In Australia, 45% of adults experience a mental disorder in their lifetime (AIHW, 2016) and WHO reports that half of mental health problems present by the age of 14 years, and three quarters by the mid-20s (WHO, n.d.).

The paradoxes in the reports cited above highlight the complexities in understanding adolescent health. Some commentators (Sawyer et al., 2012, p. 1630) have suggested that today's young people face complex new challenges in the area of health that no other generation has before. Eckersley (2007) insightfully articulated that "young people are portrayed as having the time of their lives—or struggling with life in their times" (p. 217).

Biglan, Mrazek, Carnine, & Flay (2003) claimed that how adolescent health is measured can promote effective responses to health problems in adolescents. Hence, assessing adolescent health and the determinants that influence health may benefit from a holistic understanding of the meaning of health. The WHO definition states that health is "state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (WHO, 1948). Although this definition has been debated numerous times, it provides a framework for understanding health from not only the physical but from mental and social contexts as well.

Theoretical and Conceptual Frameworks for Adolescent Health

Despite the relatively slow advances in the understanding of adolescent health, many helpful theories and frameworks have been developed. Presented below are a selection of relevant theories and frameworks which provide a theoretical foundation for the present study.

Theory of Psychosocial Development

The Theory of Psychosocial Development (TPD) developed by Erik Erikson (1971) describes human development across the life-span as occurring in eight stages, with social interaction being especially important during the childhood years. Stage one centres on the infant years (ages 0–2) and is labelled “Basic Trust versus Mistrust”. During these years, an infant’s understanding of the world is through their interactions and developing a relationship with their parents. Children are more likely to develop a sense of trust when their parents consistently take care of their basic needs, are affectionate, develop warm, loving relationships and demonstrate care (Erikson, 1971, p. 103). Conversely, children will develop a sense of mistrust if their parents fail to show affection or provide a secure environment that meets their children’s basic needs. Children who have a sense of mistrust can experience feelings of frustration, suspicion, withdrawal and a lack of confidence (Erikson, 1971, p. 101). As infants move into the toddler years (ages 2–4), a stage Erikson calls “Autonomy Versus Shame and Doubt” they begin to venture out and explore their surroundings. If parents are patient, encouraging and affirming, children are more likely to develop autonomy and feel secure and confident. If parents refuse to allow toddlers to perform tasks which they are capable of or ridicule attempts by them at self-sufficiency, children will develop a sense of inadequacy, self-doubt and have less ability to handle problems (Erikson, 1971, p. 101).

Stage three of Erikson's theory is called "Initiative versus Guilt", and centres around the ages of four to five. In this stage, children discover whom they will become as their own person (Erikson, 1971, p. 101). In this stage, children identify with their parents and desire to be like their parents (Miller, 2011, p. 152). If children have a warm, caring relationship with their parents, they are more likely to imitate their parents' positive behaviours. As noted by Bao, Whitback, Hoyt, & Conger (1999), parents play a key role in the transmission of beliefs and values to their children, and as outlined by the Social Learning Theory (Bandura, 1977), children learn by observing the attitudes and behaviours modelled to them by the significant others in their lives.

As children turn five, the big life event is the entry into school. It is at this age that Erikson's stage four begins and it ends around 12 years of age. Erikson calls this stage 'Industry versus Inferiority'. It is in this stage that the question "Am I competent compared with others?" (Erikson, 1971, p. 101) is grappled with. Successful experiences in this stage give children a sense of industry and a feeling of competency and mastery (Miller, 2011, p. 153). Gane (2012, p. 12) suggests that children who do not gain a sense of industry may experience feelings of inferiority, inadequacy and low self-esteem that creates lack of motivation and a cycle of failure. Ultimately this can stifle the development of resilience and lead to the child developing poor behaviours and belief systems that flow through to the adolescent years.

As children move into the adolescent years (13–19 years) they enter Erikson's stage five which is called "Identity versus Role Confusion". This stage is characterised by large biological, cultural and social changes as children enter adulthood (Lee, 2005, p. 190). It is during this stage that adolescents begin to separate from their parents as they begin to establish their own identity and set of beliefs. Increasingly, identity and beliefs are influenced by their peers (Erikson, 1971, p. 101). Gane (2012, p. 12) notes that poor peer influence can lead to experimentation in the area of sexual identity and involvement in at-risk behaviours. Several studies conclude, however, that as adolescents form beliefs, attitudes and behaviours, many ultimately adopt the values and belief systems of their parents (Dudley & Dudley, 1986; Ellison & Sherkat, 1993; Okagaki & Moore, 2000; Taris & Semin, 1997). Noteworthy, the values and beliefs adopted in this stage tend to lead to behaviours that extend throughout adulthood.

Stage six and seven of the TPD are where adults typically form relationships with a partner and have children. In stage six, once people establish their identity, they are ready to make a long-term commitment to a mate, and are capable of forming intimate, reciprocal relationships, and of making sacrifices and compromises for those relationships. People who cannot form these relationships develop a sense of isolation and loneliness (Erikson, 1971, p. 136). In stage seven, people contend with the question of whether they can make life count by successfully raising a family and working toward the betterment of society (Erikson, 1971, p. 138). This provides a sense of productivity and accomplishment. Central to success in stage seven is maintaining healthy life patterns, developing a sense of unity with a mate and helping children to grow into responsible adults. In contrast, a person who is self-centred or unable or unwilling to contribute to society develops feelings of stagnation and dissatisfaction.

It is evident from the TPD that children who have their basic needs met and who experience meaningful relationships with their parents that include trust, love, warmth, acceptance and encouragement, are best equipped to experience positive growth and development and form positive belief systems. These observations are relevant to the topic of this dissertation as they highlight the potential influence of early childhood experiences on adolescent health.

Bioecological Systems Theory

The Bioecological Systems Theory (BST) (Bronfenbrenner, 1993, p. 37) asserts that the environment in which individuals live and interact has a profound effect on their development. Within this model is an appreciation for how human development can vary from culture to culture, from neighbourhood to neighbourhood, and even from home to home (Sigelman & Rider, 2008, p. 22).

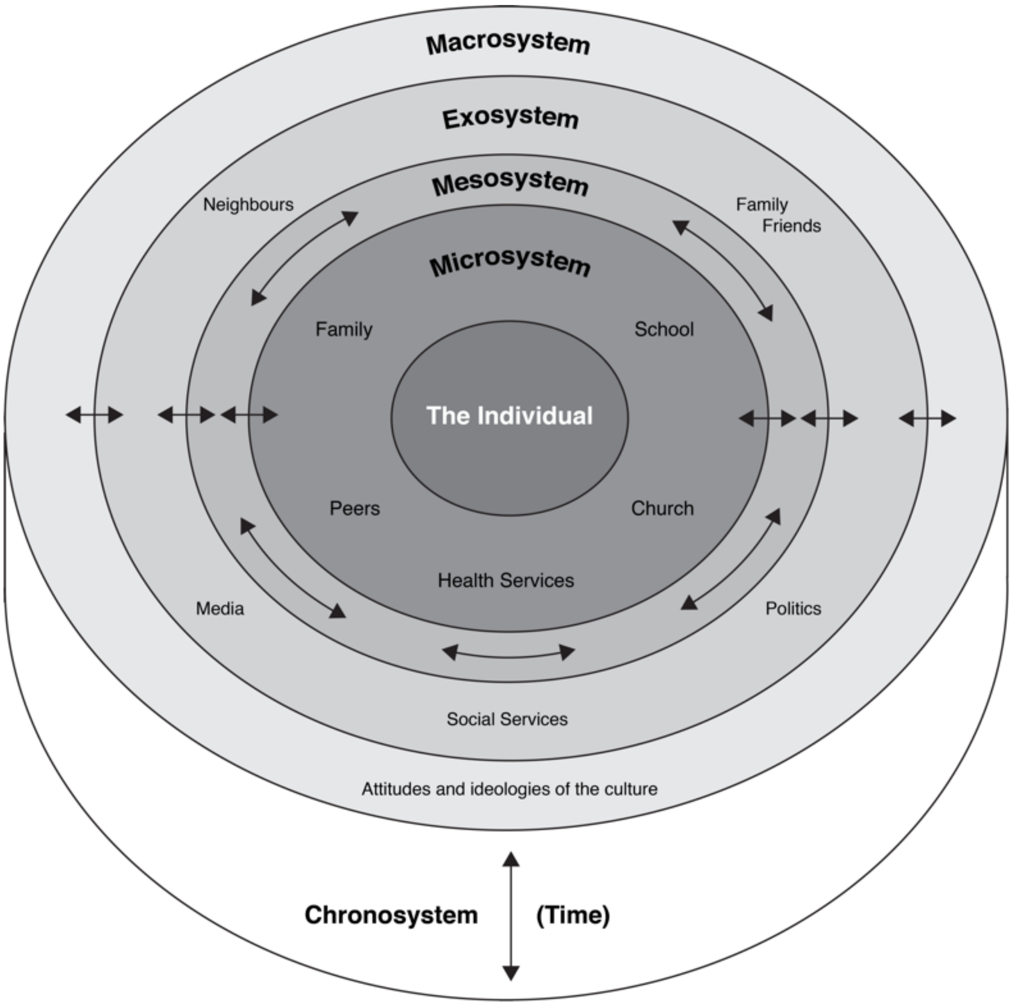


Figure 1. Bioecological systems theory (Bronfenbrenner, 1993)

The BST (Figure 1) categorises the environment into five different systems, specifying that there is interaction within and between these systems. The system that has the greatest impact on a child is the microsystem which is defined as the environment closest to the child and which includes the significant people in the child's life such as parents, peers and teachers. The microsystem not only recognises the influence of social dynamics of these people but also the biological dynamics such as habits, temperaments, capabilities and the physical characteristics of the child.

The second environmental category in the BST is the mesosystem (Bronfenbrenner, 1993, p. 40). The mesosystem recognises that interaction takes place between various elements in the microsystem. As these various elements interact and affect each other, they ultimately have an impact on the developing child. Bronfenbrenner suggests that development is likely to be optimised by strong supportive links between microsystems (Shaffer, 2009, p. 88).

The third system in the BST is the exosystem (Bronfenbrenner, 1993, p. 40), which consists of contexts that a child may or may not directly be part of, but nevertheless is affected by. For example, a parent's employment situation may have a positive or negative impact on a child depending on the parent's job satisfaction. Although the child is not directly affected by the dynamics that are taking place at the parent's place of employment, the impact that it has on the parent may ultimately impact the child.

The fourth system in the BST is the macrosystem (Bronfenbrenner, 1993, p. 40), defined as the culture (or subculture or social class) in which a person interacts is asserted to have an important role in impacting a person's identity, learning, behaviour patterns and beliefs. The fifth system in the BST is the chronosystem. This system recognises that environmental transitions over the life of the individual can affect the individual's development. These may be biological changes such as when a child reaches puberty or social changes such as the divorce of their parents.

The TPD and BST provide the present thesis with a theoretical framework for understanding human development and the complexities of the factors that influence adolescent health. The purpose of this thesis is to also understand human behaviour, particularly health behaviours. While many theories have been proposed to explain human behaviour, the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), and the Theory of Planned Behaviour (TPB) (Ajzen, 2011) that extends on the TRA, are particularly relevant.

The Theory of Reasoned Action and the Theory of Planned Behaviour

The TRA (Ajzen & Fishbein, 1980) and the TPB (Ajzen, 2011) have been used extensively to predict, explain and understand health-related behaviours in adolescents in both cross-sectional and longitudinal studies (Laflin, Moore-Hirschl, Weis, & Hayes, 1994; Lorenzo-Blanco et al., 2016; Stoddard & Pierce, 2018). Both theories were initially developed in an attempt to improve health education (Nutbeam, 2000) with the TPB becoming one of the most frequently cited and influential models for the prediction of human behaviour (Ajzen, 2011). The TPB has been successfully used to predict and explain a wide range of health behaviours and intentions including smoking, drinking, health services utilisation, breastfeeding and substance abuse. (Glanz, Rimer, & Viswanath, 2008, p. 68).

Both the TRA and the TPB views an individual's beliefs as predictors of his or her intentions (or motivation), which in turn predict his or her behaviour. The TRA, an earlier evolution of Ajzen's behaviour change research, does not include the constructs of "Control Beliefs" and "Perceived Behavioural Control", however, the premise of how it is operationalised is essentially the same as the TPB. For simplicity, the following discussion will focus solely on the TPB, which is illustrated in Figure 2.

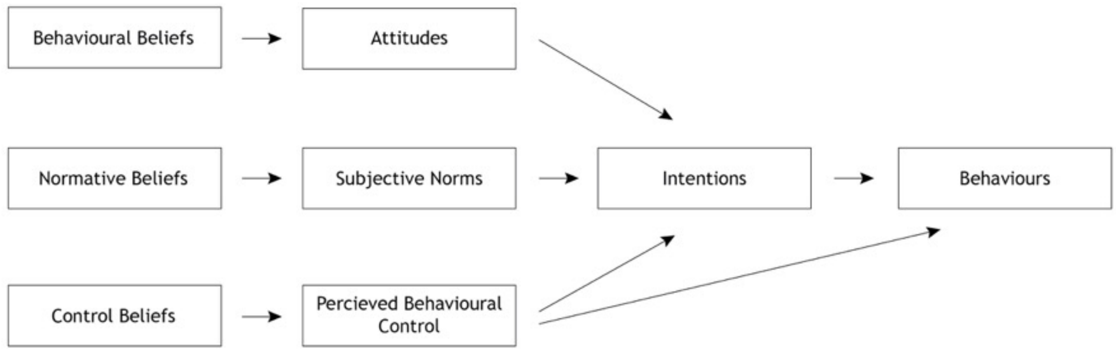


Figure 2. The theory of planned behaviour (Ajzen, 2011)

The TPB asserts that intentions, defined as an individual's readiness and desire to perform a specific behaviour, is a key driver of behaviour. The theory asserts that the stronger the intention to perform a behaviour, the more likely the behaviour will occur—as long as there are adequate opportunities and resources available.

In the TPB model, intentions are formed by the influence of three motivational constructs, namely: attitudes, subjective norms and perceived behavioural control. Attitudes are viewed as the measure or degree to which a behaviour is positively or negatively valued by an individual, and if it is of perceived benefit or not. Typically, an individual would ask questions like: "What will be the result of performing this behaviour?" and "What is the consequence of performing this behaviour?" Within the theory, it is recognised that driving an individual's attitudes are beliefs associated with that particular attitude, referred to as behavioural beliefs. In assessing behavioural beliefs, an individual will ascertain what his or her expectations are about performing a particular behaviour. Behavioural beliefs also take into account beliefs about the consequences and expected outcomes of performing a particular behaviour.

The second predictor of intentions in the TPB are subjective norms which relate to how an individual perceives the expectations of friends, family and society towards a particular behaviour. Beliefs that drive subjective norms are called normative beliefs. In forming normative beliefs, an individual determines as to whether social pressures from those they are connected with are valid or invalid, along with what motivation there is to comply to those social influences. If an individual believes that the social pressures are valid, they are more likely to adopt the opinions of those around them and form an intention.

The third predictor of intentions in the TPB is perceived behavioural control, which relates to an individual's perceived ease or difficulty at performing a particular behaviour. Perceived behavioural control specifically refers to an individual's degree of self-efficacy to perform a particular behaviour. Underpinning perceived behavioural control are control beliefs that describe an individual's consideration of the factors that may influence his or her ability to perform a task and how strong they perceive those factors to be.

The Conceptual Framework for Determinants of Health

While the theories discussed above provide frameworks for understanding human development and behaviour in general, other theories have focused specifically on health behaviours and health outcomes. The Conceptual Framework for Determinants of Health (AIHW, 2013b) developed by the Australian Institute of Welfare (AIHW) provides an organisational structure for how health in adolescents may be effected by various determinants. The framework (see Figure 3) recognises that an individual's health status is affected by a complex interplay between biological, lifestyle, socioeconomic, societal and environmental factors. While a person many have little control over some of these factors, many are modifiable. The four main areas illustrated below contain both broad and highly specific health determinants that link together to provide a web or pathway of causes that affect health. The four main areas include: broad features of society such as culture, affluence, social cohesion and environmental factors; socioeconomic factors such as education, employment, income, family, neighbourhood; health behaviours such as tobacco use, alcohol consumption, physical activity, dietary behaviours, use of illicit substances; and biomedical factors such as weight, height, blood pressure, and blood cholesterol.

The strength of this framework is that it presents an organised structure for the pathways between proximal determinants of health, upstream social determinants of health, and health outcomes. Hence, the framework highlights the need to adopt a broad approach when investigating health outcomes of adolescents, and this approach is adopted in the present thesis. The framework also provides a theoretical basis for employing SEM analysis which allows for the examination of a series of multiple and interrelated dependence relationships on multiple levels between variables simultaneously (Ho, 2013).

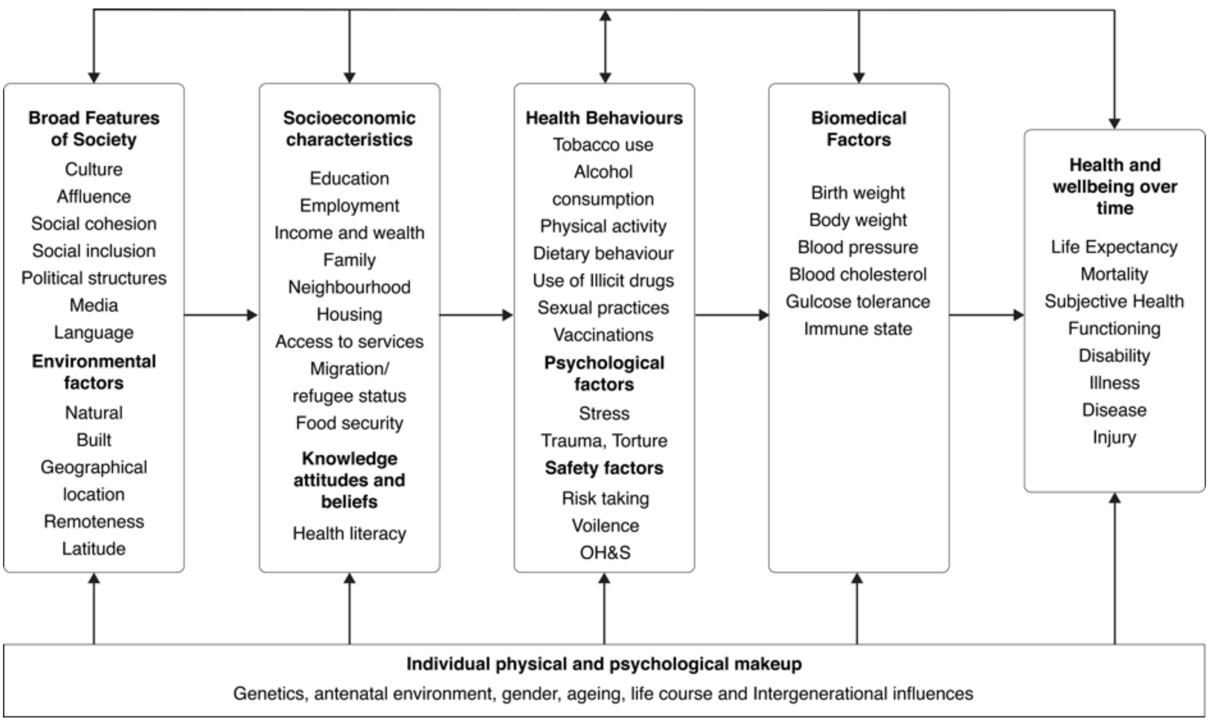


Figure 3. The conceptual framework for determinants of health (AIHW, 2013)

A Life Course Framework for Adolescent Health

In 2007, The Lancet published a series of papers on adolescent health that challenged the current paradigm for addressing adolescent health, claiming it was “not based on evidence and best practice” (Resnick & Bowes, 2007a). The series highlighted the need to understand the multidisciplinary nature of adolescent health, describing it as an interplay between biopsychosocial and cultural factors. Included in the preamble to the series of papers, The Lancet cited three fundamental principles that are implicated in patterns and trends in adolescent health (Resnick & Bowes, 2007a). These principles are: acknowledging that rapidly changing social contexts can promulgate health threats; health and ill-health are best understood as a result of a complex interplay between biological, psychological and sociological factors; and that sociological factors have a global reach in terms of its effect on young people. These principles demonstrate the growing understanding that adolescent health is multi-dimensional and complex.

In 2008, the report of the WHO Commission on Social Determinants of Health (CSDH) (WHO, 2008) adopted a life-course framework which identified the conditions or circumstances in which people are born, grow, live and age as determinants affecting present and future health. Globally, CSDH has become one of the most prominent conceptual frameworks for understanding health.

Notwithstanding, Viner et al. (2012a) claimed that research conducted in social determinants of health has somewhat neglected the period of adolescence despite it being a key developmental stage in the life course. Patton et al. (2012) claimed that few reports had addressed well the social determinants of child and adolescent development. He acknowledged that positive family, school and community connections are measured in school health surveys, but much more work needs to be done in this area. Indeed, further study of the relationship between childhood family dynamics (CFD) and adolescent health behaviours would contribute to the deficit of knowledge in this area.

In 2012, further attempts to provide a relevant list of determinants for adolescent health were made in The Lancet's second series on adolescent health (Patton et al., 2012). Through adopting the life-course conceptual framework, a list of determinants were formulated which included: relevant social determinants; risk-protective determinants such as family, school, neighbourhood, and individual; health behaviour determinants such as, substance abuse; sexual health; and adolescent-onset risk determinants resulting from puberty and social-role transitions that occur in adolescence (Patton et al., 2012).

The Lancet's second (2012a) series on adolescent health recognised that adolescents need to become a greater focus in the prevention of chronic diseases. The Lancet series set out to put the individual, rather than any specific health issues, at centre stage (2012a). This was done by adopting a life-course framework (Resnick, Catalano, Sawyer, Viner, & Patton, 2012) which recognised that an adolescent who is healthy is the best foundation for a healthy adult life, which in turn would best influence the next generation of child and adolescent health. The adoption of the life-course framework placed a focus on adolescents and young people for the prevention of NCDs in adults.

The theories and frameworks reviewed provide a theoretical framework to inform this thesis. These theories and frameworks assert that adolescent health is multi-dimensional and complex. Not only is adolescent health influenced directly by certain adolescent behaviours, but by upstream factors such as human development from childhood to adolescence and the rapidly changing social contexts and circumstances in which children and adolescents live.

Determinants of Adolescent Health

In 2001, the United Nations adopted a declaration acknowledging that the global burden and threat of NCDs constituted one of the major challenges of the 21st century. The declaration recognised health behaviours including tobacco use, harmful use of alcohol, unhealthy diet and lack of physical activity as determinants linked to the most prominent NCDs (United Nations, 2001a). Recognising the importance of adolescent health in addressing the global burden of chronic disease (The Lancet, 2012a; WHO, 2014c), notable surveys were initiated including the Health Behaviour in School-aged Children (HBSC) surveys (Currie et al., 2012), the Global School-based Health (GSHS) surveys (WHO, 2014a) and the Global Youth Tobacco Survey (GYTS) (WHO, 2014e). These studies highlighted the role of numerous proximal determinants of health as outlined in the 2001 United Nations declaration, as well as upstream social factors that influence health behaviours (Viner et al., 2012a), as previously discussed.

The present study project takes particular interest in the proximal and upstream factors outlined in the theories and conceptual frameworks discussed above as predictors of the health outcomes self-rated health status, mental health status, vitality and BMI. In order to delimit the study project, select proximal factors and select upstream factors were explored. Proximal factors examined include physical activity, diet, sleep, alcohol consumption, tobacco use, and consumption of illicit substances. Upstream factors examined include childhood family dynamics, adverse childhood experiences, religious affiliation, social influences, health behaviour intentions and attitudes towards meaning and purpose, perceived social misfit status, school academic performance and alcohol consumption. An overview of these factors is presented below.

Physical Activity

Physical activity is defined as any bodily movement produced by skeletal muscles that requires the expenditure of energy (AIHW, 2012c; WHO, 2010). It includes activities associated with work, transportation, play or other recreational activities. Exercise is defined as a subcategory of physical activity that involves planned, structured, repetitive activity with the purpose of maintaining or improving one or more aspects of physical fitness (WHO, 2010). Regular participation in physical activity has been shown to reduce the risk of NCDs such as coronary heart disease and stroke, diabetes, hypertension, colon cancer, breast cancer and depression (WHO, 2010). Physical activity improves bone and functional health, promotes adolescent emotional health (Kremer et al., 2014; Smith & McCreary Centre Society, 2011) and is a key determinant of energy expenditure and therefore fundamental to energy balance and weight control (WHO, 2010). Globally, physical inactivity has been identified as one of the leading risk factors for death (WHO, 2018b). It is estimated that physical inactivity causes 21 to 25% of breast and colon cancers, 27% of diabetes and approximately 30% of ischaemic heart disease, mediated through their associated risk factors such as raised blood pressure, raised blood sugar levels and overweight (WHO, 2010).

It is recommended that adolescents accumulate at least 60 minutes of moderate to vigorous physical activity per day for health benefits (AIHW, 2011d; WHO, 2010). The 2014 WHO Health for the World's Adolescents report (WHO, 2014c) cites that most adolescents in countries that were surveyed did not achieve the recommended level of physical activity. In Australia, data from the ABS 2011–12 Australian Health Survey (ABS, 2012) indicates that around one in five (19%) Australian children aged 5–17 meet recommended guidelines for physical activity. The survey also indicated that sedentary behaviour increases with age and the amount of time being physically activity decreased. Results of cross-sectional studies such as the 2015 New South Wales Schools Physical Activity and Nutrition Survey (SPANS)

(Hardy, Mihrshahi, Drayton, & Bauman, 2015) showed that 12% of adolescents meet the daily physical activity recommendation of at least 60 minutes of moderate to vigorous intensity physical activity every day. A systematic review by Booth, Rowlands and Dollman (2015) indicated that there had been little change in physical activity levels from 1995 to 2015.

Physical activity levels in adolescents may be affected by supporting infrastructures like sports grounds, playgrounds, parks, cycle parks, skate parks and open public spaces (AIHW, 2011d; Hardy, King, Espinel, Cosgrove, & Bauman, 2010). Socioeconomic status of families may affect participation in sporting events where private transport is unavailable or participation fees are unaffordable (AIHW, 2011d). Australian cross-sectional studies found lower levels of physical activity may be present in communities where parents have lower levels of perceived neighbourhood safety (Carver et al., 2005; Timperio, Crawford, Telford, & Salmon, 2004). Physical activity rates decrease with remoteness, with 46% living in major cities meeting recommended physical activity guidelines and 34% in outer regional and remote areas combined (ABS, 2012a).

In a cross-sectional mixed method study of Tasmanian young people (Jose, Cleland, Venn, & Hansen, 2013), the majority of participants believed that walking did not constitute a beneficial physical activity. This belief may act as a barrier to participation in physical activity among young people.

Dietary Behaviours

Dietary choices are arguably the most significant health behaviour that impacts health (Ford et al., 2009; Giugliano, Ceriello, & Esposito, 2006; Hu, 2009; National Health and Medical Research Centre [HMRC], 2013; Swain, McCarron, Hamilton, Sacks, & Appel, 2008). Due to the rapid physical and cognitive development that occurs during childhood and adolescents, good dietary habits are essential at these times (NHMRC, 2013). Further, establishing good dietary habits in childhood are important as these habits track into adulthood (NHMRC, 2013). Poor diet in children can also lead to the onset of adult health problems (Tabrizi, Segovia-Siapco, Burkholder, & Sabaté, 2014). Establishing good dietary habits in children is assisted by parent modelling and education as these are understood to be important predictors for dietary choices in children and adolescents (Ambrosini, Emmett, Northstone, & Jebb, 2014).

Evidence of the relationship between dietary patterns and disease risk is replete in the literature as found in a systematic review of randomised controlled studies by Mozaffarian and associates (2010). Nutrition contributes significantly to a healthy weight, quality of life and wellbeing, resistance to infection, protection against chronic disease, and premature death in all Australians (NHMRC, 2013). The associations between foods high in saturated fat, and the development of NCDs such as type 2 diabetes, hypertension, cancer, cardiovascular disease (CVD), overweight and poor mental health, has been reviewed in detail (NHMRC, 2013). Evidence suggests that diets high in saturated fats, even from two years of age may predispose them to develop CVD later in life (Daniels & Greer, 2008; NHMRC, 2003). Systematic reviews have found diets low in sodium have been linked to a reduction in blood pressure in children up to 18 years of age (Dickinson & Havas, 2007; He & MacGregor, 2004). The consumption of sugar-sweetened beverages is associated with increased risk of weight gain, dental caries and reduced bone strength in adults and children (NHMRC, 2013).

Dietary patterns consistent with current NHMRC (2013) guidelines suggest that consuming a wide variety of nutritious foods reduces the risks of obesity, diabetes and some forms of cancer in adolescents, and have been linked to lowering the risk of metabolic syndrome

(Esposito, Ciardiello, & Giugliano, 2014). Australian dietary recommendations set by the NHMRC (2013) suggest that children and adolescents should be encouraged to limit foods high in saturated fats and foods containing added salt and added sugar. Children and adolescents should also be encouraged to consume a wide variety of nutritious foods to support normal growth and development (National Eating Disorders Collaboration, 2010). The NHMRC (2013) recommends that adolescents consume the following serves of food per day from the five food groups; five serves (75 grams per serve) of vegetables for girls, and between five or six serves for boys depending on their age; two serves (150 grams per serve) of fruit; five to seven serves of grain foods (one serve equating to a slice of bread) for girls and six or seven serves for boys; two and a half serves of either lean meats (65 grams per serve), poultry (80 grams per serve), fish (100 grams per serve), eggs (two eggs per serve), tofu (170 grams per serve), or nuts and seeds (30 grams per serve) for both girls and boys; and three and a half serves of mostly reduced-fat dairy foods such as milk (one cup per serve), yoghurt (three quarters of a cup per serve), cheese (40 grams per serve) or alternatives. The NHMRC recognises water as an essential nutrient recommending girls drink five or six glasses of water per day depending on their age, and boys drink six to eight glasses per day (NHMRC, 2006).

Dietary patterns in adolescents continue to be of concern. The WHO 2014 Health for the World's Adolescents report (WHO, 2014c) indicates that in nearly all countries that participated in the GSHS, the majority of younger adolescents did not eat the recommended daily five or more servings of vegetables or two servings of fruit. Among older adolescents, in all 21 countries surveyed, most adolescents (80–90%) did not eat the recommended daily servings of fruit or vegetables. The popularity of soft drink consumption is of concern with one out of four adolescents in high-income countries consuming soft drinks daily (WHO, 2014c). Despite the low proportions of adolescents meeting the guidelines, in two-thirds of countries in Europe and North America, the percentage of adolescents eating fruit daily has increased significantly since 2001. Three out of every four countries reported increases in daily vegetable consumption (WHO, 2014c). Australian studies (Hardy et al., 2015) showed that although 80% of Australia adolescents met recommended daily fruit intake (up from 74% in 2010), only 11% of Australian adolescents met the daily recommendations for vegetables (up from 7% in 2010).

The result of not meeting NHMRC dietary guidelines is seen in the prevalence of metabolic syndrome in children and adolescents. Central to metabolic syndrome is obesity which has been identified as one of the most serious health challenges in the 21st century (WHO, 2014b). In the United States it has been predicted that due to premature mortality associated with obesity developing at a younger age, the current generation will be the first in the country's history to have a life expectancy lower than that of their parents (Olshansky et al., 2005).

Australia has one of the highest rates of obesity among Organisation for Economic Cooperation and Development countries (OECD) (AIHW, 2012c). Several national and state-based surveys of children and adolescents using measured height and weight data, found that 21 to 25% of children and adolescents are overweight or obese, with 5 to 8% being classified as obese (ABS, 2009; Australian Government Department of Health and Ageing, 2008; Gill et al., 2009; Olds, Tomkinson, Ferrar, & Maher, 2009; Rokholm, Baker, & Sørensen, 2010). Similar rates of overweight and obesity were observed in the 2015 SPANS survey (Hardy et al., 2015).

Overweight children and adolescents are more likely to develop sleep apnoea, breathlessness on exertion and reduced exercise tolerance, some orthopaedic and gastrointestinal problems, non-alcoholic fatty liver disease, and early signs of hypertension, hyperinsulinaemia, hypertriglyceridaemia and type 2 diabetes (Denney-Wilson, Hardy, Dobbins, Okely, & Baur, 2008; WHO, 2004). Although there is systematic review evidence that the rate of increase in overweight and obesity in adolescents has slowed (Gill et al., 2009; Olds et al., 2009), if current trends continue in Australia it is estimated that 35% of Australians will be obese by 2025 (BMI > 30) and 13% will be severely obese (BMI > 35) (Hayes, Lung, Bauman, & Howard, 2017).

The most immediate consequences of overweight and obesity in childhood are social discrimination and associated poor self-esteem and depression, increased risk of developing negative body image issues, and eating disorders (Denney-Wilson et al., 2008; WHO, 2004). A major long-term consequence is that overweight children are more likely to become overweight or obese adults, with an increased risk of NCDs and early mortality (Biro & Wien, 2010; Denney-Wilson et al., 2008; WHO, 2004).

There is convincing evidence that behavioural interventions including diet and physical activity reduce the risk of obesity in overweight children, and these interventions are more effective when they are family-based (Campbell & Hesketh, 2007; Gilles et al., 2008; Kamath et al., 2008). Evidence exists that parent feeding practices and parent-child interactions during feeding have a powerful influence on a child's developing food preferences, intake patterns and diet quality (Savage, Fisher, & Birch, 2007).

Alcohol Consumption

Alcohol is the most widely used recreational drug in Australia ('Australian Institute of Criminology - Alcohol', n.d.) and is second only to tobacco as a preventable cause of drug related death and hospitalisation of adolescents (NHMRC, 2009). Harmful use of alcohol is the most common substance use disorder, accounting for almost one third of substance use disorders in Australian adolescents (AIHW, 2011d).

Current Australian legislation prohibits the sale or supply of alcohol to people under 18 years of age (AIHW, 2011d). Despite legislation, around three quarters of Australian secondary students aged between 12 and 17 have tried alcohol at some time in their lives. In another national study, 51% of Australian secondary students reported consuming alcohol in the twelve months preceding survey (Centre for Behavioural Research in Cancer and The Cancer Council Victoria, 2012).

Early initiation of alcohol use in life predicts escalating alcohol use throughout adolescence as found by a cross-sectional study by Bolland and associates (2016). Adolescents who start drinking alcohol under 15 years of age are four times more likely to develop alcoholism than those who start drinking at 21 years of age (Premier's Drug Prevention Council, 2005). The adolescent years are an optimal time for interventions to be put in place to prevent and manage substance misuse and dependence before patterns of dependence become entrenched and continue into adulthood (Milne, Bell, Weltman, Lampropoulos, & Towns, 2009, p. 163).

There is ample evidence showing the deleterious effect of adolescent alcohol consumption on their health and wellbeing. Adolescence is a critical time for brain development and maturation, and the adolescent brain has an increased susceptibility to alcohol-induced damage (Milne et al., 2009, p. 166). Repeated exposure to alcohol during adolescence leads to long-lasting detrimental effects on brain development that can be experienced throughout adulthood (De Bellis et al., 2005). Adolescents who drink heavily tend to have smaller prefrontal cortices and white matter, structural abnormalities of white matter and reduced hippocampal volumes (De Bellis et al., 2005; White & Swartzwelder, 2004). These structural changes lead to a diminished ability to retrieve verbal and non-verbal material and poorer performances in attention-based tests (Brown & Tapert, 2004). Alcohol consumption during adolescence can also lead to significant and long-lasting cognitive and behavioural deficits, particularly in the areas of learning and memory (Brown, Tapert, Granholm, & Delis, 2000). Alcohol consumption can also lower inhibitions and impair decision making (Brevers et al., 2014) such as in the area of sexual-risk taking (Bonomo, 2005; Hingson, Heeren, & Winter, 2006). This can lead to unsafe behaviour with negative short-term and long-term consequences, and hence a diminished ability to negotiate the tasks of adolescence and successfully make the transition into adulthood (Milne et al., 2009, p. 166). Alcohol consumption during adolescence is also linked with poor mental health and social problems resulting in anxiety, depression and suicide attempts (Bonomo, 2005; Brown & Tapert, 2004; Hingson et al., 2006).

There is a strong link between alcohol consumption and violence. Young people are over-represented among victims and perpetrators of alcohol-related violence and accidental injury related to alcohol consumption, particularly among young males (Bonomo, 2005; Hingson et al., 2006; Wells & Thompson, 2009). Almost five million people (26%) in Australia aged 14 or older reported being a victim of an alcohol-related incident in 2013, declining from 2010 where 29% of people aged 14 or older reported being victims (AIHW, 2013c). Over 90% of all deaths caused by drinking among young people are due to assault, falls, road injury, alcohol abuse and dependence, and suicide (Milne et al., 2009, p. 163).

In the short term, the effects of alcohol consumption manifest when a person drinks heavily over a short period of time resulting in severe intoxication. As a result, there is risk of injury from falls, assault, road accidents, coercive sexual activity and unprotected sex (Bonomo, 2005). Damage may also occur to the small bowel leading to stomach problems. This can lead to diarrhoea, nausea, shakiness, vomiting and depression of the central nervous system which can lead decreased cognitive function and headaches (National Drug and Alcohol

Research Centre, 2004). Acute alcohol intoxication can lead to alcohol poisoning, which may result in coma or death (AIHW, 2011d).

The NHMRC (2013) provides the following recommendations for the consumption of alcohol in adolescents: not drinking alcohol is the safest option for anyone under the age of 18; parents and carers should be advised that children under the age of 15 years of age are at the greatest risk of harm and not drinking alcohol at this age is especially important; and for people aged from 15–17 years of age the safest option is to delay the initiation of drinking for as long as possible.

The 2014 Health for the World's Adolescents (HWA) report (WHO, 2014c) indicates declines in weekly drinking in adolescents in high-income countries in Europe and the Americas. Among younger adolescents, patterns of consumption in many countries have dropped by more than half since 2001, although some countries report increases. The HWA report indicates that in the United States and England, between 5–15% of adolescent boys and girls reported drinking alcohol in the week preceding the 2009 HBSC survey. This was down from 56–49% (in England) and 21–9% (in the United States) in the 2001 survey. Similar trends in adolescent alcohol consumption can be seen in Australia (National Drug Strategy Household Surveys (NDSHS)). In the 2013 NDSHS, 72% of adolescents 12–17 years of age reported abstaining from drinking alcohol (AIHW, 2013c), up from 61% in the 2010 NDSHS (AIHW, 2011a) and 31% in the 2007 NDSHS (AIHW, 2008b). There is a trend for young people to delay the initiation of alcohol consumption in Australia, from 14.4 years of age in 1998 to 15.7 years in 2013 (AIHW, 2013c).

The 2011 Australian Secondary School Students' use of Tobacco, Alcohol, and over the Counter and Illicit Substances Survey (Centre for Behavioural Research in Cancer and The Cancer Council Victoria [CBRC], 2012) reported 51% of adolescents 12–17 years of age had consumed alcohol in the preceding twelve months. The survey also reported that the proportion of adolescents 12–15 years of age drinking in the seven days prior to the survey decreased from 22% in 2005 to 17% in 2008 and 11% in 2011. Although the data in these surveys are encouraging, 28% of adolescents in the 2013 NDSHS reported consuming alcohol.

During adolescence, involvement with alcohol increases with age. According to the 2010 NDSH survey (AIHW, 2011a), 22% of adolescents 12–15 years of age had on average no more than two drinks per day, as opposed to 59% for adolescents 16–17 years of age. Adolescents who drank more than two drinks per day varied from 1% for adolescents 12–15 years of age, to 10% of adolescents 16–17 years of age. The 2011 Australian Secondary School Students' use of Tobacco, Alcohol, and over the Counter and Illicit Substances cross-sectional study (CBRC, 2012) reported similar trends with the proportion of students drinking in the seven days before the survey increasing from 8% for 13-year-old adolescents to 37% of 17-year-old adolescents. Students who consumed alcohol in the previous seven days most commonly obtained their alcohol from their parents (33%) or friends (23%) and consumed it at a party (34%) or in their own home (30%).

Tobacco Usage

Tobacco use remains one of the largest contributors to NCDs (WHO, 2014c) and is the leading cause of preventable deaths in Australian and around the world (AIHW, 2013). Most tobacco users commence in their adolescent years to the extent that it is uncommon for adults who have never used tobacco as adolescents to start using in their adult years (Chapman & Freeman, 2009). Globally, one in every ten girls aged 13–15 years, and one in every five boys aged 13–15 years use tobacco (WHO, 2014c).

Tobacco smoking is a leading risk factor for NCDs including chronic obstructive pulmonary disease, stroke, peripheral vascular disease (AIHW, 2011d), many types of cancer, respiratory disease, heart disease and stroke, and a leading risk factor for death. It is the major cause of cancer, accounting for about 20 to 30% of cancer cases in Australia (AIHW, 2012d). The Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General (U.S. Department of Health and Human Services, 2012) indicates that early signs of these diseases can be found in adolescents who smoke. Tobacco usage by adolescents has immediate adverse health consequences—including addiction, respiratory problems, and shortness of breath (AIHW, 2011d)—and accelerates the development of chronic diseases across the full life course.

In Australia, tobacco usage is the single largest cause of preventable illness and death (ABS, 2013; AIHW, 2011b) and is responsible for more cancer deaths than any other single factor (CBRC, 2013). There recommendations give no safe usage of tobacco products for persons of any age. Tobacco usage is considered dangerous and highly addictive (American Cancer Society, 2014). It is illegal to sell tobacco products to people under the age of 18 in Australia or to smoke in enclosed public places (CBRC, 2013). Despite this, according to the 2008 Australian Secondary School Students' Alcohol and Drugs Survey AIHW, 2013), 12% of 12–15 year old adolescents reported buying their last cigarette themselves. Tobacco advertising is not permitted on television, radio, newspaper or magazine (QUIT, 2014). In 2010 plain packaging laws were introduced requiring the tobacco products be sold in drab packages with large graphic images of tobacco-related diseases along with the brand name but without logos (Australian Government Com Law, 2011).

The Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General (U.S. Department of Health and Human Services, 2012) indicates that in the United

States, about 80% of adolescents who use tobacco will continue using into adulthood due to the powerful addictive effects of the drug nicotine in tobacco products. Of those who continue using tobacco into adulthood, one-half will die about 13 years earlier than their non-smoking peers. A systematic review by Mathers and associates (2006) indicated that not only is tobacco usage in adolescents a precursor for addiction and usage in adulthood, it is a gateway drug for adolescents, increasing the risk of abuse of other substances along with a range of other problems such as problematic alcohol use, mental health problems and academic and sleep problems. Adolescents who smoke are three times more likely to use alcohol, eight times more likely to use cannabis and twenty-two times more likely to use cocaine than their non-smoking peers. Smoking is associated with a host of other risky behaviours, such as fighting and engaging in unprotected sex in adolescents.

There have been significant declines in tobacco use among younger adolescents in most high-income countries and in some middle and low-income countries (WHO, 2014c). The percentage of adolescents who have tried tobacco has dropped by more than half in several countries over the past decade (WHO, 2014c). In Australia, the proportion of young people smoking has never been lower (Chapman & Freeman, 2009); however, tobacco usage among Australian adolescents still presents a serious public health concern. It is estimated that currently, 17,900 school students make the transition from experimental smoking to becoming an established smoker each year (CBRC, 2014). In 2011, 16% of males and 13% of females aged 17 years of age reported smoking in the previous week (CBRC, 2012), which is down from 24% of males and 28% of females in 1990.

Tobacco usage in adolescents is influenced by a number of factors. Children with parents or siblings who smoke are more likely to take up smoking later in life (Avenevoli & Merikangas, 2003; Better Health Channel, 2014a), as are adolescents whose peers smoke

(Kobus, 2003). According to the 2008 Household Income and Labour Dynamics in Australia (HILDA) cross-sectional study, there were a significant number of adolescents in Australia whose parents smoked tobacco and thus were a negative influence on their children. In the survey, over one in five (22%) parents with co-resident young people aged 12–24 years were current smokers (AIHW, 2011d). Parental influence also has positive influences on adolescent tobacco usage. Chapman and Freeman (2009) claim that the most likely reason for the positive change in adolescent tobacco usage rates has been the influence of falling adult usage rates.

Other influential factors for adolescent usage of tobacco include advertising and promotional activities by tobacco companies (Fergusson, Horwood, Boden, & Jenkin, 2007). In recognition of this, the WHO (2013b) instigated a policy of enforcing bans on tobacco advertising, promotion and sponsorship as one of its six key policies to counter the deadly effects of tobacco usage.

Use of Illicit Substances

The use of illicit substances, such as marijuana, ecstasy, meth/amphetamine and opiates, continues to be a problem among Australian adolescents and is a major contributor to the health burden. In the 2008–09, AIHW's National Hospital Morbidity Database (2011d) there were 8,442 hospital admissions for young people aged 12–24 years of age with a principal diagnosis of mental and behavioural disorders due to drug and alcohol use, a rate of 218 per 100,000 young people. Fourteen per cent of these admissions were due to cannabis use, 9% were due to multiple drug use and other psychoactive substances and 7% to other stimulants.

The health impact of the use of illicit substances varies depending on the specific type of drug used and the circumstances of its use. Illicit substance use is associated with illness and disease, accident and injury, self-harm, violence and crime, and family and social disruption

(Degenhardt, Lynskey, & Hall, 2000). A systematic review by Loxley and associates (2004) Illicit substance use is a major contributor to mortality and morbidity. It is associated with infection of HIV and hepatitis C virus when injecting equipment is shared, low birth weight in babies born of drug users, malnutrition, infective endocarditis, poisoning, mental illness, brain damage, respiratory problems, suicide, self-inflicted injury and overdose.

Illicit drug use is also associated with psychological and behavioural problems, such as delusions and hallucinations, memory problems, risk-taking, thoughts of suicide, personality disorders, schizophrenia and aggressive and erratic behaviour. These problems are often worsened when several drugs are used in combination (Abetz, 2005; Loxley et al., 2004). In a study of 44 schools in Victoria, weekly or more frequent cannabis use in teenagers doubled the risk of depression and anxiety (Patton et al., 2002). Like alcohol abuse, illicit substance use is also linked with criminal behaviour, with 59% of young people in juvenile justice detention reporting that they were under the influence of either alcohol or illicit substances at the time of offending (AIHW, 2011d).

Illicit substance use by Australian adolescents has decreased from 2001 to 2018 with the use of cannabis decreasing by 50% over this period, the use of ecstasy and cocaine decreasing by one third and the use of methamphetamines dropping significantly from 6.2% to 0.8% (AIHW, 2018). Among adolescents aged 12–17 years of age, the use of illicit substances has declined from 20% in 2005 to 15% in 2014 (White & Williams, 2016).

According to the 2010 NDSHS (AIHW, 2011a), the most popular illicit substance of choice is cannabis with approximately 13% of adolescents 14–17 years of age reported using cannabis in the twelve months prior to the survey. Comparably, the survey indicated that 2.3% used pharmaceuticals and less than 1% used amphetamines, ecstasy, cocaine and inhalants. Among the most commonly used illicit substances, the mean age of initiation ranged from 15.9 years for marijuana to 18.1 years each for ecstasy and meth/amphetamines (AIHW, 2011d). According to the 2013 NDSHS (AIHW, 2013c), the age of initiation into any illicit drug use increased from 16.0 years in 2010 to 16.3 years in 2013. Despite decreases in adolescents using illicit substances, the 2013 survey indicates that the number of people across all ages using illicit substances increased in 2013.

Illicit substance use is the result of interactions between developmental processes and environmental factors. Risk factors that are salient in early adolescence may go on to influence the development of further risk factors as adolescents get older (Spooner & Hetherington, 2005). Before a child reaches adolescence, factors such as maternal drug use during pregnancy, difficult temperament, early behavioural and emotional problems and early exposure to drugs can have detrimental effects. Factors that exacerbate these risk factors include cognitive limitations, poor parenting and low socio-economic status (Spooner & Hetherington, 2005). As a child reaches adolescence, other factors such as peer antisocial behaviour, poor parental control and supervision, drug use among family members, low self-esteem, academic failure, leaving school early, poor connection with family, school and community, and legal and financial problems influence illicit substance use (Spooner & Hetherington, 2005).

Many risk factors that influence the use of illicit substances have social underpinnings. Social influences can present in many forms such as modelling of behaviour by parents, siblings, peers or friends as found in a longitudinal study by Ennett and associates (2010), perceived norms of behaviour (Eisenberg & Forster, 2003) and school policies restricting use or enforcing negative consequences (Evans-Whipp et al., 2004). The most important of these social influences is the institution of the family and the role it plays in the adolescent's life (Ennett et al., 2010). In the 2010 NDSHS (AIHW, 2011a), a quarter of recent illicit substance users aged 14 years or older (25%) stated that all or most of their friends currently used illicit substances, while only 7% indicated that none of their friends used illicit substances.

In recognition of the influence of family dynamics on adolescent use of illicit substances, the State Government of Victoria in Australia (Better Health Channel, 2014b) advised that parents should endeavour to foster a close and trusting relationship with their child from an early age and support and encourage positive behaviour; model appropriate behaviour such as drinking moderately, not smoking and not using illicit drugs; establish agreements and guidelines about what is acceptable behaviour around alcohol and drugs; encourage a healthy approach to life including good foods, regular exercise and sports; and encourage their child to have more than one group of friends.

The health behaviours reviewed above are of particular interest to this thesis due to their proximal influence on the health outcomes of adolescents. Studies 1–3 and 5 explore the relationship of these behaviours with self-rated health, mental health, BMI and religious affiliation. Study 4 explores predictors of alcohol consumption in the adolescent cohort under investigation.

Attitudes

There is growing evidence of a positive relationship between meaning and purpose and health in adolescents. A systematic review by Roepke and associates (Roepke, Jayawickreme, & Riffle, 2014) reported a significant relationship exists between meaning and purpose and positive adolescent health outcomes, with a lack of meaning and purpose being related to behavioural factors that impact people's risk of negative health outcomes. In another study, a sense of purpose was negatively associated with eating disorders and poor diet control in adolescents (Piko & Brassai, 2009). A cross-sectional study of Eastern European adolescents found those with a greater sense of meaning perform more health-protective behaviours and engage in fewer at-risk behaviours (Brassai, Piko, & Steger, 2012). A study by Burrow and associates (2010), linked meaning and purpose with adolescent mental health, with adolescents reporting a strong sense of meaning and purpose being more likely to experience better mental health outcomes. More specifically, meaning and purpose has been associated with life satisfaction, positive affect and happiness (Halama & Dědová, 2007b; Hicks & King, 2007; Siahpush, Spittal, & Singh, 2008; Steger, Frazier, Oishi, & Kaler, 2006). Discovering purpose is a clear marker of flourishing and positive well-being in adolescents (Burrow et al., 2010) and a lack of meaning and purpose has been linked to depression, apathy and social and interpersonal difficulties (Damon, Menon, & Bronk, 2003).

Perceived social misfit status has been linked with poor health outcomes in adolescents in longitudinal studies (Leary, 2015; Masten, Telzer, Fuligni, Lieberman, & Eisenberger, 2012). Indeed Wright's social misfit hypothesis proposes that young people who are dissimilar in a discernible way from the norm of their social groups with regard to behaviour or appearance are often victimized, marginalized or bullied (Wright, Giammarino, & Parad, 1986). Social rejection influences a variety of outcomes including emotional, cognitive, behavioural, biological and neural (Leary, 2015). These influences are not surprising since social rejection thwarts a core human need of belonging and acceptance. Ultimately, hurt feelings are the core emotion of social rejection, which can also increase anxiety and feelings of anger, sadness and depression (Leary, 2015).

The relationship between mental health and school academic performance has been extensively discussed in the literature (McLeod, Uemura, & Rohrman, 2012). Australian studies (Mission Australia, 2017) have consistently reported that school academic performance is a key stressor that adolescents feel most concerned about, more so than body image. Findings from a cross-sectional study by Cole (1991) indicate that the negative feedback from poor academic performance at school predict depression. McCarty's (2008) longitudinal analysis suggested that students with low academic performance may be susceptible to behavioural problems, which may be linked to poor mental health (Chen & Simons-Morton, 2009). Although the relationship between mental health and school academic performance has been the subject of much research, little work has been done on the reverse relationship—school academic as a predictor of mental health.

Childhood Family Dynamics

Childhood family dynamics are well established as a determinant of health across the life course in many cultures (Irwin, Siddiqi, & Hertzman, 2007; Viner et al., 2012b; WHO, 2008). Most of the early years of a child's life are spent in home and family environments (AIHW, 2012c) and hence families are the primary influence on the health and development of children (Irwin et al., 2007) and adolescents as they transition to adulthood (AIHW, 2011d, 2012a; Viner et al., 2012b; WHO, 2008).

The WHO Commission on Social Determinants of Health (WHO, 2008) recognise that determinants such as family dynamics are positioned upstream from the adolescent risk and protective factors previously discussed (Viner et al., 2012a). As such, family dynamics are considered one of the "cause of the cause" determinants of the health of children and adolescents. The WHO Commission on Social Determinants of Health in 2008 (WHO, 2008) identified supportive, nurturing and caring parents to improve early childhood development as a crucial step to improving global health. The AIHW (2012c) reports that positive family functioning sets the foundation for children's health throughout their lives. Although there is currently no national indicator or definition for family functioning in Australia (AIHW, 2011d), a number of Australian and international studies identify similar key components for positive family functioning, including a family's ability to interact, communicate, make decisions, solve problems and maintain relationships, and for children to have parents who are positive role models (AIHW, 2012c). Positive family functioning also includes: positive family communication; spending time together; affection, support and commitment to the family; adaptability; cohesion and the ability to get along with one another (Colorado Foundation for Families and Children, 2003; Craddock, 2001; Zubrick, Williams, Silburn, & Vimpani, 2000). Safe and supportive families, along with safe and supportive schools and positive and supportive peers, are crucial in assisting adolescents in developing to their full potential and achieve the best health in their transition to adulthood (Viner et al., 2012a). Viner et al. (2012a) go so far as to say that improving adolescent health worldwide requires improving adolescents' daily life with families, along with their peers and in schools.

Resnick et al. (1997) indicated that connectedness between members of a family seems to be one of the most important factors that protect against poor health outcomes in adolescents. Children who are raised in stimulating, nurturing and safe environments have been shown to have better outcomes throughout their lives. Families with rich social networks have greater resilience and more resources to assist them in managing their daily lives and the problems that they face, which in turn promotes the healthy development and wellbeing of their children (AIHW, 2009). Young children need to experience warm, responsive family environments as inappropriate disapproval and punishment are associated with poor health outcomes (Irwin et al., 2007).

Children in families without adequate economic resources are at greater risk of poor social, health and educational outcomes. This is due to increased levels of stress in the family environment, exclusion from activities that other children participate in, inadequate nutrition, inadequate medical care and poor housing (Barnett, 2008). Low socioeconomic status can also result in fewer opportunities to learn about healthy lifestyles, and children of low socioeconomic status families are at greater risk of being influenced by family and friends towards unhealthy behaviours such as smoking and heavy alcohol use (AIHW, 2010). The AIHW (2011c) suggests that close family relationships, particularly closeness to at least one parent, appears to protect children from the worst effects of economic disadvantage. In contrast, economic disadvantage together with low family support, or strained or abusive relationships, can lead children to lower their aspirations, exclude themselves from activities, or engage in antisocial behaviour (Heady, Warren, & Harding, 2006).

Studies in the 2012 Lancet series (Viner et al., 2012a) suggested that positive outcomes in children and adolescents from positive family functioning occur irrespective of ethnic origin, family income or family structure. Adolescents are less likely to engage in a number of problematic behaviours, including illicit substance misuse, when their parents have a strong interest in them and are highly knowledgeable of their children's activities (Bonnie & O'Connell, 2004; Fletcher, Steinberg, & Williams-Wheeler, 2004). These findings have been reported in several countries including Australia (AIHW, 2011c).

Family norms and attitudes strongly affect risk factors such as tobacco and alcohol use in the adolescent years (Bonnie & O'Connell, 2004; M. Q. Wang, Fitzhugh, Westerfield, & Eddy, 1995). Children whose parents smoke (Bauman, Carver, & Gleiter, 2001; Kestilä et al., 2006), drink alcohol (Bonnie & O'Connell, 2004; J. E. Donovan, 2004) or are involved in illicit substance use (Spooner & Hetherington, 2005) are more likely to engage in these behaviours. Parental behaviour has a strong modifying effect on children's eating behaviour and therefore, on patterns of childhood obesity (Benton, 2004). A Cross-sectional study by Cleland et al. (2005) asserted that parental exercise might influence their children's participation in extracurricular sports and their cardiorespiratory fitness levels. Overall, parenting modelling of healthy behaviours protect against many risk behaviours in adolescents (Lohaus, Vierhaus, & Ball, 2009).

From a child's perspective, one indication of the presence of quality family time in a family is whether children say they enjoy spending time with their parents (AIHW, 2012e). The 2010 Longitudinal Study of Australian Children (LSAC) study (Australian Government Department of Families, Housing, Community Services and Indigenous Affairs [DFCSIA], 2011) reported that when children aged 8 to 9 and 10 to 11 were asked if they enjoyed spending time with their parents, the majority were very positive in their responses. Information about how children 10–11 years of age perceived their relationship with their parents were as follows: 81% of children responded with "almost always/ almost true" to being asked if their parents accept them as they are, 66% to being asked if their parents understood them, 83% to whether they trusted their parents, 78% to whether they can count on their parents to help them when they have problems, 62% to whether their parents pay attention to them, 56% to whether they talk to their parents about their problems, 56% to whether their parents ask them about their problems, and 43% to whether they share their thoughts and feelings with their parents. The 2008 LSAC data (DFCSIA, 2009) indicated that children from 0 to 8 years of age spend more time with their mother than with their father, irrespective of whether it be on week days or weekends.

The Australian-based 2010 LSAC survey (DFCSIA, 2011) provided data regarding how Australian families are helping children develop positive health behaviours, especially in the areas of diet and exercise. In the 24 hours prior to the survey, 92% of children 4–5 years of age had at least one serve of fresh fruit, and 48% had at least two serves of vegetables (cooked or raw); 90% of children 6–7 years of age had at least one serve of fresh fruit, and 50% had at least two serves of vegetables (cooked or raw); and 87% of children 8–9 years of age had at least one serve of fresh fruit, and 47% had at least two serves of vegetables (cooked or raw). Sixty-one per cent of parents with children 10–11 years of age were not concerned about their children eating too much or eating unhealthy foods. Forty-six per cent of parents with children 10–11 years of age were not concerned about the child spending too much time in front of the TV, computers or doing other sedentary things; 36% were a little concerned, and 18% were concerned. Data from the 2010 LSAC survey indicated that 40% of parents with children 2–3 years of age, 32% of parents with children 6–7 years of age, and 23% of parents with children 10–11 years of age indicated that they played outdoor games or had exercised with their children on three to five days in the preceding week.

The dynamics within a child's family is an important consideration in investigating health outcomes in adolescents. Hence, this construct forms an important element of the analyses performed in the studies in this thesis.

Adverse Childhood Experiences

Adverse childhood experiences (ACEs) (Felitti et al., 1998) refer to chronic, stressful or traumatic experiences that a child may encounter in early life over an extended period. These experiences include psychological, physical or sexual abuse; violence; parental substance abuse; parental separation/divorce; parental incarceration; or death of a parent, close relative or friend. The empirical evidence from both longitudinal and cross-sectional studies suggest that these stressful or traumatic experiences may influence health behaviours and health outcomes in adolescence and into adulthood (Balistreri & Alvira-Hammond, 2016; Dube et al., 2006; Flaherty et al., 2013; Gonçalves et al., 2016). Children who are raised in unstable or unsafe environments, or who have been abused or neglected emotionally or physically, often have poorer social, behavioural and health outcomes (Chartier, Walker, & Naimark, 2007). Psychological distress may result from negative family functioning such as family discord;

poor communication; poor parental disciplinary style; discontinuity of care; neglect; abuse (AIHW, 2009); and poor parental control and supervision (Spooner & Hetherington, 2005). Some studies have found that these elements are significant risk factors for children's poor health (Sourander et al., 2006; Vostanis et al., 2006).

Children that are exposed to family dissolution or re-partnering of parents can experience difficulties as a consequence of changes in parenting styles and disruption to family cohesion. Children from non-intact families, particularly one-parent families, may also experience adverse developmental outcomes such as an increased likelihood of engaging in antisocial behaviour and substance misuse in adulthood (De Vaus, 2004; Deleire & Kalil, 2002). Protecting children from risks associated with changes in family structures involve positive parent-child relationships, positive parenting and supervision, parental care, and cohesiveness (AIHW, 2011c).

In Australia, most of the early years of a child's life are spent at home in family environments that include couple families with dependent children (AIHW, 2012c). According to the ABS (2011a), of all families in 2009–10 with resident children aged 0–17, 81% were coupled families (up from 78% in 2003), and 19% were from single-parent families (down from 22% in 2003). The majority of one-parent families with resident children aged 0–17 years of age were single mother families (85%) compared to single father families (15%). Between 1990 and 2010, the proportion of divorces involving children decreased from 56% to 49% (ABS, 2012c) and 47% in 2016 (ABS, 2016). Just under half of all divorces occur between couples with children under the age of 18 (Hayes, Qu, Weston, & Baxter, 2011). In 2010, 21% of all children aged 0–17 years of age did not live with one of their natural parents because of divorce or separation. This rate has remained stable since 1997. For 81% of these children, the parent living elsewhere was their father (ABS, 2012c). The most common arrangement for children in separated families in all age groups entailed spending most nights (66 to 99% of nights) with their mother.

Data on child maltreatment (sexual abuse, physical abuse, emotional abuse and neglect) in Australia is limited. In 2003, child sexual abuse was the only form of maltreatment measured as a risk factor in the Australian Burden of Disease 2003 study (Begg, Vos, Barker, Stanley, & Lopez, 2008). The main sources of evidence for child maltreatment are from statutory child protection reports, child abuse studies and police statistics of criminal offences relating to child physical and sexual assault (Lamont, 2011). There are limitations in data from these sources, namely the unknown of how many incidences where child abuse is not reported. Lamont (2011) indicates that from the evidence available, that with the exception of child sexual abuse, children are most likely to be abused by parents and/or caregivers (ABS, 2005; Sedlak et al., 2010). A 20 year longitudinal study on child sexual abuse data (Mathews, Bromfield, Walsh, Cheng, & Norman, 2017) revealed that reporting of child sexual abuse for children aged 0 to 16 years of age increased 2.6 times from 1993 to 2012 for boys and 1.5 times for girls. A marked increase in reporting for both genders was observed from 2007 to 2012. Although these results may not be indicative of actual incidents of child sexual abuse or population increases, the study highlights heightened individual, institutional and societal awareness and responsiveness towards children in reporting abuse (Mathews & Collin-Vézina, 2016). A systematic review (Moore et al., 2015) on available data suggested that 24% of self-harm, 21% of anxiety disorders and 16% of depressive disorders in males, and 33% of self-harm, 31% of anxiety disorders and 23% of depressive disorders in females was attributable to some form of child maltreatment. The study demonstrated the importance of including all forms of maltreatment as risk factors in measuring burden of disease.

Religious Affiliation

The influence of religion on health, whether positive or negative, is now generally accepted among social and health scientists (Levin, 2015; Viner et al., 2012b). Reviews indicate that the association between religion and health remains when controlling for demographic variables (Ellison & Levin, 1998), and is analogous to other well-established predictors of health such as physical activity, diet, smoking and alcohol consumption (Cotton, McGrady, & Rosenthal, 2010; Cotton, Zebracki, Rosenthal, Tsevat, & Drotar, 2006; Rew & Wong, 2006). Religious affiliation has been shown to have positive effects on adolescent diet (Wallace & Forman, 1998), physical activity (Wallace & Forman, 1998), alcohol consumption (Beyers, Toumbourou, Catalano, Arthur & Hawkins, 2004), tobacco usage (Sinha, Cnaan & Gelles, 2007a), illicit drug usage (Cotton, Zebracki, Rosenthal, Tsevat, & Drotar, 2006), and overall health status (Zullig, Ward & Horn, 2006). However, religious affiliation has also been shown to be both positively and negatively associated with adolescent obesity (Dewes, Scragg & Elley, 2013), and with poor mental health, including depression (Cotton et al., 2006).

Of special interest to this study project is the faith-based Seventh-day Adventist (Adventist) population. The Adventist population belong to a Christian religion with approximately 21 million members worldwide (Seventh-day Adventist Church, 2017). From its inception in 1863, the Adventist religion has emphasised the role lifestyle plays in promoting health and wellbeing (Fraser, 2003). The Adventist religion advocates a holistic lifestyle including a vegetarian diet, regular exercise, the avoidance of caffeine, refined foods, tobacco, alcohol and illicit substances, the promotion of rest, spiritual meditation, positive relationships, an emphasis on family values and finding purpose through positively serving communities (Ministerial Association of Seventh-Day Adventists, 1988).

Globally, Adventists have been the subject of extensive health research that has demonstrated Adventists tend to experience relatively better health than the general population, characterised by significantly lower rates of many chronic diseases, lower overall rates of premature mortality, and better mental health (Beezhold, Johnston, & Daigle, 2010; Ellison & Levin, 1998; Grant et al., 2008; Willett, 1999).

The first major study of the Adventist population was a prospective study of over 22,000 Californian Adventist that commenced in 1958. The study, known as the Adventist Mortality Study ('Adventist Mortality Study', n.d.), was conducted around the same time as the American Cancer Society study of non-Adventists, which allowed comparisons to be made between causes of death of the two study cohorts. The results showed that the Adventist lifestyle provided some protection from cancer and other fatal diseases ('Adventist Mortality Study', n.d.). A weakness of the Adventist Mortality Study was that it did not measure non-fatal factors for various diseases, however, the study did raise interesting questions, namely: What was it about the Adventist lifestyle that enabled Adventists to live longer? Would lifestyle differences among Adventists produce different risks for contracting disease?

The second major study ('The Adventist Health Study-1', n.d.) of the Adventist population occurred from 1974 to 1988 and was called the Adventist Health Study-1. This study was designed to determine what aspects of the Adventist lifestyle conferred protection against disease. Initially the study focused on cancer, but in 1981 a cardiovascular component was included. The initial census questionnaires were sent to every Adventist household in California (63,530). In addition, a lifestyle questionnaire was re-administered at 6-year follow-up and then yearly thereafter. Numerous studies ('Adventist Health Study-1 Publication Database', n.d.) evolved from this substantive dataset examining the relationship between diet, substance abuse, exercise and air pollution on chronic disease progression and mortality. The study found that on average Adventist men lived 7.3 years and Adventist women lived 4.4 years longer than non-Adventist Californians ('Adventist Health Study-1 Publication Database', n.d.) and those individuals who were more compliant with Adventist lifestyle health behaviours experiencing better health outcomes.

In 2002, the Adventist Health Study-2 commenced ('About Adventist Health Study-2', n.d.) and is ongoing. With 96,000 participants from the US and Canada, this study is one of the largest and most comprehensive studies of diet and cancer in the world. The study seeks to understand what foods enhance quality of life, whether soy products prevent breast and prostate cancer, and what foods prevent cancer, diabetes, heart disease and Alzheimer's and arthritis. The study also sought to understand whether heredity was more important than lifestyle. Numerous publications ('Adventist Health Study-2 Publication Database', n.d.) have arisen from the Adventist Health Study-2 and have clearly demonstrated the positive influence of healthy diet on various health outcomes.

In 2006, a sub study of the Adventist Health Study-2 commenced, involving 11,000 Adventist Americans. The study sought to understand what aspects of religion, life stressors and other health behaviours are associated with health outcomes. The study, known as the Adventist Religion and Health Study ('Adventist Religion and Health Study: 2006-Present', n.d.), found that those who experience an abusive home as a child were less likely to be religious. The study also found that religious individuals experienced more positive emotions, lower blood inflammatory markers and better physical health.

Although the above studies provide a significant contribution to the awareness of the relationship between lifestyle and health, their focus was on the adult populations. Studies that focused on Adventist adolescent populations, referred to as the Valuegenesis studies, commenced in the United States in 1989 with 13,000 adolescents (Valuengensis-1 (Gillespie, 2004a), with a follow-up study (Valuegensis-2) in 2000 involving 18,000 adolescents (Gillespie, 2004b). These studies were cross-sectional in design. The primary purpose of these studies was to describe the faith and values of Adventist adolescents.

The Valuegensis studies were also conducted in Australia and New Zealand in 1997 and 2012 (Gane, 2012), expanding on the previous Valuegensis work. The 1997 study, involving 1811 adolescents, focused on faith development, loyalty to the Adventist religion, response to Adventist lifestyle proscriptions, and the prevalence of alcohol consumption, illicit substance use and other health risk behaviours. The study found that 53% of respondents agreed that religious faith was most important or very important in their lives. The study also found a steady drop in loyalty to the Adventist religion from 13 years to 18 years of age. Notably, 67% of Adventist adolescents aged 17 had never consumed alcohol, albeit marijuana use and binge drinking was evident. Thirty-seven per cent of year 11 and 12 students had been involved in at least one "at risk" behaviour in the previous 12 months, and up to 18% were depressed most or all of the time. The study also considered parenting styles and their relationship with selected health behaviours and found associations between positive parenting and positive lifestyle outcomes. The study concluded that the Adventist lifestyle was effective in protecting adolescents from the negative influence of the wider culture.

The 2012 Valuegenesis study surveyed 3263 adolescents attending Adventist schools and churches across Australia and New Zealand and extended the themes explored in the 1997 study, namely: how home, church and Adventist schooling contributed to faith development and commitment to the Adventist lifestyle. Like the 1997 study, the 2012 Valuegensis study found a steady drop in loyalty to the Adventist church from 13 years to 18 years of age. There was a decrease in adolescents who had never consumed alcohol from 67% in 1997 to 59% in 2012 and marijuana use and binge drinking and was reported. Forty-three per cent of year 11 and 12 students had been involved in at least one “at risk” behaviour (up from 37% in 1997) in the previous 12 months. The study concluded that the Adventist lifestyle was effective in protecting adolescents from the negative influence of the wider culture, however, the study mostly reported descriptive statistics and did not involve in-depth analyses.

The present study project extends the work of the Valuegenesis studies with the aim to understand the complex network of factors that predict health behaviours and health outcomes in Adventist adolescents in Australia.

Addressing the Complexities of Adolescent Health

The increasing research interest in adolescent health, undertaken globally in recent decades, is encouraging and has informed a better understanding of the unique challenges faced by this cohort. In 2004, the WHO Health for the World’s Adolescents report (WHO 2014c) triumphantly claimed that “adolescent health has come of age”, however, there are many gaps in the literature and in understanding how to best care for health during this important and pivotal period of life.

What is apparent is that the optimal way forward in understanding adolescent health is one that adopts an incipient view that adolescent health is multi-dimensional and complex, perhaps more complex than any other age group, and that it encompasses a broad network of determinants of health previously not considered. To date, little research has considered multiple determinants concomitantly when assessing factors associated with the health behaviours and health outcomes of adolescents. By not adopting this approach, studies potentially yield partial or confounded information on the determinants of the health (Mantzavinis et al., 2005; McLeod et al., 2012; Patel, Flisher, Hetrick, & McGorry, 2007). Hence there is a need to use sophisticated analysis methods, undergirded by theoretical relevance and prior empirical evidence, to investigate the influence of multiple determinants, ranging from proximal to distal, on the health behaviours and health outcomes of adolescents (Mantzavinis et al., 2005). The aim of this study project is to address this need.

Chapter 3: Methods

Background

In 2012 the Seventh-day Adventist (Adventist) Church in Australia commissioned a survey to be administered in Adventist schools (n = 21) across Australia to examine the health and wellbeing of students. Members of the research team associated with the present study had input into the development of the questionnaire, which built on previous work that had been undertaken in 2001. While the information collected represented a rich source of data for mining, no further work had been undertaken. In 2014 the candidate commenced a thesis to investigate the data collected from the 2012 survey. The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No: 2011:21). Participation in the study was voluntary and anonymous. Written informed consent was collected from parents or guardians and students.

Study Design

This study project employed a cross-sectional study design.

Sample

At the time of the survey, 4674 students attended Adventist private secondary schools in Australia. Responses to the survey were received from 1734 students (37%). Classes from years 7 to 12 were represented in the survey with students ranging from 12 to 18 years of age (mean = 14.5 ± 1.6). A summary of the participant cohort is shown in Table 1. Approximately 41% of adolescents in Australia attended private secondary schools at the time of the survey (ABS, 2017).

Table 1. *Descriptive Details of the Participants*

Variables	N	%
Ages		
12yrs	189	10.9%
13yrs	339	19.6%
14yrs	353	20.4%
15yrs	341	19.7%
16yrs	285	16.4%
17yrs	188	10.8%
18yrs	38	2.2%
Gender		
Males	919	54%
Females	787	46%
State		
New South Wales	665	38.4%
Victoria	489	28.2%
Queensland	498	28.7%
Western Australia	57	3.3%
South Australia/Tasmania/Australian Capital Territory	24	1.4%
Faith		
Adventist	788	57%
Other Christian	435	32%
No Religion	157	11%

Survey Instrument

The survey captured information about the participants' current health outcomes (self-rated health status, mental health status, vitality, and body mass index [BMI]), health behaviours (diet, physical activity, sleep quantity, sedentary behaviour, alcohol consumption, and use of tobacco and illicit substances), attitudes, intentions, subjective norms, perceived social rejection, sense of meaning and purpose, academic school performance, religious affiliation, childhood experiences such as childhood family dynamics (CFD) and adverse childhood experiences (ACEs), and selected personal demographics. Pilot testing was done on a class of year 10 students prior to the administration of the survey to explore the validity and reliability of the respective survey items. Details of these measures are provided below.

Self-Rated Health Status

Self-rated health status was assessed with a single item involving a five-point Likert scale ranging from "Excellent," "Very Good," "Good," "Fair" and "Poor." Self-rated heath (SRH) is an appropriate measure used in adolescent populations (Boardman, 2006; Breidablik, Meland, & Lydersen, 2008, 2009a; Idler & Benyamini, 1997; Jerdén, Burell, Stenlund, Weinehall, & Bergström, 2011; Meireles, Xavier, Proietti, et al., 2015; Vingilis, Wade, & Seeley, 2002; Wade, Pevalin, & Vinglis, 2000; Zhang, Zhao, Feng, & Hu, 2016) to measure general health status. A review by Idler and Benyamini (1997) proposed that an individual's health status cannot be assessed without the SRH measure as it captures an "irreplaceable dimension of health status" (p.34) that spans past, present and future physical, behavioural, emotional, cognitive (Sehulster, 1994) and social (Breidablik et al., 2008) dimensions of health. There is widespread agreement in the literature (Boardman, 2006; Breidablik, Meland, & Lydersen, 2009b; Cavallo et al., 2015; Mantzavinis et al., 2005) that SRH is a complex parameter affected by numerous determinants. Specifically SHR is influenced by BMI (Vingilis et al., 2002); mental health measures such as emotional wellbeing, acceptance (Breidablik et al., 2008) and self-esteem (Wade et al., 2000); health behaviours (Breidablik et al., 2008) including diet (Meireles, Xavier, Proietti, et al., 2015), physical activity (Breidablik et al., 2008), substance abuse (Wade et al., 2000) and sleep (Zhang et al., 2016); demographics such as age and gender (Jerdén et al., 2011); social and school factors including family dynamics, child-parent relationships, school achievement (Wade et al., 2000), other school experiences (Jerdén et al., 2011) and socio-economic status (Meireles, Xavier, Proietti, et al., 2015); and religion (Zullig et al., 2006). Many of these factors have complex interrelationships (Mantzavinis et al., 2005) that directly or indirectly affect self-perception of health status (Boardman, 2006).

Body Mass Index

Height and weight were self-reported and used to calculate BMI using the standard equation: BMI = weight in kg/(height in m)^2. BMI was further trichotomised according to the conventional classifications of “underweight” (BMI < 18.5kg/m^2), “normal weight” (BMI from 18.5–4.99 kg/m^2) and “overweight” (BMI ≥ 25kg/m^2). However, as the cohort was an adolescent population, BMI cut-off points were calculated according to the World Health Organization standardised BMI index (BMI-z) for classifying adolescents’ weight status (de Onis, Onyango, Van den Broeck, Chumlea, & Martorell, 2004).

Mental Health and Vitality

Mental health and vitality were measured using the validated and reliable (Brazier et al., 1992) five-item mental health and four-item vitality subscales from the SF-36 (‘RAND Health, 36-Item short form survey’, n.d.). These subscales measure general mental health status and assess the individual’s energy and fatigue. The five items that make up the mental health subscale are “How much of the time during the last four weeks”: 1. “Have you been a very nervous person?” 2. “Have you felt so down in the dumps that nothing could cheer you up?” 3. “Have you felt calm and peaceful?” 4. Have you felt down?” 5. “Have you been a happy person?” The four items that make up the vitality subscale are “How much of the time during the last four weeks”: 1. “Do you feel full of life?” 2. “Did you have a lot of energy?” 3. “Did you feel worn out?” 4. “Did you feel tired?”. Each item in the mental health and vitality subscales has six response options ranging from “All of the time” to “Not at all.” Standardised scores for these subscales were calculated creating a 0 to 100 scale according to the standard procedure for calculating the mental health and vitality scores (Ware, Kosinski,

& Dewey, 2000). Higher scores indicated better mental health and vitality. Internal reliability of the mental health and vitality subscales have been reported at $\alpha = .78$ to .87 and $\alpha = .72$ to .87 respectively in studies across eleven countries (Gandek et al., 1998). The literature indicates that the MHI-5 is a good predictor of mental health disorders including depression, generalized anxiety and affective disorders generally (Berwick et al., 1991; Strand, 2003). While exact cut-off scores for predicting mental disorders have not been determined, studies have suggested that a score below 52 (Holmes, 1998) to 56 (Shaw, Treglia, Motheral, & Coons, 2000) is indicative of major depression. With respect to vitality and fatigue, scores less than 45 on the vitality subscale have been established as representing clinically significant fatigue (Donovan, Jacobsen, Small, Munster, & Andrykowski, 2008).

Sleep Quantity

Sleep quantity was assessed by an item that asked: "How many hours do you usually sleep per night?" with eight response options ranging from "3 hours or less" to "10 hours or more".

Physical Activity

Physical activity was measured separately using two items. The first item asked if the respondent had a regular exercise program ('Adventist Health Study-2', n.d.), and the second asked: "How many times per week do you usually do any vigorous or moderate physical activity for at least 30 minutes?" with seven response options ranging from "none" to "6 or more times" (Giffin, Jorm, Taylor, & Thomas, 2004).

Diet

Fruit and vegetable intake was assessed using food frequency questions adapted from items previously used in adolescent studies (Kolodziejczyk, Merchant, & Norman, 2012). Fruit consumption was measured by an item that asked: "How many serves of fruit do you usually eat each day? (A serve = 1 medium piece or 2 small pieces of fruit or 1 cup of diced pieces)".

Response options ranged from “I do not eat fruit” to “6 serves or more”. Vegetable consumption was measured by an item that asked: “How many serves of vegetables and salad vegetables (exclude potatoes) do you usually eat each day? (A serve = 1/2 cup of cooked vegetables or 1 cup of salad vegetables)”. Response options ranged from “I do not eat vegetables” to “6 servers or more”. The fruit and vegetable items were summed to provide an overall fruit and vegetable intake score. Grain consumption was measured by an item that asked: “How many serves of breads and cereals do you usually eat each day? (A serve = 1 slice of bread, 1⁄2 a bread roll or 1⁄2 cup of ready-to-eat breakfast cereal or 1⁄2 cup of cooked breakfast cereal, pasta, rice or noodles)”. Response options ranged from “I do not eat bread and/or cereals” to “10 serves or more”. Soft drink consumption was measured by an item that asked: “How often do you consume these beverages (Cola drinks (Coca-Cola, Pepsi), Fanta, Sprite, Ginger Beer)) Response options ranged from “never or rarely” to “6 or more times per day”. Eating a meal at breakfast was measured by an item that asked: “How many days per week do you usually have something to eat for breakfast?” Response options included: “Rarely or never”, “1–2 days”, “3–4 days”, “5 or more days”. As a measure of the respondents’ overall diet, an item asked: “How would you describe your usual diet?” Response options included: 1. “Total Vegetarian (no animal products: no red meat, chicken, fish, eggs, or milk/dairy products)”; 2. “Lacto-ovo vegetarian (no red meat, chicken or fish but diet includes eggs and/or milk/dairy products)”; 3. “Pesco-vegetarian (diet includes fish but no red meat or chicken, but may include eggs and/or milk/dairy products)”; 4. Non-Vegetarian (diet includes red meat, chicken, fish)”. For this study, this item was dichotomised as a vegetarian (response 1 or 2) or non-vegetarian diet (response 3 or 4). This item was included in the study because a high proportion of Adventists adhere to a vegetarian diet (Bes-Rastrollo, Sabaté, Jaceldo-Siegl, & Fraser, 2011).

Alcohol, Tobacco and Marijuana

Alcohol consumption, tobacco and marijuana use were assessed with frequency questions ranging from "none" to "60+" for alcoholic drinks consumed and cigarettes or marijuana smoked in the last four weeks. Current alcohol consumption status was measured using an item used in studies by the Australian Government Department of Health and Ageing (White & Bariola, 2012) and another South Australian Study (Bowden, Delfabbro, Room, Miller, & Wilson, 2017a) that asked: "At the present time, do you consider yourself: 1. Non-drinker. 2. Occasional Drinker. 3. Light Drinker. 4. Party Drinker. 5. Heavy Drinker." For the purpose of this study, this item was trichotomised to Non-Drinker (response 1), Light Drinker (responses 2 and 3) and Heavy Drinker (responses 4 and 5). Differences in gender and age using this measure in the above studies are in line with other studies (AIHW, 2014; Livingston, 2014) measuring alcohol consumption with quantifiable measures.

Intention to consume alcohol was measured with a single item that asked the participants to respond to the statement "I plan to drink alcohol at my age" with a choice of five options ranging from "Strongly Disagree" to "Strongly Agree". Attitudes towards alcohol consumption where measured by asking participants to respond to the following statements: "It is ok to drink alcohol at my age", "Alcohol is harmful to my relationships" and "Alcohol is harmful to my health" with a choice of five options for each statement ranging from "Strongly Disagree" to "Strongly Agree". The attitudinal items were not combined into a scale so that the individual relationship of each item could be examined, as previously assessed elsewhere (Marcoux & Shope, 1997).

Subjective norms relating to alcohol consumption were measured using three items. The first item asked respondents: "In the past month would any of your close friends have used alcohol?" with response options "Yes, some of my friends" and "No, none of my friends".

Items two and three used to measure subjective norms asked participants to respond to the following statements: “It is ok for me to say ‘no’ to drinking if friends offer me a drink” and “It is ok for me to say ‘no’ to drinking if family members offer me a drink”. Responses for these items included five options ranging from “Strongly Disagree” to “Strongly Agree”. The subjective norm items were not combined in a scale so that the individual relationship of each normative item could be examined, as previously assessed elsewhere (Marcoux & Shope, 1997).

Sedentary Behaviour

Sedentary behaviour was assessed using frequency questions measuring hours per day for time watching television, videos and DVDs, playing computer games and surfing the Internet. These items were summed to compute a total score for sedentary behaviour.

Attitudes

Perceived social misfit status was measured with a single item that asked the participants to respond “yes/no” to the statement: “I often felt like a social misfit”. The social misfit hypothesis (Wright et al., 1986) proposes that children who deviate from the social group norm and are different in some discernible way, whether it be in relation to behaviour or appearance, are often victimised, marginalised or bullied. Meaning and purpose was measured with a single item that asked the participants to respond on a five-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree” to the statement: “My life is filled with meaning and purpose”. School academic performance was measured by asking the students how they rated themselves at school work on a five-point Likert scale ranging from “A lot below average” to “A lot above average”. Measuring school academic performance with this item has been used in previous studies and national surveys (Bowden, Delfabbro, Room, Miller, & Wilson, 2017b; Centre for Epidemiology and Research NSW Department of Health, 2008; The Cancer Council Victoria, 2006).

Religion

Religious affiliation was included in this study due to the special nature of the sample. Previous studies report associations between religion and SRH (Levin, 2015) with some reviews reporting that this association is unaffected when controlling for demographic variables (Ellison & Levin, 1998). Religious affiliation was assessed by asking the participants: "Which of the following best describes your religious belief now?" Options ranged from: 1. "Seventh-day Adventist Christian", 2. "Other Christian", 3. "Other Religion", 4. "No Formal Religion", and 5. "Don't Know".

Adverse Childhood Experiences

Adverse childhood experiences were assessed by creating an ACEs score developed by Felitti and associates (Felitti et al., 1998) and used in other investigations (Balistreri & Alvira-Hammond, 2016; Dube et al., 2006; Flaherty et al., 2013; Gonçalves et al., 2016). The ACEs score used in this study project was generated by collating responses from the following nine items: 1. "One or both of my parents were in trouble with the law," 2. "My parents were separated or divorced," 3. "One or both my parents died," 4. "One or both parents were absent from home for long periods," 5. "There were times when family violence occurred," 6. "There were times when I was physically abused," and 7. "There were times when I was sexually abused," 8. "One or both parents smoked tobacco," and 9. "One or both parents drank alcohol weekly or more often." Each of the nine items included "no/yes" response options which were given a corresponding value of zero or one. Responses from each item were summed to calculate an overall ACEs score.

Childhood Family Dynamics

Childhood family dynamics were assessed by creating a CFD score from six items, namely: 1. "As a child, my parents showed me love," 2. "As a child, my parents understood me," 3. "While I was a child my family had a lot of fun," 4. "As a child, my parents didn't trust me," 5. "As a child, my parents didn't care what I did," and 6. "As a child, I enjoyed being at home with my family." Each item included five response options ranging from "strongly disagree" through to "strongly agree." Each response was given a corresponding value from one to five and items 4 and 5 were then reverse coded so that higher scores represented increasingly positive outcomes. Responses from each item were summed to calculate the overall CFD score.

Data Entry, Screening and Preparation

The returned surveys were visually checked and pre-edited prior to electronic scanning into computer data files. Significant work was undertaken to format the data in an appropriate state ready for statistical analysis. The data was appropriately formatted in Microsoft Excel then imported into SPSS (version 24; IBM, Armonk, NY). Preparation of the data in SPSS included adding labels and values, and appropriately coding each variable. Variables were then categorised as nominal or scale measures. Data cleaning involved assessment for missing data, unengaged responses and outliers.

Where appropriate, variables were recoded in SPSS to conform to positive outcome convention. Scores used in the analysis were created by transforming variables in SPSS using the "compute variable" function according to the standard procedures for calculating each validated score. Where deemed appropriate, dichotomised or trichotomised variables were created by recoding variables into new variables for analysis. Recoded variables were crossed checked by computing descriptive statistics and frequencies.

Data Analysis

The data were analysed using SPSS (version 24; IBM, Armonk, NY) and AMOS (Version 24; Amos Development Corporation, Crawfordville, FL, USA). Data analysis included descriptive analysis, normality and reliability testing, bivariate and multivariate analysis, Exploratory Factor Analysis (EFA) and Structural Equation Modelling (SEM) along with multi-group SEM analysis.

Descriptive statistics are presented using number, mean ± standard deviations, percentages, minimum and maximum. Initial exploratory analysis of the variables in the dataset involved correlational studies. Pearson product-moment correlation coefficient was used to describe the relationships between continuous variables and Spearman rank-order correlation coefficient was used to describe the relationships between ordinal variables. Statistical significance was measured at $p > .05$. The following guidelines were adopted to assess strength of association between variables (r value): .00 to .30 (.00 to −.30), negligible correlation; .30 to .50 (−.30 to −.50), low correlation; .50 to .70 (−.50 to −.70), moderate correlation; .70 to .90 (−.70 to −.90), high correlation; .90 to 1.00 (−.90 to −1.00), very high correlation (Hinkle, Wiersma, & Jurs, 2002).

Several of the studies compiled in this thesis employed bivariate analysis to compare differences between two groups of continuous data. Independent-Sample t Tests were employed for bivariate analysis. In order to assess practical, biological or clinical significance, effect size analysis was performed by calculating the Cohen's d statistic (Cohen, 1988). The Cohen's d statistic was interpreted as follows: .20 to .49, small to moderate effect; .50 to .79, moderate to strong effect; and .80 or greater, large effect (Cohen, 1988).

Examination of differences between two or more groups of continuous-level data was conducted using the One-Way ANOVA tests. Prior to performing the One-Way ANOVA, the data were tested for homogeneity of variances to test for population variances in each group. In the case that the assumption of homogeneity of variances was violated, the Brown-Forsyth (Brown & Forsythe, 1974) and Welch (Welch, 1951) test were used. Significance was measured at the standard alpha level of $p < .05$. For groups that were statistically significantly different, effect size was calculated as partial eta squared (Cohen, 1973) with the following levels being adopted: .01, small effect size; .06, medium effect size; and .14, large effect size (Cohen, 1988). For significant models, post hoc analysis was carried out to determine statistically significant differences between the groups. For analyses where the assumption of homogeneity of variances had been met, the Tukey post hoc test was used (Ruxton & Beauchamp, 2008). For analyses where the homogeneity of variances had been violated, the Games Howell post hoc test was used (Ruxton & Beauchamp, 2008).

For categorical variables, Pearson's Chi-square tests were used to assess differences between groups. Main effects are reported as F-values and p-values. For significant models, post hoc comparisons were carried out to produce adjusted residuals (z-scores) from which p values were calculated for each cell (MacDonald & Gardner, 2000). To adjust for inflation of Type I error due to multiple comparisons, a Bonferroni correction was applied (MacDonald & Gardner, 2000).

A major focus of the study project was the exploration of the effect of a number of variables on certain outcome variables. Linear Regression Modelling was one method employed as this type of analysis is used to predict the value of an outcome variable based on the value of several predictor or independent variables. The regression modelling employed was the linear backward stepwise method, involving the gradual deletion of poor performers on the basis of whether the partial F-value was less than a critical value (Coakes, 2013). Model analysis involved reporting the R Square statistic which indicates how much of the total variance of the outcome could be explained by the independent variables in the model. Model fit signifies how well the regression equation fits the data (i.e. predicts the outcome variable) and was assessed by the p value at the standard alpha level of $p < .05$. Standardised coefficients (β) were reported as the estimates in the regression analysis which referred to how many standard deviations an outcome variable changed per standard deviation in the predictor variable.

Exploratory work in generating and testing scales was conducted using exploratory factor analysis (EFA) in SPSS. The principal components method was used for extraction and the Direct oblimin method was used for rotation during EFA. The reliability scales generated for analysis in the various publications were tested using Cronbach's alpha (α) and were reported with descriptive statistics.

Three of the aims of this thesis were to investigate a complex network of factors that concomitantly predict health outcomes and health behaviours in the cohort under investigation. In order to explore these complex networks, SEM analysis was employed using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA). Structural Equation Modelling is a statistical technique that allows for the examination of a series of multiple and interrelated dependence relationships on multiple levels between predictor and outcomes variables simultaneously (Ho, 2013). A further advantage of SEM is that it accounts for measurement error in the variables thus improving statistical estimation. This results in structural paths between variables that are relatively free of the unreliabilities of their measurement indicators. Most importantly, SEM is theory-driven demanding justification for the specification of the dependence relationships (Ho, 2013).

Prior to SEM analysis, variables with missing data of 8% or under used in structural equation modelling with AMOS (Version 24; Amos Development Corporation, Crawfordville, FL, USA) were treated by replacing missing values using the series means method in SPSS. This was required as SEM analysis in AMOS requires that datasets for analysis have no missing data. There is no established cut-off for the acceptable percentage of missing data in the literature (Dong & Peng, 2013). Shafer (1999) asserted that missing data of 5% is inconsequential, however Bennett (2001) maintained that statistical analysis is not likely to be biased if up to 10% of data are missing.

In this study project, SEM analysis consisted of two analyses: the estimation of model fit of the data (i.e. how well the data predicted the outcome variable) and the analysis of the structural models. Firstly, hypothesised models based on theoretical considerations and prior empirical research were submitted for analysis using techniques developed by Jöreskog and Sörbom (1989). This involved utilising an iterative process of inspection of the statistical significance of the path coefficients in the model and the theoretical relevance of the constructs in the model to derive an optimal SEM that best fit the dataset and were theoretically meaningful. Overall model fit of the data was examined using multiple goodness-of-fit indices, namely: chi-square (X^2) statistic (CMIN), relative X^2 (CMIN/DF), baseline comparisons fit indices of normative fit index (NFI), relative fit index (RFI), incremental fit index (IFI), Tucker-Lewis Index (TLI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). A CMIN/DF statistic below three is considered good model fit (Kline, 2010), as are baseline comparison fit indices above 0.9 (Bentler, 1990). An RMSEA value less than .06 indicates a close fit between the data and the model (Hu & Bentler, 1999).

In the final structural models, the squared multiple correlation was calculated and converted to a percentage figure. This figure indicates by what per cent the predictor variables in the model explained the variance in the outcome variable. The squared multiple correlation is a measure of the strength of the linear relationship whereby a small squared multiple correlation indicates a weak relationship and suggests that the model is not good and a large squared multiple correlation indicates a strong model with greater predictability (Ho, 2013). Standardised path coefficients (β) were presented in the final structural models as single-headed arrows. Bootstrapping (Preacher & Hayes, 2008) was applied to verify the statistical significance of indirect effects of variables in the model at $p < .05$. Multi-group analysis was employed to test for gender and age variations among the pathways in the models. Multi-group differences were calculated using the critical ratios for differences test. This test assesses regression weight differences in the groups in each structural model (i.e. age groups or gender) (Ho, 2013). The Critical Ratios (CR) for differences test was employed in AMOS to obtain the critical ratio statistics for differences among group regression weights. Significance difference in path weight coefficients were identified at $CR < \pm 1.96$, $p < .05$.

Chapter 4: The association between self-rated health and social environments, health behaviours and health outcomes: a structural equation analysis

Chapter Overview

This chapter addresses the first objective of the thesis which was: To investigate the complex network of factors that predict the self-rated health of adolescents attending Adventist schools in Australia. The chapter is presented as a manuscript titled "The association between self-rated health and social environments, health behaviours and health outcomes: a structural equation analysis", which was published in *BMC Public Health*. The objective of this study was to investigate the complex network of factors, including personal demographics, environmental factors, health behaviours and health outcomes that concomitantly predict self-rated health in adolescents attending Adventist schools in Australia. The study contributes to the body of knowledge relating to adolescent health by simultaneously investigating numerous determinants of adolescent health and the relationships that exist between them. The model developed in this publication formed the platform for subsequent publications collated in this thesis. The findings and implications of the study are further discussed in Chapter 9.

Co-Author Statement

I attest that Research Higher Degree candidate Bevan Craig contributed to the paper/publication entitled:

The association between self-rated health and social environments, health behaviours and health outcomes: a structural equation analysis

By:

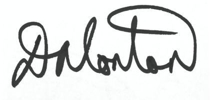
- Contributing to the conception and design of the study
- Cleaning the data
- Development of measures to be used
- Leading the data analysis (Including use of AMOS SEM Software)
- Contributing to interpretation of the data
- Leading the writing of the manuscript
- Submitted the manuscript for review
- Addressed reviewers' comments

Signature of Candidate:

Name of Candidate: Bevan Craig

Date: 5 March 2019

Signature Principal Supervisor:



Name of Principal Supervisor: Dr Darren Morton

Date: 5 March 2019

Abstract

Background

The factors shaping the health of the current generation of adolescents are multi-dimensional and complex. The purpose of this study was to explore the determinants of self-rated health (SRH) of adolescents attending a faith-based school system in Australia.

Methods

A total of 788 students attending 21 Seventh-day Adventist schools in Australia responded to a health and lifestyle survey that assessed SRH as well as potential determinants of SRH including the health outcomes mental health, vitality, body mass index (BMI), select health behaviours, social factors and personal demographics. Structural equation modelling was used to analyse the data and examine the direct and indirect effects of these factors on SRH.

Results

The structural model developed was a good fit with the data. The health outcome mental health had the strongest association with SRH ($\beta = 0.17$) Several upstream variables were also associated with higher SRH ratings. The health behaviour sleep hours had the strongest association with SRH ($\beta_{total} = 0.178$) followed by fruit/vegetable consumption ($\beta_{total} = 0.144$), physical activity ($\beta_{total} = 0.135$) and a vegetarian diet ($\beta_{total} = 0.103$). Of the demographic and social variables measured, adverse childhood experiences (ACEs) had the strongest association with SRH ($\beta_{total} = -0.125$), negatively influencing SRH and gender also associated with an increase in SRH ($\beta_{total} = 0.092$), with the influence of these factors being mediated through other variables in the model.

Conclusions

This study presents a conceptual model that illustrates the complex network of factors concomitantly associated with SRH in adolescents. The outcomes of the study provide

insights into the determinants of adolescent SRH which may inform priority areas for improving this construct.

Background

The factors shaping the health of the current and largest generation of adolescents in human history are multi-dimensional, complex and unparalleled (Patton et al., 2016; Sawyer et al., 2012). Until recently, adolescent health has been overlooked and misunderstood, which is one reason why adolescents historically have had fewer health gains than any other age group (Patton et al., 2016), and hence are now central to a number of major current global health challenges (Sawyer et al., 2012). However, addressing adolescent health potentially provides a triple dividend with benefits now, later in adult life and for the next generation of children (Patton et al., 2016). Further, the period of adolescence may also provide a second chance to reduce or reverse early-life disadvantage (WHO, 2014c).

In recent decades, theorists have argued that understanding the factors driving the growing adolescent health concerns requires a broad focus (Viner et al., 2012a). Clearly, risk and protective factors of adolescent health include levels of physical activity, substance use, alcohol consumption, tobacco usage (Patton et al., 2012), diet (Patton et al., 2016), adolescent abnormal weight (underweight, over weight) and mental health (Patton et al., 2012). However, it has been asserted that as well as focusing on an individual's health risk and protective factors, the upstream social patterns and structures in which adolescents exist needs to be considered (Viner et al., 2012a). Ecological theorists (Bronfenbrenner, 2005) argue that an individual's social environment, both present and past, influence their health behaviours and health outcomes, mediated by other factors including their demographics and physical and psychological makeup.

Social environments are multifaceted and include peer, school, community, societal, cultural, new media influences and family dynamics (Viner et al., 2012a). Adverse childhood experiences (ACEs) such as psychological, physical or sexual abuse, violence, parental substance abuse, parental separation/divorce, parental incarceration or death of a parent, close relative or friend may also influence health behaviours and health outcomes in adolescents (Balistreri & Alvira-Hammond, 2016; Dube et al., 2006; Flaherty et al., 2013; Gonçalves et al., 2016). Conceptual frameworks have been developed to represent the complex web of causal "pathways" through which social factors interact with an individual's health risk and protective factors throughout the life course (Figure 4) (AIHW, 2012f). However, these models have not been tested among adolescent populations.

Self-rated heath is a legitimate and stable construct used in adolescent populations (Boardman, 2006; Breidablik et al., 2008, 2009a; Idler & Benyamini, 1997; Jerdén et al., 2011; Meireles, Xavier, Proietti, et al., 2015; Vingilis et al., 2002; Wade et al., 2000; Zhang et al., 2016). Reviews by Idler and Benyamini (1997) proposed that an individual's health status cannot be assessed without the SRH measure as it captures an "irreplaceable dimension of health status," spanning past, present and future physical, behavioural, emotional, cognitive (Sehulster, 1994) and social (Breidablik et al., 2008) dimensions of health.

Widespread agreement in the literature (Boardman, 2006; Breidablik et al., 2009b; Cavallo et al., 2015; Mantzavinis et al., 2005) recognizes that SRH is a complex parameter affected by multifarious determinants. Specifically SHR is influenced by higher body mass index (Vingilis et al., 2002), mental health (emotional wellbeing, acceptance (Breidablik et al., 2008), self-esteem (Wade et al., 2000)) select health behaviours (Breidablik et al., 2008) (diet (Meireles, Xavier, Proietti, et al., 2015), physical activity (Breidablik et al., 2008) substance abuse (Wade et al., 2000), lack of sleep (Zhang et al., 2016)), demographics (age, gender (Jerdén et al., 2011)) and social factors (family dynamics, child-parent relationships, school achievement (Wade et al., 2000) positive school experiences (Jerdén et al., 2011) socio-economic status (Meireles, Xavier, Proietti, et al., 2015), religion (Zullig et al., 2006). Many of these factors have complex interrelationships (Mantzavinis et al., 2005), directly or indirectly affecting self-perception of health status (Boardman, 2006).

While an increasing number of studies have been reported on SRH among adolescents (Jerdén et al., 2011), most research in this field (Boardman, 2006; Breidablik et al., 2009b; Cavallo et al., 2015; Jerdén et al., 2011; Meireles, Xavier, Proietti, et al., 2015; Vingilis et al., 2002; Wade et al., 2000; Zhang et al., 2016; Zullig et al., 2006) address only select factors affecting health status, and thus yield only partial or confounded information on the determinants of adolescent health (Mantzavinis et al., 2005). Investigations need to assess concomitantly the factors associated with this multi-faceted health measure (Mantzavinis et al., 2005).

Utilizing structural equation modelling and SRH as a measure of health status, this study aimed to explore concomitantly the complex relationships between SRH and social environments, health behaviours and health outcomes among adolescents attending a faith-based school system in Australia.

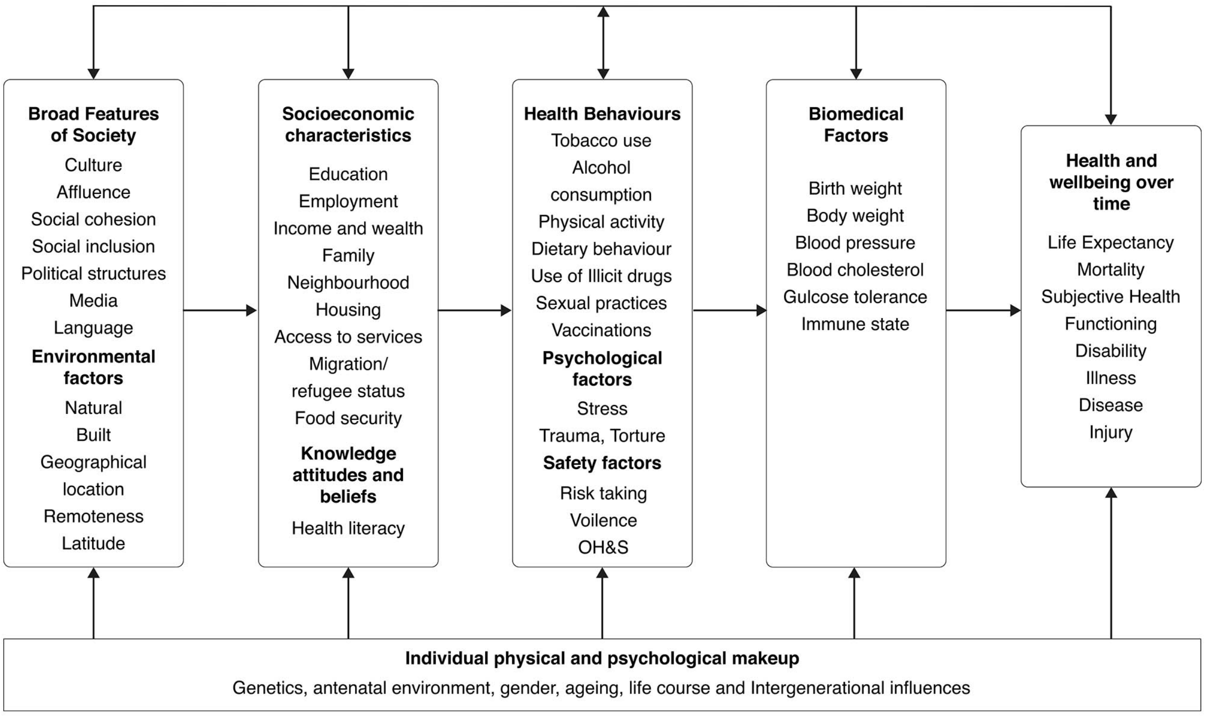


Figure 4. Conceptual framework for determinants of health

Methods

Study Design and Participants

In 2012, 1734 students aged 12 to 18 years of age responded to a health and lifestyle survey that was administered in 21 Seventh-day Adventist (Adventist) private secondary schools in Australia. The database created by this survey has been used in previous studies (Craig et al., 2017; Craig, Morton, Kent, et al., 2018). Seven hundred and eighty-eight students from this database met the inclusion criteria for this study which included useable data for the following domains: SRH, BMI, Mental Health, and Vitality. Notably, BMI data were not collected on over 900 students in the database, hence these cases did not meet the inclusion criteria.

The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No: 2011:21), and participation in the study was voluntary and anonymous.

A hypothesized model informed by ecological theory and the conceptual framework for determinants of health (AIHW, 2012f) is presented in Figure 5. The dependent variable was the measure SRH. In order to concomitantly explore factors associated with SRH yet retain a parsimonious model, we delimited our study by restricting our explanatory variables to the following: health outcome variables (BMI, mental health, vitality); health behaviour variables (sleep hours per night, amount of moderate to vigorous physical activity, fruit and vegetable intake, vegetarian diet, marijuana abuse, alcohol consumption and tobacco use); and demographic and social variables (age, gender, ACEs, Childhood family dynamics (CFD), religious affiliation).

Survey Instrument

The survey instrument recorded the participant's SRH as well as: BMI; measures of mental health and vitality; selected health behaviours; personal demographics; and social influences.

Self-Rated Health Status

SRH status was assessed with a single item involving a five-point Likert scale ranging from "Excellent," "Very Good," "Good," "Fair" and "Poor."

Body Mass Index

Height and weight were self-reported and used to calculate BMI using the standard equation: BMI = weight in kg/(height in m)^2.

Mental Health and Vitality

Mental health and vitality were measured using the validated and reliable (Brazier et al., 1992) five-item mental health and four-item vitality subscales from the SF-36 ('RAND Health, 36-Item short form survey', n.d.). These subscales measure general mental health status and assess the individual's energy and fatigue. Each item in the mental health and vitality subscales has six response options ranging from "All of the time" to "Not at all." Standardized scores for these subscales were calculated creating a 0–100 scale according to the standard procedure for calculating the mental health and vitality scores (Ware et al., 2000). Higher scores indicated better mental health and vitality. Internal reliability of the mental health and vitality subscales have been reported at $\alpha = .78$ to .87 and $\alpha = .72$ to .87 respectively in studies across eleven countries (Gandek et al., 1998). As seen in Table 2, the reliability of vitality in this study was comparatively lower than in these reports.

Selected Health Behaviours

Sleep hygiene was assessed by an item that asked: "How many hours do you usually sleep per night?", with eight response options ranging from "3 hours or less" to "10 hours or more". Physical activity was measured by an item that asked: "How many times per week do you usually do any vigorous or moderate physical activity for at least 30 minutes?", with seven response options ranging from "none" to "6 or more times" (Giffin et al., 2004). Fruit and vegetable intake was assessed using food frequency questions adapted from items previously used in adolescent studies (Kolodziejczyk et al., 2012). Fruit consumption was measured by an item that asked: "How many serves of fruit do you usually eat each day? (A serve = 1 medium piece or 2 small pieces of fruit or 1 cup of diced pieces)". Response options ranged from "I do not eat fruit" to "6 serves or more". Vegetable consumption was measured by an item that asked: "How many serves of vegetables and salad vegetables (exclude potatoes) do you usually eat each day? (A serve = 1/2 cup of cooked vegetables or 1 cup of salad vegetables)". Response options ranged from "I do not eat vegetables" to "6 servers or more". The fruit and vegetable items were summed to provide an overall fruit and vegetable intake score. As a measure of the respondents' overall diet, an item asked: "How would you describe your usual diet?" Response options included: 1. "Total Vegetarian (no animal products: no red meat, chicken, fish, eggs, or milk/dairy products)"; 2. "Lacto-ovo vegetarian (no red meat, chicken or fish but diet includes eggs and/or milk/dairy products)"; 3. "Pesco-vegetarian (diet includes fish but no red meat or chicken, but may include eggs and/or milk/dairy products)"; 4. Non-Vegetarian (diet includes red meat, chicken, fish)". For the purpose of this study, this item was dichotomized as a vegetarian (response 1 or 2) or non-vegetarian diet (response 3 or 4). This item was included in the study because a high proportion of Adventists adhere to a vegetarian diet (Bes-Rastrollo et al., 2011). Alcohol consumption, tobacco and marijuana use were assessed with frequency questions ranging from "none" to "60+" for alcoholic drinks drunk and cigarettes or marijuana smoked in the last four weeks.

Religion

Religious affiliation was included in this study due to the special nature of the sample. Previous studies report associations between religion and SRH (Levin, 2015) with some reviews reporting that this association is unaffected when controlling for demographic variables (Ellison & Levin, 1998). Religious affiliation was assessed by asking the participants: "Which of the following best describes your religious belief now?" Options ranged from: 1. Seventh-day Adventist Christian, 2. Other Christian, 3. Other Religion, 4. No Formal Religion, and 5. Don't Know. This item was dichotomized to "Non-Adventist" (response 2–4), and Adventist (response 1).

Social Factors

In this study, an Adverse Childhood Experiences score (Balistreri & Alvira-Hammond, 2016; Dube et al., 2006; Flaherty et al., 2013; Gonçalves et al., 2016) was generated by collating responses from the following nine items: 1. “One or both of my parents were in trouble with the law,” 2. “My parents were separated or divorced,” 3. “One or both my parents died,” 4. “One or both parents were absent from home for long periods,” 5. “There were times when family violence occurred,” 6. “There were times when I was physically abused,” and 7. “There were times when I was sexually abused,” 8. “One or both parents smoked tobacco,” and 9. “One or both parents drank alcohol weekly or more often.” Each of the nine items included no/yes response options which were given a corresponding value of zero or one. Responses from each item were summed to calculate an overall ACEs score.

Childhood family dynamics were assessed by creating a CFD score from six items, namely: 1. “As a child, my parents showed me love,” 2. “As a child, my parents understood me,” 3. “While I was a child my family had a lot of fun,” 4. “As a child, my parents didn’t trust me,” 5. “As a child, my parents didn’t care what I did,” and 6. “As a child, I enjoyed being at home with my family.” Each item included five response options ranging from “strongly disagree” through to “strongly agree.” Each response was given a corresponding value from one to five and was recoded so that higher scores represented positive outcomes. Responses from each item were summed to calculate the overall CFD score.

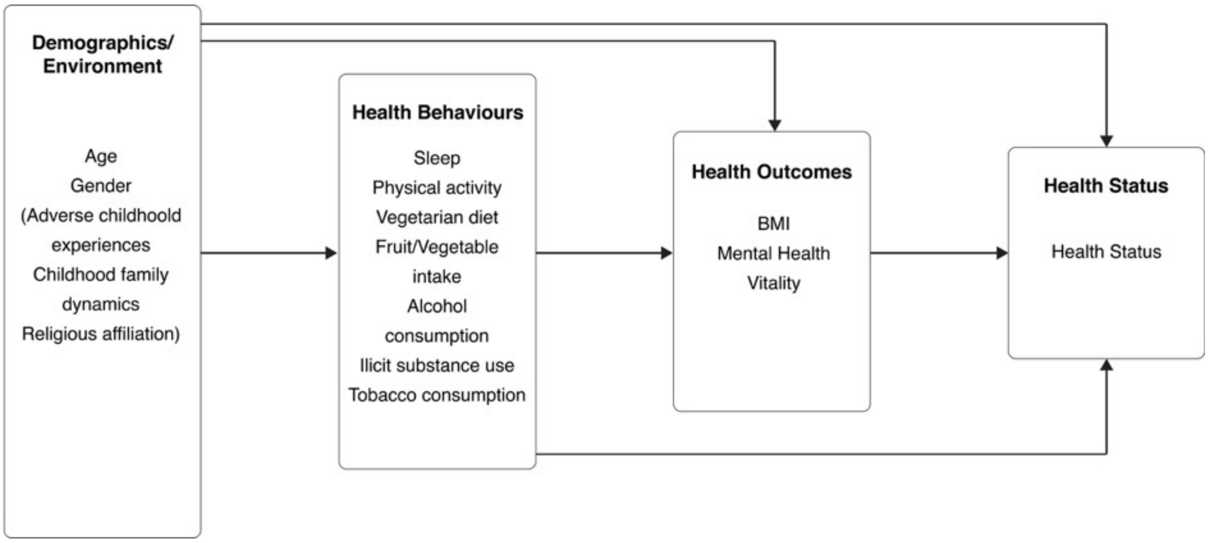


Figure 5. Hypothesized model for factors associated with self-rated health in adolescents

Analysis

The objective of this study was to simultaneously analyse all paths of the hypothesized model (Figure 5) in order to explore the complexity of the associations between multiple factors and SRH. Hence, structural equation modelling (SEM) (Bucy & Holbert, 2014) was employed using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA) to estimate the model fit of the data and analyse the direct and indirect associations of the multiple factors in the hypothesized model with ACS. The hypothesized model (Figure 5) based on theoretical considerations was submitted for analysis using techniques developed by Jöreskog and Sörbom (1989) utilizing an iterative process of inspection of the statistical significance of path coefficients and theoretical relevance of constructs in the model to derive an optimal SEM that best fit the dataset and were theoretically meaningful. Overall model fit was examined using multiple goodness-of-fit indices, namely; chi-square (X^2) statistic (CMIN), relative X^2 (CMIN/DF), baseline comparisons fit indices of NFI, RFI, IFI, TLI, CFI, and RMSEA. Structural equation modelling was carried out using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA). The Bootstrapping method

(Preacher & Hayes, 2008) was applied to verify statistical significance of indirect and total associations at $p < .05$. The data were imported into SPSS (version 24; IBM, Armonk, NY) to calculate means, standard deviations, distributions and internal reliability.

Table 2. *Descriptive Statistics and Scale Reliability of Variables Used in the Analysis*

Variables	**N**	**%**	**Mean**	**Standard Deviation**	**Min**	**Max**	**Scale Reliability (α)**
Age	788		14.90	± 1.57	12	18	
Gender							
Males	379	48.1%					
Females	409	51.9%					
ACEs score	788		1.39	± 1.60	0	9	
Childhood family dynamics scale	788		23.93	± 4.95	0	30	.83
Religious affiliation	383	48.6%					
Adventist	405	51.4%					
Not Adventist							
Sleep hours per night	788		7.92	± 1.30	3	10	
30 min sessions of MVPA per week	788		3.69	± 1.72	0	6	
Serves of fruit and vegetables per day	788		5.31	± 2.39	0	12	
Vegetarian diet							
Yes	123	15.6%					
No	665	84.4%					
Drinks of alcohol in the last four weeks	788		1.46	± 6.48	0	50	
Cigarettes smoked in the last four weeks	788		0.84	± 5.84	0	60	
Times smoked Marijuana in the last four weeks	788		0.32	± 2.78	0	40	
BMI	788		20.25	± 2.89	14.30	30.07	
Mental health scale	788		65.73	± 18.00	0	100	.77
Vitality scale	788		57.32	± 17.73	0	100	.66
Self-rated health							
Poor	6	0.6%					
Fair	42	5.2%					
Good	258	32.8%					
Very Good	341	43.4%					
Excellent	141	17.9%					

Abbreviations: α = Cronbach's alpha

Results

Descriptive Statistics

A summary of descriptive statistics and reliability estimates is shown in Table 2. Sixty-one per cent of the students in the study reported "very good" to "excellent" health. This is comparable with the 2014/15 Australian Bureau of Statistics (ABS) survey (ABS, 2015) which reported that 63% of young Australians (aged 15–24yrs) rated their health as very good or excellent. Unique to the study cohort was that 49% of the students reported an affiliation with a Christian faith and low rates of alcohol consumption (11% reported consuming alcohol in the past four weeks) tobacco use (4% reported using tobacco in the past four weeks) and marijuana use (3% reported using marijuana in the past for weeks).

The Model for Factors Associated with Self-Rated Health in Adolescents

The final structural model (Figure 6) as a whole fitted the data very well, as indicated by the goodness-of-fit indices (CMIN = 33.615; p = 0.214; CMIN/DF=1.201; NFI=0.976, RFI=0.933; IFI=0.996; TLI=0.988, CFI=0.996 and RMSEA=0.016). CMIN/DF statistic below three is considered good model fit (Kline, 2010) as are baseline comparisons fit indices above 0.9 (Bentler, 1990). The RMSEA value was less than 0.06, which indicated a close fit between the data and the model (Hu & Bentler, 1999). The items that asked the participants about alcohol, tobacco, and marijuana use were removed from the model due to their non-significant contributions generating the final structural model (Figure 6). Modification indices suggested that the health behaviour variables be allowed to covary, as well as the health outcome variables mental health and vitality. In Figure 6, the standardized path coefficients are presented as single-headed arrows, and all shown paths are statistically significant including all indirect and total effect pathways.

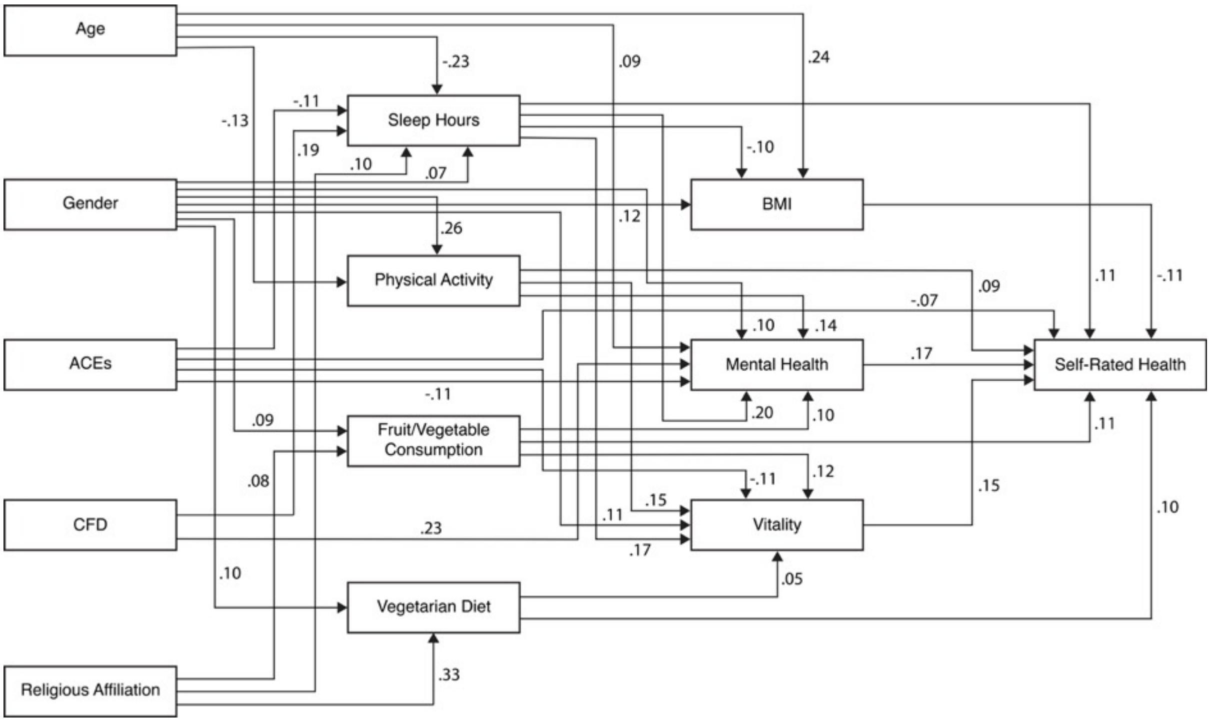


Figure 6. Structural equation model predicting self-rated health status

The final structural model (Figure 6) describes the upstream associations of BMI, mental health and vitality, health behaviours, demographics and social factors on SRH as well as their interactions. The squared multiple correlation calculated for SRH was 0.20 which indicates that the model explained 20% of the variance in self-rated health.

Based on standardized path weight coefficients (β's), the health outcome variables BMI ($\beta = -0.11$), mental health ($\beta = 0.17$) and vitality ($\beta = 0.15$) had a direct association with SRH. This indicates that adolescents who reported a higher BMI reported a poorer SRH, and adolescents who reported higher mental health and vitality scores reported better SRH.

The health behaviour variables sleep hours ($\beta = 0.11$), physical activity ($\beta = 0.09$), fruit/vegetable consumption ($\beta = 0.11$) and a vegetarian diet ($\beta = 0.10$) had a direct association with SRH. This indicates that adolescents reporting more sleep each night, more physical activity, greater consumption of fruit and vegetables and a vegetarian diet also reported a better SRH. The health behaviour variables were also associated with SRH indirectly through the health outcome mediating variables. Sleep hours was associated with SRH indirectly through the mediating health outcome variables BMI, mental health and vitality. Physical activity was associated with SRH indirectly through the mediating health outcome variables mental health and vitality. Fruit/vegetable consumption was associated with SRH indirectly through the mediating health outcome variables mental health and vitality. A vegetarian diet was associated with SRH indirectly through the mediating health outcome variable vitality. Of the health behaviour variables, sleep hours had the strongest combined direct and indirect association with SRH ($\beta_{total} = 0.178$) followed by fruit/vegetable consumption ($\beta_{total} = 0.144$), physical activity ($\beta_{total} = 0.135$) and then vegetarian diet ($\beta_{total} = 0.103$).

Of the demographic and social variables, ACEs was the only variable that had a direct association with SRH ($\beta = 0.07$) with the other demographic and social variables indirectly associated with SRH. Age was associated with SHR through the mediating health behaviour variables sleep hours and physical activity, and through the mediating health outcome variables BMI and mental health. Gender was associated with SHR through the mediating health behaviour variables sleep hours, physical activity, fruit/vegetable consumption, and vegetarian diet, and through the mediating health outcome variables BMI, mental health, and vitality. ACEs was associated with SHR directly and through the mediating health behaviour variable sleep hours and the mediating health outcome variable mental health and vitality. CFD was associated with SHR through the mediating health behaviour variable sleep hours and through the health outcome variable mental health. Religious affiliation was associated with SHR through the mediating health behaviour variables sleep hours, fruit/vegetable consumption and vegetarian diet.

Notably, of the demographic and social variables in the model, ACEs had the strongest association with SRH (β_{total} = -0.125). Hence, more ACEs were associated with lower SRH. Gender had the second strongest association with SRH of the demographic and social factors (β_{total} = 0.092) and also interacted with the greatest number of the mediating variables in the model. The association of age on SRH (β_{total} = -0.067) demonstrated that older adolescents reported poorer SRH, however, overall, males rated their health better which is in line with other studies (Jerdén et al., 2011). The association of CFD (β_{total} = -0.047) on SRH demonstrated that adolescents reporting better CFD also reported better SRH. Finally, the model indicated that although the respondent's religion did have indirect links to SRH its association was small (β_{total} = 0.005). Adolescents who identified as Adventist were more likely to report higher SRH, and better health behaviours than those who identified themselves as not affiliated with the Adventist Church.

Discussion

This study explored concomitantly the relationships between factors associated with SRH in adolescents attending Adventist schools in Australia. By including a number of variables into one conceptual model and analysing them simultaneously, the study is unique in that it was able to describe a complex network of associations between the factors that influence SRH. This study supports the need for a broad multi-component approach to the study of adolescent health.

The findings in this study demonstrate the association between mental health and SRH which is in line with findings from previous studies (Breidablik et al., 2008; Sehulster, 1994). The mental health measure used in this study had the strongest association with SRH of the three health outcome variables measured and was associated with the most health behaviours, demographics and social variables in the model. Several health behaviours (sleep hours, physical activity, and fruit/vegetable consumption), as well as demographics (age and gender), and social factors (ACEs and CFD) had a direct association with mental health. Notably, the association between the adolescent's childhood upbringing (ACEs and CFD) and mental health demonstrates how social factors early in life are associated with mental health status years later in adolescence.

The vitality metric used in this study (a measure of energy and fatigue status) had the second strongest association on SRH of the health outcome variables. All health behaviours in the model (sleep hours, physical activity, fruit/vegetable consumption, vegetarian diet) along with gender and ACEs directly associated with the measure vitality. Research on vitality is limited; however, one study found that up to 30% of healthy teens experience symptoms of fatigue that affect their normal functioning (Findlay, 2008). The observed influence of health behaviours on vitality in this study highlights the importance of targeting healthy behaviours for improving the energy levels and lessening fatigue among adolescents.

There is a wealth of literature supporting the importance of health behaviours on adolescent health (WHO, 2014c), however, a unique aspect of this study was the simultaneous assessment of the association of four health behaviours (sleep hours, physical activity, fruit/vegetable consumption, vegetarian diet) on SRH. This allowed the health behaviours to be ranked according to their strength of association on SHR. While all health behaviours had a direct association with SRH and an indirect association through one or more of the health outcome variables, sleep had the strongest association on SRH, followed by fruit/vegetable consumption, physical activity, and vegetarian diet. This finding highlights the value of prioritizing healthy sleep hygiene among adolescent cohorts (McKnight-Eily et al., 2011), although clearly, interventions that address all health behaviours are likely to be most efficacious and therefore desirable.

In the SEM analysis, the items measuring the health behaviours: consumption of alcohol and the use of tobacco and marijuana had non-significant pathways to SRH. It is well documented (Patton et al., 2012) that these health behaviours influence adolescent health negatively. A possible explanation for the non-significant effect of these health behaviours in this study may be that the study cohort reported a low prevalence of these behaviours. While this low prevalence was expected given the Adventist community proscribes such behaviour, further exploration as to what motivates the use of alcohol, tobacco and marijuana in a low using cohort would be of interest.

Of the selected demographics and social factors included in the model predicting SRH, ACEs presented as having the strongest association. Indeed, it is remarkable that adolescents who reported higher incidents of adverse experiences in their earlier childhood, reported poorer SRH in their adolescent years. Although children may have no choice in the ACEs they experience, this study reinforces the necessity for childhood human rights, health promotion and resilience building (Felitti et al., 1998) to be at the forefront of global policy and intervention development to provide benefits not only in childhood, but also later in adolescent life.

Of the five demographic and social factors assessed, gender had the second strongest association with SRH, and was associated with the most number mediating variables, interacting with all health behaviour and health outcome variables in the model. This suggest that interventions targeting improving general health of adolescents may be more effective if they were gender specific. The influence of CFD and religion on SRH in this model is noted, albeit not as strong as ACEs and gender.

Strengths and Limitations

The strength of this study is that it concomitantly explored a number of factors associated with SRH and describe the complex interaction between these factors and SRH. It is acknowledged, however, that model presented in this study, although strong, represents only part of the big picture of the overall influences of SRH. For example, socio-economic status is a well-known predictor of SRH (Vingilis et al., 2002), and this was not assessed in this study as no data on socioeconomic status was collected. Another limitation of this study is that it focused on a comparatively homogeneous group of adolescents who were exposed to a faith-based community, namely, Adventist Christians who place a strong emphasis on health and a holistic lifestyle. Since its inception in 1983, the Adventist religion has promoted the adoption of a healthy lifestyle to its members that includes regular exercise, a vegetarian diet and rest. Alcohol, caffeine, tobacco and illicit substances are also proscribed (Fraser, 2003). The Adventist population has been the focus of numerous health studies as they tend to experience good health and lower rates of disease (Willett, 1999). Adventist schools espouse the health practices of the Adventist church. Hence, while approximately half of this study cohort did not identify themselves as Adventist, they were likely influenced the by health focus of the Adventist church. It is possible that the adolescents in this study potentially underscored their self-rated health status compared to adolescents in the general population due to the high health ideals advocated by the faith-based schools they attend. This may have resulted in these adolescents perceiving and judging “very good” or “excellent” health against a more rigorous standard. This limits the generalization of the findings to other populations. The cross-sectional nature of this study means that only associations could be measured, it is not possible to say whether these relationships were causal. Although SRH has been established as a legitimate and stable construct for use in adolescent populations (Boardman, 2006; Breidablik et al., 2008, 2009a; Idler & Benyamini, 1997; Jerdén et al., 2011; Meireles, Xavier, Proietti, et al., 2015; Vingilis et al., 2002; Wade et al., 2000; Zhang et al., 2016) to measure general health status, objective measures of health including biomedical testing as represented in the conceptual framework for determinants of health (AIHW, 2012f) may improve the validity of the findings in this study.

Conclusion

This study presented a conceptual model that described the complex network of factors concomitantly associated with SRH in adolescents. The results highlight the association of mental health with SHR. Gender-sensitive interventions prioritizing modifiable health behaviours such as sleep, healthy diet, and physical activity may achieve a greater combined effect in improving adolescent health status than select single factor interventions. The association between ACEs and adolescent SRH reinforces the necessity to address childhood human rights, resilience, family dynamics, and health promotion in children for lasting benefits later in adolescent life. Further research into what influences the variables interacting with SRH may provide insight into more effective interventions to improve adolescent health.

Chapter 5: Factors predicting the mental health of adolescents attending a faith-based Australian school system: A multi-group structural equation analysis

Chapter Overview

This chapter addresses the second objective of the study project which was: To explore the complex network of factors that predict the mental health of adolescents attending Adventist schools in Australia. The chapter is presented as a manuscript entitled "Factors predicting the mental health of adolescents attending a faith-based Australian school system: A multi-group structural equation analysis.", which was published in the *Journal of Mental Health*. This study builds on the work of Study 1 (Chapter 4) that found mental health to have the highest degree of association with the self-rated health among the study cohort. The objective of the study was to concomitantly explore the relationship between a complex network of factors, including childhood experiences, attitudes and select health behaviours on the mental health of the adolescents in the study. The study contributes to the body of knowledge as no study has simultaneously explored the influence and interrelatedness of the complex network of factors that affect the mental health of adolescents of this population. The findings and implications of the study are further discussed in Chapter 9.

Contribution of Authentication Statement

I attest that Research Higher Degree candidate Bevan Craig contributed to the paper/publication entitled:

Factors predicting the mental health of adolescents attending a faith-based Australian school system: A multi-group structural equation analysis.

By:

- Leading the conception and design of the study
- Cleaning the data
- Development of measures to be used
- Leading the data analysis (Including use of AMOS SEM Software)
- Interpretation of the data
- Leading the writing of the manuscript
- Submitted the manuscript for review
- Addressed reviewers' comments

Signature of Candidate:

Name of Candidate: Bevan Craig

Date: 5 March 2019

Signature Principal Supervisor:

Name of Principal Supervisor: Dr Darren Morton

Date: 5 March 2019

Abstract

Background

Adolescents attending Seventh-day Adventist schools (Adventist) in Australia tend to experience good health and exhibit better health behaviours than national norms, however few studies have investigated factors predicting their mental health.

Aims

The aim of this study was to explore the complex network of factors that predict the mental health status (MHS) of adolescents attending Adventist schools in Australia.

Methods

A survey instrument was used to collect data from 1527 secondary school students attending Adventist schools across Australia. Structural equation modeling was employed to examine concomitantly the direct and indirect effects of childhood experiences, present attitudes and selected health behaviours on MHS.

Results

Childhood family dynamics had the strongest association with MHS ($\beta_{total} = 0.33$) followed by a sense of meaning and purpose ($\beta_{total} = 0.27$), perceived social misfit status ($\beta_{total} = -0.19$) and school academic performance ($\beta_{total} = 0.18$). Multi-group analysis found significant pathway differences in the model for gender with regards to the association of meaning and purpose, physical activity and sleep quantity with MHS.

Conclusions

The outcomes of the study highlight the importance of early positive childhood family dynamics and the discovery of meaning and purpose during adolescence to promote positive mental health among adolescents.

Introduction

Poor mental health in young people is a pressing global concern (Erskine et al., 2015). In a recent Australian report, which is the context of the present study, 14% of young people aged 4–17 years had experienced a mental health disorder in the preceding twelve months rising to 27% among the 18–24 year age group (Lawrence et al., 2016). In Australia, like many developed countries, nearly half (45%) of adults will experience a mental disorder in their lifetime (Australian Institute of Health and Welfare, 2016) and half of these mental health problems present by the age of 14 and three quarters by the mid 20's (WHO, n.d.).

Poor mental health can impede adolescent development and learning (Patel et al., 2007; Patton, Coffey, et al., 2014), and adversely affect the individual's trajectory through life. Poor mental health is associated with poor physical health, poor reproductive and sexual health, poor academic achievement (Patel et al., 2007), unemployment (Colman et al., 2009), anti-social behaviour (Patel et al., 2007), illicit substance and alcohol use (Hopfer et al., 2013), self-harm and suicide, the latter being the leading cause of death among adolescents globally (Patel et al., 2007).

Adolescence is a critical life period where many developmental, biological, behavioural, social and lifestyle changes occur at different times depending on gender and the individual (Call et al., 2002; Erikson, 1968). Australian studies indicate that adolescent females experience poorer mental health than males which is thought to be associated with poor family dynamics, pressure at school and western societal pressures (Mission Australia, 2017). While a number of risk and protective factors influencing mental health among adolescents have been explored, evidence supports a complex multifactorial causation, with many of the associations between risk factors and poor mental health being bidirectional (AIHW, 2012f; Craig, Morton, Morey, et al., 2018; Lawrence et al., 2016; Patel et al., 2007). While various protective mechanisms are understood to buffer the risks of poor mental health, these are equally complex (Lawrence et al., 2016).

Several theoretical models have been developed to explain how the determinants of mental health have their influence (AIHW, 2012f; Kieling et al., 2011). These models organize determinants as proximal, such as health behaviours, through to distal, which include upstream social determinants such as school, family and peer environments. Other important determinants of mental health that have been identified in the theoretical models are attitudes relating to a sense of meaning and purpose (Brassai, Piko, & Steger, 2011; Burrow et al., 2010; Damon et al., 2003; Halama & Dědová, 2007a), social exclusion and feelings of being a social misfit (DeWall & Bushman, 2011; Huitsing, Veenstra, Sainio, & Salmivalli, 2012; Juvonen & Gross, 2005; Wright et al., 1986), and school academic performance (McLeod et al., 2012). The influence of these determinants on mental health have not been comprehensively investigated through concomitant analyses.

Of particular interest to this study was the Seventh-day Adventist (Adventist) population who tend to experience lower rates of many chronic diseases in adulthood (Willett, 2003). Adventist adolescents have also been shown to have better health behaviours and outcomes than other Christian and non-religious adolescents (Craig et al., 2017; Craig, Morton, Kent, et al., 2018). A previous investigation has found that the mental health status of Adventist adolescents was predicted by health behaviours, childhood experiences and gender (Craig, Morton, Morey, et al., 2018) but no study has concomitantly investigated the complex relationships between the numerous determinants, both proximal and distal, of the mental health of this population. Students attending Adventist schools in Australia constitute an interesting study cohort in that only approximately half of the students attending identify as Adventist. Hence studies of this cohort allow for comparisons to be made between

Adventists, who tend to have better health behaviours and health outcomes and, non-Adventists who are more representative of the general population.

Utilizing structural equation modeling (SEM), this study aimed to concomitantly explore the complex relationships between a number of factors that may predict the MHS of adolescents, including: childhood factors such as childhood family dynamics (CFD) and adverse childhood experiences (ACES); present attitudes such as perceived social misfit status, level of meaning and purpose and school academic performance; and select health behaviours such as participation in physical activity, fruit and vegetable consumption and sleep quantity. Further, the study aimed to explore gender variations in these relationships through multi-group SEM analyses. The findings of this study may provide a better understanding of the complex relationship between multiple factors and the MHS of Adventist adolescents and inform the development of appropriate interventions for improving MHS in adolescent populations.

Methods

Study Participants

A survey was administered in 21 private secondary schools across Australia in 2012. Participation in the study was voluntary and anonymous and written consent was collected from the students as well as their parents or guardians. Completed responses were collected from 1527 students (mean age =14.7 years, age range = 12–18 years, 55% males). The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No:2011:21).

Survey Instrument

The survey instrument assessed the participant's MHS as well as factors relating to CFD, ACEs, religious affiliation, personal demographics, attitudes (perceived social misfit status, level of meaning and purpose and school academic performance), and select health behaviours (participation in physical activity, fruit and vegetable consumption, and sleep quantity).

Mental Health

Mental health status (MHS) was measured using the validated and reliable (Brazier et al., 1992) five-item mental health subscale (MHI-5) from the SF-36 ('RAND Health, 36-Item short form survey', n.d.), which measures general MHS. The literature indicates that the MHI-5 is a good predictor of mental health disorders including depression, generalized anxiety and affective disorders generally (Berwick et al., 1991; Strand, 2003). The five items that make up the MHI-5 are "How much of the time during the last four weeks": 1. "Have you been a very nervous person?" 2. "Have you felt so down in the dumps that nothing could cheer you up?" 3. "Have you felt calm and peaceful?" 4. Have you felt down?" 5. "Have you been a happy person?" Each item has six response options ranging from "All of the time" to "Not at all." A standardized score on a scale of 0–100 was created for MHS, as previously described (Ware et al., 2000), with higher scores indicating better mental health. Internal reliability of the MHI-5 has been reported at $\alpha = .78$ to .87 in studies across eleven countries (Gandek et al., 1998). While exact cut-off scores for predicting mental disorders are undetermined, studies have suggested that a score below 52 (Holmes, 1998) to 56 (Shaw et al., 2000) are indicative of major depression.

Childhood Factors

Childhood family dynamics were assessed by creating a CFD score which has been published previously (Craig, Morton, Morey, et al., 2018). The CFD score is made of six items which include: 1. "As a child, my parents showed me love"; 2. "As a child, my parents understood me"; 3. "While I was a child my family had a lot of fun"; 4. "As a child, my parents didn't trust me"; 5. "As a child, my parents didn't care what I did"; and, 6. "As a child, I enjoyed being at home with my family." Each item included five options ranging from "Strongly disagree" to "Strongly agree." Responses were coded from one to five and items 4 and 5 were then reverse coded so higher item values represented increasingly positive outcomes. Responses from each item were then summed to calculate an overall CFD score.

Adverse Childhood Experiences were assessed by creating an ACEs score developed by Felitti and associates (Felitti et al., 1998) which has been previously published (Craig, Morton, Morey, et al., 2018). Adverse childhood experiences including psychological, physical or sexual abuse, violence, parental substance abuse, parental separation/divorce, parental incarceration or death of a parent, close relative or friend has been linked with poor mental health in childhood through to adulthood (Kerker et al., 2015; Schilling, Aseltine, & Gore, 2007). The ACEs score was created from nine items which include: 1. "One or both of my parents were in trouble with the law"; 2. "My parents were separated or divorced"; 3. "One or both my parents died"; 4. "One or both parents were absent from home for long periods"; 5. "There were times when family violence occurred"; 6. "There were times when I was physically abused"; 7. "There were times when I was sexually abused"; 8. "One or both parents smoked tobacco"; and, 9. "One or both parents drank alcohol weekly or more often." Each item included no/yes response options which were given a corresponding value of zero or one. Responses from each item were summed to calculate an overall ACEs score.

Religious affiliation was included in this study due to the special nature of the sample. As seen in Table 1, 46% of participants in this study reported being affiliated with the Seventh-day Adventist Protestant religion. Religious affiliation was assessed by asking the participants: "Which of the following best describes your religious belief now?" Options ranged from: 1. Seventh-day Adventist Christian; 2. Other Christian; 3. Other Religion; 4. No

Formal Religion; and 5. Don't Know. For the purpose of this study, this item was dichotomized to Adventist (response 1) and not Adventist (responses 2–4).

Attitudes

Perceived social misfit status was measured with a single item that asked the participants to respond yes/no to the statement: "I often feel like a social misfit". The social misfit hypothesis (Wright et al., 1986) proposes that children who deviate from the social group norm and are different in some discernible way, whether it be in relation to behaviour or appearance, are often victimized, marginalized or bullied impacting their mental health. Meaning and purpose was measured with a single item that asked the participants to respond on a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" to the statement: "My life is filled with meaning and purpose". Attitudes surrounding meaning and purpose have been found to be associated with adolescent mental health (Burrow et al., 2010) with adolescents reporting meaning and purpose more likely to experience better mental health (Brassai et al., 2011; Damon et al., 2003; Halama & Dědová, 2007a). School academic performance was measured by asking the students how they rated themselves at school work on a five-point Likert scale ranging from "A lot below average" to "A lot above average". Measuring school academic performance with this item has been used in previous studies and national surveys (Bowden et al., 2017b; Centre for Epidemilogy and Research NSW Department of Health, 2008; The Cancer Council Victoria, 2006).

Selected Health Behaviours

Fruit and vegetable intake was assessed using food frequency questions adapted from items previously used in studies of adolescent cohorts (Kolodziejczyk et al., 2012). Fruit consumption was measured by an item that asked: "How many serves of fruit do you usually eat each day? (1 serve = 1 medium piece or 2 small pieces of fruit or 1 cup of diced pieces)".

Response options ranged from “I do not eat fruit” to “6 serves or more”. Vegetable consumption was measured by an item that asked: “How many serves of vegetables and salad vegetables (excluding potatoes) do you usually eat each day? (1 serve = 1/2 cup of cooked vegetables or 1 cup of salad vegetables)”. Response options ranged from “I do not eat vegetables” to “6 servers or more”. The fruit and vegetable items were summed to provide an overall fruit and vegetable intake score. Physical activity was measured by an item that asked: “How many times per week do you usually do any vigorous or moderate physical activity for at least 30 minutes?” with seven response options ranging from “none” to “6 or more times” (Giffin et al., 2004). Sleep quantity was assessed by an item that asked: “How many hours do you usually sleep per night?” with eight response options ranging from “3 hours or less” to “10 hours or more”.

Analysis

The objective of this study was to examine the direct and indirect predictors of adolescent MHS by employing structural equation modeling (SEM). A hypothesized model informed by the literature and theoretical models (AIHW, 2012f; Kieling et al., 2011) was developed (see Figure 1) for analysis. In order to concomitantly explore factors associated with MHS yet retain a parsimonious model, the study was delimited by restricting explanatory variables as follows: As shown in Figure 7, the most proximal explanatory variables in the model were the health behaviours (fruit and vegetable consumption, physical activity and sleep quantity). Antecedent to the health behaviours were attitudes (perceived social misfit status, meaning and purpose in life and school academic performance). Childhood factors (CFD, ACEs and religious affiliation) were arranged in the model as the most distal predictors.

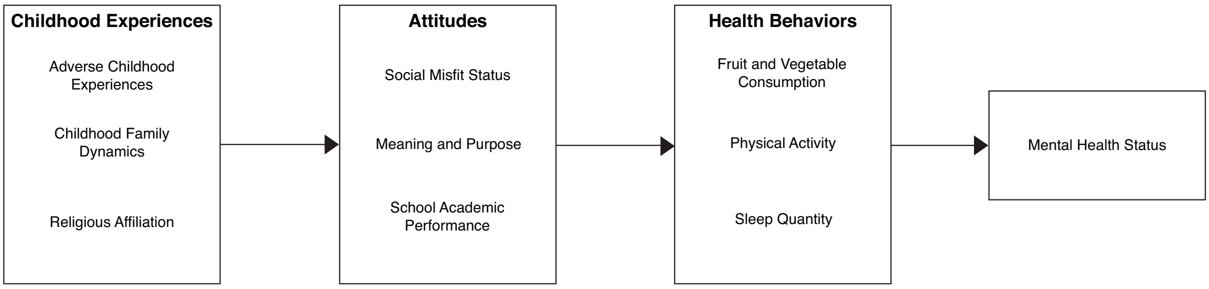


Figure 7. Hypothesised model predicting mental health status

The data was imported into SPSS (version 24; IBM, Armonk, NY) to calculate means, standard deviations, distributions and internal reliability. Structural equation modelling using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA) was conducted using techniques developed by Jöreskog and Sörbom (1989). This involved an iterative process of inspection of the statistical significance of path coefficients and theoretical relevance of the constructs in the model to derive an optimal SEM that best fit the dataset and was theoretically meaningful.

Overall model fit was examined using multiple goodness-of-fit indices, namely: relative X^2 (CMIN/DF), baseline comparisons fit indices of NFI, RFI, IFI, TLI, CFI, and RMSEA. Bootstrapping (Preacher & Hayes, 2008) was applied to verify statistical significance of indirect and total effects at $p < .05$. Multi-group analysis was employed to test for gender variations among the pathways in the study as gender has been observed to moderate the relationship of predictors on adolescent mental health (Craig, Morton, Morey, et al., 2018; Mission Australia, 2017; Patel et al., 2007). The critical ratios for differences test was applied to assess for regression weight differences for gender within the SEM (Ho, 2013).

Results

Descriptive Statistics

A summary of descriptive statistics and reliability estimates is shown in Table 3. The mean mental health score was 65 and was significantly higher among the males than the females (67.7 ± 16.6 versus 63.2 ± 18.3, $p < .001$). There was no significant difference ($p = 0.11$) in the mental health score of the respondents affiliated with the Adventist church (66.1 ± 17.5) compared to those who were not (64.6 ± 18.0).

Table 3. *Descriptive Statistics and Scale Reliability of Variables Used in the Analysis*

Variables	**N**	**%**	**Mean**	**SD**	**Min**	**Max**	**Scale Reliability (α)**
Age	1527		14.56	± 1.57	12	18	
Gender							
Males	838	54.9%					
Females	689	45.1%					
Adverse Childhood Experiences Score	1527		1.39	± 1.65	0	9	.69
Childhood Family Dynamics Score	1527		24.21	± 4.82	5	30	.84
Religious Affiliation							
Adventist	698	45.7%					
Not Adventist	829	54.3%					
Perceived social rejection							
No	1295	84.8%					
Yes	232	15.2%					
Meaning and Purpose	1527		3.94	± 1.02	1	5	
Self-rated school academic performance							
A lot below average	13	0.9%					
Below average	84	5.5%					
Average	722	47.3%					
Above average	595	39.0%					
A lot above average	113	7.4%					
30 min or more sessions of MVPA per week	1527		3.28	± 1.18	0	6	
Serves of fruit and vegetables per day	1527		5.14	± 2.34	0	12	
Sleep hours per night	1527		7.94	± 1.13	3	10	
Mental Health Scale	1527		65.26	± 17.76	4	100	.75

Abbreviations: α = Cronbach's alpha

Model Predicting Mental Health Status

The final structural model (Figure 8) fitted the data well, as indicated by the goodness-of-fit indices (CMIN/DF=1.854; NFI=0.993, RFI=0.967; IFI=0.997; TLI=0.985, CFI=0.997 and RMSEA=0.024). CMIN/DF statistic below three is considered good model fit (Kline, 2010) as are baseline comparisons fit indices above 0.9 (Bentler, 1990). The RMSEA value was less than 0.06, which indicated a close fit between the data and the model (Hu & Bentler, 1999). The squared multiple correlation calculated for MHS of 0.30 indicates that the model explained 30% of the variance for MHS. Standardized path coefficients are presented as single-headed arrows in the final model. All shown paths are statistically significant including all indirect and combined total pathways.

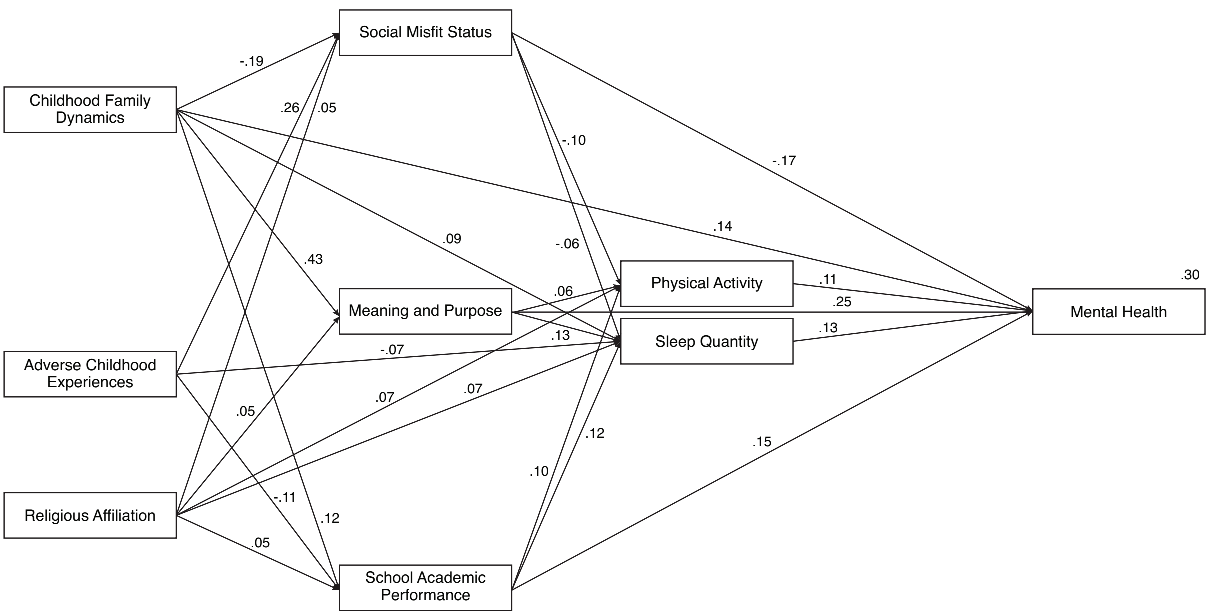
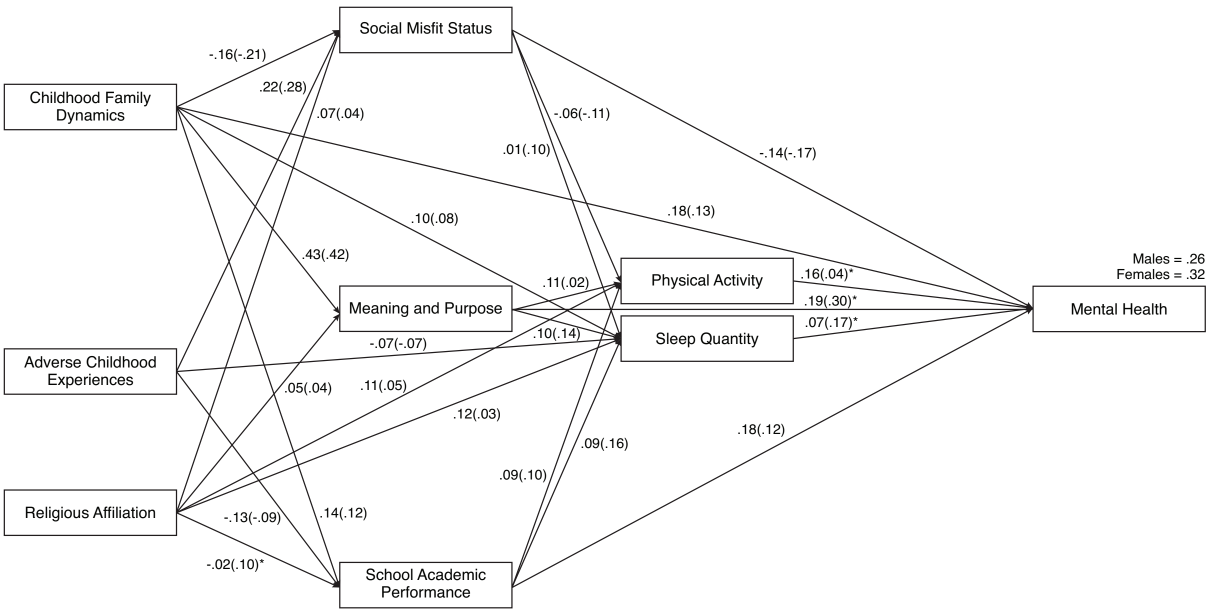


Figure 8. Structural equation model predicting adolescent mental health

Based on standardized path weight coefficients (β's), the item measuring meaning and purpose had the strongest direct association ($\beta = 0.25$) with MHS followed by perceived social misfit status ($\beta = -0.17$), school academic performance ($\beta = 0.15$), the CFD score ($\beta = 0.14$), sleep quantity ($\beta = 0.13$) and physical activity ($\beta = 0.11$). Combining direct and indirect effects, the CFD score ($\beta_{total} = 0.33$) was the strongest predictor of MHS followed by the item that measured meaning and purpose ($\beta_{total} = 0.27$), perceived social misfit status ($\beta_{total} = 0.19$), school academic performance ($\beta_{total} = 0.18$), ACEs ($\beta_{total} = -0.08$) and religious affiliation ($\beta_{total} = 0.03$). The combined beta of all three attitudes measured in the model was 0.64.

Multi-group analysis for gender (Figure 9) found a significant difference in the path coefficient between physical activity and MHS, with this association stronger for males ($\beta = 0.16$) than for females ($\beta = 0.04$). A significant difference in the path coefficients between sleep quantity and MHS was also observed, with this association stronger for females ($\beta = 0.17$) than for males ($\beta = 0.07$). Significant differences in path coefficients for gender were also found between life has meaning and purpose and MHS, with this association stronger for females ($\beta = 0.30$) than for males ($\beta = 0.19$). Finally, significant differences in path coefficients for gender were found between religious affiliation and school academic performance, with this association stronger for females ($\beta = 0.10$) than for males ($\beta = -0.02$).



Males(Females); * Significant difference between males and females at p < .05

Figure 9. Structural equation model multi-group analysis for gender

Discussion

This study explored the effect of a complex network of factors on the metal health status of adolescents attending Adventist schools in Australia. The study was unique in that it concomitantly measured the relationship within this cohort between MHS childhood factors, attitudes and select health behaviours.

The association of meaning and purpose with the MHS of the adolescents in this study is in line with findings from other studies (Brassai et al., 2011; Damon et al., 2003; Halama & Dědová, 2007a). Indeed, discovering purpose is a clear marker of flourishing and positive well-being (Burrow et al., 2010) in adolescents and a lack of meaning and purpose has been linked to depression, apathy and social and interpersonal difficulties (Damon et al., 2003). The finding that meaning and purpose had the strongest direct association with MHS (β = 0.25) of all the variables measured in the model suggests that developing meaning and purpose is an important predictor of MHS in this cohort. Developmental theorist Erikson

(Erikson, 1968) proposed that actualizing purpose and meaning early in life is important to help adolescents resolve identity crises and hence promote positive development throughout the lifespan. Erikson suggested that engaging adolescents in activities that empower expression of their inner selves enables them to determine goals and values that shape their identity, meaning and purpose. Exploring cultural rites of passage that provide adolescents with activities intended to define them as adults with a larger sense of meaning and purpose may also have a positive association with MHS (Van Dyke & Elias, 2007). The finding in this study that CFD was associated with meaning and purpose suggest that positive CFD assisted the adolescents in this study to find meaning and purpose.

The association of perceived social misfit status with MHS in this study is consistent with other reports (Leary, 2015; Masten et al., 2012). Adolescents may be more vulnerable to social rejection than both adults and younger children (Kloep, 1999) due to increased peer influence susceptibility (Erikson, 1968). The social misfit hypothesis (Wright et al., 1986) proposes that children who deviate from the social group norm and are different in some discernible way whether it be in relation to behaviour or appearance, are often victimized, marginalized or bullied. These findings provide impetus for exploring strategies to reduce experiences of social rejection among adolescents which may improve their MHS. Programs and interventions that focus on growing interpersonal skills such as healthy relationship development, understanding boundaries, community building, acceptance (including acceptance of minorities and differences), group/clique inclusiveness, prosocial behaviour (Wright et al., 1986) and antibullying, are important considerations for promoting the MHS of adolescents. For recipients of social rejection, therapies targeting forgiveness and building resilience may be valuable (Van Dyke & Elias, 2007).

Although the association of mental health and school academic performance has been extensively discussed (McLeod et al., 2012), little research has looked at the reverse relationship—school academic performance as a predictor of mental health. The finding in this study that school academic performance was associated with MHS extends the findings of a previous study linking school academic performance and depression in females but not males (McCarty, 2008). An Australia study (Mission Australia, 2017) reported that school academic performance is one of the key issues adolescents are concerned about, even more so than body image, and hence poor mental health may be mediated by stress associated with poor school academic performance (Cole, 1991).

The combined beta of all three attitudinal variables in the model with MHS was 0.65 with a medium effect size (f-square 0.16). The attitudinal variables explained 37% of the variance in MHS. This finding extends the work of a previous study (Craig, Morton, Morey, et al., 2018) linking childhood experiences with MHS. This finding highlights the collective impact of these three factors on MHS and indicates that interventions that jointly target meaning and purpose, social rejection and school academic performance may be of value in improving the MHS of adolescents.

An important observation of this study was the effect of upstream childhood factors on MHS. While the association between CFD and MHS in adolescence is well-documented in the literature (Craig, Morton, Morey, et al., 2018; Patton, Coffey, et al., 2014), its importance is highlighted in the present study as CFD had the strongest association ($\beta_{total} = 0.33$) with MHS of all the variables in the model. It is noteworthy that CFD interacted with four other variables in the model including social rejection, meaning and purpose, academic performance and sleep quantity. The finding that ACEs was not directly associated with MHS is counterintuitive and surprising as this association was found in other studies and theory (AIHW, 2012f; Craig, Morton, Morey, et al., 2018). This result may be due to the strong mediating effect of the present attitudes included in the model. Indeed, finding meaning and purpose, improving school academic performance and addressing social misfit status may dampen the effect ACEs may have on MHS directly. Adverse childhood experiences did have an indirect effect on MHS through perceived social misfit status, school academic performance and sleep quantity. These findings support the necessity for early interventions and prevention programs that promote positive CFD, namely positive parent child relationships and family enjoyment, focusing in particular on providing skills and support to parents and guardians (Patel et al., 2007).

This cohort was selected as approximately half of the adolescents who attend Adventist schools identify as Adventist. Further, these Adventist adolescents have been shown to practice better health behaviours and experience better health outcomes than the non-Adventist adolescents attending these schools (Craig et al., 2017; Craig, Morton, Kent, et al., 2018). The weak association observed between religious affiliation and other variables in the model is interesting and in relation to mental health may suggest that this population are not atypical.

The multi group analysis in this study resulted in several significant pathway differences for gender. The stronger association between meaning and purpose and MHS for females compared to males is consistent with the findings of other studies (Brassai et al., 2011). This suggests that meaning and purpose functions differently as a protective factor for female and male adolescents. A greater emphasis on interventions designed to enhance meaning and purpose as a protective factor for MHS in females without neglecting males may be worth considering. The findings of this study also suggest that physical activity is more protective of MHS for males and sleep quantity is more protective of MHS for females. A difference in emphasis in intervention and prevention programs among genders would be appropriate whereby more emphasis is placed on physical activity for males and sleep quantity for females when implementing interventions and prevention initiatives to improve MHS.

The strength of this study is that it was able to concomitantly measure and describe the effect of multiple factors on MHS in adolescents including past childhood experiences, present attitudes and selected health behaviours on MHS. A limitation of the study is that it was cross-sectional therefore causation cannot be determined. Although the model presented is strong, it is acknowledged that other factors also predict MHS. Future studies may consider the inclusion of biological, psychological, socioeconomic, and societal factors to further understand their influence on MHS (Patel et al., 2007). In addition, asking adolescents to retrospectively report their CFD may introduce bias into the data with adolescents currently experiencing poor MHS possibly reporting more negative CFD. Assessing social misfit status may be improved in future studies with peer or teacher reporting in conjunction with self-reports (Bellmore, Witkow, Graham, & Juvonen, 2004; Wright et al., 1986). Although the theoretical frameworks driving this study provide the basis for exploring the pathways presented in the model, it is acknowledged that some predictors may just as well be explained in reverse. Poor MHS for example may predict adolescent's having more difficulty finding meaning and purpose or poor school academic performance (McLeod et al., 2012). Another limitation of this study is that it focused on adolescents attending Adventist schools which belong to the private sector. While the Adventist schools draw students from many socioeconomic statuses, further studies in public schools are required to determine the generalizability of findings. Noteworthy, approximately 40% of adolescents in Australia attend private schools (ABS, 2017).

Conclusion

This study presents a model describing a complex network of factors predicting the mental health status of adolescents attending a faith-based school system in Australia. The results confirm the effect of early childhood family dynamics, having a sense of meaning and purpose, social misfit status and school academic performance on the mental health status of adolescents. The findings support the need for gender appropriate multi-component approaches when developing effective interventions and prevention programs to promote positive mental health among adolescents, with an emphasis on the discovery of meaning and purpose during adolescence and early positive childhood family dynamics.

Chapter 6: The Body Mass Index of adolescents attending Seventh-day Adventist Schools in Australia: 2001–2012

Chapter Overview

This chapter addresses the third objective of the study project which was: To examine the complex network of factors that predict the BMI of adolescents attending Adventist schools in Australia. The chapter is presented as a manuscript entitled "The Body Mass Index of adolescents attending Seventh-day Adventist Schools in Australia: 2001–2012", which was published in the *Journal of School Health*. This study augments the work of Study 1 (Chapter 4) that found BMI to be associated with adolescent health status by more fully elucidating the factors driving overweight and obesity among adolescents in the study. In this way, the study contributes to the adolescent obesity literature, but it is also novel due to the nature of the cohort who tend to experience better health than the general population (Willett, 1999). The findings and implications of the study are further discussed in Chapter 9.

Co-Author Statement

I attest that Research Higher Degree candidate Bevan Craig contributed to the paper/publication entitled:

The Body Mass Index of adolescents attending Seventh-day Adventist Schools in Australia: 2001-2012

By:

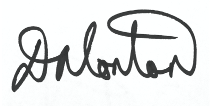
- Contributing to the conception and design of the study
- Cleaning the data
- Development of measures to be used
- Contributing to the data analysis
- Leading the interpretation of the data
- Leading the writing of the manuscript
- Submitted the manuscript for review
- Addressed reviewers' comments

Signature of Candidate:

Name of Candidate: Bevan Craig

Date: 5 March 2019

Signature Principal Supervisor:



Name of Principal Supervisor: Dr Darren Morton

Date: 5 March 2019

Abstract

Background

The purpose of this study was to examine the body mass index (BMI) of Students attending Seventh-day Adventist (Adventist) schools in Australia in 2001 and 2012.

Methods

A total of 3069 students attending Adventist schools in Australia responded to a health and lifestyle survey in 2001(N=1335) and 2012 (N=1734). The survey captured self-reported height and weight, demographics (age, sex, year level, religion) and select health behaviours.

Results

Compared to national norms, lower rates of overweight and obesity were observed in the study cohort, but higher rates of underweight. There was no change in the mean body mass index (BMI) of the students attending Adventist schools in Australia from 2001 to 2012. Regression analyses indicated that a lower BMI was associated with age, sex, more regularly eating breakfast, consuming less soft drink and having a regular exercise program. The students reported a high consumption of fruits, vegetables, and whole grains compared to Australian national norms, and 29% claimed to be vegetarian.

Conclusions

Students attending Adventist schools appear to have a lower prevalence of overweight and obesity than the secular population, but a higher prevalence of underweight. The mechanisms through which Adventist schools may influence student's BMI warrants further investigation.

Introduction

The prevalence of abnormal weight in adolescents is a major global public health concern. In Australia, obesity rates are among the highest in OECD (Organization for Economic Cooperation and Development) countries (AIHW, 2012c). Overweight and obesity among Australian adolescents have more than doubled in the last three decades (Olds et al., 2009). In 2012 approximately 27% of Australian adolescents were overweight or obese ABS, 2012b). Overweight adolescents have an 80% chance of becoming overweight or obese adults (Lifshitz, 2008) and it is predicted that by 2022, Australia will have the highest overweight/obesity rates in the world (Sanders, Han, Baker, & Cobley, 2015). Although there is evidence that obesity rates are plateauing in adolescents (Olds et al., 2009), it has been asserted that the current generation of adolescents will be the first in history to die at a younger age than their parents due to obesity-related comorbidities (Olshansky et al., 2005). Overweight and obesity in adolescents may be associated with serious physical and psychosocial comorbidities. Physical comorbidities include an increased risk of type 2 diabetes, cardiovascular disease, metabolic syndrome, pulmonary and liver disease, sleep apnoea and reduced exercise tolerance (Denney-Wilson et al., 2008; WHO, 2004). Psychosocial comorbidities include social discrimination, negative body image and eating disorders (Denney-Wilson et al., 2008; WHO, 2004), poor self-esteem (Kalra, De Sousa, Sonavane, & Shah, 2012) compromised mental health (Kalra et al., 2012; Pulgarón, 2013), and even suicide ideation (Harriger & Thompson, 2012). Unremarkably, these factors can adversely affect school performance (Neumark-Sztainer, Story, French, & Resnick, 1997) and overall quality of life (Williams, Wake, Hesketh, Maher, & Waters, 2005).

While overweight and obesity among children and adolescents have been extensively researched, the prevalence and comorbidities of underweight are largely understudied (Bovet, Kizirian, Madeleine, Blössner, & Chiolero, 2011). It has been recently acknowledged that underweight poses a considerable public health problem and warrants further investigation (Bovet et al., 2011). Underweight is an often overlooked phenomenon which frequently coexists with obesity, even within the same family (Lazzeri et al., 2014).

The Adventist Church is a Christian denomination with approximately 19 million members worldwide (Seventh-day Adventist Church, 2017). The Adventist Church advocates certain lifestyle behaviours that may affect body weight including a vegetarian diet, regular exercise, and the avoidance of caffeine, refined foods, tobacco and alcohol (Ministerial Association of Seventh-Day Adventists, 1988). The Adventist population has been the focus of numerous health studies as they tend to experience good health and lower rates of disease (Willett, 1999). In Australia, the Adventist church has an extensive education system, including 27 schools that cater for both Adventist and non-Adventist students, which espouses the health practices of the church. Although Adventist adults have been studied since 1960, there has been limited research on Adventist Australian adolescents and their body weight.

The aim of this study was to evaluate the BMI of adolescent students attending Adventist schools in Australia in 2001 and 2012 and to investigate the influence of age, sex, mental health and vitality, and select health behaviours on BMI.

Specifically, the following research questions were examined. First, how has BMI changed from 2001 to 2012? Second, what influence does select health behaviours advocated by the Adventist church have on student's BMI? We hypothesize that influences of Adventist lifestyle will be observed in the Adventist school context and that these will be associated with lower BMI in the students attending Adventist schools.

Methods

Procedure and Participants

A health and lifestyle survey were commissioned by the Adventist church to be conducted in all Adventist schools in Australia in 2001 and 2012. A total of 7,850 students attended Adventist schools in these two years (N=3176 in 2001, and N=4674 in 2012). Valid responses to the surveys were obtained from 1,886 students (24%) comprising 788 responses from 2001 (25%) and 1098 in 2012 (23%). Participation in the questionnaire was voluntary and anonymous.

The respondents across the two-time epochs were similar with regards to age in 2001 and 2012 (14.7±1.7 versus 14.5±1.6) and sex (47% and 46% male.

Instruments

The survey instrument recorded the participant's age and sex. Self-reported health status was assessed using a validated single-item Likert scale, used in adolescent cohorts by (Fosse & Haas, 2009a). Dietary intake was assessed using questions derived from a previously validated food frequency questionnaire ('Adventist Health Study-2', n.d.). Physical activity was assessed separately using two items. The first item asked if the respondent had a regular exercise program ('Adventist Health Study-2', n.d.) and the second asked how many times per week they usually performed moderate or vigorous physical activity for at least 30 minutes (Centre for Epidemiology and Research, NSW Department of Health, 2004). Sedentary behaviour was assessed using frequency questions measuring hours per day for time watching television, videos and DVDs, playing computer games and surfing the Internet. These items were summed to compute a total score for sedentary behaviour. Sleep and sitting were assessed using frequency questions measuring hours per day/night. Validated subscales from the Short-Form 36 Health Survey (SF-36) ('RAND Health, 36-Item short form survey’, n.d.) were used to assess separately mental health and vitality. The mental health subscale is based on five items in the SF-36 measuring general mental health status. The vitality subscale is based on four items of the SF-36 and assesses energy and fatigue status.

Height and weight were self-reported and used to calculate BMI using the standard equation: BMI = weight in kg/(height in m)^2. BMI was further trichotomized into “underweight” “normal weight” and “overweight/obese”. Adolescent BMI cut-off points were calculated according to the World Health Organization (WHO) standardized BMI index (BMI-z) age and sex cut-offs used for classifying adolescents’ weight status (de Onis et al., 2004). The WHO standardized BMI-z age and sex cut-offs are based on adult (18 years and older) cut-offs classifying underweight as a BMI < 18.5kg/m^2, normal weight as a BMI between 18.5 to 24.99 kg/m^2 and overweight as a BMI ≥ 25kg/m^2.

Data Analysis

The data were analysed using SPSS (version 20) and after cleaning was screened for normality using Levene’s test for quality of variances. Descriptive statistics involved mean ± standard deviation. Independent T-tests were used to examine differences between continuous variables over the two time periods. Chi-square was used to assess changes over the two testing periods in the proportion of participants belonging to the three weight categories.

Regression analyses were conducted separately for 2001 and 2012 and then combined using BMI as the dependent variable and age, sex, the mental health and vitality subscales derived from the SF-36 and select health behaviours as the independents. The select health behaviours included as independent variables in the regression were the measures of physical activity and sedentary behaviour described above, sleep hours, and the consumption frequency of fruit, vegetable, whole grain, soft drink, fast food and breakfast.

Results

BMI Status and Changes

There was no significant difference ($p = .16$) in the overall mean BMI of the respondents from 2001 (20.5 ± 3.3 kg.m^{-2}) to 2012 (20.2 ± 2.9 kg.m^{-2}). Table 4 shows the number of respondents belonging to the various BMI categories in 2001 and 2012, as well as in the years combined. The mean BMI for all students involved in the study across the two sampling periods was 20.4 ± 3.1 kg.m^{-2}.

Table 4. *Number of Respondents Belonging to the Trichotamized BMI Categories from 2001 to 2012*

BMI category	**2001**		**2012**		**Combined**	
	N	**%**	**N**	**%**	**N**	**%**
Underweight	126	12.5	92	11.9	218	12.2
Normal weight	713	70.7	576	74.5	1289	72.4
Overweight/obese	169	16.8	105	13.6	274	15.4

Influence of Sex on BMI

When the data from both sampling periods were combined, there was no significant difference between the mean BMI of the males and females (20.5 ± 3.2 versus 20.2 ± 3.0 kg.m^{-2} respectively, $p = .08$).

When the data were stratified for sex, there remained no difference in the mean BMI of the males from 2001 to 2012 (20.4 ± 3.3 versus 20.6 ± 3.0 kg.m^{-2}, $p = .49$). There was a significant reduction in the BMI of the females over the two sampling periods (20.4 ± 3.2 versus 19.9 ± 2.7 kg.m^{-2}, $p = .01$); however, the effect size was very small (Cohen's $d = .17$).

Table 5 shows the number of males and females in the trichotamized BMI categories in the two sampling years. Chi-square analysis indicated a significant change in the proportion of the females belonging to the various categories, with less belonging to the overweight/obese category and more to the normal weight category ($X^2 = 9.2$, $p = .01$) in 2012.

Table 5. *Number of Males and Females Belonging to the Trichotamized BMI Categories from 2001 to 2012*

BMI category	**2001**				**2012**				**Combined**			
	Male		**Female**		**Male**		**Female**		**Male**		**Female**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Under Weight	46	9.7	80	15.0	39	10.5	53	13.2	85	10.1	133	14.2
Normal weight	339	71.5	374	70.0	263	70.9	313	77.9	602	71.2	687	73.4
Overweight /obese	89	18.8	80	15.0	69	18.6	36	9.0	158	18.7	116	12.4

Influence of Age on BMI

From 2001 to 2012 there was no significant change in the BMI for any of the age categories except the 13-year-olds, which decreased (19.8 ± 3.2 versus 19.0 ± 2.9, $p = .025$). Further analysis indicated that this only occurred among the females (19.3 ± 3.2 versus 18.8 ± 2.6, $p = .03$).

Analysis of the data pooled for the two sampling periods indicated a progressive increase ($p < .01$) in the mean BMI of the students with increasing age (12 yrs: 18.8 ± 3.1 $kg.m^{-2}$; 13 yrs: 19.5 ± 3.1 $kg.m^{-2}$; 14 yrs: 20.1 ± 3.2 $kg.m^{-2}$; 15 yrs: 20.4 ± 3.1 $kg.m^{-2}$; 16 yrs: 20.9 ± 2.8 $kg.m^{-2}$; 17 yrs: 20.9 ± 2.8 $kg.m^{-2}$; 18 yrs: 21.7 ± 3.1 $kg.m^{-2}$).

Influence of Select Factors on BMI

Table 6 shows separate regression models for 2001 and 2012 using BMI as the dependent variable and age, sex, mental health and vitality, and select health behaviours as independents. The observation that vegetarianism was not associated with BMI was further supported by independent-samples t test, which showed no difference ($p = .98$) in the BMI of the vegetarian students (20.4 ± 3.2 $kg.m^{-2}$), compared to the non-vegetarians (20.4 ± 3.1 $kg.m^{-2}$). Interestingly, 29% cent of the participants in the study indicated that they subscribed to a vegetarian diet, which was likely influenced by 74% stating that they had one or more parents who were Adventist in their childhood.

Table 6. *Regression Models for 2001 and 2012 for Select Factors Associated with BMI*

Dependent Variable: BMI			
Independent Variables	**2001 (Model R Square = .051) Beta (p)**	**2012 (Model R Square = .101) Beta (p)**	**Combined 2001, 2012 (Model R Square = .066) Beta (p)**
Age	.198**	.236**	.203**
Sex		.105*	.063*
Daily drinks of soft drink	.079*	.117**	.052*
Frequency of breakfast	-.107**		-.068**
Regular exercise program		.073 (.06)	.06*
Hours per night sleeping		-.071 (.091)	-.47 (.084)
Vitality scale		-.077 (.057)	-.47 (.078)

Statistical model: backwards regression. * denotes $p < .05$, ** denotes $p < .001$
Sex: female coded as "1", male coded as "2".

Fruit, Vegetable and Whole Grain Intake.

From 2001 to 2012 there was a significant decrease in the consumption of vegetables (2.16 ± 0.89 versus 2.06 ± 0.77, $p = .001$) and whole grains (2.95 ± 1.11 versus 2.46 ± 0.91, $p < .001$) but not fruit. Further analysis indicated that the decrease in vegetable consumption only occurred among the males (2.19 ± 0.93 versus 2.01 ± 0.82, $p = .019$) and the decrease in whole grain consumption occurred among both males (3.18 ± 1.19 versus 2.58 ± 1.03, $p < .001$) and females (2.76 ± 0.97 versus 2.36 ± 0.78, $p < .001$).

Students meeting recommended daily serves of fruit, vegetables and whole grains as set out by the Australian Government Department of Health and Ageing [DHA] (2008) was above national norms in this study. Seventy-six per cent of females and 73% of males in this study met the recommended daily three serves of fruit. Twenty-three per cent of females and 28% of males met the recommended daily four serves of vegetables (excluding potatoes) and 36% of females and 48% of males in this study met the daily recommended four serves of whole grains.

Discussion

This is the first Australia-wide study of the BMI of adolescents attending Adventist schools. The findings indicate that adolescents attending Adventist schools in Australia report lower rates of overweight and obesity, but higher rates of underweight, than national norms. Further, there was no change in the mean BMI of adolescents attending Adventist schools in Australia from 2001 to 2012.

There is convincing evidence that the rate of overweight and obesity among Australian adolescents has substantially increased over the last thirty years (Olds et al., 2009). Data from 1985 indicated that approximately 11% of 13–15-year-olds were overweight or obese. This increased to 19% by 1997 (Booth et al., 2003) and a report in 2012 by the Australian Bureau of Statistics (2012b) categorized 27% of 12–15 year-olds as overweight or obese. Comparably, the results of Australian school-based studies conducted within the past five years have reported rates of overweight and obesity between 22% (Hardy et al., 2010) and 32% (Allender et al., 2011). The prevalence of overweight and obesity observed among the adolescents attending Adventist schools in this study (17% for 2001 and 14% for 2012) compared favourably with these data. Indeed, it would appear that adolescents attending Adventist schools in Australia are trending some 20 years behind the wider population.

Notwithstanding the secular trend for a progressive increase in the prevalence of overweight and obesity among adolescents over the past 30 years, a review by Olds and associates (2009) suggested that there has been a slowing of the rate of increase over the previous two decades. The present study observed no increase in overweight or obesity among the adolescents attending the Adventist schools. This was observed for all age categories except the 13-year-olds, and for both the males and females. In fact, the female cohort trended towards a decrease in BMI from 2001 to 2012. The significant reduction in the proportion of females in 2012 belonging to the overweight/obese category and the corresponding increase in the normal category is encouraging. This is particularly so considering no significant increase was seen in the underweight category.

The explanation for the lower BMI of adolescents attending the Adventist schools in this study needs further investigation. The Ecological Model for Predictors of Childhood Obesity (Bleich, Ku, & Wang, 2011) suggests that body weight is influenced by three factors: characteristics of the child/adolescent, family influences and societal elements which include the school they attend.

Characteristics of the Adolescent

The students in this study were atypical compared to national norms, as evidenced by 29% claiming to be vegetarian. There is no data on the prevalence of vegetarianism among Australian adolescents, however, in 2009, 2% of Australian adults reported being vegetarian (AIHW, 2012b). Vegetarianism has been consistently associated with lower body weight than non-vegetarian eating patterns in both adults (Sabaté & Wien, 2010) and adolescents (Grant et al., 2008) and may in part explain the lower mean BMI of the students in this study compared to the wider Australian community. It is interesting however that within the study cohort, there was no significant difference in the BMI of vegetarians and non-vegetarians.

There is considerable disparity between reports of fruit, vegetable and whole grain consumption among Australian adolescents (DHA, 2008; Hardy, King, Espinel, Cosgrove, & Bauman, 2011) with some studies indicating less than one per cent meet the national guidelines (DHA, 2008). Comparatively, a high number of the adolescents in this study were categorized as meeting the National recommendations for these foods, especially concerning fruit consumption in which approximately three-quarters of the adolescents met the criteria.

Noteworthy, within the study cohort, vegetable, fruit or whole grains were not associated with BMI. This seems counterintuitive to the underlying hypothesis that vegetable, fruit and whole grain consumption is associated with BMI. This, however, may be explained in part due to this cohort having a lower mean BMI compared to the wider Australian community.

The association between soft drink consumption and BMI in both the 2001 and 2012 samples is supported by other studies of adolescent soft drink consumption (Grant et al., 2008). In 2001, 16% of adolescents in this study consumed one cup of soft drink per day, which declined to 4% in 2012. Comparatively, studies in 2010 and BMI is supported by other studies surveying adult cohorts (Kent & Worsley, 2010). Grant and associates (Grant et al., 2008) found breakfast eating in adolescents contributed to healthier biological profiles. These results are of interest to this study as a focus on breakfast eating and canteen beverage menus may be a useful component of school and family health promotions or interventions. Associations in this study between adolescent's reporting a regular physical activity program and BMI have been found in other studies (Allender et al., 2011) and highlight the importance of physical activity promotion in adolescents.

The higher proportion of vegetarianism in this cohort may also explain the higher prevalence of underweight in this study. A 2007 study of 14 and 16-year-old Australian students found the prevalence of underweight to be approximately 5% (DHA, 2008) which is less than half that observed in this study (12%). Incidences of underweight have been found in environments that place an emphasis on health and wellbeing which have inadvertently led to undesirable outcomes in the thinness of some adolescents (Lazzeri et al., 2014) Underweight has also been associated with unhealthy weight control behaviours from exposure to images of ideally thin models in popular and social media (Lazzeri et al., 2014). With increasing exposure to social media in modern society, this is worth further investigation. Underweight is largely understudied and deserves further research attention due to its association with lower levels of physical fitness compared to “normal” weight adolescents (Lazzeri et al., 2014) and poorer health outcomes (DHA, 2008).

Family Influences

The families of students in this study were atypical compared to national norms, as evidenced by 74% of students indicating that they grew up in a family that had, at least, one Adventist parent. Knowledge and compliance by parents of the healthy holistic lifestyle espoused by the Adventist Church may see an adoption of healthy behaviours in their children. This phenomenon has been observed in other studies (Bleich et al., 2011) where healthy behaviour “copying” in parents, children and siblings has been reported. Behaviour copying in family members demonstrates the influence parent modelling and sibling interaction can have on a child’s evolving health behaviours. Bleich and associates (Bleich et al., 2011) reported that a higher socioeconomic status is also associated with lower BMI levels in adolescents. It is possible that Adventist schools attract more affluent families who can afford the financial burden of private education. The extent to which family dynamics affect adolescent BMI is worthy of further investigation.

School Influences

The Adventist health behaviours and beliefs are promoted and encouraged in Adventist schools. Only vegetarian meals are served in school canteens, and fruit or vegetable snacks are encouraged (and in some schools enforced) during recess breaks. Adventist schools are active in the implementation of needs-based health interventions such as school breakfast programs in underprivileged areas. Staff at Adventist schools are required to model Adventist lifestyle practices at school, which may strengthen the adoption of these behaviours in students. It is well documented that behaviours linked to social learning and cultural norms influence adolescent health behaviours (Rew & Wong, 2006).

Holistic approaches to chaplaincy programs in Adventist schools also promote positive life skills, spiritual development, and service models. A review by Rew and Wong (2006) found that spirituality exerts a positive influence on health attitudes and behaviours. There may have been other unique elements about this study's cohort that were not captured but warrant further investigation.

Limitations

A limitation of this study is the use of self-reported BMI. BMI based on self-reported data has been found to be fairly reliable (Strauss, 1999) and suitable for identifying valid relationships in epidemiological studies (Goodman, Hinden, & Khandelwal, 2000; Strauss, 1999). Several researchers have found self-reported BMI to produce lower prevalence estimates of overweight and higher prevalence estimates of underweight than those based on actual measured height and weight (De Vriendt, Huybrechts, Ottevaere, Van Trimpont, & De Henauw, 2009; Himes, Hannan, Wall, & Neumark-Sztainer, 2005; Jayawardene, Lohrmann, & YoussefAgha, 2014). Notwithstanding, others have reported high accuracy for weight classification of on self-reported data (Bes-Rastrollo et al., 2011; Goodman et al., 2000; Strauss, 1999). In the present study, the students' responses were anonymous in order to negate a reporting bias associated with a desire to be socially accepted.

Conclusions

Students attending Adventist schools appear to be faring better than the secular Australian population with regards to overweight and obesity, although they display a higher prevalence of underweight. In response to the obesity epidemic presently observed among Australian adolescents, the factors responsible for the lower body weights observed among the adolescents in this study is worthy of further investigation. While the adolescents in this study may be atypical in several ways, further research may identify school-based modifiable factors that could be replicated and introduced in other school settings.

Implications for School Health

Schools can play a leading role in addressing concerns over rising rates of overweight and obesity in school aged children (Olds et al., 2009), as well as the associated comorbidities (Denney-Wilson et al., 2008; Kalra et al., 2012; Pulgarón, 2013; WHO, 2004), adverse effects on school performance (Neumark-Sztainer et al., 1997), and overall quality of life (Williams et al., 2005). Hence, reducing overweight and obesity provides academic (Neumark-Sztainer et al., 1997) and behavioural benefits (Kalra et al., 2012) in students that are congruent with the priorities of school administrators and educators. This study identified several behaviours associated with lower rates of overweight and obesity: regularly eating breakfast, consuming less soft drink, having a regular exercise program, and consuming fruits, vegetables, and whole grains. Studies indicate that less than 1% of adolescents meet the national guidelines (AIHW, 2008a) for these health behaviours.

Schools could benefit their students by expanding on traditional health education and physical education pedagogy. Classroom education could be supported with nutrition and cooking classes across the school years teaching the benefits of healthy eating such as consumption of plant-based diets, breakfast eating and the disadvantages of soft drink consumption. Studies (Drummond, 2011) have shown that when students participate in nutrition and cooking classes, the acceptability of healthy foods, such as vegetables, increases. Furthermore, as food awareness and food preparation skills increase, so does interest in home food preparation, essentially growing the students as agents of change within their family. Interestingly, students in this study considered that food allowed or available in school canteens and vending machines was healthy, further supporting the benefits of using the school environment to promote healthy behaviours.

Schools can also promote healthy eating behaviours by enforcing fruit/vegetable snacks for recess, as occurs in some of the schools involved in the present study, as well as reducing the offering of unhealthy foods and drinks at school canteens while increasing the offering of nutritious options. Further, schools may consider offering a healthy breakfast program, as occurs in some of the schools in this study, in underprivileged areas where students come to school without consuming breakfast resulting in midmorning hunger, loss of attention, and increased classroom discipline issues.

The benefits of student physical activity are widely discussed in the literature, however, reduction in time provisions in crowded curriculums and other barriers have seen school administrators cut physical education classes (Jenkinson & Benson, 2010) and recess breaks. Schools can increase physical activity opportunities that complement their physical education classes for all school aged students, not just those who are athletically inclined, with organized recess and lunchtime sports, physical activity clubs, interschool sports programs, and classroom lessons that incorporate physical activity to decrease sedentarism. An emerging strategy for increasing daily participation in physical activity in schools is the implementation of structured classroom-based physical activity breaks. A break of 10-15minutes focused on moderate to vigorous physical activity has been found to be effective in significantly increasing physical activity levels students (Mahar et al., 2006). Studies (Donnelly et al., 2009) have found that sustained use of such breaks has shown to decrease student BMI over a 2-year period. Programs such as Texas I_CAN (Bartholomew & Jowers, 2011) helped teachers incorporate physical activity by modifying lesson plans to include more active activities. These classes may help students learn how to weave physical activity into their daily routines. In the present study, we found some schools successfully ran ‘‘get active’’ after school care and vacation care programs for students to participate in a variety of sports to increase physical activity levels.

Unique to this study cohort is the high percentage of students reporting a vegetarian diet (29%) and, unremarkably, reporting family affiliation with the Adventist Church (74% reporting at least 1 Adventist parent). The influence of the health emphasis of the Adventist Church on both school and family domains highlight the need for schools to recognize the positive effect (Rew & Wong, 2006) school and family collaboration has on educating children. School students could benefit by schools facilitating health programming between school and community and between school and family. An example of how school community and family could collaborate is in organized active transport such ‘‘bike bus’’ or ‘‘walking bus’’ initiatives where volunteer parents escort children from pickup points or homes along fixed routes to school. Walking bus initiatives are popular in Europe and Australia and emerging in the United States.

Chapter 7: Factors predicting alcohol consumption in adolescents attending a faith-based school system in Australia: A multi-group structural equation analysis

Chapter Overview

This chapter addresses the fourth objective of the study project which was: To explore the predictors of alcohol consumption of adolescents attending Adventist schools in Australia. The chapter is presented as a manuscript entitled "Factors predicting alcohol consumption in adolescents attending a faith-based school system in Australia: A multi-group structural equation analysis", which was published in the *Journal of Child and Adolescent Substance* Abuse. The first study (Chapter 4) in this dissertation proposed a hypothesised model for health status that included alcohol consumption as a predictor variable. Interestingly, this variable was removed from the model due to its non-significant contribution to the outcome variable. This finding was unanticipated as alcohol consumption in adolescence is an issue of major public health concern in Australia and globally (Gore et al., 2011; National Health and Medical Research Council, 2009). Accordingly, the aim of this study was to more deeply explore the predictors of alcohol consumption among this unique cohort. The findings of the study contribute to the body of knowledge surrounding adolescent alcohol consumption by exposing the predictors of consumption within a population known for lower consumption of alcohol compared to the general population. The findings and implications of the study are further discussed in Chapter 9.

Co-Author Statement

I attest that Research Higher Degree candidate Bevan Craig contributed to the paper/publication entitled:

Factors predicting alcohol consumption in adolescents attending a faith-based school system in Australia: A multi-group structural equation analysis

By:

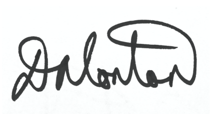
- Leading the conception and design of the study
- Development of measures to be used
- Cleaning the data
- Leading the data analysis (Including use of AMOS SEM Software)
- Interpretation of the data
- Leading the writing of the manuscript
- Submitted the manuscript for review
- Addressed reviewers' comments

Signature of Candidate:

Name of Candidate: Bevan Craig

Date: 5 March 2019

Signature Principal Supervisor:



Name of Principal Supervisor: Dr Darren Morton

Date: 5 March 2019

Abstract

Struct Structural equation modelling was used to explore the direct and indirect association of childhood experiences, attitudes, subjective norms and intentions on the alcohol consumption of adolescents attending faith-based schools in Australia. Data were collected on 1266 adolescents and the structural model developed explained 48% of the variance for alcohol consumption. Intentions had the highest degree of association with Alcohol Consumption Status (ACS) ($\beta = 0.52$). Attitudes were more strongly associated to ACS ($\beta_{total} = 0.36$) than subjective norms ($\beta_{total} = 0.17$). Adverse Childhood Experiences (ACEs) were associated with every variable in the model and had a combined direct and indirect association with ACS of $\beta_{total} = 0.14$. Multi-group analysis found significant pathway differences in the model for gender and age with regards to the association of intentions, attitudes, ACEs and Childhood Family Dynamics with alcohol consumption status. The study fills a gap in the alcohol literature by presenting a model describing the complex network of factors that predict alcohol consumption in a low ACS population. The outcomes of the study highlight the importance of early intervention for children and their families to delay or minimize alcohol consumption in adolescents.

Introduction

The consumption of alcohol by adolescents is an issue of major public health concern globally as it is associated with an array of poor physical, psychological and behavioural outcomes (Gore et al., 2011; National Health and Medical Research Council, 2009). Adolescent alcohol consumption is a leading cause of premature death and injury in adolescents (Gore et al., 2011) and is a key risk factor for early sexual debut (Coleman & Cater, 2005), depression (Fergusson, Boden, & Horwood, 2009) compromised brain function and development (Jacobus & Tapert, 2013; McQueeny et al., 2009), poor academic outcomes (Koch & McGeary, 2005), alcohol dependence (McCambridge, McAlaney, & Rowe, 2011) and adverse mental and physical health in adulthood (Andréasson, Romelsjö, & Allebeck, 1991).

Over the past few decades, there has been a steady decline in alcohol consumption in adolescent populations in many countries including England, the United States (Looze et al., 2015), Australia (Livingston, 2014) and a number of European countries (Looze et al., 2015). In Australia, these declines have occurred across a wide range of population subgroups defined by demographic, geographic and socio-economic factors (Livingston, 2014). Little attempt has been made to explore the factors driving the reduction in alcohol consumption in adolescent populations (Livingston, 2015; Pennay, Livingston, & MacLean, 2015) despite the potential public health benefits (Livingston, 2014).

Factors driving drinking behaviours in adolescents are wide-ranging, occurring on multiple levels. Behaviour change theories such as the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) have been used extensively to predict, explain and understand health-related behaviours such as alcohol consumption in adolescents (Laflin et al., 1994; Lorenzo-Blanco et al., 2016; Stoddard & Pierce, 2018). The TRA's premises are threefold. Firstly, the TRA proposes that intentions are an important predictor of behaviour. Secondly, intentions are directly determined by two motivational factors, namely: attitudes and subjective norms. Attitudes refer to the evaluation of a particular behaviour by the individual. Subjective norms capture social pressures that may influence an individual's intention to use alcohol (Ajzen & Fishbein, 1980). The literature on alcohol use suggests that attitudes towards alcohol use, normative influences and intention to use alcohol are important predictors of adolescent alcohol consumption (Marcoux & Shope, 1997). Thirdly, antecedent to attitudes and subjective norms are beliefs. Fishbein and Ajzen (Fishbein & Ajzen, 2011) regard these beliefs as the psychological determinants that need to be altered to bring about behaviour change.

While numerous theories explain the development of beliefs, Bronfenbrenner's (Bronfenbrenner, 2005) Bioecological Systems Theory (BST) suggests that the environment in which a child grows, particularly the family environment contributes to a child's developing beliefs and ultimately their behaviour. Many studies (Kelly et al., 2011; Laghi, Baiocco, Lonigro, Capacchione, & Baumgartner, 2012; Yap, Cheong, Zaravinos-Tsakos, Lubman, & Jorm, 2017) confirm that an adolescent's family dynamics, including relationship quality, may predict adolescent drinking beliefs, however little research has investigated the relationship between early childhood family dynamics and ACS later in the adolescent years. Other childhood experiences that may influence the development of beliefs are Adverse Childhood Experiences (ACEs) (Felitti et al., 1998). ACEs refer to stressful or traumatic experiences that a child may encounter in early life such as physical, psychological and sexual abuse, neglect, and family dysfunction. These traumatic, stressful experiences have been established as factors that predict alcohol consumption in adolescents (Dube et al., 2006; Felitti et al., 1998; Gonçalves et al., 2016). Studies that have applied the TRA to alcohol consumption have largely overlooked the influence of important antecedent beliefs

(Pabian & Vandebosch, 2014). This study attempts to address this gap in the literature by including both the TRA and antecedent beliefs measured through the influence of ACEs and CFD when exploration of predictors of ACS are assessed.

One population of interest is the faith-based Seventh-day Adventist (Adventist) population which has been the subject of extensive health research. Adventists tend to consume significantly lower rates of alcohol than the general population (Orlich et al., 2013a). Indeed the Adventist faith proscribes alcohol consumption and advocates positive family dynamics (Ministerial Association of Seventh-Day Adventists, 1988). A previous study on Adventist adolescents suggested that the Adventist faith influenced the impact family dynamics have on adolescent attitudes towards alcohol consumption and alcohol consumption status. In the study, adolescents with no Adventist parents compared to one Adventist parent, or both parents who were Adventist had increasingly negative attitudes towards alcohol consumption and lower rates of consuming alcohol (Gane, 2012).

The present study employed Structural Equation Modelling (SEM) and applied the TRA and the antecedent childhood experiences ACEs and CFD to examine the direct and indirect association of alcohol consumption operationalized as Alcohol Consumption Status (ACS) among adolescents attending a faith-based school system in Australia. In addition, multi-group SEM analyses were used to more extensively explore gender and age variations in these relationships.

Methods

Study Participants

In 2012 a survey was administered in 21 private Adventist secondary schools across Australia which cater for both Adventist and non-Adventist students. A total of 4674 students attended Adventist secondary schools (years 7–12) in 2012. Completed responses were received from

1266 students (27%) in years seven to twelve. Participation in the study was voluntary and anonymous, and written consent was collected from the students as well as their parents or guardians. The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No:2011:21). Approximately 41% of adolescents in Australia attended private secondary schools at the time of the survey with 0.9% attending the Adventist school system (ABS, 2017).

Survey Instrument

The survey instrument recorded the participant's ACS as well as: intentions to consume alcohol, attitudes towards alcohol consumption, subjective norms, CFD, ACEs, and personal demographics.

Alcohol Consumption

Current ACS was measured using an item used in previous Australian adolescent studies (Bowden et al., 2017a; White & Bariola, 2012; White, Hill, & Segan, 1997) that asked: "At the present time, do you consider yourself: 1. Non-drinker. 2. Occasional Drinker. 3. Light Drinker. 4. Party Drinker. 5. Heavy Drinker." For the purpose of this study, this item was trichotomized to Non-Drink (response 1), Light Drinker (responses 2 and 3) and Heavy Drinker (responses 4 and 5). The authors acknowledge the absence of quantification of this measure, however differences in gender and age using this measure in the above studies are in line with other studies (AIHW, 2014; Livingston, 2014) measuring alcohol consumption with quantifiable measures.

Intentions to Consume Alcohol

Intention to consume alcohol was measured with the single item asking the participants to respond to the statement "I plan to drink alcohol at my current age" with a choice of five options ranging from "Strongly Disagree" to "Strongly Agree".

Attitudes towards Alcohol Consumption

Attitudes towards alcohol consumption where measured by asking participants to respond to the following statements: “It is ok to drink alcohol at my age”, “Alcohol is harmful to my relationships” and “Alcohol is harmful to my health” with a choice of five options for each statement ranging from “Strongly Disagree” to “Strongly Agree”. The attitudinal items were not combined into a scale so that the individual relationship of each item with ACS could be examined as previously assessed elsewhere (Marcoux & Shope, 1997).

Subjective Norms Surrounding Alcohol Consumption

Subjective norms relating to alcohol consumption were measured using three items. The first item asked respondents: “In the past month would any of your close friends have used alcohol?” with response options “Yes, some of my friends” and “No, none of my friends”. Items two and three used to measure subjective norms asked participants to respond to the following statements: “It is ok for me to say ‘no’ to drinking if friends offer me a drink” and “It is ok for me to say ‘no’ to drinking if family members offer me a drink”. Responses for these items included five options ranging from “Strongly Disagree” to “Strongly Agree”. The subjective norm items were not combined in a scale so that the individual relationship of each normative item with ACS could be examined as previously assessed elsewhere (Marcoux & Shope, 1997).

Childhood Family Dynamics

Childhood family dynamics were assessed by creating a CFD score used in a previous study (Craig, Morton, Morey, et al., 2018) from six items: “As a child, my parents showed me love”; “As a child, my parents understood me”; “While I was a child my family had a lot of fun”; “As a child, my parents didn’t trust me”; “As a child, my parents didn’t care what I did”; and, “As a child, I enjoyed being at home with my family.” Each item included five options ranging from “Strongly disagree” to “Strongly agree.” Each response was given a corresponding value from one to five with higher scores representing increasingly positive outcomes. Responses from each item were summed to calculate an overall CFD score.

Adverse Childhood Experiences

In this study, an adapted ACEs score as described elsewhere (Felitti et al., 1998) and used in a prior study (Craig, Morton, Morey, et al., 2018) was generated by collating the responses from the following nine items: “One or both of my parents were in trouble with the law”; “My parents were separated or divorced”; “One or both my parents died”; “One or both parents were absent from home for long periods”; “There were times when family violence occurred”; “There were times when I was physically abused”; “There were times when I was sexually abused”; “One or both parents smoked tobacco”; and, “One or both parents drank alcohol weekly or more often.” Each item included no/yes response options which were given a corresponding value of zero or one. Responses from each item were summed to calculate an overall ACEs score. It is acknowledged that the item asking about parent’s consumption of weekly alcohol may not equate to an ACE directly, however, may be associated with parental absence or other potential harms.

Religious Affiliation

Religious affiliation was included in this study due to the special nature of the sample. Religious affiliation was assessed by asking the participants: “Which of the following best describes your religious belief now?” Options ranged from: 1. Seventh-day Adventist Christian; 2. Other Christian; 3. Other Religion; 4. No Formal Religion; and 5. Don’t Know. For the purpose of this study, this item was dichotomized to Adventist (response 1) and not Adventist (responses 2-4).

Analysis

The objective of this study was to examine the direct and indirect predictors of alcohol consumption employing SEM. A hypothesized model informed by the literature and the TRA (Ajzen & Fishbein, 1980) is presented in Figure 10 for analysis.

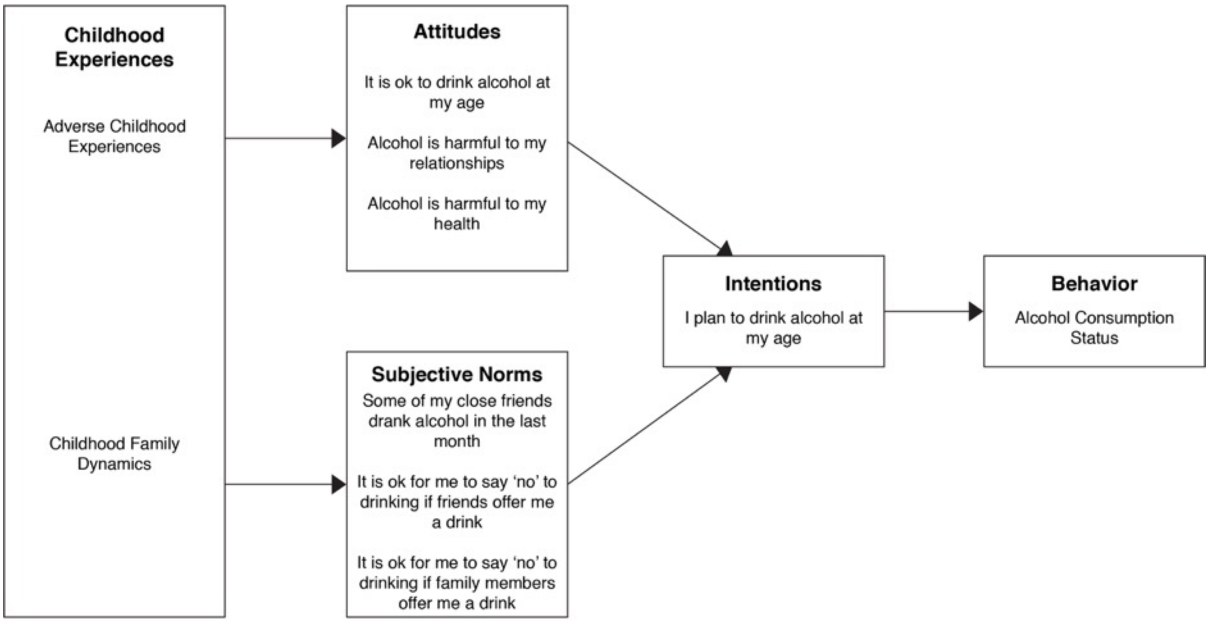


Figure 10. Hypothesised model predicting alcohol consumption status

The most proximal explanatory variables were intentions to consume alcohol followed by attitudes towards alcohol consumption and subjective norms. The distal variables included childhood experiences. The data were imported into SPSS (version 24; IBM, Armonk, NY) to calculate means, standard deviations, distributions and internal reliability. Structural equation modeling using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA) was conducted to estimate the model fit of the data in the hypothesized model (Figure 1) and simultaneously analyze the direct and indirect effects of the explanatory variables on the outcome variable (Bucy & Holbert, 2014). This was done using techniques developed by Jöreskog and Sörbom (1989) which involved an iterative process of inspection of the statistical significance of path coefficients and theoretical relevance of the constructs in the model to derive an optimal SEM that best fit the dataset and was theoretically meaningful. Overall model fit was examined using multiple goodness-of-fit indices, namely: relative X^2 (CMIN/DF), baseline comparisons fit indices of normative fit index (NFI), relative fit index (RFI), incremental fit index (IFI), Tucker-Lewis Index (TLI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). A CMIN/DF statistic below three is considered good model fit (Kline, 2010) as are baseline comparisons fit indices above 0.9 (Bentler, 1990). The RMSEA value was less than 0.06, which indicated a close fit between the data and the model (Hu & Bentler, 1999). Bootstrapping (Preacher & Hayes, 2008) was applied to verify the statistical significance of indirect effects at $p < .05$. Multi-group analysis was employed to test for gender and age variations among the pathways in the study, as age and gender differences have been observed in previous TRA and alcohol consumption studies (Cooke, Dahdah, Norman, & French, 2016). The critical ratios for differences test were applied to assess for regression weight differences in the gender and age groups within the SEM (Ho, 2013).

Results

Descriptive Statistics

A summary of descriptive statistics and reliability estimates is shown in Table 7. Students ages ranged from 12-18 years, mean age 14.6 years, 56% males and 47% of students identified as belonging to the Adventist faith. Eighty-two per cent of the adolescents in the study reported "non-drinker" status, 12% reported "light drinker" status and 6% "heavy drinker" status. Chi-square analysis indicated a significant difference in the proportion adolescents belonging to the ACS categories with less older adolescents (15–18 years) belonging to the non-drinker category and more belonging to the light drinker and heavy drinker categories compared to younger adolescents (12–14 years) ($X^2 = 101.6$, $p < .01$). Further, less non-Adventist students belonged to the non-drinker category and more belonged to the light drinker and heavy drinker category compared to Adventist students ($X^2 = 44.2$, $p < .01$).

Table 7. *Descriptive Statistics and Scale Reliability of Variables Used in the Analysis*

Variables	**N**	**%**	**Mean**	**Standard Deviation**	**Min**	**Max**	**Scale Reliability (α)**
Age	1266		14.64	± 1.59	12	18	
Younger Adolescents (12–14 yr olds)	597	47.2%					
Older Adolescents (15–18 yr olds)	669	52.8%					
Gender							
Males	557	44%					
Females	709	56%					
Adverse childhood experiences score	1266		1.39	± 1.62	0	9	.69
Childhood family dynamics score	1266		24.20	± 4.73	5	30	.84
It is ok to drink alcohol at my age	1266		1.92	± 1.19	1	5	
Alcohol is harmful to my relationships	1266		3.94	± 1.26	1	5	
Alcohol is harmful to my health			4.25	± 1.13	1	5	
Some of my close friends drank alcohol in past month	1266		1.52	± 0.50	1	2	
It is ok for me to say 'no' to drinking if friends offer me a drink	1266		4.56	± 1.04	1	5	
It is ok for me to say 'no' to drinking if family members offer me a drink	1266		4.52	± 1.07	1	5	
I plan to drink alcohol at my age	1266		1.75	± 1.20	1	5	

Alcohol Consumption Status	**Males**		**Females**		**Younger Adolescents**		**Older Adolescents**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
A non-drinker	460	82.6%	575	81.1%	556	93.1%	479	71.6%	1035	81.8%
An occasional drinker	54	9.7%	75	10.6%	26	4.4%	103	15.4%	129	10.2%
A light drinker	10	1.8%	11	1.6%	8	1.3%	13	1.9%	21	1.7%
A heavy drinker	33	5.9%	48	6.8%	7	1.2%	74	11.1%	81	6.3%

Abbreviations: α = Cronbach's alpha

The Model Predicting Alcohol Consumption Status

A final structural model is presented in Figure 11 and describes the associations of childhood experiences (ACES and CFD), attitudes towards alcohol consumption, subjective norms relating to alcohol consumption and intentions to consume alcohol with alcohol consumption status, along with their interactions.

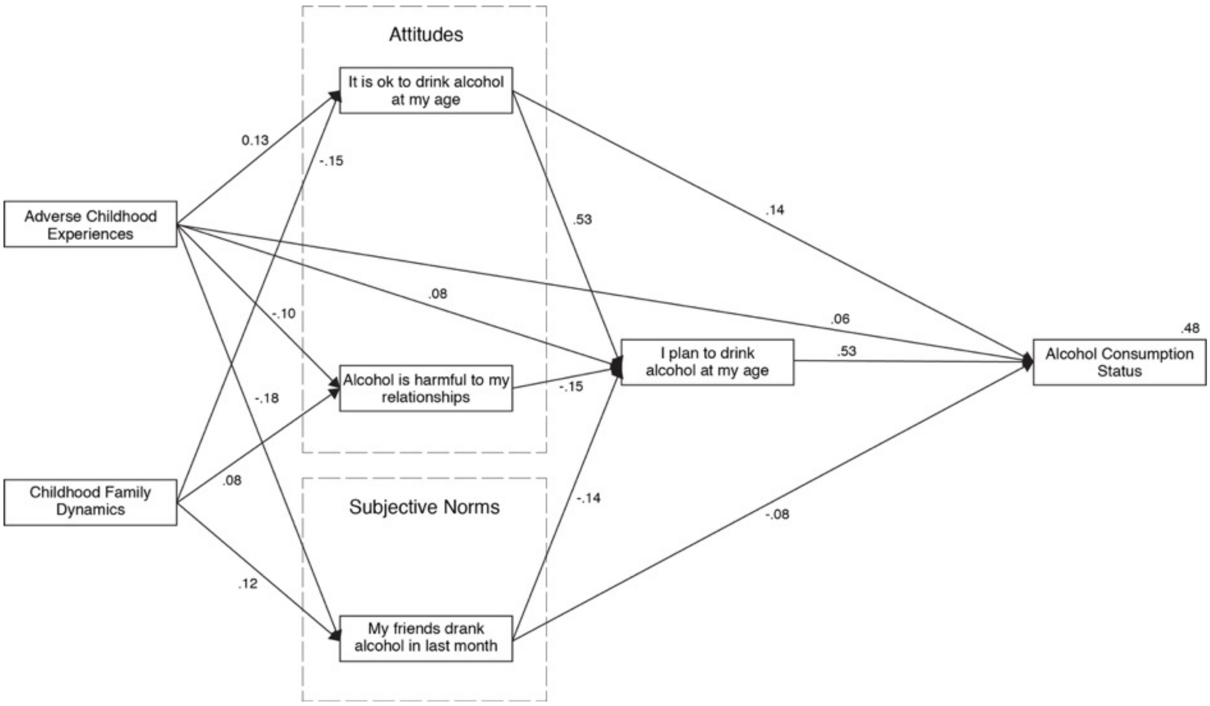


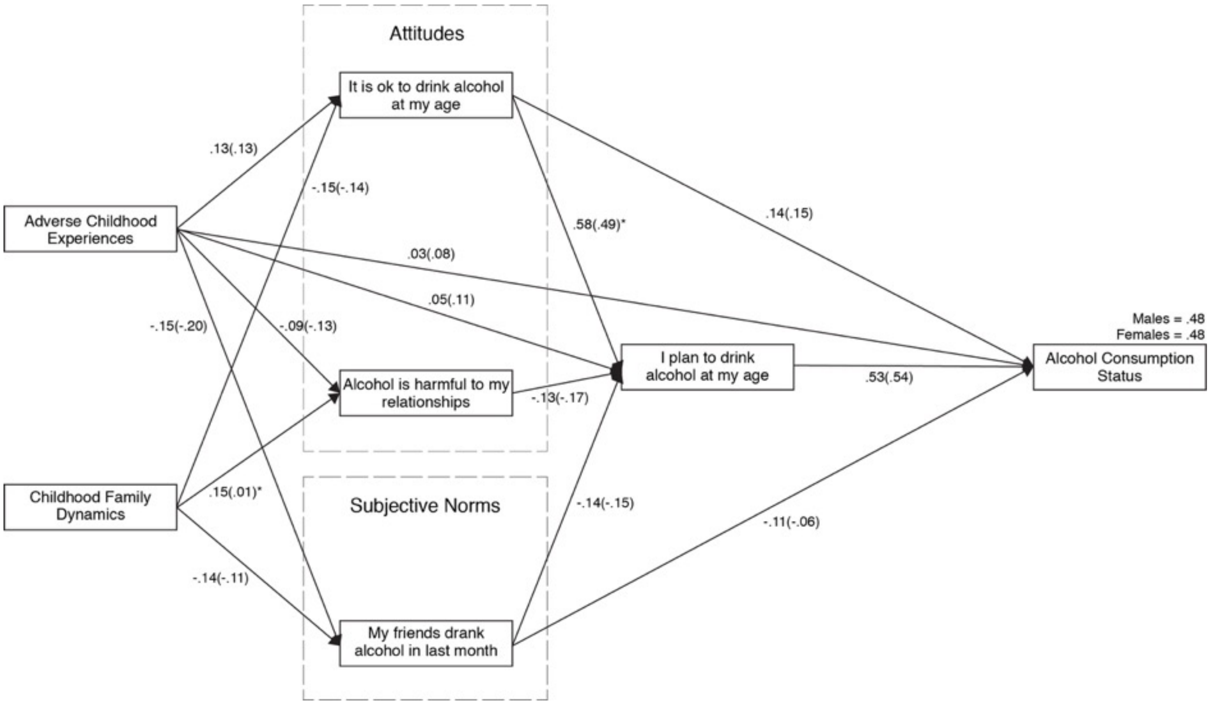
Figure 11. Structural equation model predicting alcohol consumption status in adolescents

The final structural model fitted the data very well, as indicated by the goodness-of-fit indices (CMIN/DF=2.365; NFI=0.997, RFI=0.978; IFI=0.998; TLI=0.987, CFI=0.998 and RMSEA=0.033). The subjective norm items asking: "It is ok for me to say 'no' to drinking if friends offer me a drink" and "It is ok for me to say 'no' to drinking if family members offer me a drink" were removed from the model due to their non-significant contributions generating the final structural model (Figure 11). Standardized path coefficients are presented as single-headed arrows in the final model. All shown paths are statistically significant including all indirect and combined total pathways. The squared multiple correlation calculated for ACS of 0.48 indicates that the model explained 48% of the variance for alcohol consumption status. The attitudinal variable: "Alcohol is harmful to my health", and the subjective norm variables "It is ok for me to say 'no' to drinking if friends offer me a drink" and “It is ok for me to say ‘no’ to drinking if family members offer me a drink” were removed from the final structural model because of their non-significant contributions to ACS.

The combined direct and indirect association (β_{total}) of the two attitudinal variables (“It is ok to drink alcohol at my age”, “Alcohol is harmful to my relationships”) with ACS was β_{total} = 0.36. This compared with the combined direct and indirect association of the subjective norms variable (“Some of my close friends drank alcohol in the past month”) with ACS which was β_{total} = 0.17. Of the childhood factors measured in the model, the combined direct and indirect association of ACEs with ACS was β_{total} = 0.14 compared to the combined direct and indirect association of CFD with ACS which was β_{total} = -0.10.

Multi-group analysis for gender (Figure 12) found a significant difference in the path coefficient between CFD and “Alcohol is harmful to my relationships” with this association stronger for males (β = 0.15) than for females (β = 0.01). A significant difference in the path coefficient was also found between “It is ok to drink alcohol at my age” and “I plan to drink alcohol at my age” with this association stronger for males (β = 0.58) than for females (β = 0.49).

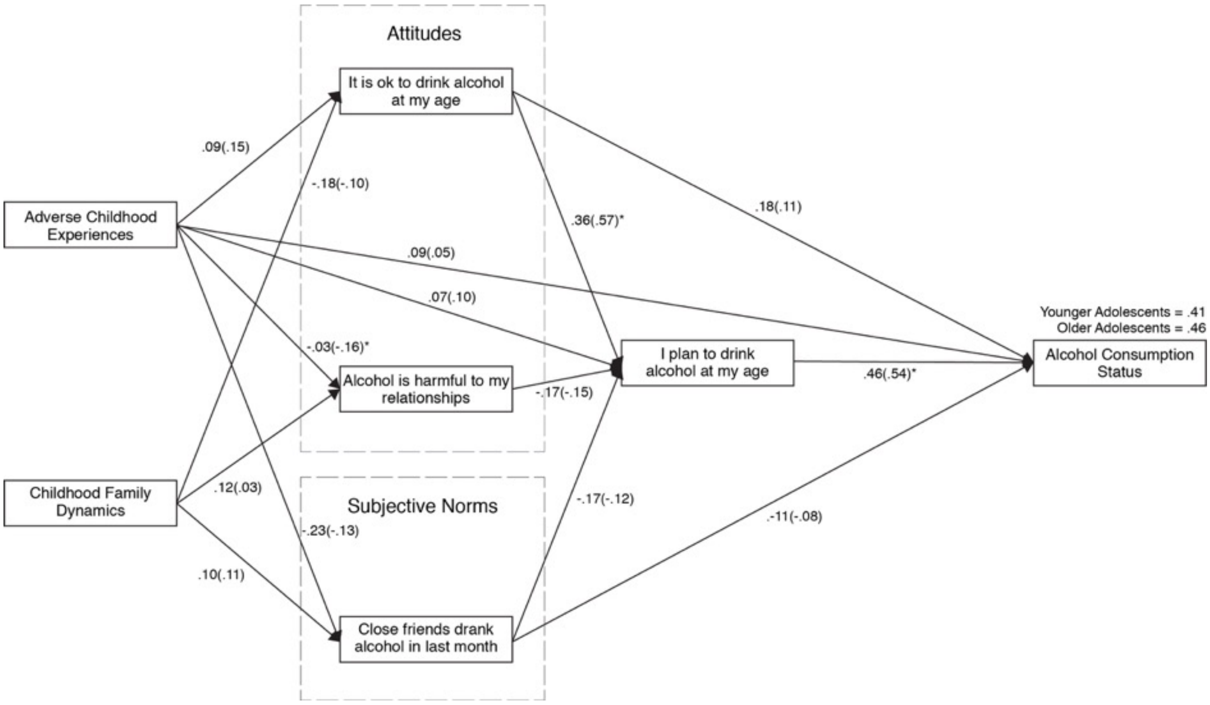
Multi-group analysis for age groups (12–14yrs versus 15–18yrs) (Figure 12) found a significant difference in three path coefficients. Firstly, the association between ACEs and “Alcohol is harmful to my relationships”, was significantly stronger for older adolescents (β = -0.16) than for younger adolescents (β = -0.03). Secondly, the association between “It is ok to drink alcohol at my age” and “I plan to drink alcohol at my age” was stronger for older adolescents (β = 0.57) than for younger adolescents (β = 0.36). Thirdly, the association between “I plan to drink alcohol at my age” and ACS was stronger for older adolescents (β = 0.51) than for younger adolescents (β = 0.46).



Males(Females); * Significant difference between males and females at p < .05

Figure 12. Structural equation model multi-group analysis for gender

Multi-group analysis for age groups (12–14yrs versus 15–18yrs) (Figure 4) found a significant difference in three path coefficients. Firstly, the association between ACEs and "Alcohol is harmful to my relationships", was significantly stronger for older adolescents ($\beta = -0.16$) than for younger adolescents ($\beta = -0.03$). Secondly, the association between "It is ok to drink alcohol at my age" and "I plan to drink alcohol at my age" was stronger for older adolescents ($\beta = 0.57$) than for younger adolescents ($\beta = 0.36$). Thirdly, the association between "I plan to drink alcohol at my age" and ACS was stronger for older adolescents ($\beta = 0.51$) than for younger adolescents ($\beta = 0.46$).



Younger adolescents, 12–14 years (Older adolescents, 15–18 years)
* Significant difference between younger and older adolescents at $p < .05$

Figure 13. Structural equation model multi-group analysis for age groups

Discussion

This study explored a complex network of factors predicting alcohol consumption status in adolescents attending faith-based schools that promote alcohol abstinence. The study was unique in that it simultaneously measured the association of both negative and positive childhood experiences, current attitudes and subjective norms with intentions to consume alcohol and alcohol consumption status.

Eighty-two per cent of adolescents in this study reported that they were non-drinkers compared to 66% in a 2011 national study (White & Bariola, 2012) and 69% in a South Australian study (Bowden et al., 2017a). These previous studies utilized the same item to measure ACS. The lower rates of alcohol consumption in this study may be due to the high percentage (47%) of adolescents in this study that identify as Adventist. Indeed, more students identifying as Adventist reported belonging to the ACS non-drinker category compared to non-Adventist students. Previous research links religion with lower rates of alcohol consumption in adolescents across multiple measures of religiosity (Sinha, Cnaan, & Gelles, 2007b) however other research has suggested that the protective effect of religion operated more strongly for some religions compared to others (Marsiglia, Kulis, Nieri, & Parsai, 2005). How the Adventist faith may influence predictors of adolescent alcohol consumption is worth further investigation.

The study supports the TRA's (Ajzen & Fishbein, 1980) ability to enhance understanding of the factors associated with alcohol consumption in adolescents. Intention to consume alcohol had the strongest association with ACS ($\beta = 0.52$) which is in line with other TRA and alcohol consumption studies (Cooke et al., 2016). Interestingly, the attitudinal variable "It is ok to drink alcohol at my age" ($\beta = 0.13$) and the social norm variable "Some of my close friends drank alcohol in the last month" $\beta = 0.07$) was not only associated with intentions to consume alcohol as theorized in the TRA but was also directly associated with ACS (Figure 2).

Examination of the relative importance of the attitudinal and subject norm variables revealed that the combined direct and indirect association of the attitudinal variables ("It is ok to drink alcohol at my age", and "alcohol is harmful to my relationships", $\beta_{total} = 0.36$) were more predictive of ACS than the subjective norm variable ("In the past month would any of your close friends have used alcohol?", $\beta_{total} = 0.17$). This may be expected considering two subjective norm items were removed from the model during analysis. This result is in line with other studies (Cooke et al., 2016) in adult cohorts, however, TRA and alcohol research (Marcoux & Shope, 1997; Stoddard & Pierce, 2018) in adolescent groups have found that subjective norms were more predictive of adolescent alcohol consumption than attitudes.

Wide spread agreement in the literature (Donovan, 2004; Janssen, Mathijssen, van Bon-Martens, van Oers, & Garretsen, 2014; Kuntsche et al., 2015; Ryan, Jorm, & Lubman, 2010) recognizes the powerful influence of social pressures on adolescent drinking behaviours. The lack of importance of subjective norms in the model in this study may be related to overall low prevalence of drinking in this cohort, and in turn, faith. Further study could explore this as a faith-based phenomenon. Minimal research has targeted attitudinal constructs in adolescent cohorts, and this study would suggest that this is worth further investigation.

The non-significant association of the attitudinal variable "Alcohol is harmful to my health" with intention to consume alcohol or ACS was surprising. This adolescent cohort was exposed to a faith-based culture with a long history of emphasizing health and lifestyle education as well as general compliance to the prohibition of alcohol consumption (Craig et al., 2017). The majority of adolescents in a study by Harvey & McKay (2017) did not consider the health consequences of alcohol consumption in their decision making to consume alcohol. While health education is important in any age group, the literature suggests that attitudes towards health in adolescent populations may not be firmly established until later adolescence (Marcoux & Shope, 1997).

Many studies have highlighted the influence of peer and family pressure on adolescent drinking behaviours (Donovan, 2004; Janssen et al., 2014; Kuntsche et al., 2015; Ryan et al., 2010). Accordingly, it was surprising in the present study that two subjective norm items did not significantly predict intentions to consume alcohol or alcohol consumption status. The non-significant association of these subjective norm items may be attributable to the atypical nature of this cohort resulting in lower rates of exposure to alcohol drinking peers and parents. Further investigation into this social phenomenon and its influence on alcohol consumption in adolescents exhibiting low rates of drinking maybe worthwhile.

A key objective of the present study was to simultaneously measure the association of childhood experiences, and the TRA constructs of attitudes, subjective norms, and intentions, on alcohol consumption. Notably, ACEs were associated with every variable in the model, thus further expanding upon the work of others who have reported connection a between ACEs and alcohol consumption in adolescents (Dube et al., 2006). Interventions intended to delay the onset of drinking alcohol in adolescents may be enhanced from understanding the contribution that ACEs have on the lives of children, not only directly, but indirectly through attitudes, social pressures and intentions. As the ACEs score accessed early life experiences, this study highlights the importance gathering information about the early lives of children and their families in order to design preventive strategies targeting ACEs for children and families as early as possible. For adolescents suffering ACEs, advances in neuroeducation based interventions (Leitch, 2017) may enable ACEs affected adolescents to respond in a healthy way to stress caused by ACEs. Although children may have no choice in the ACEs they experience, this study reinforces the necessity for childhood human rights and protection to be at the forefront of global policy and intervention development. Further research examining the mechanism through which ACEs in early childhood contribute to the development of beliefs that drive attitudes and subjective norms would be valuable.

The association of CFD with adolescent alcohol consumption observed in this study is not surprising given that interventions targeting family dynamics have been shown to be the most effective prevention and treatment for adolescent alcohol use (Foxcroft, Ireland, Lister-Sharp, Lowe, & Breen, 2003; Livingston, 2015). Understanding how family dynamics not only influence alcohol use directly but indirectly through attitudes, social pressures and intentions may benefit intervention development. The originating role of family dynamics in early childhood and alcohol consumption later in the adolescent years, points to the potential value of family-based alcohol prevention programs promoting positive family dynamics in early childhood. Comparisons of the CFD experienced by this faith cohort compared to other populations and ACS warrants further investigation.

The multi-group analysis in this study demonstrated several significant pathway differences between gender and adolescent age groups. The stronger association between intention to consume alcohol and alcohol consumption in older adolescents compared to younger adolescents was expected. The attitude that it is ok to drink alcohol had a stronger association with intention to consume alcohol for males and older adolescents which may also explain the higher ACS in older adolescents compared to younger adolescents. Interventions addressing this attitude in males and older adolescents may decrease alcohol consumption in these groups. The gender and age differences in the pathways between ACEs and CFD and the attitudinal variable "alcohol is harmful to my relationships" also highlight the importance of age and gender appropriate intervention development in these areas.

Strengths and Limitations

The strength of this study is that it simultaneously measured the association of the childhood experiences, ACEs and CFD and the key TRA constructs of attitudes, subjective norms, intentions on alcohol consumption. However, it is acknowledged that the model presented in this study, although strong, does not represent all factors that are related to adolescent alcohol consumption. For example, individual characteristics, policy, pricing, advertising and higher densities of alcohol outlets are also associated with ACS (Livingston, 2014). Although the item measuring ACS has been used in previous studies (Bowden et al., 2017a; White & Bariola, 2012; V. M. White et al., 1997), its subjective nature is acknowledged. Future studies may benefit from an alcohol consumption frequency measure in an attempt to gain a more objective measure of alcohol consumption. The cross-sectional nature of this study means that only associations could be measured and hence it is not possible to conclude causality. Futures studies may also benefit from employing the Theory of Planned Behaviour which extends on the TRA by positing that the construct perceived behavioural control also influences intentions and subsequent behaviours.

Conclusion

This study presents a model describing a complex network of factors associated with alcohol consumption in adolescents that exhibit lower rates of drinking than the general population. The results confirm the association of intentions, attitudes towards alcohol consumption, subjective norms surrounding alcohol consumption and childhood experiences with alcohol consumption status. The study fills a gap in the literature relating to factors predicting alcohol consumption in a low ACS population. The findings highlight the importance of designing age and gender appropriate interventions for children and families as early as possible in order to delay or minimize alcohol consumption in adolescents.

Chapter 8: Religious affiliation Influences on the health status and behaviours of students attending Seventh-day Adventist Schools in Australia

Chapter Overview

This chapter addresses the fifth objective of the study project which was: To investigate the influence of religious affiliation on the health behaviours and health status of adolescents attending Adventist schools in Australia. The chapter is presented as a manuscript entitled "Religious affiliation Influences on the health status and behaviours of students attending Seventh-Day Adventist Schools in Australia", which was published in the *Journal of Religion* and Health. A unique aspect of the cohort under investigation in this study project is the exposure it has to the Adventist faith community. The Adventist faith emphasises a holistic healthy lifestyle which is promoted in Adventist schools and churches. Study 3 (Chapter 5) found that adolescents attending Adventist schools have better health behaviours and outcomes than national norms. However, Adventist schools cater to both Adventists and non-Adventists. The objective of this study was therefore to investigate the influence of religious affiliation on the adolescents' health behaviours and health status. This study contributed to the literature in that while Adventist adult populations have been extensively studied since 1960 through the Adventist Health Studies (Dinu, Abbate, Gensini, Casini, & Sofi, 2017; Orlich et al., 2013b), there has been limited research examining the influence of religion among Adventist Australian adolescents. The findings and implications of the study are further discussed in Chapter 9.

Co-Author Statement

I attest that Research Higher Degree candidate Bevan Craig contributed to the paper/publication entitled:

Religious affiliation Influences on the health status and behaviours of students attending Seventh-day Adventist Schools in Australia

By:

- Contributing to the conception and design of the study
- Development of measures to be used
- Cleaning the data
- Leading the data analysis
- Interpretation of the data
- Leading the writing of the manuscript
- Submitted the manuscript for review
- Addressed reviewers' comments

Signature of Candidate:

Name of Candidate: Bevan Craig

Date: 5 March 2019

Signature Principal Supervisor:

Name of Principal Supervisor: Dr Darren Morton

Date: 5 March 2019

Abstract

Students attending Seventh-day Adventist (Adventist) schools in Australia have been shown to have better health behaviours compared to secular norms, yet these schools cater for a high percentage of non-Adventist students. The purpose of this study was to investigate the influence of religious affiliation (Adventist/Other Christian/Non-religious) on the health status and behaviours of students attending Adventist secondary schools in Australia. The sample included 1734 students who responded to a health and lifestyle survey that captured demographic details, self-reported height and weight, self-reported health status, mental health, and select health behaviours. Students who identified themselves as Adventist, reported significantly better health behaviours than the other Christian and non-religious students in several behavioural domains, especially among the older adolescence (16–18 years). However, this did not translate to a difference in health status. Further research is needed to understand the causal mechanisms responsible for the potential health advantage of Adventist students, which may include family or religious influences.

Introduction

Adolescent health is a major worldwide concern and central to a number of current and urgent global health challenges (Patton, Ross, et al., 2014; Sawyer et al., 2012). In developed countries such as Australia, adolescents have the highest growth rate of chronic disease prevalence of all population cohorts (AIHW, 2008c). Of concern, health behaviours and attitudes realised in adolescence flow through to adulthood and largely determine adult health (Eckersley, 2007).

Over the past few decades, theorists have begun to argue that in order to better understand and improve adolescent health, a shift in focus is needed. This shift moves upstream from individual to social factors (Viner et al., 2012a). Commonly referred to as the social determinants of health approach, the WHO (2008) defines these as “the conditions in which people are born, grow, live, work and age”. These conditions can be proximal to the individual, structural or both and are supported by behaviour change theories (Ajzen, 2011; Bandura, 2001). Viner and associates (Viner et al., 2012a) suggest religion moderates the social determinants of health and ultimately the health of the individual.

It is now generally accepted among social and health scientists that there is an association (both positive and negative) between religion and health (Levin, 2015). The association is unaffected when controlling for demographic variables (Ellison & Levin, 1998) and is similar to other well-established predictors of health such as physical activity, diet, smoking and alcohol consumption (Cotton, McGrady, & Rosenthal, 2010; Cotton, Zebracki, Rosenthal, Tsevat, & Drotar, 2006; Rew & Wong, 2006). More specifically, religion has been shown to have positive relationships in adolescent diet (Wallace & Forman, 1998), physical activity (Wallace & Forman, 1998), alcohol consumption (Beyers et al., 2004), tobacco usage (Sinha et al., 2007a), illicit drug usage (Cotton et al., 2006), and health status (Zullig et al., 2006).

Religion has also been positively and negatively associated with adolescent obesity (Craig et al., 2017; Dewes et al., 2013) and mental health, including depression (Cotton et al., 2006).

The Adventist religion places a strong emphasis on healthful living within their denomination and has been the subject of extensive health research. The Adventist Church is a worldwide religion with over 18 million members ("Seventh-day Adventist World Church Statistics," 2014) making up 0.3% (over 50,000 people) of the Australian population (ABS, 2011). From its inception in 1863 in the United States of America, the Adventist religion has emphasized the role lifestyle plays in promoting health and wellbeing (Fraser, 2003). Adventist health philosophy advocates good health practice as a valuable spiritual discipline and aligns with the dietary health laws in Leviticus and the biblical teaching in 1 Corinthians 6:19. The human body is considered the temple of the Holy Spirit and as such, should be cared for meticulously. In essence, Adventists recognise that the body, mind and spirit are integrally interconnected and interrelated in so much as what affects one affects the other and indeed the functioning of the whole being (Fraser, 2003). The Adventist religion encourages adopting a healthy lifestyle that includes adequate physical activity, rest and an unprocessed vegetarian diet whereas "unclean foods" (as described in Leviticus), alcohol, caffeine, tobacco and illicit substances are proscribed (Fraser, 2003).

Adventist schools promote and encourage Adventist religious practice and lifestyle. The school culture, values and programs are built around these beliefs, which are actively communicated to present and new enrolling students and their families. School staff are encouraged to actively model Adventist lifestyle and beliefs. Vegetarian meals are served in school canteens, and plant-based fruit or vegetable snacks are encouraged (and in some schools enforced) during recess breaks. Schools advocate physical activity, development of positive life skills, life balance and wellbeing.

Studies suggest that Adventists tend to experience good health characterised by significantly lower rates of many chronic diseases, total mortality, and better mental health (Beezhold, Johnston, & Daigle, 2010; Ellison & Levin, 1998; Grant et al., 2008; Willett, 1999). Further, it has been observed that adolescents attending Adventist schools in Australia have better health behaviours and outcomes than the national norms (Craig et al., 2017). However, Adventist schools in Australia cater for both Adventist and non-Adventist students. The purpose of this study was therefore to assess the influence of religious affiliation on the health status and health behaviours of adolescents attending Adventist schools in Australia.

Methods

Study Design and Participants

A health and lifestyle survey was administered in Adventist secondary schools in Australia (N=21 in 2012). A total of 4,674 students attended Adventist secondary schools at the time and valid responses to the survey were obtained from 1734 (37%) students. The age range of the participants was 12–18 years (mean = 14.5) with 46% males. For the purpose of this study, age was stratified into "early adolescence" (age 13–15 years, 51%) and "late adolescence" (age 16–18 years, 49%). The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No: 2011:21) and participation in the study was voluntary and anonymous.

Survey Instrument

Health Status

The survey instrument recorded the participant's age and gender. Self-reported health status was assessed with a single item five-point Likert scale ranging from "Excellent", "Very Good", "Good", "Fair" and "Poor". The Self-reported health status item is used in the validated Short-Form 36 Health Survey ('RAND Health, 36-Item short form survey', n.d.).

The Self-reported health status item is hypothesised to be a robust indicator of health status because it spans the past, present and future physical, behavioural, emotional and cognitive aspects of health (Sehulster, 1994). An extensive body of literature supports self-reported health as predictive of morbidity and mortality (Breidablik et al., 2009b), the presence or absence of chronic disease, emotional problems (Fosse & Haas, 2009b), life satisfaction (Meireles, Xavier, Andrade, Proietti, & Caiaffa, 2015), overweight or obesity (Fosse & Haas, 2009b), underweight, consumption of fruit, (Meireles, Xavier, Andrade, et al., 2015), consumption of vegetables (Goodwin et al., 2006), physical activity (B. Piko, 2000), and use of alcohol (Johnson & Richter, 2002) and tobacco (Wang, Ho, Lo, Lai, & Lam, 2012) in adolescents. Height and weight were self-reported and used to calculate body mass index (BMI) using the standard equation: BMI = weight in kg/(height in m)^2.

Mental Health

Mental health and vitality were measured using the validated and reliable five-item mental health and four-item vitality subscales from the SF-36 ('RAND Health, 36-Item short form survey', n.d.). These subscales measure general mental health status and energy and fatigue status. Each item in the mental health and vitality subscales has six alternative answers ranging from "All of the time" to "Not at all". Scores from these subscales were linearly transformed to a 0–100 scale according to the standard procedure for calculating the mental health and vitality scores (Ware et al., 2000). Subjects with two or more missing values were excluded from the analysis. High scores indicate good mental health and vitality. It is not clear which cut-off point is optimal for predicting mental disorder as assessed by clinical interviews. Some authors (Holmes, 1998) suggest a score of 52 for major depression, while others (Shaw et al., 2000) a score of 56. It is less clear what cut-offs are appropriate for the prediction of other mental health conditions. With respect to vitality and fatigue, scores less than 45 on the vitality subscale have been established as representing clinically significant fatigue (Donovan, Jacobsen, Small, Munster, & Andrykowski, 2008).

Diet and Physical Activity

Dietary intake was measured using food frequency questions adapted from questions previously used in a number of adolescent studies (Kolodziejczyk et al., 2012). In measuring overall diet, an item asked: "How would you describe your usual diet? (i.e. What you eat at least weekly or more often)." There were four options to select from: 1. Vegetarian (no red meat, chicken, fish, eggs, or milk/dairy products), 2. Lacto-ovo vegetarian (no red meat, chicken or fish but diet excludes eggs and/or milk/dairy products), 3. Pesco-vegetarian (diet includes fish but no red meat or chicken, but may include eggs and/or milk/dairy products), 4. Non-Vegetarian (diet includes red meat, chicken, fish). For the purpose of this study, this item was dichotomised for vegetarian (response 1 or 2) or non-vegetarian diet (response 3 or 4).

Physical activity was measured by an item that asked: "How many times per week do you USUALLY do any vigorous or moderate physical activity for at least 30 minutes?", with seven alternative answers ranging from "none" to "6 or more times" (Centre for Epidemiology and Research [CER], NSW Department of Health, 2004). Sedentary behaviour was assessed using frequency questions measuring hours per day watching television, videos and DVDs, playing computer games and surfing the Internet. The mean scores for these items were calculated to compute an overall sedentary behaviour score. Sleep was assessed by an item that asked: "How many hours do you usually sleep per night?"

Alcohol, Tobacco and Illicit Substances

Alcohol consumption and tobacco use were assessed with frequency questions ranging from "none" to "40+" for cigarettes smoked or alcoholic drinks consumed over the last four weeks.

The use of Marijuana, Ecstasy, Hallucinogens, Heroin, Cocaine, Amphetamines, and glue sniffing were assessed by items that asked about lifetime use of these substances. For example, the item relating to glue sniffing specifically asked: "How many times, if ever, have you deliberately sniffed (inhaled) from spray cans or deliberately sniffed things like glue, paint, petrol or thinners in order to get high or for the way it makes you feel?" The lifetime time frame was used as illicit substance use rates in Australian adolescents are very low (AIHW, 2014). The mean scores for the hard drugs Ecstasy, Hallucinogens, Heroin, Cocaine, and Amphetamines were calculated to compute a hard drug overall score. For the purpose of this study, all items relating to illicit substance use were dichotomised into yes/no responses.

Religion

Religious affiliation was assessed by asking the participants: "Which of the following best describes your religious belief now?" Options ranged from: 1. SDA (Adventist) Christian, 2. Other Christian, 3. Other Religion, 4. No Formal Religion, and 5. Don't Know. This item was trichotomised to "Adventist" (response 1), "Other Christian" (response 2) and "No Religion" (response 4). Religious affiliation has been used by an extensive body of literature and reviews to evaluate health status and behaviour (Cotton, McGrady, & Rosenthal, 2010; Cotton et al., 2006).

Statistical Analysis

The data were analysed using SPSS (version 20; IBM, Armonk, NY). Descriptive statistics involved mean ± standard deviation and percentages. For continuous variables, One-way ANOVAs were used to assess differences between students in the trichotamized religious affiliation groups (Adventist, other Christian and No Religion). Effect size was calculated as partial eta squared, where .01 represents a small effect size, .06 a medium effect size and .14 a large effect size. For significant models, post hoc comparisons were conducted for further examination of group differences (Table 8,10,12). For categorical variables, Pearson's Chi-square tests were used to assess differences between adolescents in the trichotamized religious affiliation groups. Main effects are reported as F-values and p-values. For significant models, post hoc comparisons were carried out to produce adjusted residuals (z-scores) from which p values were calculated for each cell (MacDonald & Gardner, 2000, 2000). To adjust for inflation of Type I error due to multiple comparisons, a Bonferroni correction was applied (MacDonald & Gardner, 2000) (Table 9,11,13).

Results

Demographics and Religion

The total sample of 1734 students consisted of 787 males (46%) and 919 females (54%). When the religious affiliation item was Trichotamized, 788 (57%) students reported affiliation with the Adventist religion, 435 (32%) reported affiliation with another Christian religion and 157 (11%) reported no affiliation with religion. From the total sample, 74% of students indicated they had grown up in a family that had at least one Adventist parent. One-way ANOVA indicated no significant difference in the mean age ($F(2,1376) = .497$, $p = .609$) between the Adventist, Other Christian and No Religion groups. Chi Square analysis indicated a significant difference in the gender distribution ($X^2=9.63$, $p = .008$) between the religious affiliation groups with more males than expected belonging to the Other Christian and No Religion groups.

Health Status

No significant difference was observed in the self-reported health status of students in the Adventist, Other Christian and No religion groups ($F(2,1367) = .056$, $p = .945$). Further, no significant difference was observed in the mean BMI of students in the three groups ($F(2,650) = 2.119$, $p = .121$). Analysis of mental health indicated no significance differences between the three groups in the mental health scale ($F(2,1330) = .213$, $p = .808$) or the vitality scale ($F(2,1305) = .032$, $p = .968$) in the three groups.

Health Behaviours

Table 8 shows comparisons in dietary behaviours, physical activity, sleep and alcohol and tobacco consumption between the Adventist, Other Christian and No Religion groups. Significant differences were observed between the groups with Adventist students reporting better health behaviours in ten of the sixteen items measured. The greatest differences were observed between the Adventist and No Religion groups. Compared to the No Religion group, the Adventist students reported: consuming more daily serves of fruit and vegetables and fewer cups of soft drink, coffee and high-energy drinks; more hours of sleep per night; less hours of sedentary behaviour; less alcoholic drinks; and less cigarettes smoked in the last four weeks. The effect size however for these differences was small (partial eta squared < .06). There were no differences between Adventist students and students in the No Religion group in the reported consumption of whole grains, fast food meals or breakfast meals per week, and 30-minute sessions of MVPA per week. Adventist students also reported more serves of fruit and vegetables, fewer cups of coffee and soft drink, and more hours of sleep than students belonging to the Other Christian group.

Table 8. *Comparisons of Health Behaviours Among Adventist, Other Christian and no Religion Students (one-way ANOVA)*

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Daily serves of vegetables	6.52	.001	.01	2.75 ± 1.43	2.47 ± 1.37[a]	2.49 ± 1.19[a]
Daily serves of fruit	5.56	.004	.01	2.68 ± 1.43	2.48 ± 1.32[a]	2.33 ± 0.11[a]
Daily serves of whole grains	2.16	.118	.01	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	2.00	.138	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	6.35	.002	.03	5.38 ± 3.18	5.87 ± 3.30[a]	6.30 ± 3.44[a]
Cups of coffee per day	11.03	<.001	.03	1.55 ± 1.19	1.85 ± 1.53[a]	2.03 ± 1.80[a]
Cups of high energy drinks per day	8.27	<.001	.02	0.49 ± 1.21	0.62 ± 1.30	0.95 ± 1.58[a]
Breakfast meals per week	0.19	.831	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	1.92	.147	.01	4.46 ± 1.81	4.25 ± 1.80	4.32 ± 1.94
Sedentary behaviour hours per day	4.88	.008	.02	12.93 ± 3.50	13.28 ± 3.31	13.85 ± 3.46[a]
Sleep hours per night	5.60	.004	.02	6.07 ± 1.24	5.84 ± 1.37[a]	5.80 ± 1.40[a]
Alcoholic drinks (last four weeks)	8.80	.001	.03	1.80 ± 0.40	1.76 ± 0.43	1.58 ± 0.50[a,b]
Cigarettes smoked (last four weeks)	6.61	.025	.03	1.90 ± 0.30	1.90 ± 0.31	1.73 ± 0.45[a,b]

Abbreviations: F, F statistic, ηp2, partial eta squared.
Superscript “a” denotes post hoc analyses are significantly different from the “Adventist” group and “b” denotes significantly different from the “other Christian” group at p < .05 level.
Data were presented as mean ± SD.

Table 9 shows comparisons in illicit substance use between the Adventist, Other Christian and No Religion groups. Chi-squared analysis indicated a significant difference in the proportion of students taking Marijuana (X^2=25.05, p<.001) and hard drugs (X^2=7.75), p=.021). Post hoc residual analysis indicated the proportion of Adventist students reporting 'ever using Marijuana' was significantly lower than expected (adjusted residual = -2.7, p = .0063), and non-religious students reporting 'ever using Marijuana' was significantly higher than expected (adjusted residual = 5.0, p < .0001). The proportion of students in the No Religion group reporting ever using hard drugs was significantly higher than expected (adjusted residual = 2.7, p = .0079). No differences were observed between the groups in having ever sniffed glue, paint, petrol or thinners. Chi-squared analysis indicated a significant difference (X^2=115.5, p<.001) in the proportion of Adventist students who reported a vegetarian diet (23.8%) compared with the Other Christian group (3.1%) and the No Religion group (2%).

Table 9. *Comparisons of Illicit Substance Use Among Adventist, Other Christian and No Religion Students (Pearson Chi-square test of independence)*

Variable	Adventist (Yes) N (%)	Other Christian (Yes) N (%)	No Religion (Yes) N (%)	X^2 (sig)
Ever taken marijuana	42 (5.4)*	28 (6.5)	26 (16.6)*	25.05 (<.001)
Ever sniffed glue/paint/petrol/thinners	176 (22.6)	99 (23.0)	36 (23.8)	.120 (.924)
Ever taken or consumed hard drugs	33 (4.2)	23 (5.3)	15 (9.6)*	7.75 (.021)

Abbreviations: X2, Pearson's Chi-square. Asterisks denote categories with standardized adjusted residuals significant at a Bonferroni-corrected α=.00833.

Gender Influences on Health Status and Health Behaviours

When the data were stratified for gender, no significant difference was observed in the self-reported health status, BMI, mental health scale or vitality scale between the males or females within the Adventist, Other Christian and No religion groups.

Adventist males reported significantly better health behaviours (Tables 10,11) compared to the males in the No Religion group in four of the sixteen items measured including: daily serves of fruit, cups of soft drink per day, hours of sleep per night and consumption of alcoholic drinks in the last four weeks. Adventist males also reported better health behaviours in two of the health behaviour measures compared to males in the Other Christian group, namely: daily serves vegetables and hours of sleep per night. Adventist females reported significantly better health behaviours compared to females in the No Religion group in three of the sixteen items measured including: daily serves of vegetables, daily cups coffee and daily cups of high energy drinks. Adventist females also reported less cups of coffee per day compared to females in the Other Christian group.

Table 10. *Comparisons of the Health Behaviours Among the Adventist, Other Christian and No Religion Students by Gender (one-way ANOVA)*

Variable	**F**	**p (ANOVA)**	**η_p^2**	**Adventist**	**Other Christian**	**No Religion**
Males						
Daily serves of vegetables	4.67	.012	.01	2.88 ± 1.57	2.46 ± 1.45[a]	2.61 ± 1.33
Daily serves of fruit	7.70	.027	.02	2.77 ± 1.55	2.51 ± 1.34	2.35 ± 1.40[a]
Daily serves of whole grains	1.62	.157	.02	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	1.51	.223	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	4.68	.010	.06	1.94 ± 1.73	2.37 ± 1.80	2.51 ± 1.85[a]
Cups of coffee per day	3.02	.063	.04	1.60 ± 1.35	1.87 ± 1.53	1.95 ± 1.67
Cups of high energy drinks per day	3.10	.057	.03	0.65 ± 1.46	0.89 ± 1.66	1.09 ± 1.66
Breakfast meals per week	0.48	.617	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	2.06	.129	.02	4.46 ± 1.81	4.25 ± 1.80	4.32 ± 1.94
Sedentary behaviour hours per day	2.69	.178	.05	13.34 ± 3.81	13.91± 3.15	14.21 ± 3.36
Sleep hours per night	8.53	<.001	.03	5.91 ± 1.25	5.83 ± 1.34[a]	5.81 ± 1.52[a]
Alcoholic drinks (last four weeks)	6.64	.008	.04	1.82 ± 0.38	1.80 ± 0.40	1.57 ± 0.50[a,b]
Cigarettes smoked (last four weeks)	5.03	.109	.04	1.94 ± 0.24	1.94 ± 0.25	1.76 ± 0.44

Table 10 (Continued)

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Females						
Daily serves of vegetables	3.23	.014	.03	2.66 ± 1.30	2.49 ± 1.32	2.29 ± 0.96[a]
Daily serves of fruit	2.14	.118	.01	2.66 ± 1.31	2.46 ± 1.31	2.31 ± 1.21
Daily serves of whole grains	0.33	.717	.01	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	1.90	.151	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	1.75	.175	.03	1.88 ± 1.46	1.68 ± 1.52	1.69 ± 1.41
Cups of coffee per day	8.61	.001	.04	1.49 ± 1.00	1.84 ± 1.54[a]	2.07 ± 1.96[a]
Cups of high energy drinks per day	6.10	.036	.03	0.34 ± 0.89	0.44 ± 0.97	0.79 ± 1.49[a]
Breakfast meals per week	0.33	.720	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	1.65	.193	<.01	4.46 ± 1.81	4.25 ± 1.80	4.32 ± 1.94
Sedentary behaviour hours per day	2.28	.103	.03	12.56 ± 3.18	12.85 ± 3.24	13.45 ± 3.58
Sleep hours per night	0.39	.667	.02	5.91 ± 1.25	5.83 ± 1.34	5.81 ± 1.52
Alcoholic drinks (last four weeks)	2.61	.129	.02	1.78 ± 0.42	1.75 ± 0.44	1.59 ± 0.50
Cigarettes smoked (last four weeks)	1.61	.334	.01	1.86 ± 0.35	1.85 ± 0.36	1.71 ± 0.46

Abbreviations: F, F statistic, ηp2, partial eta squared.
a denotes post hoc analyses are significantly different from "Adventist" group and b denotes significantly different from the "other Christian" group at p < .05 level.
Data were presented as mean ± SD.

Table 11. *Comparisons of Illicit Substance Use Among Adventist, Other Christian and No Religion Students by Gender (Pearson Chi-square test of independence)*

Variable	**Adventist (Yes) N (%)**	**Other Christian (Yes) N (%)**	**No Religion (Yes) N (%)**	**X^2 (sig)**
Males				
Ever taken marijuana	20 (5.6)	13 (7.5)	15 (17.6)*	13.84 (.001)
Ever sniffed glue/paint/petrol/thinners	83 (23.2)	45 (26.0)	18 (22.5)	.592 (.744)
Ever taken or consumed hard drugs	16 (4.4)	13 (7.4)	11 (12.9)*	8.76 (.013)
Females				
Ever taken marijuana	22 (5.4)	15 (6.1)	10 (14.3)*	7.87 (.020)
Ever sniffed glue/paint/petrol/thinners	92 (22.5)	54 (21.6)	18 (26.1)	.623 (.732)
Ever taken or consumed hard drugs	17 (4.1)	10 (4.0)	4 (5.7)	.438 (.803)

Abbreviations: X2, Pearson's Chi-square. Asterisks denote categories with standardized adjusted residuals significant at a Bonferroni-corrected α=0.00833.

Age Influences on Health Status and Health Behaviours

When the data were stratified for the two age groups (early adolescence, 13–15 years; late adolescence, 16–18 years), no significant difference was observed in the self-reported health status, BMI, mental health scale or vitality scale between the Adventist, Other Christian and No religion groups for students in either age category.

With regards to health behaviours, younger adolescents in the Adventist group reported significantly more daily serves of fruit than those in the No Religion group and Other Christian group (Table 12). Among the late adolescents, Adventist students reported significantly better health behaviours than students in the No Religion group in seven of the sixteen items measured, including: daily serves of whole grains, cups of soft drinks per day, cups of coffee per day, cups of high energy drinks per day, sleep hours per day, alcoholic drinks in the last for weeks and lower than expected percentage of student adolescents reporting ever taking marijuana (Table 13). Adventist students in the late adolescence age group also reported significantly better health behaviours in five of the health behaviours measured compared to students in the Other Christian group including: daily serves of whole grains, cups of soft drink per day, cups of coffee per day, cups of high energy drinks per day and hours of sleep per night.

Table 12. *Comparisons of Health Behaviours Among Adventist, Other Christian and No Religion Students by Age Group (one-way ANOVA)*

Variable	**F**	**p (ANOVA)**	**η_p^2**	**Adventist**	**Other Christian**	**No Religion**
Younger Adolescents (12–13 yrs)						
Daily serves of vegetables	3.99	.019	.02	2.73 ± 1.51	2.47 ± 1.37[a]	2.49 ± 1.19
Daily serves of fruit	4.92	.008	.02	2.68 ± 1.43	2.80 ± 1.49[a]	2.32 ± 1.19[a]
Daily serves of whole grains	0.18	.837	.02	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	0.90	.409	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	0.79	.454	.04	1.81 ± 1.73	1.93 ± 1.68	2.00 ± 1.46
Cups of coffee per day	3.24	.110	.02	1.48 ± 1.14	1.62 ± 1.33	1.91 ± 1.80
Cups of high energy drinks per day	0.09	.919	.02	0.53 ± 1.35	0.49 ± 1.20	0.56 ± 1.04
Breakfast meals per week	1.27	.282	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	1.46	.233	.02	4.61 ± 1.89	4.35 ± 1.81	4.50 ± 1.92
Sedentary behaviour hours per day	0.57	.565	.03	12.76 ± 3.62	12.93 ± 3.51	13.25 ± 3.79
Sleep hours per night	0.91	.403	<.01	6.26 ± 1.26	6.15 ± 1.40	6.36 ± 1.18
Alcoholic drinks (last four weeks)	1.41	.246	<.01	1.88 ± 0.33	1.87 ± 0.34	1.75 ± 0.44
Cigarettes smoked (last four weeks)	3.19	.308	.01	1.97 ± 0.18	1.98 ± 0.14	1.86 ± 0.35

Table 12 (Continued)

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Older Adolescents (15–18 yrs)						
Daily serves of vegetables	2.90	.055	.01	2.78 ± 1.34	2.56 ± 1.36	2.48 ± 1.25
Daily serves of fruit	1.08	.340	<.01	2.56 ± 1.36	2.45 ± 1.25	2.34 ± 1.41
Daily serves of whole grains	5.33	.004	.03	3.30 ± 2.09	2.84 ± 1.56[a]	2.77 ± 1.63[a]
Fast food meals per week	1.20	.302	.01	1.48 ± 1.32	1.60 ± 1.40	1.34 ± 1.16
Cups of soft drink per day	7.48	<.001	.07	1.59 ± 1.46	1.98 ± 1.68[a]	2.25 ± 1.86[a]
Cups of coffee per day	8.81	<.001	.04	1.62 ± 1.24	2.10 ± 1.69[a]	2.11 ± 1.80[a]
Cups of high energy drinks per day	14.33	<.001	.05	0.45 ± 1.06	0.75 ± 1.37[a]	1.25 ± 1.82[a]
Breakfast meals per week	1.17	.313	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	0.58	.147	<.01	4.31 ± 1.83	4.16 ± 1.81	4.17 ± 1.96
Sedentary behaviour hours per day	5.35	.561	.03	13.11 ± 3.36	13.64 ± 3.05	14.33 ± 3.12
Sleep hours per night	8.35	.005	.05	5.87 ± 1.89	5.54 ± 1.27[a]	5.38 ± 1.41[a]
Alcoholic drinks (last four weeks)	4.77	.017	.02	1.72 ± 0.45	1.71 ± 0.46	1.51 ± 0.50[a,b]
Cigarettes smoked (last four weeks)	2.06	.202	.02	1.80 ± 0.40	1.80 ± 0.40	1.64 ± 0.49

Table 13. *Comparisons in Illicit Substance use Between Adventist, Other Christian and No Religion Students by Age Group (Pearson Chi-square test of independence)*

Variable	**Adventist (Yes) N (%)**	**Other Christian (Yes) N (%)**	**No Religion (Yes) N (%)**	**X^2 (sig)**
Younger Adolescents (12–13 yrs)				
Ever taken marijuana	11 (2.8)	6 (2.8)	4 (5.9)	1.94 (.378)
Ever sniffed glue/paint/petrol/thinners	101 (25.6)	56 (25.8)	14 (21.5)	.531 (.767)
Ever taken or consumed hard drugs	15(3.7)	12 (5.4)	2 (2.9)	1.31 (.520)
Older Adolescents (15–18 yrs)				
Ever taken marijuana	31 (8.1)*	22 (10.4)	22 (24.7)*	20.56 (<.001)
Ever sniffed glue/paint/petrol/thinners	75 (19.6)	43 (20.2)	22 (25.6)	1.57 (.456)
Ever taken or consumed hard drugs	18 (4.7)	11 (5.1)	13 (14.6)*	12.99 (.002)

Abbreviations: X2, Pearson's Chi-square. Asterisks denote categories with standardized adjusted residuals significant at a Bonferroni-corrected α=.00833.

Discussion

This is the first Australia-wide study to examine the influence of religious affiliation on the health status and health behaviours of adolescents attending Adventist schools. The findings indicate that there is no difference in the self-reported health status, BMI, mental health or vitality between those students attending Adventist schools in Australia who claim to be or not to be affiliated with the Adventist church. Paradoxically, Adventist affiliated students reported better health behaviours in several domains than those students not affiliated with the Adventist Church and this was most prominent in late adolescence.

The lack of influence of religious affiliation on the health statuses measured in this study is not consistent with other studies. In a small study of the Adventist population involving five schools in the Sydney and Hunter region, Grant (2008) found that students consuming a predominantly vegetarian diet (as encouraged by the Adventist religion) had significantly lower BMIs than students who were not vegetarian. Reviews in adolescent populations have also reported an influence of religion on BMI, self-reported health status and mental health (Cotton et al., 2006; Dewes et al., 2013; Zullig et al., 2006).

There are several factors that may account for lack of difference observed in self-reported health status between the Adventist and non-Adventist students in this study. Firstly, this study sample is not typical of the Australian population. We have previously reported this study cohort to have lower rates of obesity than the national norms, trending approximately 20 years behind the wider population in the obesity epidemic (Craig et al., 2017). Hence, the study participants were already a healthier sample, which would make it more unlikely to observe differences within the cohort. It is possible that Adventist schools attract families with high socioeconomic status who can afford private education, once again making the study cohort more atypical. High socioeconomic status has also been linked to better physical and mental health outcomes (Viner et al., 2012a). Finally, it is possible that the Adventist students potentially underscored their self-reported health status compared to the non-Adventist students due to the high health ideals advocated by the religion resulting in them perceiving and judging “very good” or “excellent” health against a more rigorous standard.

The differences observed in the health behaviours of the Adventist and no religion students are consistent with reviews that have examined the influence of religious affiliation on health behaviours (Cotton et al., 2010, 2006; Rew & Wong, 2006). Interestingly, differences were observed in the health behaviours of Adventist students compared to Other Christian students in six of the sixteen health behaviours measured. It is possible that Adventist lifestyle may be more influential than Other Christian religions on the health behaviours of this cohort because of the emphasis the Adventist religion places on healthy living. When stratified for gender, Adventist males reported significantly better health behaviours compared to males in the No Religion group in four of the sixteen health behaviours measured. This compared to three out of the sixteen health behaviours for females. Evidence is lacking on gender differences in the influence of religion on health behaviours, however a study of Slovakian adolescents reported religiosity was more strongly associated with moderating smoking, drunkenness and marijuana use in females than in males (Pitel et al., 2012). Pitel and colleagues (2012) also reported no gender differences in the effect of religiosity on fruit, vegetable, soft drink and breakfast consumption or physical activity.

It is interesting that the health behaviour differences were more prominent in the older adolescents. It would seem that Adventist schools are having a greater impact on older adolescent students compared to younger adolescents. This is of interest as reviews (Patton et al., 2016) indicates that as adolescents increase in age, health behaviours in a number of domains decrease.

The students reporting affiliation with the Adventist religion in this study may be influenced by Adventist health beliefs not only because of their affiliation with the Adventist religion, but also through Adventist schooling and family dynamics that embrace Adventist health beliefs. Unique to the cohort in this study is also the fact that 74% of students reported growing up in a family with at least one Adventist parent. It is possible that Adventist health values were an influential aspect of their family dynamic. It is known that nutritional and physical activity behaviours stem from childhood (Pitel, Madarasová Gecková, Reijneveld, & van Dijk, 2013) and are heavily influenced by parents and family background (Pitel et al., 2013; Xie, Gilliland, Li, & Rockett, 2003) Bandura (Ajzen, 2011; Bandura, 2001) proposed that being part of a social phenomenon such as experienced by the Adventist students in this study would help them adhere to the health behaviours espoused by the Adventist religion that are not practiced by mainstream society.

While the health behaviours of students affiliated with the Adventist church are encouraging, on average students in this study did not meet national recommendations for adolescents in any health behaviour except daily serves of fruit. The negative side-effects of poor dietary behaviour, physical inactivity, lack of sleep and substance abuse are well documented. While recommendations may vary, the following provides a reference point. The National Health and Medical Research Council (NHMRC) (2013) of Australia recommends adolescents consume fives serves of vegetables, seven serves of whole grains and two serves of fruit each day. Further, adolescents should avoid beverages containing caffeine such as high-energy drinks or coffee and limiting the intake of soft drinks and fast foods high in sugar and saturated fats. Adolescents should consume a nutritious, energy appropriate breakfast on a daily basis (Rampersaud, 2009). Recommendations for physical activity include participating in 60 minutes of physical activity every day, and limit sedentary behaviour to no more than two hours per day (National Health and Medical Research Council, 2013). Students in this study on average did not even meet half of what is recommended for daily serves of vegetables, whole grains, breakfast meals per week or physical activity, and engaged in up to one and a half hours above what is recommended for sedentary behaviours. The National Sleep Foundation (Hirshkowitz et al., 2015) recommends adolescents get eight to ten hours of sleep per night. On average the student group in this study reported sleeping eight hours or less per night. Alcohol consumption, smoking and illicit substance use is not recommended for adolescents (National Health and Medical Research Council, 2013). Fifty-three per cent of students in the non-Adventist group reported ever consuming alcohol, 14.4% reported ever smoked cigarettes, 9.5% reported ever using marijuana, 24.6% reported ever sniffing glue and 5.9% reported ever using hard drugs. Despite observing significantly better health behaviours in Adventist students compared to non-Adventist students, the overall status of health behaviours reported by students in this study highlight the concerns (Patton, Ross, et al., 2014; Sawyer et al., 2012) surrounding adolescent health.

Understanding the mechanism through which religious affiliation influences better health behaviours in Adventist students warrants investigation. In particular, the larger influence religious influence had on the older adolescent age group is interesting. The evidence that social determinants of health influences adolescent health (Viner et al., 2012a) may help to understand the mechanisms that influence adolescent health including religious affiliation. Adolescence is second only to early childhood as a crucial period of psychological and biological change occurring in a complex web of family, peer, societal and cultural influences that affect present and future health (Viner et al., 2012a) . It is now understood that crucial to adolescents attaining their best health are up stream factors such as safe supportive school, family and community elements like religious communities, together with positive and supportive peers. Addressing risk and protective factors within the context of these environments and networks is key to improving adolescent health worldwide (Viner et al., 2012a). Longitudinal studies in the social network effect phenomenon suggest that domains such as physical activity, healthy eating (Ball, Jeffery, Abbott, McNaughton, & Crawford, 2010), obesity (Christakis & Fowler, 2007) and mental health (Fowler & Christakis, 2008) appear to spread through social ties, in some instances up to three degrees of separation. Exploiting this phenomenon in order to spread positive health behaviours is worth investigation.

A strength of this study is the focus on a single religious denomination. Single denominational studies eliminate the need to control for potential confounders such as variability of beliefs between denominations. Stratifying for gender and age groups allows for more in-depth analysis of adolescent health as modifiable health risks change rapidly across adolescence (Patton et al., 2016). The use of one dimension in measuring religion, which is a multidimensional construct, is a limitation. It is noted that daily minimum recommendation for MVPA for adolescents is 60 minutes per day (National Health and Medical Research Council, 2013). This was not possible in this study as this measure was not included in the survey. The study is cross-sectional, and no causal association could be indicated.

Conclusion

Our findings have identified that students who regard themselves as Adventist reported significantly better health behaviours than students who identify with other Christian denominations or have no religion, especially among the older adolescent age group (16–18 years). However, this did not translate to a difference in the health status of the students. Despite the apparent advantage for older Adventist students, it is nonetheless disconcerting that, the results of this study indicated that on average the adolescents did not meet the national recommendations in any assessed health behaviour except daily serves of fruit. Further research is needed to understand the causal mechanisms responsible for the potential health advantage of Adventist students, which may include family or religious influences.

Chapter 9: Discussion and Conclusions

The overarching aim of this thesis was to further understand the complex network of factors that predict the health behaviours and health outcomes of adolescents, with a particular focus on adolescents attending Seventh-day Adventist (Adventist) schools in Australia. To fulfil the objective of this thesis, a coherent series of five distinct but complementary studies were undertaken to be published in peer review journals. The first study (Chapter 4) concomitantly investigated the complex network of factors that predict self-rated health (SRH). Studies 2 to 5 augmented the findings of Study 1 more extensively by exploring factors predicting mental health (Study 2, Chapter 5), body mass index (BMI, Study 3, Chapter 6) and alcohol consumption (Study 4, Chapter 7), and the influence of religious affiliation on health outcomes and health behaviours (Study 5, Chapter 8). In this concluding chapter, the findings of the respective studies are summarised and synthesised. The chapter concludes by outlining implications of the studies.

Summary of Findings

Study 1 (Chapter 4): The association between self-rated health and social environments, health behaviours and health outcomes: a structural equation analysis

This study concomitantly investigated a complex network of factors that predict SRH in adolescents. The study was unique in that it included a number of health outcome variables, health behaviour variables and personal demographic and social environmental variables in one conceptual model, which were analysed simultaneously for their relationship with self-rated health. The study found that the health outcome variables mental health status (β = 0.17), BMI (β = -0.11), and Vitality (β = 0.15) were directly associated with SRH. Mental health was associated with a greater number of health behaviours, and demographic and social variables than BMI or Vitality. Of the health behaviour variables included in the study, sleep hours ($\beta = 0.11$), physical activity ($\beta = 0.09$), fruit/vegetable consumption ($\beta = 0.11$) and a vegetarian diet ($\beta = 0.10$) were directly positively associated with SRH. Of the demographic and social variables included in the study, adverse childhood experiences (ACEs) was the only variable that was directly associated with SRH ($\beta = 0.07$) and it had the strongest association with SRH ($\beta_{total} = -0.125$) of the personal demographic and social environment variables. Gender interacted with all explanatory variables in the model. Religious affiliation was positively associated with sleep hours, fruit and vegetable consumption and vegetarian diet.

The findings of this study are in line with previous studies that recognise SRH is associated with numerous health determinants (Boardman, 2006; Breidablik et al., 2009b; Cavallo et al., 2015; Mantzavinis et al., 2005). The study confirmed that adolescent health is not only influenced by proximal risk and protective factors such as health behaviours, but upstream social environments in which adolescents exist (Viner et al., 2012a). The effect of mental health—both in its relationship with SRH and as a mediating factor for a number of health behaviours and demographic and social variables—extends the work of other studies linking mental health to these various factors (Breidablik et al., 2008; Sehulster, 1994). The relative strength of the upstream ACEs variable on SRH demonstrates how adverse experiences early in life are associated with poorer SRH later in adolescence. This study also highlighted the moderating effect of gender on health as illustrated by the direct association of gender with every variable in the model, except for SRH.

The findings reinforce the necessity for prioritising gender sensitive interventions and prevention programs, along with the need to address modifiable health behaviours such as sleep duration, a healthy diet, and physical activity. In addition, the study reinforces the necessity to address childhood human rights, resilience and family dynamics as early as possible for lasting benefits later in adolescent life. Addressing these areas collectively may achieve a greater combined effect in improving adolescent health status than select single-factor interventions. The finding that religious affiliation was associated with various health behaviours is worth further consideration. Further exploration of the variables interacting with SRH may provide insight into more effective interventions to improve adolescent health.

Study 2 (Chapter 5): Factors predicting the mental health of adolescents attending a faith-based Australian school system: A multi-group structural equation analysis.

This study explored the complex relationship between select health behaviours, adolescent attitudes, childhood experiences and mental health status. The findings of this study indicated that childhood family dynamics (CFD) (β_{total} = 0.33) were the strongest predictor of mental health status, followed by levels of meaning and purpose (β = 0.25), perceived social rejection (β = -0.17) and school academic performance (β = 0.15). Multi-group structural equation modelling (SEM) analysis for gender found significant differences, with the mental health of males more greatly affected by physical activity than females and the mental health of females more greatly affected by sleep duration than males.

The findings of this study are in line with previous studies linking meaning and purpose (Brassai et al., 2011; Damon et al., 2003; Halama & Dědová, 2007a), perceived social rejection (Leary, 2015; Masten et al., 2012) and academic performance (McCarty, 2008) with the mental health of adolescents. While the association between CFD and MHS is well documented in the literature (Patton, Coffey, et al., 2014), this study extends previous work by demonstrating how CFD in childhood is associated with mental health later in adolescence.

An important outcome of this study was that it extended the work of previous adolescent mental health studies as it was able to measure and describe the effect of multiple factors on

MHS in adolescents. The findings support the need for gender-specific multi-component approaches to developing interventions and prevention programs which address early CFD, discovery of meaning and purpose, issues around perceived social rejection, and school academic performance to promote positive mental health among adolescents.

Study 3 (Chapter 6): The Body Mass Index of adolescents attending Seventh-day Adventist Schools in Australia: 2001-2012

This study examined the BMI of adolescents and described the effect of personal demographics, health behaviours and health outcomes on BMI. The findings from this study indicated that compared to national norms, lower rates of overweight and obesity, but higher rates of underweight, were observed in adolescents attending Adventist schools in Australia in 2012. Interestingly, there was no change in the BMI of adolescents attending Adventist Schools from 2001 to 2012, in contrast to national trend data (Allender et al., 2011), indicating that adolescents attending Adventist schools in Australia are trending some 20 years behind the wider population.

Lower BMI in this cohort was associated with age, gender, more regular breakfast consumption, lower consumption of soft drink, and having a regular exercise program. These findings are in line with previous studies (Allender et al., 2011; Grant et al., 2008). In response to the obesity epidemic presently observed among Australian adolescents, the factors responsible for lower body weights observed among this cohort are worthy of further investigation. Students in this study were atypical compared to national norms as evidenced by 29% claiming to be vegetarian. Vegetarianism has been consistently associated with lower body weight compared to non-vegetarians (Grant et al., 2008; Sabaté & Wien, 2010). Students in this cohort also reported a higher consumption of fruits, vegetables and wholegrains compared to national norms (DHA, 2008; Hardy et al., 2011), however, these health behaviours were not associated with BMI in this study. Families of students in this study were also atypical compared to national norms as evidenced by 74% of students indicating they grew up in a family with at least one parent that was an Adventist. Parental knowledge of and compliance with the healthy lifestyle espoused by the Adventist faith may see an adoption of health behaviours in their children (Bleich et al., 2011). Of note, the health beliefs of the Adventist faith are promoted and modelled by staff in Adventist schools, which serve only vegetarian meals in their canteens. It is well documented that adolescent health behaviours are influenced through social learning such as observing teacher behaviour (Rew & Wong, 2006). The unique aspects of this cohort suggest that further investigation into the synergy between school environments, home environments and faith community may contribute to identifying modifiable factors and strategies to address overweight in adolescents.

Study 4 (Chapter 7): Factors predicting alcohol consumption in adolescents attending a faith-based school system in Australia: A multi-group structural equation analysis

This study explored the complex relationship between intentions to consume alcohol, attitudes towards alcohol consumption, subjective norms surrounding alcohol use, early childhood experiences and alcohol consumption in adolescents. The findings from this study indicated that 82% of this cohort reported that they were non-drinkers, compared to 66% (White & Bariola, 2012) and 69% (Bowden et al., 2017a) in other national studies. The study supported the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) in terms of its ability to predict alcohol consumption among adolescents. Intentions to consume alcohol had the highest degree of association with alcohol consumption which is in line with other TRA and alcohol consumption studies (Cooke et al., 2016). Attitudes towards alcohol consumption and subjective norms surrounding alcohol consumption were also significant predictors of consumption, which is in line with studies in adult cohorts (Cooke et al., 2016), although several studies of alcohol consumption among adolescent cohorts that have applied the Theory of Reasoned Action have found that subjective norms are more predictive of alcohol consumption than attitudes (Marcoux & Shope, 1997; Stoddard & Pierce, 2018). There is wide spread agreement in the literature regarding the powerful influence of social pressures on adolescent drinking behaviours (Donovan, 2004; Janssen et al., 2014; Kuntsche et al., 2015; Ryan et al., 2010). The finding that attitudes towards alcohol consumption were more predictive of ACS than subjective norms may be worth further investigation considering the lower levels of ACS in this cohort compared to national norms.

Adverse childhood experiences were associated with every variable in the model presented in this study, thus further expanding upon the work of others who have reported a connection between ACEs and alcohol consumption in adolescents (Dube et al., 2006). Multi-group SEM analysis for age and gender found significant path differences in the model. The attitude "Alcohol is harmful to my relationships" was more greatly affected by ACEs for older adolescents than for younger adolescents. Intentions to consume alcohol was more greatly affected by the attitude "It is ok to drink alcohol at my age" for older adolescents than for younger adolescents. Alcohol consumption was more greatly affected by intentions to consume alcohol for older adolescents than for younger adolescents. The attitude "Alcohol is harmful to my relationships" was more greatly affected by CFD for males than for females and intentions to consume alcohol was more greatly affected by the attitude "It is ok to drink alcohol at my age" for males than for females.

This study fills a gap in the alcohol literature by presenting a model describing the complex network of factors that predict alcohol consumption in an adolescent cohort with uniquely low alcohol consumption. The findings support the need for gender specific multi-component approaches to developing interventions and prevention programs that address adolescents' intentions to consume alcohol and attitudes towards alcohol consumption, subjective norms surrounding alcohol consumption, and early childhood experiences in order to delay or minimise alcohol consumption in adolescents.

Study 5 (Chapter 8): Religious affiliation influences on the health status and behaviours of students attending Seventh-day Adventist Schools in Australia

This study investigated the influence of religious affiliation on the health behaviours and health status of adolescents. The findings of this study indicated that students who identified themselves as Adventist reported significantly better health behaviours than the other Christian and non-religious students in several behavioural domains, especially among the older adolescents (16–18 years). The Adventist students reported better health behaviours in ten of the sixteen items measured, namely higher consumption of vegetables and fruit; lower consumption of soft drink, coffee and high energy drinks; less sedentary behaviour; more sleep; fewer cigarettes smoked; and lower likelihood of having used marijuana or hard drugs. These findings are consistent with previous studies (Cotton et al., 2010, 2006; Rew & Wong, 2006). When stratified for gender, males reported significantly better health behaviours in four of the health behaviours measured compared to three for females. Evidence is lacking on gender differences and the influence of religion on health behaviours in the literature. However, in one study religion was more strongly associated with lower levels of substance use among females than males (Pitel et al., 2012). Interestingly, health behaviour differences in this study were more prominent in older adolescents, suggesting that Adventist schools may have a greater impact on older adolescents compared to younger ones. A review by Patton and associates (Patton et al., 2016) indicated that as adolescents increase in age, health behaviours in a number of domains decrease. While the health behaviours of students claiming to identify with the Adventist faith are encouraging, on average students in this study still did not meet national recommendations for adolescents in any health behaviour except daily serves of fruit.

Remarkably, the better health behaviours in Adventist adolescents compared to the other groups did not translate to better health outcomes measured by BMI, mental health status or vitality. This is not consistent with other studies involving adolescent populations that have reported religion to positively influence BMI, SRH status and mental health (Cotton et al., 2006; Dewes et al., 2013; Zullig et al., 2006). It was concluded that this paradox in the present study may have been partly attributable to the cohort having lower rates of obesity than the national norms which suggests they were already a healthier sample. Understanding the mechanism through which religious affiliation influences better health behaviours in Adventist adolescents compared to other adolescents identifying with other Christian religions or no religion, warrants further investigation, particularly for older adolescents.

Discussion of Key Outcomes

The findings of the series of published studies compiled for this thesis provide—for the first time—a comprehensive description of the interactions between numerous factors that are associated with the health behaviours and health outcomes of Adventist adolescents in Australia. This body of work has identified several important overall findings whose significance of these findings is discussed below.

The complexity and multi-dimensional nature of adolescent health

Firstly, this thesis confirms the emerging paradigm that adolescent health is complex and multi-dimensional, encompassing a broad network of interrelated proximal and upstream determinants (AIHW, 2013b; Bronfenbrenner, 1993; Erikson, 1971; Patton et al., 2012, 2016). In Study 1, proximal determinants of health such as a healthy diet, physical activity and sleep quantity were positively associated with SRH, better mental health, more vitality and a lower BMI. Sleep quantity and physical activity were also positively associated with better mental health in Study 2, and physical activity and a healthy diet were positively associated with a lower BMI in Study 3. Although the literature (AIHW, 2013b; Patton et al., 2012) consistently demonstrates that good healthy behaviours are paramount to ensuring positive health outcomes, the findings of this thesis demonstrate the positive association of healthy behaviours measured simultaneously across several health outcome domains, illustrating the collective importance of these health behaviours to adolescent health.

The outcomes from the studies in this thesis also supported the literature (Viner et al., 2012a) and theory (AIHW, 2013b; Bronfenbrenner, 1993; Erikson, 1971; Patton et al., 2012) indicating the importance of upstream social determinants of heath in affecting both health behaviours and health outcomes. In Study 1, CFD, ACEs and religious affiliation were associated with several health behaviours and health outcomes. Further exploration of CFD, ACEs and religious affiliation were conducted in Study 2, 4 and 5 with the findings of these studies confirming direct and indirect association with various health behaviours and health outcomes.

Important determinants of health

Several upstream social determinants of health emerged as important in the overall findings of the five studies in this thesis. Of particular note is the influence of CFD and ACEs, which were associated with multiple explanatory and outcome variables. These determinants are discussed in more detail below.

Childhood Family Dynamics

There is extensive published work within many cultures (Viner et al., 2012a) indicating that family structure is among the most influential factors on child and adolescent health, growth and wellbeing (AIHW, 2011d, 2012a; Patton et al., 2016; WHO, 2008). The theories cited in Chapter 3 also support the family as foundational to adolescent development and health

(AIHW, 2013b; Bronfenbrenner, 1993; Erikson, 1971; Patton et al., 2012). However, information gaps exist regarding the influence of family dynamics, and there is still no single overarching measure for family dynamics (AIHW, 2012c; Patton et al., 2016). Given that families remain the most important figures in the lives of most children and adolescents, the lack of comprehensive investigation into family dynamics and adolescent health is a significant knowledge gap. In this thesis, a CFD score was generated to explore how CFD may affect various determinants of adolescent health and health outcomes. It was found that CFD was associated with select health behaviours, adolescent attitudes and various health outcomes. In Study 1, CFD was found to have a positive association with fruit and vegetable consumption, sleep duration, mental health and, indirectly, SRH. Further exploration of mental health in Study 2, found CFD was also negatively associated with perceived social rejection and positively associated with finding meaning and purpose, as well as school academic performance. Exploration of alcohol consumption in Study 4 found CFD negatively associated with positive attitudes towards alcohol consumption and having friends that drank alcohol.

Although no direct comparison can be made with other empirical research using the CFD score, one study that was of interest to this thesis was the Valuegenesis II Study (Gane, 2012) which looked at parenting styles and adolescent behaviour in Australian Adventist adolescents. The study found that parenting style predicted abstinence from alcohol, tobacco and illicit substance use, as well as other lifestyle choices. The findings from the studies in this thesis support the literature that indicates that upstream determinants of health, such as family influences, impacts the pathways that translate into health behaviours and health outcomes (Viner et al., 2012a). Neuroscience research demonstrates that the protective and strength-oriented factors measured in items that make up the CFD score promote a healthy balance of the autonomic nervous system (Leitch, 2017). This balance promotes a better capacity for problem-solving, strategic thinking and ability to engage in pro-social and healthy behaviours (Leitch, 2017). The findings from this thesis fill a gap in the literature by extending this relationship from present family dynamics experienced by adolescents, to adolescent perceptions of their early CFD. The prominent role of family dynamics in early childhood and its effects on health in the adolescent years points to the potential value of promoting positive family dynamics through appropriate interventions and initiatives.

This thesis provides opportunities for further exploration of the relationship between CFD and other determinants of health such as illicit substance use, tobacco use, sexual initiation, sedentary behaviour, exposure to social/digital media, religious affiliation and vitality levels, which were not explored in depth in this thesis. Of interest would also be investigations into how the family dynamics of this cohort differ from the general population.

Adverse Childhood Experiences

Empirical evidence accumulated over a number of years suggests that children who encounter chronic stressful or adverse conditions lasting over extended periods of time in early life may have poorer health behaviours and health outcomes (Balistreri & Alvira-Hammond, 2016; Dube et al., 2006; Felitti et al., 1998; Flaherty et al., 2013; Gonçalves et al., 2016). Given that very little work has been done on adverse experiences in Adventist children or adolescents (Gane, 2012), the findings of this project are insightful. In Study 1, ACEs was negatively associated with sleep duration, mental health, vitality and general health status (SRH). Further exploration of mental health in Study 2, found ACEs to be positively associated with perceived social rejection and negatively associated with finding meaning and purpose and school academic performance. Exploration of alcohol consumption in Study 4 found ACEs to be associated with every variable in the model, including attitudes towards drinking alcohol, attitudes toward alcohol being harmful to health, having friends that drank alcohol, intentions to consume alcohol, and quantity of alcohol consumed.

The findings relating to ACEs and their association with multiple determinants of health and health outcomes support the ACEs literature (Balistreri & Alvira-Hammond, 2016; Dube et al., 2006; Felitti et al., 1998; Flaherty et al., 2013; Gonçalves et al., 2016). In a study of college students, Windle and associates (2018) found that more ACEs were associated with poorer mental health, BMI, alcohol use, lower intake of fruit and vegetables and less sleep. Importantly, the findings of the present study project extend the ACEs literature by describing the association of ACEs with a broad range of factors that affect the adolescent population. This provides further evidence for the pervasive influence of ACEs on health behaviours and health outcomes, and therefore ACEs should be a key consideration when addressing adolescent health and optimal functioning.

Interesting work on ACEs is emerging in the neurobiology and health psychology literature, suggesting that ACEs are associated with adverse changes in biological responses to severe stress that may rewire the brain to make individuals more vulnerable to further stressors (Evans & Kim, 2010; Leitch, 2017). Cumulative ACEs can wire in dysregulation of the autonomic nervous system placing the brain in a threat-oriented mode outside the brain's resilient zone (through neuroplasticity), due to undigested trauma from ACEs (Leitch, 2017). The dysregulation that occurs when an individual is outside the resilient zone can lead to increased anti-social behaviours and substance use, leading to physical and emotional health problems (Leitch, 2017). These physiological processes are accessible through interventions such as neuroeducation which can be used to motivate skills-based approaches, so vulnerable individuals can return to and remain in, the resilient zone. Adolescents who can develop a deeper resilient zone can learn how to respond healthily to stress caused by ACEs (Leitch, 2017).

Although children may have no choice in the ACEs they experience, the findings of this thesis ultimately reinforce the necessity for childhood human rights and protection to be at the forefront of global policy. In an Australian context, initiatives addressing ACEs have progressed somewhat. The recent Royal Commission into Institutional Responses to Child Sexual Abuse mandated a number of recommendations for organisations to protect children (Royal Commission into Institutional Responses to Child Sexual Abuse, 2018). Government response has also seen newly legislated sexual abuse laws. However, vastly underfunded community services leave children and families vulnerable to potential harm.

While this thesis provides an insight into the pervasiveness of ACEs on adolescent health, it provides opportunities for further investigation of the impact of ACEs on adolescent health. As the ACEs score was associated with most variables in Study 4 that related to alcohol consumption, the ACEs literature may benefit from studies that examine the association between ACEs and tobacco and illicit substance use. Of further interest is an investigation into the relationship of ACEs with sexual initiation, sedentary behaviour, exposure to social/digital media, current religious affiliation and vitality levels. There is evidence in the neuroscience literature (Leitch, 2017) that elements of family dynamics may mediate the effect of ACEs on health behaviours and health outcomes. Investigating this further would be of interest. As ACEs make the individual vulnerable to further stressors, an investigation into the reciprocal or cumulative effect of ACEs would contribute to the ACEs and adolescent health literature.

Age and Gender

Although adolescence is generally classed as the period from 10–19 years of age (WHO, 2018a), there are vast developmental changes that occur between the age of 10 and 19 (Bronfenbrenner, 1993; Erikson, 1971). These changes occur at differing rates for different individuals and across genders (Mendle, 2014). As such, determinants of adolescent health have varying degrees of influence across the adolescent years and for the different genders (Patton et al., 2016). The findings of Study 1 describe numerous interactions with age and gender. Age was associated with sleep hours, physical activity, BMI and mental health. Gender was associated with every explanatory and health outcome variable in the model, including sleep hours, physical activity, fruit and vegetable consumption, vegetarian diet, BMI, mental health and vitality. Studies 2 and 4 further explored the influence of age and gender differences on mental health, BMI and alcohol consumption, and found numerous significant associations. In Study 3 there was no significant difference in the mean BMI of males and females. However, there was a progressive increase in the mean BMI of adolescents with increasing age, which was to be expected. In Study 5, the influence of the Adventist faith seemed to influence males more than females, with Adventist males reporting significantly better health behaviours in several behavioural domains than the other Christian or non-Christian adolescents. The influence of religious affiliation was also age-related with older adolescents reporting significantly better health behaviours in several behavioural domains.

Collectively, the findings from the studies in this thesis add to the adolescent development literature by comprehensively describing the effect of age and gender through the path analysis. A key implication of these findings is that interventions and prevention programs targeting adolescent health must consider age appropriateness and gender orientation in order to optimise outcomes.

Religious Affiliation

Of the adolescents in this study project, 57% identified themselves as Adventist, 32% identified themselves as belonging to another Christian faith, and 11% identified themselves as belonging to no religion. Overall, 74% of adolescents claimed to have at least one parent that was an Adventist during the adolescent's childhood. This unique faith-based aspect of the cohort provided the opportunity to ascertain the association of religious affiliation with various health behaviours and health outcome measures.

In Study 1, religious affiliation was positively associated with vegetarian diet, fruit and vegetable consumption and sleep duration. This finding was not surprising as the Adventist religion has promoted a holistic healthy lifestyle, including a vegetarian diet, since near its inception in 1863 (Fraser, 2003). In Study 2, religious affiliation was positively associated with perceived social rejection, levels of meaning and purpose, school academic performance, and with the health behaviours of physical activity and sleep duration. Although Study 3 did not directly measure the association of religious affiliation with BMI, the lower mean BMI and higher consumption of fruits, vegetables and wholegrains in this cohort compared to national norms (DHA, 2008; Hardy et al., 2011) was explained by the unique characteristics of the religion the study population was exposed to. Similarly, the lower rates of alcohol consumption compared to national norms, found in Study 4, may also be explained by religious affiliation. Study 5 found that adolescents who identified themselves as Adventist reported significantly better health behaviours than the other Christian and non-religious students in several behavioural domains, especially among the older adolescents (16–18 years). Interestingly, this did not translate to improved health outcomes. Overall, the findings of this thesis highlight the association of religious affiliation with multiple health behaviours and upstream social determinants of health, but not with improved health outcomes such as SRH, BMI, mental health or vitality.

A better understanding of the mechanism through which religious affiliation influences better health behaviours in adolescents warrants investigation. It is well documented that religious affiliation impacts health via a number of pathways, including offering better integration into social support networks (Krause, 2006); providing tools for coping with stress (Pargament, 2001); promoting health behaviours (D. R. Williams & Sternthal, 2007), and encouraging self-control which leads to better health behaviour (McCullough & Willoughby, 2009). However, the influence of religion on health is also known to negatively affect health (Levin, 2015; Viner et al., 2012b). Failure to conform to a religious communities' expectations may evoke criticism by other members or clergy. Empirical research demonstrates that resulting religious guilt and failure to meet religious expectation or cope with religious fear can contribute to illness (Trenholm, Trent, & Compton, 1998). The discrepancies in the relationship of religious affiliation and health may be explained by the multidimensional nature of religious affiliation as a construct and the uncertainty of which aspects of religious affiliation are most closely associated with health outcomes (Idler et al., 2003). As the Adventist religion is positively associated with better heath behaviours, exploring the religious qualities of the Adventist faith as understood by adolescents may benefit the health and religion literature, and could better inform strategies to improve adolescent health.

Unique to this cohort is a synergy between the Adventist religion that promotes healthy behaviours and lifestyle, schools that promote and encourage Adventist health beliefs, and families that are exposed to the Adventist health ethos. Studies in the social network effect phenomenon suggest that health behaviours and health outcomes appear to spread through social ties (Ball et al., 2010; Christakis & Fowler, 2007; Fowler & Christakis, 2008), which may occur through religious networks. Investigating this phenomenon in order to spread positive health behaviours is worth further exploration.

Future Directions

The findings from the studies in this thesis provide a more comprehensive picture of the determinants of health, which may inform evidence-based health interventions and preventive measures for the advancement of adolescent health. Further progress in understanding adolescent health may be advanced by future prospective studies and randomised-controlled trials that investigate causality. This would provide a better understanding of the influencers of adolescent health and drive action to improve health outcomes in adolescents. This would provide a better understanding of what influences adolescent health and drive action to improve health outcomes in adolescents. Landmark papers such as the Lancet's "Our future: a Lancet commission on adolescent health and wellbeing" (Patton et al., 2016) suggested that comprehensive evidenced-based action that adopts multi-dimensional intersectoral approaches "offer[s] the possibility of this being the healthiest generation of adolescents ever" (Patton et al., 2016). Such claims are encouraging and provide the impetus for further exploration of the complexities of adolescent health in the face of current global concerns over adolescent health (Patton, Ross, et al., 2014; Sawyer et al., 2012). Patton and associates suggested that future actions should include research in structural, family, community, media, online and school-based elements as well as provide improved prevention and treatment health services (Patton et al., 2016). Further, research should evaluate the effectiveness of health interventions and preventive measures, as for most adolescent health problems there is a current scarcity of published literature in this area (Patton et al., 2016).

Conclusions

The findings from this thesis provide for the first time a comprehensive picture of the complex network of factors associated with the health behaviours and health outcomes of Adventist adolescents in Australia. This body of work has identified several important overall findings. Firstly, the findings confirm the emerging paradigm that adolescent health is complex and multi-dimensional, encompassing a broad network of interrelated proximal and distal determinants. Secondly, several determinants of health emerged as important including CFD, ACEs and religious affiliation, along with gender and age. The thesis contributes to gaps in adolescent health literature by simultaneously investigating multiple determinants of adolescent health and describing their relationship with health outcomes. The findings support the need for age and gender appropriate multi-component interventions and prevention initiatives to promote positive health outcomes in adolescents, with an emphasis on prioritising not only modifiable health behaviours but upstream factors such as CFD, ACEs and religious affiliation.

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The association between self-rated health and social environments, health behaviors and health outcomes: a structural equation analysis

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Abstract

Background: The factors shaping the health of the current generation of adolescents are multi-dimensional and complex. The purpose of this study was to explore the determinants of self-rated health (SRH) of adolescents attending a faith-based school system in Australia.

Methods: A total of 788 students attending 21 Seventh-day Adventist schools in Australia responded to a health and lifestyle survey that assessed SRH as well as potential determinants of SRH including the health outcomes mental health, vitality, body mass index (BMI), select health behaviors, social factors and personal demographics. Structural equation modeling was used to analyze the data and examine the direct and indirect effects of these factors on SRH.

Results: The structural model developed was a good fit with the data. The health outcome mental health had the strongest association with SRH ($\beta = 0.17$). Several upstream variables were also associated with higher SRH ratings. The health behavior sleep hours had the strongest association with SRH ($\beta_{total} = 0.178$) followed by fruit/vegetable consumption ($\beta_{total} = 0.144$), physical activity ($\beta_{total} = 0.135$) and a vegetarian diet ($\beta_{total} = 0.103$). Of the demographic and social variables measured, adverse childhood experiences (ACEs) had the strongest association with SRH ($\beta_{total} = -0.125$), negatively influencing SRH, and gender also associated with an increase in SRH ($\beta_{total} = 0.092$), with the influence of these factors being mediated through other variables in the model.

Conclusions: This study presents a conceptual model that illustrates the complex network of factors concomitantly associated with SRH in adolescents. The outcomes of the study provide insights into the determinants of adolescent SRH which may inform priority areas for improving this construct.

Keywords: Self-rated health, Adolescent health behaviors, Mental health, Family dynamics, Adverse childhood experiences, Social determinants of health

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Background

The factors shaping the health of the current and largest generation of adolescents in human history are multi-dimensional, complex and unparalleled [1, 2]. Until recently, adolescent health has been overlooked and misunderstood, which is one reason why adolescents historically have had fewer health gains than any other age group [1], and hence are now central to a number of major current global health challenges [2]. However, addressing adolescent health potentially provides a triple dividend with benefits now, later in adult life and for the next generation of children [1]. Further, the period of adolescence may also provide a second chance to reduce or reverse early-life disadvantage [3].

In recent decades, theorists have argued that understanding the factors driving growing adolescent health concerns requires a broad focus [4]. Clearly, risk and protective factors of adolescent health include levels of physical activity, substance use, alcohol consumption, tobacco usage [5], diet [1], adolescent abnormal weight (underweight, over weight) and mental health [5]. However, it has been asserted that as well as focusing on an individual's health risk and protective factors, the upstream social patterns and structures in which adolescents exist needs to be considered [4]. Ecological theorists [6] argue that an individual's social environment, both present and past, influence their health behaviors and health outcomes, mediated by other factors including their demographics and physical and psychological makeup.

Social environments are multifaceted and include peer, school, community, societal, cultural, new media influences and family dynamics [7]. Adverse childhood experiences (ACEs) such as psychological, physical or sexual abuse, violence, parental substance abuse, parental separation/divorce, parental incarceration or death of a parent, close relative or friend may also influence health behaviors and health outcomes in adolescents [8–11]. Conceptual frameworks have been developed to represent the complex web of causal "pathways" through which social factors interact with an individual's health risk and protective factors throughout the life course (Fig. 1) [12]. However, these models have not been tested among adolescent populations.

Self-rated heath is a legitimate and stable construct used in adolescent populations [13–21]. Reviews by Idler and Benyamini [19] proposed that an individual's health status cannot be assessed without the SRH measure as it captures an "irreplaceable dimension of health status," spanning past, present and future physical, behavioral, emotional, cognitive [22] and social [20] dimensions of health.

Widespread agreement in the literature [15, 23–25] recognizes that SRH is a complex parameter affected by multifarious determinants. Specifically, SHR is influenced by higher body mass index [17], mental health (emotional wellbeing, acceptance [20], self-esteem [16]) select health behaviors [20] (diet [18], physical activity [20] substance abuse [16], lack of sleep [14]), demographics (age, gender [13]) and social factors (family dynamics, child-parent relationships, school achievement [16], positive school experiences [13], socio-economic status [18], religion [26]). Many of these factors have complex interrelationships [23], directly or indirectly affecting self-perception of health status [15].

While an increasing number of studies have been reported on SRH among adolescents [13], most research in this field [13–18, 24–26] address only select factors

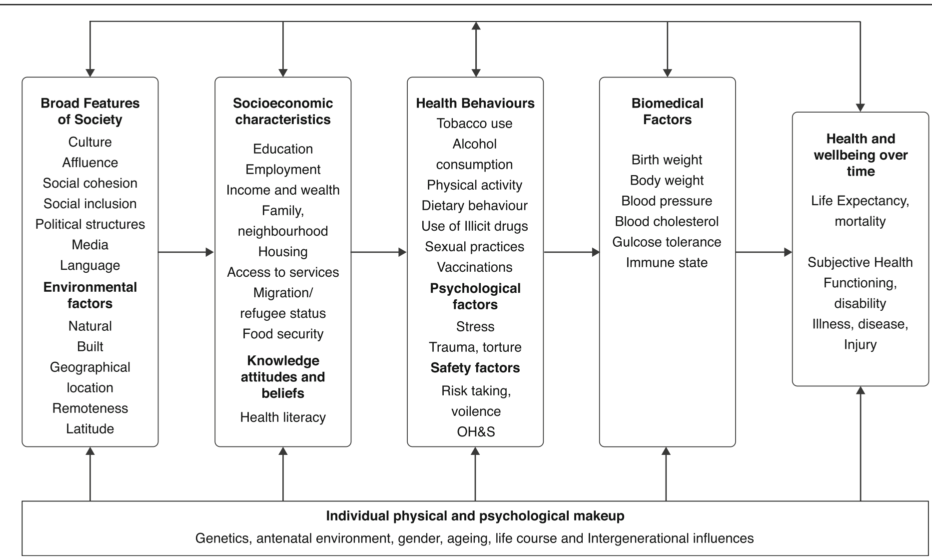

Fig. 1 Conceptual Framework for Determinants of Health

affecting health status, and thus yield only partial or confounded information on the determinants of adolescent health [23]. Investigations need to assess concomitantly the factors associated with this multi-faceted health measure [23].

Utilizing structural equation modeling and SRH as a measure of health status, this study aimed to explore concomitantly the complex relationships between SRH and social environments, health behaviors and health outcomes among adolescents attending a faith-based school system in Australia.

Methods

Study design and participants

In 2012, 1734 students aged 12 to 18 years of age responded to a health and lifestyle survey that was administered in 21 Seventh-day Adventist (Adventist) private secondary schools in Australia. The database created by this survey has been used in previous studies [27, 28]. Seven hundred and eighty eight students from this database met the inclusion criteria for this study which included useable data for the following domains: SRH, BMI, Mental Health, and Vitality. Notably, BMI data were not collected on over 900 students in the database, hence these cases did not meet the inclusion criteria.

The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No:2011:21), and participation in the study was voluntary and anonymous.

A hypothesized model informed by ecological theory and the conceptual framework for determinants of health [12] is presented in Fig. 2. The dependent variable was the measure SRH. In order to concomitantly explore factors associated with SRH yet retain a parsimonious model, we delimited the study by restricting the explanatory variables to the following: health outcome variables (BMI, mental health, vitality); health behavior variables (sleep hours per night, amount of moderate to vigorous physical activity, fruit and vegetable intake, vegetarian diet, marijuana use, alcohol consumption and tobacco use); and demographic and social variables (age, gender, ACEs, Childhood family dynamics (CFD), religious affiliation).

Survey instrument

The survey instrument recorded the participant's SRH as well as: BMI; measures of mental health and vitality; selected health behaviors; personal demographics; and social influences.

Self-rated health status

SRH status was assessed with a single item involving a five-point Likert scale ranging from "Excellent," "Very Good," "Good," "Fair" and "Poor."

Body mass index

Height and weight were self-reported and used to calculate BMI using the standard equation: BMI = weight in kg/(height in m)^2.

Mental health and vitality

Mental health and vitality were measured using the validated and reliable [29] five-item mental health and four-item vitality subscales from the SF-36 [30]. These subscales measure general mental health status and assess the individual's energy and fatigue. Each item in the mental health and vitality subscales has six response options ranging from "All of the time" to "Not at all." Standardized scores for these subscales were calculated creating a 0-100 scale according to the standard procedure for calculating the mental health and vitality scores [31]. Higher scores indicated better mental health and vitality. Internal reliability of the mental health and vitality subscales have been reported at $\alpha = .78$ to .87 and $\alpha = .72$ to .87 respectively in studies across eleven countries [32]. As seen in

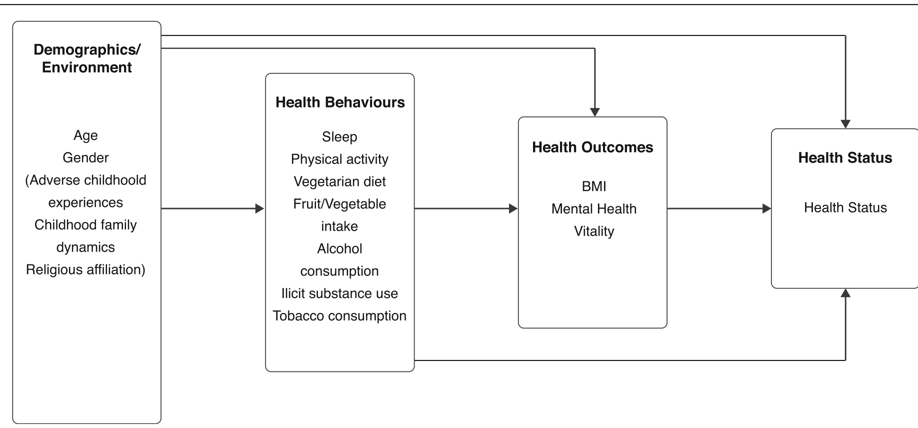

Fig. 2 Hypothesized Model for Factors Associated with Self-Rated Health in Adolescents

Table 1, the reliability of vitality in this study was comparatively lower than in these reports.

Selected health behaviors

Sleep hygiene was assessed by an item that asked: "How many hours do you usually sleep per night?", with eight response options ranging from "3 h or less" to "10 h or more". Physical activity was measured by an item that asked: "How many times per week do you usually do any vigorous or moderate physical activity for at least 30 minutes?", with seven response options ranging from "none" to "6 or more times" [33]. Fruit and vegetable intake was assessed using food frequency questions adapted from items previously used in adolescent studies [34]. Fruit consumption was measured by an item that asked: "How many serves of fruit do you usually eat each day? (A serve = 1 medium piece or 2 small pieces of fruit or 1 cup of diced pieces)". Response options ranged from "I do not eat fruit" to "6 serves or more". Vegetable consumption was measured by an item that asked: "How many serves of vegetables and salad vegetables (exclude potatoes) do you usually eat each day? (A serve = 1/2 cup of cooked vegetables or 1 cup of salad vegetables)". Response options ranged from "I do not eat vegetables" to "6 servers or more". The fruit and vegetable items were summed to provide an overall fruit and vegetable intake score. As a measure of the respondents' overall diet, an item asked: "How would you describe your usual diet?" Response options included: 1. "Total Vegetarian (no animal products: no red meat, chicken, fish, eggs, or milk/dairy products)"; 2. "Lacto–ovo vegetarian (no red meat, chicken or fish but diet includes eggs and/or milk/dairy products)"; 3. "Pesco–vegetarian (diet includes fish but no red meat or chicken, but may include eggs and/or milk/dairy products)"; 4. "Non-Vegetarian (diet includes red meat, chicken, fish)". For the purpose of this study, this item was dichotomized as a vegetarian (response 1 or 2) or non-vegetarian diet (response 3 or 4). This item was included in the study because a high proportion of Adventists adhere to a vegetarian diet [35].

Table 1 Descriptive statistics and scale reliability of variables used in the analysis

Variables	N	%	Mean	Standard Deviation	Min	Max	Scale Reliability (α)
Age	788		14.90	± 1.57	12	18	
Gender							
Males	379	48.1%					
Females	409	51.9%					
ACEs score	788		1.39	± 1.60	0	9	
Childhood family dynamics scale	788		23.93	± 4.95	0	30	.83
Religious affiliation							
Adventist	383	48.6%					
Not Adventist	405	51.4%					
Sleep hours per night	788		7.92	± 1.30	3	10	
30 min sessions of MVPA per week	788		3.69	± 1.72	0	6	
Serves of fruit and vegetables per day	788		5.31	± 2.39	0	12	
Vegetarian diet							
Yes	123	15.6%					
No	665	84.4%					
Drinks of alcohol in the last four weeks	788		1.46	± 6.48	0	20	
Cigarettes smoked in the last four weeks	788		0.84	± 5.84	0	30	
Times smoked Marijuana in the last four weeks	788		0.32	± 2.78	0	5	
BMI	788		20.25	± 2.89	14.30	30.07	
Mental health scale	788		65.73	± 18.00	0	100	.77
Vitality scale	788		57.32	± 17.73	0	100	.66
Self-rated health							
Poor	6	0.6%					
Fair	42	5.2%					
Good	258	32.8%					
Very Good	341	43.4%					
Excellent	141	17.9%					

Abbreviation: α cronbach's alpha

Alcohol consumption, tobacco and marijuana use were assessed with frequency questions ranging from “none” to “60+” for alcoholic drinks drunk and cigarettes or marijuana smoked in the last four weeks.

Religion

Religious affiliation was included in this study due to the special nature of the sample. Previous studies report associations between religion and SRH [36] with some reviews reporting that this association is unaffected when controlling for demographic variables [37]. Religious affiliation was assessed by asking the participants: “Which of the following best describes your religious belief now?” Options ranged from: 1. “Seventh-day Adventist Christian”, 2. “Other Christian”, 3. “Other Religion”, 4. “No Formal Religion”, and 5. “Don’t Know”. This item was dichotomized to “Non-Adventist” (response 2-4), and “Adventist” (response 1).

Social factors

In this study, an Adverse Childhood Experiences score [8–11] was generated by collating responses from the following nine items: 1. “One or both of my parents were in trouble with the law,” 2. “My parents were separated or divorced,” 3. “One or both my parents died,” 4. “One or both parents were absent from home for long periods,” 5. “There were times when family violence occurred,” 6. “There were times when I was physically abused,” 7. “There were times when I was sexually abused,” 8. “One or both parents smoked tobacco,” and 9. “One or both parents drank alcohol weekly or more often.” Each of the nine items included no/yes response options which were given a corresponding value of zero or one. Responses from each item were summed to calculate an overall ACEs score.

Childhood family dynamics were assessed by creating a CFD score from six items, namely: 1. “As a child, my parents showed me love,” 2. “As a child, my parents understood me,” 3. “While I was a child my family had a lot of fun,” 4. “As a child, my parents didn’t trust me,” 5. “As a child, my parents didn’t care what I did,” and 6. “As a child, I enjoyed being at home with my family.” Each item included five response options ranging from “strongly disagree” through to “strongly agree.” Each response was given a corresponding value from one to five and was recoded so that higher scores represented positive outcomes. Responses from each item were summed to calculate the overall CFD score.

Analysis

The objective of this study was to simultaneously analyze all paths of the hypothesized model (Fig. 2) in order to explore the complexity of the associations between multiple factors and SRH. Hence, structural equation modeling (SEM) [38] was used to estimate the model fit of the data and analyze the direct and indirect effects of the multiple factors in the hypothesized model. Overall model fit was examined using multiple goodness-of-fit indices, namely; chi-square (X^2) statistic (CMIN), relative X^2 (CMIN/DF), baseline comparisons fit indices of NFI, RFI, IFI, TLI, CFI, and RMSEA. Structural equation modeling was carried out using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA). The Bootstrapping method [39] was applied to verify statistical significance of indirect and total effects at $p < .05$. The data were imported into SPSS (version 24; IBM, Armonk, NY) to calculate means, standard deviations, distributions and internal reliability.

Results

Descriptive statistics

A summary of descriptive statistics and reliability estimates is shown in Table 1. Sixty-one percent of the students in the study reported “very good” to “excellent” health. This is comparable with the 2014-15 Australian Bureau of Statistics (ABS) survey [40] which reported that 63% of young Australians (aged 15-24 yrs) rated their health as very good or excellent. Unique to the study cohort was that 49% of the students reported an affiliation with a Christian faith and low rates of alcohol consumption (11% reported consuming alcohol in the past four weeks) tobacco use (4% reported using tobacco in the past four weeks) and marijuana use (3% reported using marijuana in the past for weeks).

The model for factors associated with self-rated health in adolescents

The hypothesized model (Fig. 2) based on theoretical considerations was submitted for analysis using techniques developed by Jöreskog and Sörbom [41] utilizing an iterative process of inspection of the statistical significance of path coefficients and theoretical relevance of constructs in the model to derive an optimal SEM that best fit the dataset and were theoretically meaningful. The items that asked the participants about alcohol, tobacco, and marijuana use were removed from the model due to their non-significant contributions generating a final structural model (Fig. 3). Modification indices suggested that the health behavior variables be allowed to covary, as well as the health outcome variables mental health and vitality.

The final structural model (Fig. 3) as a whole fitted the data very well, as indicated by the goodness-of-fit indices (CMIN = 33.615; $p = 0.214$; CMIN/DF = 1.201; NFI = 0.976; RFI = 0.933; IFI = 0.996; TLI = 0.988; CFI = 0.996 and RMSEA = 0.016). CMIN/DF statistic below three is considered good model fit [42] as are baseline

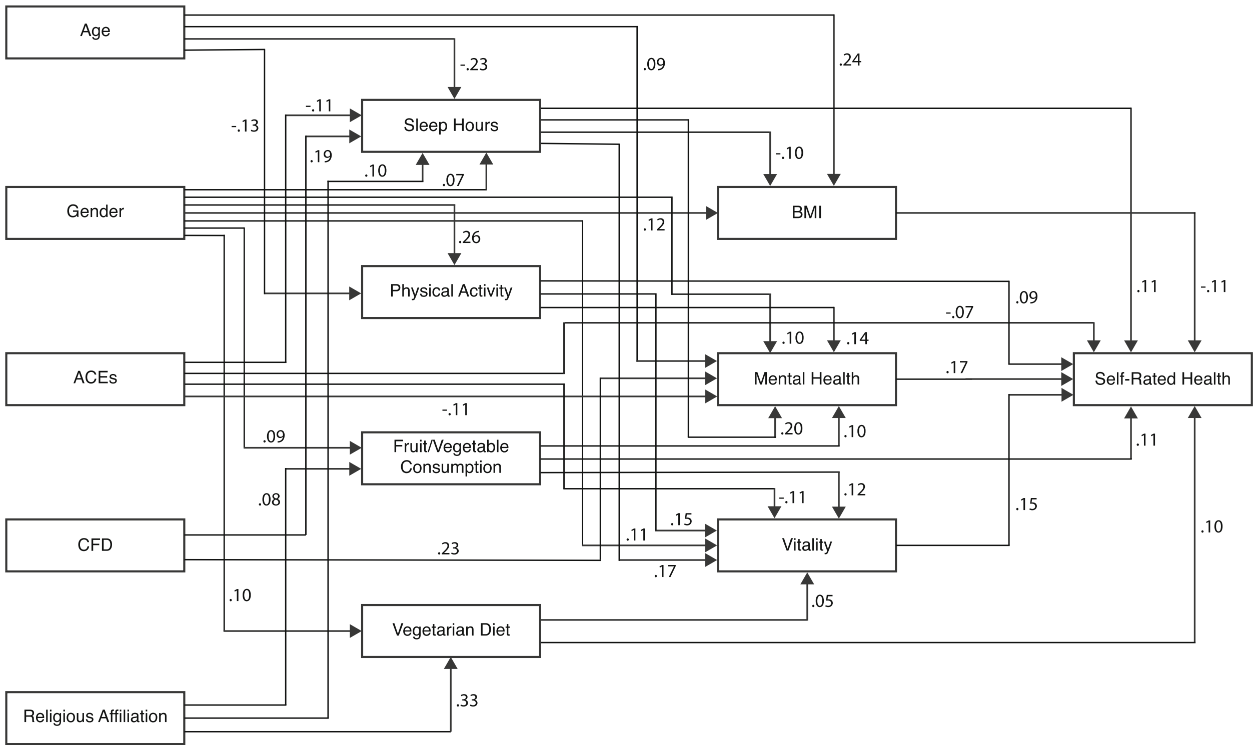

Fig. 3 Structural Equation Model Predicting Self-rated Health Status

comparisons fit indices above 0.9 [43]. The RMSEA value was less than 0.06, which indicated a close fit between the data and the model [44]. In Fig. 3, the standardized path coefficients are presented as single-headed arrows, and all shown paths are statistically significant including all indirect and total effect pathways.

The final structural model (Fig. 3) describes the upstream associations of BMI, mental health and vitality, health behaviors, demographics and social factors on SRH as well as their interactions. The squared multiple correlation calculated for SRH was 0.20 which indicates that the model explained 20% of the variance in self-rated health.

Based on standardized path weight coefficients (β's), the health outcome variables BMI ($\beta = -0.11$), mental health ($\beta = 0.17$) and vitality ($\beta = 0.15$) had a direct association with SRH. This indicates that adolescents who reported a higher BMI reported a poorer SRH, and adolescents who reported higher mental health and vitality scores reported better SRH.

The health behavior variables sleep hours ($\beta = 0.11$), physical activity ($\beta = 0.09$), fruit/vegetable consumption ($\beta = 0.11$) and a vegetarian diet ($\beta = 0.10$) had a direct association with SRH. This indicates that adolescents reporting more sleep each night, more physical activity, greater consumption of fruit and vegetables and a vegetarian diet also reported a better SRH. The health behavior variables were also associated with SRH indirectly through the health outcome mediating variables. Sleep hours was associated with SRH indirectly through the mediating health outcome variables BMI, mental health and vitality. Physical activity was associated with SRH indirectly through the mediating health outcome variables mental health and vitality. Fruit/vegetable consumption was associated with SRH indirectly through the mediating health outcome variables mental health and vitality. A vegetarian diet was associated with SRH indirectly through the mediating health outcome variable vitality. Of the health behavior variables, sleep hours had the strongest combined direct and indirect association with SRH ($\beta_{total} = 0.178$) followed by fruit/vegetable consumption ($\beta_{total} = 0.144$), physical activity ($\beta_{total} = 0.135$) and then vegetarian diet ($\beta_{total} = 0.103$).

Of the demographic and social variables, ACEs was the only variable that had a direct association with SRH ($\beta = -0.07$) with the other demographic and social variables indirectly associated with SRH. Age was associated with SHR through the mediating health behavior variables sleep hours and physical activity, and through the mediating health outcome variables BMI and mental health. Gender was associated with SHR through the mediating health behavior variables sleep hours, physical activity, fruit/vegetable consumption, and vegetarian diet, and through the mediating health outcome variables BMI, mental health, and vitality. ACEs was associated with SHR directly and through the mediating health behavior variable sleep hours and the mediating health outcome variable mental health and vitality. CFD was associated with SHR through the mediating health behavior variable sleep hours and through the health outcome variable mental health. Religious affiliation was associated with SHR through the mediating health behavior variables sleep hours, fruit/vegetable consumption and vegetarian diet.

Notably, of the demographic and social variables in the model, ACEs had the strongest association with SRH ($\beta_{total} = -0.125$). Hence, more ACEs were associated with lower SRH. Gender had the second strongest association with SRH of the demographic and social factors ($\beta_{total} = 0.092$) and also interacted with the greatest number of the mediating variables in the model. The association of age on SRH ($\beta_{total} = -0.067$) demonstrated that older adolescents reported poorer SRH, however, overall, males rated their health better which is in line with other studies [13]. The association of CFD ($\beta_{total} = 0.047$) on SRH demonstrated that adolescents reporting better CFD also reported better SRH. Finally, the model indicated that although the respondent's religion did have indirect links to SRH its association was small ($\beta_{total} = .005$). Adolescents who identified as Adventist were more likely to report higher SRH, and better health behaviors than those who identified themselves as not affiliated with the Adventist Church.

Discussion

This study explored concomitantly the relationships between factors associated with SRH in adolescents attending Adventist schools in Australia. By including a number of variables into one conceptual model and analyzing them simultaneously, the study is unique in that it was able to describe a complex network of associations between the factors that influence SRH. This study supports the need for a broad multi-component approach to the study of adolescent health.

The findings in this study demonstrate the association between mental health and SRH which is in line with findings from previous studies [20, 22]. The mental health measure used in this study had the strongest association with SRH of the three health outcome variables measured and was associated with the most health behaviors, demographics and social variables in the model. Several health behaviors (sleep hours, physical activity, and fruit/vegetable consumption), as well as demographics (age and gender), and social factors (ACEs and CFD) had a direct association with mental health. Notably, the association between the adolescent's childhood upbringing (ACEs and CFD) and mental health demonstrates how social factors early in life are associated with mental health status years later in adolescence.

The vitality metric used in this study (a measure of energy and fatigue status) had the second strongest association with SRH of the health outcome variables. All health behaviors in the model (sleep hours, physical activity, fruit/vegetable consumption, vegetarian diet) along with gender and ACEs directly associated with the measure vitality. Research on vitality is limited; however, one study found that up to 30% of healthy teens experience symptoms of fatigue that affect their normal functioning [45]. The observed influence of health behaviors on vitality in this study highlights the importance of targeting healthy behaviors for improving the energy levels and lessening fatigue among adolescents.

There is a wealth of literature supporting the importance of health behaviors on adolescent health [3], however, a unique aspect of this study was the simultaneous assessment of the association of four health behaviors (sleep hours, physical activity, fruit/vegetable consumption, vegetarian diet) with SRH. This allowed the health behaviors to be ranked according to their strength of association with SHR. While all health behaviors had a direct association with SRH and an indirect association through one or more of the health outcome variables, sleep had the strongest association with SRH, followed by fruit/vegetable consumption, physical activity, and vegetarian diet. This finding highlights the value of prioritizing healthy sleep hygiene among adolescent cohorts [46], although clearly, interventions that address all health behaviors are likely to be most efficacious and therefore desirable.

In the SEM analysis, the items measuring the health behaviors: consumption of alcohol and the use of tobacco and marijuana had non-significant pathways to SRH. It is well documented [5] that these health behaviors influence adolescent health negatively. A possible explanation for the non-significant effect of these health behaviors in this study may be that the study cohort reported a low prevalence of these behaviors. While this low prevalence was expected given the Adventist community proscribes such behavior, further exploration as to what motivates the use of alcohol, tobacco and marijuana in a low using cohort would be of interest.

Of the selected demographics and social factors included in the model predicting SRH, ACEs presented as having the strongest association. Indeed, it is remarkable that adolescents who reported higher incidents of adverse experiences in their earlier childhood, reported poorer SRH in their adolescent years. Although children may have no choice in the ACEs they experience, this study reinforces the necessity for childhood human rights, health promotion and resilience building [47] to be at the forefront of global policy and intervention development to provide benefits not only in childhood, but also later in adolescent life.

Of the five demographic and social factors assessed, gender had the second strongest association with SRH, and was associated with the most number mediating variables, interacting with all health behavior and health outcome variables in the model. This suggest that interventions targeting improving general health of adolescents may be more effective if they were gender specific. The influence of CFD and religion on SRH in this model is noted, albeit not as strong as ACEs and gender.

Strengths and limitations

The strength of this study is that it concomitantly explored a number of factors associated with SRH and describe the complex interaction between these factors and SRH. It is acknowledged, however, that model presented in this study, although strong, represents only part of the big picture of the overall influences of SRH. For example, socio-economic status is a well-known predictor of SRH [17], and this was not assessed in this study as no data on socioeconomic status was collected. Another limitation of this study is that it focused on a comparatively homogeneous group of adolescents who were exposed to a faith-based community, namely, Adventist Christians who place a strong emphasis on health and a wholistic lifestyle. Since its inception in 1863, the Adventist religion has promoted the adoption of a healthy lifestyle to its members that includes regular exercise, a vegetarian diet and rest. Alcohol, caffeine, tobacco and illicit substances are also proscribed (Fraser, 2003). The Adventist population has been the focus of numerous health studies as they tend to experience good health and lower rates of disease [48]. Adventist schools espouse the health practices of the Adventist church. Hence, while approximately half of this study cohort did not identify themselves as Adventist, they were likely influenced the by health focus of the Adventist church. It is possible that the adolescents in this study potentially underscored their self-rated health status compared to adolescents in the general population due to the high health ideals advocated by the faith-based schools they attend. This may have resulted in these adolescents perceiving and judging “very good” or “excellent” health against a more rigorous standard. This limits the generalization of the findings to other populations. The cross-sectional nature of this study means that only associations could be measured, it is not possible to say whether these relationships were causal. Although SRH has been established as a legitimate and stable construct for use in adolescent populations [13–21] to measure general health status, objective measures of health including biomedical testing as represented in the conceptual framework for determinants of health [12] may improve the validity of the findings in this study.

Conclusion

This study presented a conceptual model that described the complex network of factors concomitantly associated with SRH in adolescents. The results highlight the association of mental health with SHR. Gender-sensitive interventions prioritizing modifiable health behaviors such as sleep, healthy diet, and physical activity may achieve a greater combined effect in improving adolescent health status than select single factor interventions. The association between ACEs and adolescent SRH reinforces the necessity to address childhood human rights, resilience, family dynamics, and health promotion in children for lasting benefits later in adolescent life. Further research into what influences the variables interacting with SRH may provide insight into more effective interventions to improve adolescent health.

Abbreviations

ABS: Australian Bureau of Statistics; ACEs: Adverse childhood experiences; BMI: Body mass index; CFD: Childhood family dynamics; CFI: Comparative Fit Index; CMIN: Chi-square statistic; CMIN/DF: Relative X^2; IFI: Incremental fit index; NFI: Normed Fit Index; RFI: Relative fit index; RMSEA: Root Mean Square Error of Approximation; SEM: Structural equation modeling; SRH: Self-rated health; TLI: Tucker Lewis index; X^2: Chi-square

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Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Authors’ contributions

BC, DM, LK, PR and BG conceived of the study, participated in its design and coordination. TB and KP coordinated the data collection. BC and PM performed the statistical analysis and data interpretation. BC drafted the manuscript and DM, PM, LK, BG, PR assisted in critical revision of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No:2011:21), and participation in the study was voluntary and anonymous. Written informed consent was collected from parents or guardians and students.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Factors predicting the mental health of adolescents attending a faith-based Australian school system: a multi-group structural equation analysis

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Factors predicting the mental health of adolescents attending a faith-based Australian school system: a multi-group structural equation analysis

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ABSTRACT

Background: Adolescents attending Seventh-day Adventist schools (Adventist) in Australia tend to experience good health and exhibit better health behaviors than national norms, however few studies have investigated factors predicting their mental health.

Aims: The aim of this study was to explore the complex network of factors that predict the mental health status (MHS) of adolescents attending Adventist schools in Australia.

Methods: A survey instrument was used to collect data from 1527 secondary school students attending Adventist schools across Australia. Structural equation modeling was employed to examine concomitantly the direct and indirect effects of childhood experiences, present attitudes and selected health behaviors on MHS.

Results: Childhood family dynamics had the strongest association with MHS ($\beta_{total} = 0.33$) followed by a sense of meaning and purpose ($\beta_{total} = 0.27$), perceived social misfit status ($\beta_{total} = -0.19$), and school academic performance ($\beta_{total} = 0.18$). Multi-group analysis found significant pathway differences in the model for gender with regards to the association of meaning and purpose, physical activity and sleep quantity with MHS.

Conclusions: The outcomes of the study highlight the importance of early positive childhood family dynamics and the discovery of meaning and purpose during adolescence to promote positive mental health among adolescents.

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Introduction

Poor mental health in young people is a pressing global concern (Erskine et al., 2015). In a recent Australian report, which is the context of the present study, 14% of young people aged 4–17 years had experienced a mental health disorder in the preceding twelve months rising to 27% among the 18–24 year age group (Lawrence et al., 2016). In Australia, like many developed countries, nearly half (45%) of adults will experience a mental disorder in their lifetime (AIHW, 2016) and half of these mental health problems present by the age of 14 and three quarters by the mid 20's (World Health Organisation. Child and adolescent mental health, 2018).

Poor mental health can impede adolescent development and learning (Patel, Flisher, Hetrick, & McGorry, 2007; Patton et al., 2014), and adversely affect the individual's trajectory through life. Poor mental health is associated with poor physical health, poor reproductive and sexual health, poor academic achievement (Patel et al., 2007), unemployment (Colman et al., 2009), anti-social behavior (Patel et al., 2007), illicit substance and alcohol use (Hopfer et al., 2013), self-harm and suicide, the latter being the leading cause of death among adolescents globally (Patel et al., 2007).

Adolescence is a critical life period where many developmental, biological, behavioral, social, and lifestyle changes occur at different times depending on gender and the individual (Call et al., 2002; Erikson, 1968). Australian studies indicate that adolescent females experience poorer mental health than males which is thought to be associated with poor family dynamics, pressure at school, and western societal pressures (Mission Australia, 2017). While a number of risk and protective factors influencing mental health among adolescents have been explored, evidence supports a complex multifactorial causation, with many of the associations between risk factors and poor mental health being bidirectional (AIHW, 2012; Craig, Morton, Morey, et al., 2018; Lawrence et al., 2016; Patel et al., 2007). While various protective mechanisms are understood to buffer the risks of poor mental health, these are equally complex (Lawrence et al., 2016).

Several theoretical models have been developed to explain how the determinants of mental health have their influence (AIHW, 2012; Kieling et al., 2011). These models organize determinants as proximal, such as health behaviors, through to distal, which include upstream social determinants such as school, family, and peer environments. Other important determinants of mental health that have been identified in

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the theoretical models are attitudes relating to a sense of meaning and purpose (Brassai, Piko, & Steger, 2011; Burrow, O'Dell, & Hill, 2010; Damon, Menon, & Bronk, 2003; Halama & Dědová, 2007), social exclusion and feelings of being a social misfit (DeWall & Bushman, 2011; Huitsing, Veenstra, Sainio, & Salmivalli, 2012; Juvonen & Gross, 2005; Wright, Giammarino, & Parad, 1986), and school academic performance (McLeod, Uemura, & Rohrman, 2012). The influence of these determinants on mental health have not been comprehensively investigated through concomitant analyses.

Of particular interest to this study was the Seventh-day Adventist (Adventist) population who tend to experience lower rates of many chronic diseases in adulthood (Willett, 2003). Adventist adolescents have also been shown to have better health behaviors and outcomes than other Christian and nonreligious adolescents (Craig et al., 2017; Craig, Morton, Kent, et al., 2018). A previous investigation has found that the mental health status of Adventist adolescents was predicted by health behaviors, childhood experiences and gender (Craig, Morton, Morey, et al., 2018) but no study has concomitantly investigated the complex relationships between the numerous determinants, both proximal and distal, of the mental health of this population. Students attending Adventist schools in Australia constitute an interesting study cohort in that only approximately half of the students identify as Adventist. Hence studies of this cohort allow for comparisons to be made between Adventists, who tend to have better health behaviors and health outcomes and, non-Adventists who are more representative of the general population.

Utilizing structural equation modeling (SEM), this study aimed to concomitantly explore the complex relationships between a number of factors that may predict the MHS of adolescents, including: childhood factors such as childhood family dynamics (CFD) and adverse childhood experiences (ACES); present attitudes such as perceived social misfit status, level of meaning and purpose and school academic performance; and select health behaviors such as participation in physical activity, fruit and vegetable consumption, and sleep quantity. Further, the study aimed to explore gender variations in these relationships through multi-group SEM analyses. The findings of this study may provide a better understanding of the complex relationship between multiple factors and the MHS of Adventist adolescents and inform the development of appropriate interventions for improving MHS in adolescent populations.

Methods

Study participants

A survey was administered in 21 private secondary schools across Australia in 2012. Participation in the study was voluntary and anonymous and written consent was collected from the students as well as their parents or guardians. Completed responses were collected from 1527 students (mean age = 14.7 years, age range = 12–18 years, 55% males). The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No: 2011:21).

Survey instrument

The survey instrument assessed the participant's MHS as well as factors relating to CFD, ACEs, religious affiliation, personal demographics, attitudes (perceived social misfit status, level of meaning and purpose, and school academic performance), and select health behaviors (participation in physical activity, fruit and vegetable consumption, and sleep quantity).

Mental health

Mental health status (MHS) was measured using the validated and reliable (Brazier et al., 1992) five-item mental health subscale (MHI-5) from the SF-36 ("RAND Health, 36-Item short form survey", 1996), which measures general MHS. The literature indicates that the MHI-5 is a good predictor of mental health disorders including depression, generalized anxiety and affective disorders generally (Berwick et al., 1991; Strand, Dalgard, Tambs, & Rognerud, 2003). The five items that make up the MHI-5 are "How much of the time during the last four weeks": 1. "Have you been a very nervous person?" 2. "Have you felt so down in the dumps that nothing could cheer you up?" 3. "Have you felt calm and peaceful?" 4. Have you felt down?" 5. "Have you been a happy person?" Each item has six response options ranging from "All of the time" to "Not at all." A standardized score on a scale of 0–100 was created for MHS, as previously described (Ware, Kosinski, & Dewey, 2000), with higher scores indicating better mental health. Internal reliability of the MHI-5 has been reported at $\alpha = 0.78$ to 0.87 in studies across eleven countries (Gandek et al., 1998). While exact cutoff scores for predicting mental disorders are undetermined, studies have suggested that a score below 52 (Holmes, 1998) to 56 (Shaw, Treglia, Motheral, & Coons, 2000) are indicative of major depression.

Childhood factors

Childhood family dynamics were assessed by creating a CFD score which has been published previously (Craig, Morton, Morey, et al., 2018). The CFD score is made of six items which include: 1. "As a child, my parents showed me love"; 2. "As a child, my parents understood me"; 3. "While I was a child my family had a lot of fun"; 4. "As a child, my parents didn't trust me"; 5. "As a child, my parents didn't care what I did"; and, 6. "As a child, I enjoyed being at home with my family." Each item included five options ranging from "Strongly disagree" to "Strongly agree." Responses were coded from one to five and items 4 and 5 were then reverse coded so higher item values represented increasingly positive outcomes. Responses from each item were then summed to calculate an overall CFD score.

Adverse Childhood Experiences were assessed by creating an ACEs score developed by Felitti and associates (Felitti et al., 1998) which has been previously published (Craig, Morton, Morey, et al., 2018). Adverse childhood experiences including psychological, physical or sexual abuse, violence, parental substance abuse, parental separation/divorce, parental incarceration or death of a parent, close relative or friend has been linked with poor mental health in childhood through to adulthood (Kerker et al., 2015; Schilling, Aseltine, & Gore, 2007). The ACEs score was created from nine items which include: 1. "One or both of my parents were in trouble with the law"; 2. "My parents were separated or divorced"; 3. "One or both my parents died"; 4. "One or both parents were absent from home for long periods"; 5. "There were times when family violence occurred"; 6. "There were times when I was physically abused"; 7. "There were times when I was sexually abused"; 8. "One or both parents smoked tobacco"; and, 9. "One or both parents drank alcohol weekly or more often." Each item included no/yes response options which were given a corresponding value of zero or one. Responses from each item were summed to calculate an overall ACEs score.

Religious affiliation was included in this study due to the special nature of the sample. As seen in Table 1, 46% of participants in this study reported being affiliated with the Seventh-day Adventist Protestant religion. Religious affiliation was assessed by asking the participants: "Which of the following best describes your religious belief now?" Options ranged from: (1) Seventh-day Adventist Christian; (2) Other Christian; (3) Other Religion; (4) No Formal Religion; and (5) Don't Know. For the purpose of this study, this item was dichotomized to Adventist (response 1) and not Adventist (responses 2–4).

Present attitudes

Perceived social misfit status was measured with a single item that asked the participants to respond yes/no to the statement: "I often feel like a social misfit". The social misfit hypothesis (Wright et al., 1986) proposes that children who deviate from the social group norm and are different in some discernible way, whether it be in relation to behavior or appearance, are often victimized, marginalized or bullied impacting their mental health. Meaning and purpose was measured with a single item that asked the participants to respond on a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" to the statement: "My life is filled with meaning and purpose". Attitudes surrounding meaning and purpose have been found to be associated with adolescent mental health (Burrow et al., 2010) with adolescents reporting meaning and purpose more likely to experience better mental health (Brassai et al., 2011; Damon et al., 2003; Halama & Dědová, 2007). School academic performance was measured by asking the students how they rated themselves at school work on a five-point Likert scale ranging from "A lot below average" to "A lot above average". Measuring school academic performance with this item has been used in previous studies and national surveys (Bowden, Delfabbro, Room, Miller, & Wilson, 2017; Centre for Epidemilogy and Research NSW Department of Health, 2008; The Cancer Council Victoria, 2006).

Selected health behaviors

Fruit and vegetable intake was assessed using food frequency questions adapted from items previously used in studies of adolescent cohorts (Kolodziejczyk, Merchant, & Norman, 2012). Fruit consumption was measured by an item that asked: "How many serves of fruit do you usually eat each day? (1 serve = 1 medium piece or 2 small pieces of fruit or 1 cup of diced pieces)". Response options ranged from "I do not eat fruit" to "6 serves or more". Vegetable consumption was measured by an item that asked: "How many serves of vegetables and salad vegetables (excluding potatoes) do you usually eat each day? (1 serve = 1/2 cup of cooked vegetables or 1 cup of salad vegetables)". Response options ranged

Table 1. Descriptive statistics and scale reliability of variables used in the analysis.

Variables	N	%	Mean	SD	Min	Max	Scale reliability (α)
Age	1527		14.56	±1.57	12	18	
Gender							
Males	838	54.9%					
Females	689	45.1%					
Adverse childhood experiences score	1527		1.39	±1.65	0	9	0.69
Childhood family dynamics score	1527		24.21	±4.82	5	30	0.84
Religious affiliation							
Adventist	829	54.3%					
Not adventist	698	45.7%					
Perceived social rejection							
No	1295	84.8%					
Yes	232	15.2%					
Meaning and purpose	1527		3.94	±1.02	1	5	
Self-rated school academic performance							
A lot below average	13	0.9%					
Below average	84	5.5%					
Average	722	47.3%					
Above average	595	39.0%					
A lot above average	113	7.4%					
30 min or more sessions of MVPA per week	1527		3.28	±1.18	0	6	
Serves of fruit and vegetables per day	1527		5.14	±2.34	0	12	
Sleep hours per night	1527		7.94	±1.13	3	10	
Mental health scale	1527		65.26	±17.76	4	100	0.75

α: cronbach's alpha; SD: standard deviation; MVPA: moderate to vigorous physical activity.

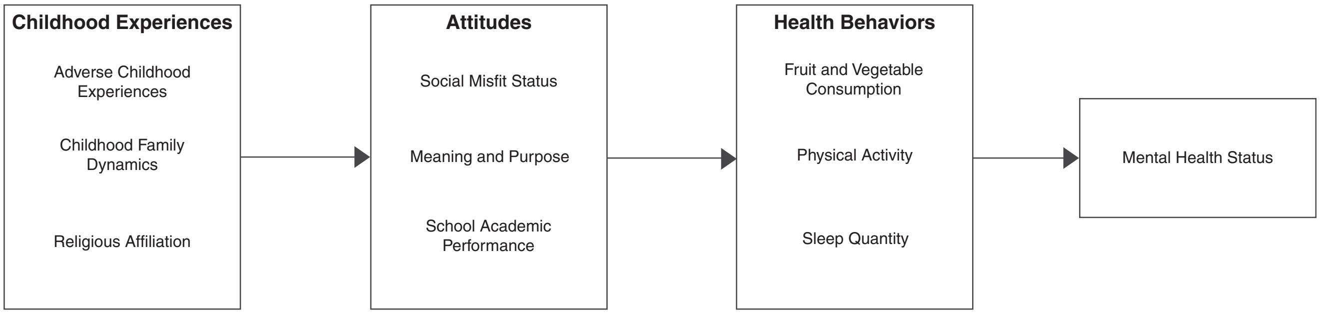

Figure 1. Hypothesized model predicting mental health status.

from "I do not eat vegetables" to "6 servers or more". The fruit and vegetable items were summed to provide an overall fruit and vegetable intake score. Physical activity was measured by an item that asked: "How many times per week do you usually do any vigorous or moderate physical activity for at least 30 minutes?" with seven response options ranging from "none" to "6 or more times" (Giffin, Jorm, Taylor, & Thomas, 2004). Sleep quantity was assessed by an item that asked: "How many hours do you usually sleep per night?" with eight response options ranging from "3 hours or less" to "10 hours or more".

Analysis

The objective of this study was to examine the direct and indirect predictors of adolescent MHS by employing structural equation modeling (SEM). A hypothesized model informed by the literature and theoretical models (AIHW, 2012; Kieling et al., 2011) was developed (see Figure 1) for analysis. In order to concomitantly explore factors associated with MHS yet retain a parsimonious model, the study was delimited by restricting explanatory variables as follows: As shown in Figure 1, the most proximal explanatory variables in the model were the health behaviors (fruit and vegetable consumption, physical activity, and sleep quantity). Antecedent to the health behaviors were attitudes (perceived social misfit status, meaning and purpose in life and school academic performance). Childhood factors (CFD, ACEs, and religious affiliation) were arranged in the model as the most distal predictors.

The data was imported into SPSS (version 24; IBM, Armonk, NY) to calculate means, standard deviations, distributions and internal reliability. Structural equation modeling using AMOS (Versions 24; Amos Development Corporation, Crawfordville, FL, USA) was conducted using techniques developed by Jöreskog and Sörbom (Jöreskog & Sörbom, 1989). This involved an iterative process of inspection of the statistical significance of path coefficients and theoretical relevance of the constructs in the model to derive an optimal SEM that best fit the dataset and was theoretically meaningful (Figure 2).

Overall model fit was examined using multiple goodness-of-fit indices, namely: relative X^2 (CMIN/DF), baseline comparisons fit indices of NFI, RFI, IFI, TLI, CFI, and RMSEA. Bootstrapping (Preacher & Hayes, 2008) was applied to verify statistical significance of indirect and total effects at $p < 0.05$. Multi-group analysis was employed to test for gender variations among the pathways in the study as gender has been observed to moderate the relationship of predictors on adolescent mental health (Craig, Morton, Morey, et al., 2018; Mission Australia, 2017; Patel et al., 2007). The critical ratios for differences test was applied to assess for regression weight differences for gender within the SEM (Ho, 2013).

Results

Descriptive statistics

A summary of descriptive statistics and reliability estimates is shown in Table 1. The mean mental health score was 65 and was significantly higher among the males than the females (67.7 ± 16.6 versus 63.2 ± 18.3, $p < 0.001$). There was no significant difference ($p = 0.11$) in the mental health score of the respondents affiliated with the Adventist church (66.1 ± 17.5) compared to those who were not (64.6 ± 18.0).

Model predicting mental health status

The final structural model fitted the data well, as indicated by the goodness-of-fit indices (CMIN/DF = 1.854; NFI = 0.993; RFI = 0.967; IFI = 0.997; TLI = 0.985, CFI = 0.997; and RMSEA = 0.024). CMIN/DF statistic below three is considered good model fit (Kline, 2010) as are baseline comparisons fit indices above 0.9 (Bentler, 1990). The RMSEA value was less than 0.06, which indicated a close fit between the data and the model (Hu & Bentler, 1999). The squared multiple correlation calculated for MHS of 0.30 indicates that the model explained 30% of the variance for MHS. Standardized path coefficients are presented as single-headed arrows in the final model. All shown paths are statistically significant including all indirect and combined total pathways.

Based on standardized path weight coefficients (β's), the item measuring meaning and purpose had the strongest direct association ($\beta = 0.25$) with MHS followed by perceived social misfit status ($\beta = -0.17$), school academic performance ($\beta = 0.15$), the CFD score ($\beta = 0.14$), sleep quantity ($\beta = 0.13$) and physical activity ($\beta = 0.11$). Combining direct and indirect effects, the CFD score ($\beta_{total} = 0.33$) was the strongest predictor of MHS followed by the item that measured meaning and purpose ($\beta_{total} = 0.27$), perceived social misfit status ($\beta_{total} = 0.19$), school academic performance

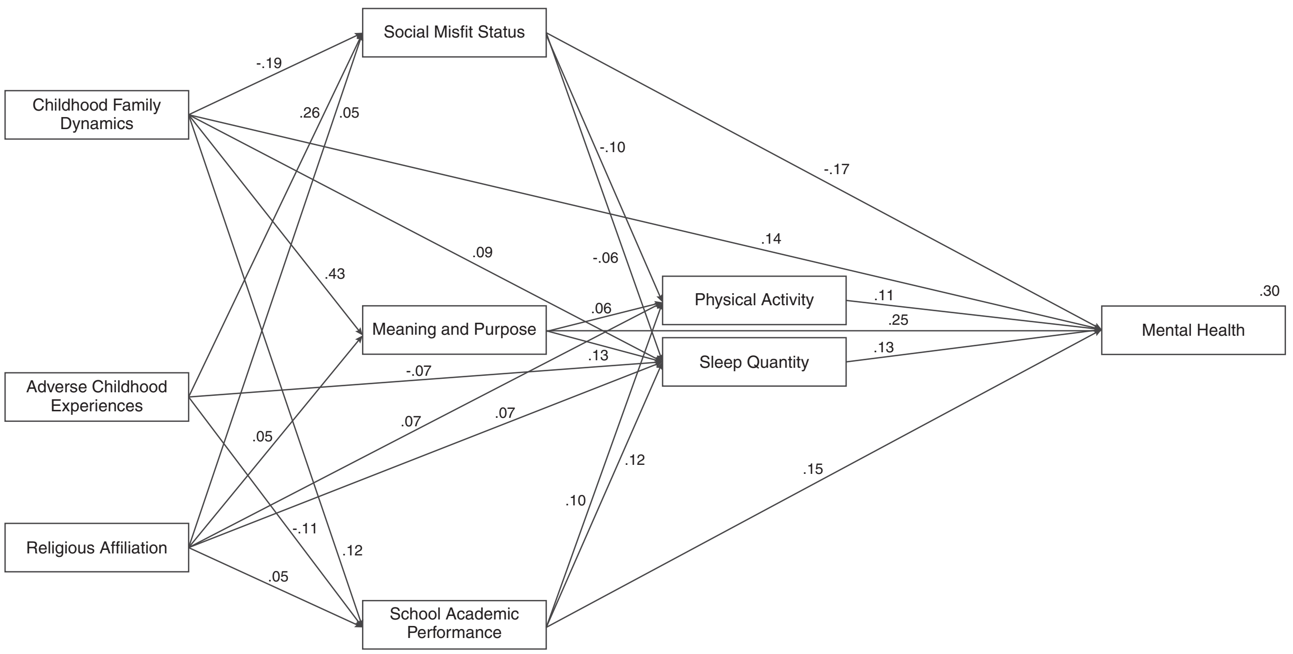

Figure 2. Structural equation model predicting adolescent mental health.

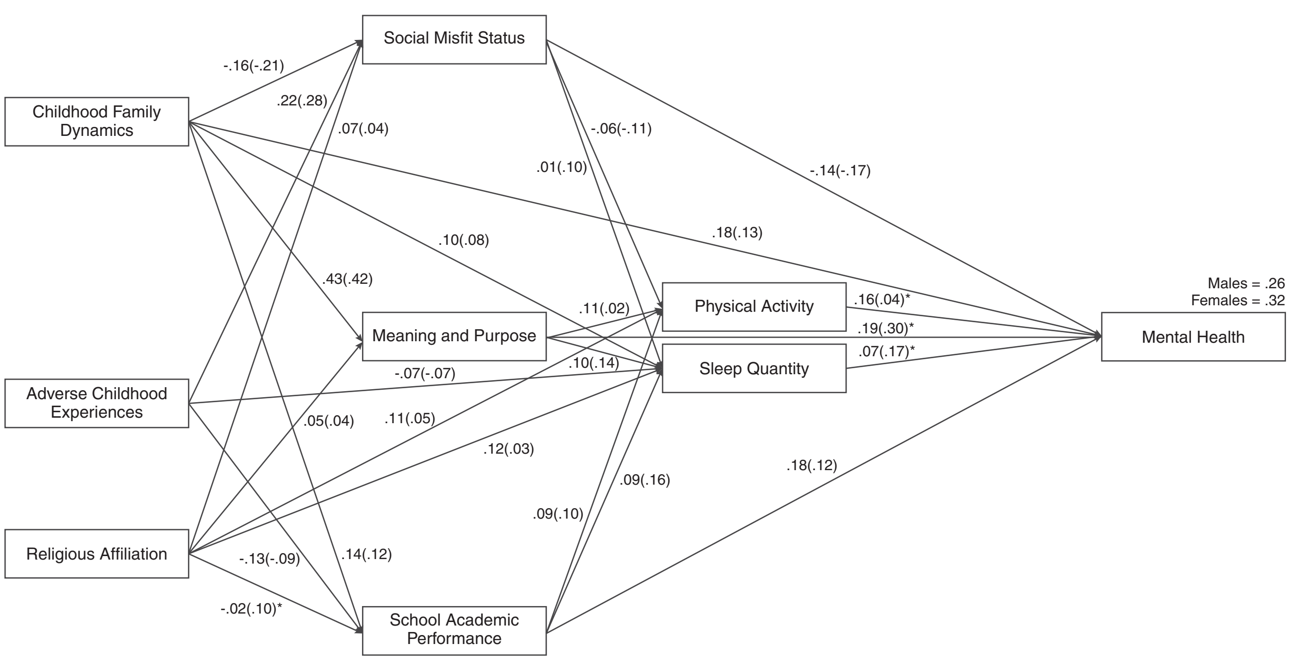

Figure 3. Structural equation model multigroup analysis for gender. Males(Females); *Significant difference between males and females at $p < 0.05$.

($\beta_{total} = 0.18$), ACEs ($\beta_{total} = -0.08$) and religious affiliation ($\beta_{total} = 0.03$). The combined beta of all three attitudes measured in the model was 0.64.

Multi-group analysis for gender (Figure 3) found a significant difference in the path coefficient between physical activity and MHS, with this association stronger for males ($\beta = 0.16$) than for females ($\beta = 0.04$). A significant difference in the path coefficients between sleep quantity and MHS was also observed, with this association stronger for females ($\beta = 0.17$) than for males ($\beta = 0.07$). Significant differences in path coefficients for gender were also found between life has meaning and purpose and MHS, with this association stronger for females ($\beta = 0.30$) than for males ($\beta = 0.19$). Finally, significant differences in path coefficients for gender were found between religious affiliation and school academic performance, with this association stronger for females ($\beta = 0.10$) than for males ($\beta = -0.02$).

Discussion

This study explored the effect of a complex network of factors on the metal health status of adolescents attending Adventist schools in Australia. The study was unique in that it concomitantly measured the relationship within this cohort between MHS childhood factors, attitudes and select health behaviors.

The association of meaning and purpose with the MHS of the adolescents in this study is in line with findings from other studies (Brassai et al., 2011; Damon et al., 2003; Halama & Dědová, 2007). Indeed, discovering purpose is a clear marker of flourishing and positive well-being (Burrow et al., 2010) in adolescents and a lack of meaning and purpose has been linked to depression, apathy and social and interpersonal difficulties (Damon et al., 2003). The finding that meaning and purpose had the strongest direct association with MHS ($\beta = 0.25$) of all the variables measured in the model suggests that developing meaning and purpose is an important predictor of MHS in this cohort. Developmental theorist Erikson (Erikson, 1968) proposed that actualizing purpose and meaning early in life is important to help adolescents resolve identity crises and hence promote positive development throughout the lifespan. Erikson suggested that engaging adolescents in activities that empower expression of their inner selves enables them to determine goals and values that shape their identity, meaning and purpose. Exploring cultural rites of passage that provide adolescents with activities intended to define them as adults with a larger sense of meaning and purpose may also have a positive association with MHS (Van Dyke & Elias, 2007). The finding in this study that CFD was associated with meaning and purpose suggest that positive CFD assisted the adolescents in this study to find meaning and purpose.

The association of perceived social misfit status with MHS in this study is consistent with other reports (Leary, 2015; Masten, Telzer, Fuligni, Lieberman, & Eisenberger, 2012). Adolescents may be more vulnerable to social rejection than both adults and younger children (Kloep, 1999) due to increased peer influence susceptibility (Erikson, 1968). The social misfit hypothesis (Wright et al., 1986) proposes that children who deviate from the social group norm and are different in some discernible way whether it be in relation to behavior or appearance, are often victimized, marginalized or bullied. These findings provide impetus for exploring strategies to reduce experiences of social rejection among adolescents which may improve their MHS. Programs and interventions that focus on growing interpersonal skills such as healthy relationship development, understanding boundaries, community building, acceptance (including acceptance of minorities and differences), group/clique inclusiveness, prosocial behavior (Wright et al., 1986) and antibullying, are important considerations for promoting the MHS of adolescents. For recipients of social rejection, therapies targeting forgiveness and building resilience may be valuable (Van Dyke & Elias, 2007).

Although the association of mental health and school academic performance has been extensively discussed (McLeod et al., 2012), little research has looked at the reverse relationship – school academic performance as a predictor of mental health. The finding in this study that school academic performance was associated with MHS extends the findings of a previous study linking school academic performance and depression in females but not males (McCarty et al., 2008). An Australia study (Mission Australia, 2017) reported that school academic performance is one of the key issues adolescents are concerned about, even more so than body image, and hence poor mental health may be mediated by stress associated with poor school academic performance (Cole, 1991).

The combined beta of all three attitudinal variables in the model with MHS was 0.65 with a medium effect size (f-square 0.16). The attitudinal variables explained 37% of the variance in MHS. This finding extends the work of a previous study (Craig, Morton, Morey, et al., 2018) linking childhood experiences with MHS. This finding highlights the collective impact of these three factors on MHS and indicates that interventions that jointly target meaning and purpose, social rejection and school academic performance may be of value in improving the MHS of adolescents.

An important observation of this study was the effect of upstream childhood factors on MHS. While the association between CFD and MHS in adolescence is well-documented in the literature (Craig, Morton, Morey, et al., 2018; Patton et al., 2014), its importance is highlighted in the present study as CFD had the strongest association ($\beta_{\text{total}} = 0.33$) with MHS of all the variables in the model. It is noteworthy that CFD interacted with four other variables in the model including social rejection, meaning and purpose, academic performance, and sleep quantity. The finding that ACEs was not directly associated with MHS is counterintuitive and surprising as this association was found in other studies and theory (AIHW, 2012; Craig, Morton, Morey, et al., 2018). This result may be due to the strong mediating effect of the present attitudes included in the model. Indeed, finding meaning and purpose, improving school academic performance and addressing social misfit status may dampen the effect ACEs may have on MHS directly. Adverse childhood experiences did have an indirect effect on MHS through perceived social misfit status, school academic performance, and sleep quantity. These findings support the necessity for early interventions and prevention programs that promote positive CFD, namely positive parent child relationships and family enjoyment, focusing in particular on providing skills and support to parents and guardians (Patel et al., 2007).

This cohort was selected as approximately half of the adolescents who attend Adventist schools identify as Adventist. Further, these Adventist adolescents have been shown to practice better health behaviors and experience better health outcomes than the non-Adventist adolescents attending these schools (Craig et al., 2017; Craig, Morton, Kent, et al., 2018). The weak association observed between religious affiliation and other variables in the model is interesting and in relation to mental health may suggest that this population are not atypical.

The multi group analysis in this study resulted in several significant pathway differences for gender. The stronger association between meaning and purpose and MHS for females compared to males is consistent with the findings of other studies (Brassai et al., 2011). This suggests that meaning and purpose functions differently as a protective factor for female and male adolescents. A greater emphasis on interventions designed to enhance meaning and purpose as a protective factor for MHS in females without neglecting males may be worth considering. The findings of this study also suggest that physical activity is more protective of MHS for males and sleep quantity is more protective of MHS for females. A difference in emphasis in intervention and prevention programs among genders would be appropriate whereby more emphasis is placed on physical activity for males and sleep quantity for females when implementing interventions and prevention initiatives to improve MHS.

The strength of this study is that it was able to concomitantly measure and describe the effect of multiple factors on MHS in adolescents including past childhood experiences, present attitudes and selected health behaviors on MHS. A limitation of the study is that it was cross-sectional therefore causation cannot be determined.

Although the model presented is strong, it is acknowledged that other factors also predict MHS. Future studies may consider the inclusion of biological, psychological, socioeconomic, and societal factors to further understand their influence on MHS (Patel et al., 2007). In addition, asking adolescents to retrospectively report their CFD may introduce bias into the data with adolescents currently experiencing poor MHS possibly reporting more negative CFD. Assessing social misfit status may be improved in future studies with peer or teacher reporting in conjunction with self-reports (Bellmore, Witkow, Graham, & Juvonen, 2004; Wright et al., 1986). Although the theoretical frameworks driving this study provide the basis for exploring the pathways presented in the model, it is acknowledged that some predictors may just as well be explained in reverse. Poor MHS for example may predict adolescent's having more difficulty finding meaning and purpose or poor school academic performance (McLeod et al., 2012). Another limitation of this study is that it focused on adolescents attending Adventist schools which belong to the private sector. While the Adventist schools draw students from many socioeconomic statuses, further studies in public schools are required to determine the generalizability of findings. Noteworthy, approximately 40% of adolescents in Australia attend private schools (Australian Bureau of Statistics, 2017).

Conclusion

This study presents a model describing a complex network of factors predicting the mental health status of adolescents attending a faith-based school system in Australia. The results confirm the effect of early childhood family dynamics, having a sense of meaning and purpose, social misfit status and school academic performance on the mental health status of adolescents. The findings support the need for gender appropriate multi-component approaches when developing effective interventions and prevention programs to promote positive mental health among adolescents, with an emphasis on the discovery of meaning and purpose during adolescence and early positive childhood family dynamics.

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RESEARCH ARTICLE

The Body Mass Index of Adolescents Attending Seventh-Day Adventist Schools in Australia: 2001-2012

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ABSTRACT

BACKGROUND: We examined the body mass index (BMI) of students attending Seventh-day Adventist (Adventist) schools in Australia in 2001 and 2012.

METHODS: A total of 3069 students attending Adventist schools in Australia responded to a health and lifestyle survey in 2001 (N = 1335) and 2012 (N = 1734). The survey captured self-reported height and weight, demographics (age, sex, year level, religion), and select health behaviors.

RESULTS: Compared with national norms, lower rates of overweight and obesity were observed in the study cohort, but higher rates of underweight. There was no change in the mean BMI of the students attending Adventist schools in Australia from 2001 to 2012. Regression analyses indicated that a lower BMI was associated with age, sex, more regularly eating breakfast, consuming less soft drink, and having a regular exercise program. The students reported a high consumption of fruits, vegetables, and whole grains compared with Australian national norms, and 29% claimed to be vegetarian.

CONCLUSIONS: Students attending Adventist schools appear to have a lower prevalence of overweight and obesity than the secular population, but a higher prevalence of underweight. The mechanisms through which Adventist schools may influence student's BMI warrants further investigation.

Keywords: adolescent health behaviors; body mass index; fruit and vegetable consumption; obesity; underweight.

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The prevalence of abnormal weight in adolescents is a major global public health concern. In Australia, obesity rates are among the highest in OECD (Organisation for Economic Co-operation and Development) countries.[1] Overweight and obesity among Australian adolescents have more than doubled in the last 3 decades.[2] In 2012, approximately 27% of Australian adolescents were overweight or obese.[3] Overweight adolescents have an 80% chance of becoming overweight or obese adults[4] and it is predicted that by 2022, Australia will have the highest overweight/obesity rates in the world.[5] Although there is evidence that obesity rates are plateauing in adolescents,[2] it has been asserted that the current generation of adolescents will be the first in history to die at a younger age than their parents due to obesity-related comorbidities.[6]

Overweight and obesity in adolescents may be associated with serious physical and psychosocial comorbidities. Physical comorbidities include an increased

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risk of type 2 diabetes, cardiovascular disease, metabolic syndrome, pulmonary and liver disease, sleep apnea, and reduced exercise tolerance.[7,8] Psychosocial comorbidities include social discrimination, negative body image and eating disorders,[7,8] poor self-esteem.[9] compromised mental health,[9,10] and even suicide ideation.[11] Unremarkably, these factors can adversely affect school performance[12] and overall quality of life.[13]

While overweight and obesity among children and adolescents have been extensively researched, the prevalence and comorbidities of underweight are largely understudied.[14] It has been recently acknowledged that underweight poses a considerable public health problem and warrants further investigation.[14] Underweight is an often overlooked phenomenon which frequently coexists with obesity, even within the same family.[15]

The Adventist Church is a Christian denomination with approximately 19 million members worldwide.[16] The Adventist Church advocates certain lifestyle behaviors that may affect body weight including a vegetarian diet, regular exercise, and the avoidance of caffeine, refined foods, tobacco, and alcohol.[17] The Adventist population has been the focus of numerous health studies as they tend to experience good health and lower rates of disease.[18] In Australia, the Adventist Church has an extensive education system, including 27 schools that cater for both Adventist and non-Adventist students, which espouses the health practices of the church. Although Adventist adults have been studied since 1960, there has been limited research on Adventist Australian adolescents and their body weight.

The aim of this study was to evaluate the body mass index (BMI) of adolescent students attending Adventist schools in Australia in 2001 and 2012 and to investigate the influence of age, sex, mental health and vitality, and select health behaviors on BMI.

Specifically, the following research questions were examined. First, how has BMI changed from 2001 to 2012? Second, what influence does select health behaviors advocated by the Adventist Church have on student's BMI? We hypothesize that influences of Adventist lifestyle will be observed in the Adventist school context and that these will be associated with lower BMI in the students attending Adventist schools.

METHODS

Procedure and Participants

A health and lifestyle survey was commissioned by the Adventist Church to be conducted in 21 Adventist schools in Australia in 2001 and 2012. A total of 7850 students attended Adventist schools in these 2 years (N = 3176 in 2001, and N = 4674 in 2012). Valid responses to the surveys were obtained from 1886 students (24%) comprising 788 responses from 2001 (25%) and 1098 in 2012 (23%). Participation in the questionnaire was voluntary and anonymous. The respondents across the 2 time epochs were similar with regards to age in 2001 and 2012 (14.7 ± 1.7 vs 14.5 ± 1.6) and sex (47% girls and 46% boys).

Instruments

The survey instrument recorded the participant's age and sex. Self-reported health status was assessed using a validated single-item Likert scale, used in adolescent cohorts by.[19] Dietary intake was assessed using questions derived from a previously validated food frequency questionnaire.[20] Physical activity was assessed separately using 2 items. The first item asked if the respondent had a regular exercise program[20] and the second asked how many times per week they usually performed moderate or vigorous physical activity for at least 30 minutes.[21] Sedentary behavior was assessed using frequency questions measuring hours per day for time watching television, videos and DVDs, playing computer games and surfing the Internet. These items were summed to compute a total score for sedentary behavior. Sleep and sitting were assessed using frequency questions measuring hours per day/night. Validated subscales from the Short-Form 36 Health Survey (SF-36)[22] were used to assess separately mental health and vitality. The mental health subscale is based on 5 items in the SF-36 measuring general mental health status. The vitality subscale is based on 4 items of the SF-36 and assesses energy and fatigue status.

Height and weight were self-reported and used to calculate BMI using the standard equation: $\text{BMI} = \text{weight in kg}/(\text{height in m})^2$. BMI was further trichotomized into "underweight," "normal weight," and "overweight/obese." Adolescent BMI cutoff points were calculated according to the World Health Organization (WHO) standardized BMI index (BMI-z) age and sex cutoffs used for classifying adolescents' weight status.[23] The WHO standardized BMI-z age and sex cutoffs are based on adult (18 years and older) cutoffs classifying underweight as a BMI < 18.5 kg/m^2, normal weight as a BMI between 18.5 and 24.99 kg/m^2 and overweight as a BMI ≥ 25 kg/m^2.

Data Analysis

The data were analyzed using SPSS (versions 20; IBM, Armonk, NY), and after data cleaning was performed, they were screened for normality using Levene's test for quality of variances. Descriptive statistics involved mean ± standard deviation. Independent *t* tests were used to examine differences between continuous variables over the 2 time periods. Chi-square was used to assess changes over the 2 testing periods

Table 1. **The Number of Respondents Belonging to the Trichotamized BMI Categories From 2001 to 2012**

	2001		2012		Combined	
BMI category	N	%	N	%	N	%
Underweight	126	12.5	92	11.9	218	12.2
Normal weight	713	70.7	576	74.5	1289	72.4
Overweight/obese	169	16.8	105	13.6	274	15.4

BMI, body mass index.

in the proportion of participants belonging to the 3 weight categories.

Regression analyses were conducted separately for 2001 and 2012 and then combined using BMI as the dependent variable and age, sex, the mental health and vitality subscales derived from the SF-36, and select health behaviors as the independents. The select health behaviors included as independent variables in the regression were the measures of physical activity and sedentary behavior described above, sleep hours, and the consumption frequency of fruit, vegetable, whole grain, soft drink, fast food, and breakfast.

RESULTS

BMI Status and Changes

There was no significant difference ($p = .16$) in the overall mean BMI of the respondents from 2001 ($20.5 \pm 3.3\ kg/m^2$) to 2012 ($20.2 \pm 2.9\ kg/m^2$). Table 1 shows the number of respondents belonging to the various BMI categories in 2001 and 2012, as well as in the years combined. The mean BMI for all students involved in the study across the 2 sampling periods was $20.4 \pm 3.1\ kg/m^2$.

Influence of Sex on BMI

When the data from both sampling periods were combined, there was no significant difference between the mean BMI of boys and girls (20.5 ± 3.2 vs $20.2 \pm 3.0\ kg/m^2$, respectively, $p = 0.08$).

When the data were stratified for sex, there remained no difference in the mean BMI of the boys from 2001 to 2012 (20.4 ± 3.3 vs $20.6 \pm 3.0\ kg/m^2$, $p = .49$). There was a significant reduction in the BMI of the girls over the 2 sampling periods (20.4 ± 3.2 vs $19.9 \pm 2.7\ kg/m^2$, $p = .01$); however, the effect size was small (Cohen's $d = .17$). Table 2 shows the number of boys and girls in the trichotomized BMI categories in the 2 sampling years. Chi-square analysis indicated a significant change in the proportion of the girls belonging to the various categories, with fewer belonging to the overweight/obese category and more to the normal weight category ($\chi^2 = 9.2$, $p = .01$) in 2012.

Influence of Age on BMI

From 2001 to 2012, there was no significant change in the BMI for any of the age categories except the 13-year-olds, which decreased (19.8 ± 3.2 vs 19.0 ± 2.9, $p = .025$). Further analysis indicated that this only occurred among the girls (19.3 ± 3.2 vs 18.8 ± 2.6, $p = .03$).

Analysis of the data pooled for the 2 sampling periods indicated a progressive increase ($p < .01$) in the mean BMI of the students with increasing age (12 years: $18.8 \pm 3.1\ kg/m^2$; 13 years: $19.5 \pm 3.1\ kg/m^2$; 14 years: $20.1 \pm 3.2\ kg/m^2$; 15 years: $20.4 \pm 3.1\ kg/m^2$; 16 years: $20.9 \pm 2.8\ kg/m^2$; 17 years: $20.9 \pm 2.8\ kg/m^2$; 18 years: $21.7 \pm 3.1\ kg/m^2$).

Influence of Select Factors on BMI

Table 3 shows separate regression models for 2001 and 2012 using BMI as the dependent variable and age, sex, mental health and vitality, and select health behaviors as independents. The observation that vegetarianism was not associated with BMI was further supported by independent-samples *t* test, which showed no difference ($p = .98$) in the BMI of the vegetarian students ($20.4 \pm 3.2\ kg/m^2$), compared with the nonvegetarians ($20.4 \pm 3.1\ kg/m^2$). Interestingly, 29% of the participants in the study indicated that they subscribed to a vegetarian diet, which was likely influenced by 74% stating that they had 1 or more parents who were Adventist in their childhood.

Fruit, Vegetable, and Whole Grain Intake

From 2001 to 2012, there was a significant decrease in the consumption of vegetables (2.16 ± 0.89 vs 2.06 ± 0.77, $p = .001$) and whole grains (2.95 ± 1.11

Table 2. **The Number of Boys and Girls Belonging to the Trichotomized BMI Categories From 2001 to 2012**

	2001				2012				Combined			
	Boys		Girls		Boys		Girls		Boys		Girls	
BMI category	N	%	N	%	N	%	N	%	N	%	N	%
Underweight	46	9.7	80	15.0	39	10.5	53	13.2	85	10.1	133	14.2
Normal weight	339	71.5	374	70.0	263	70.9	313	77.9	602	71.2	687	73.4
Overweight/obese	89	18.8	80	15.0	69	18.6	36	9.0	158	18.7	116	12.4

BMI, body mass index.

Table 3. **Regression Models for 2001 and 2012 for Select Factors Associated With BMI**

Dependent variable: BMI			
Independent variables	**2001 (Model R square = .051) Beta (p)**	**2012 (Model R square = .101) Beta (p)**	**Combined 2001, 2012 (Model R square = .066) Beta (p)**
Age	.198**	.236**	.203**
Sex		.105*	.063*
Daily drinks of soft drink	.079*	.117**	.052*
Frequency of breakfast	−.107**		−.068**
Regular exercise program		.073 (.06)	.06*
Hours per night sleeping		−.071 (.091)	−.47 (.084)
Vitality scale		−.077 (.057)	−.47 (.078)

Statistical model: backwards regression. *p < .05, **p < .001.
BMI, body mass index.

vs 2.46 ± 0.91, p < .001) but not fruit. Further analysis indicated that the decrease in vegetable consumption only occurred among the boys (2.19 ± 0.93 vs 2.01 ± 0.82, p = .019) and the decrease in whole grain consumption occurred among both boys (3.18 ± 1.19 vs 2.58 ± 1.03, p < .001) and girls (2.76 ± 0.97 vs 2.36 ± 0.78, p < .001).

Students meeting recommended daily servings of fruit, vegetables and whole grains as set out by the Australian Government Department of Health and Ageing[24] was above national norms in this study. About 76% of girls and 73% of boys in this study met the recommended daily 3 servings of fruit. About 23% of girls and 28% of boys met the recommended 4 daily servings of vegetables (excluding potatoes) and 36% of girls and 48% of boys in this study met the daily recommended 4 servings of whole grains.

DISCUSSION

This is the first Australia-wide study of the BMI of adolescents attending Adventist schools. The findings indicate that adolescents attending Adventist schools in Australia report lower rates of overweight and obesity, but higher rates of underweight, than national norms. Furthermore, there was no change in the mean BMI of adolescents attending Adventist schools in Australia from 2001 to 2012.

There is convincing evidence that the rate of overweight and obesity among Australian adolescents has substantially increased over the last 30 years.[2] Data from 1985 indicated that approximately 11% of 13- to 15-year-olds were overweight or obese. This increased to 19% by 1997[25] and a report in 2012 by the Australian Bureau of Statistics[3] categorized 27% of 12- to 15-year-olds as overweight or obese. Comparably, the results of Australian school-based studies conducted within the past 5 years have reported rates of overweight and obesity between 22%[26] and 32%.[27] The prevalence of overweight and obesity observed among the adolescents attending Adventist schools in this study (17% for 2001 and 14% for 2012) compared favorably with these data. Indeed, it would appear that adolescents attending Adventist schools in Australia are trending some 20 years behind the wider population.

Notwithstanding the secular trend for a progressive increase in the prevalence of overweight and obesity among adolescents over the past 30 years, a review by Olds et al[2] suggested that there has been a slowing of the rate of increase over the previous 2 decades. The present study observed no increase in overweight or obesity among the adolescents attending the Adventist schools. This was observed for all age categories except the 13-year-olds, and for both the boys and girls. In fact, the cohort of girls trended toward a decrease in BMI from 2001 to 2012. The significant reduction in the proportion of girls in 2012 belonging to the overweight/obese category and the corresponding increase in the normal category is encouraging. This is particularly so considering no significant increase was seen in the underweight category.

The explanation for the lower BMI of adolescents attending the Adventist schools in this study needs further investigation. The Ecological Model for Predictors of Childhood Obesity[28] suggests that body weight is influenced by 3 factors: characteristics of the child/adolescent, family influences, and societal elements which include the school they attend.

Characteristics of the Adolescent

The students in this study were atypical compared with national norms, as evidenced by 29% claiming to be vegetarian. There are no data on the prevalence of vegetarianism among Australian adolescents; however, in 2009, 2% of Australian adults reported being vegetarian.[29] Vegetarianism has been consistently associated with lower body weight than nonvegetarian eating patterns in both adults[30] and adolescents[31] and may in part explain the lower mean BMI of the students in this study compared to the wider Australian community. It is interesting however that within the study cohort, there was no significant difference in the BMI of vegetarians and nonvegetarians.

There is considerable disparity between reports of fruit, vegetable, and whole grain consumption among Australian adolescents,[24,32] with some studies indicating less than 1% meet the national guidelines.[24] Comparatively, a high number of the adolescents in this study were categorized as meeting the National recommendations for these foods, especially concerning fruit consumption in which approximately three-fourths of the adolescents met the criteria.

Noteworthy, within the study cohort, vegetable, fruit, or whole grains were not associated with BMI. This appears counterintuitive to the underlying hypothesis that vegetable, fruit, and whole grain consumption is associated with BMI. This, however, may be explained in part due to this cohort having a lower mean BMI compared with the wider Australian community.

The association between soft drink consumption and BMI in both the 2001 and 2012 samples is supported by other studies of adolescent soft drink consumption.[31] In 2001, 16% of adolescents in this study consumed 1 cup of soft drink per day, which declined to 4% in 2012. Comparatively, studies in 2010[32] indicated that 9% of Australian 14 to 16 year-olds were consuming 1 cup of soft drink per day. The association with breakfast eating and BMI is supported by other studies surveying adult cohorts.[33] Grant et al[31] found breakfast eating in adolescents contributed to healthier biological profiles. These results are of interest to this study as a focus on breakfast eating and canteen beverage menus may be a useful component of school and family health promotions or interventions. Associations in this study between adolescent's reporting a regular physical activity program and BMI have been found in other studies[27] and highlight the importance of physical activity promotion in adolescents.

The higher proportion of vegetarianism in this cohort may also explain the higher prevalence of underweight in this study. A 2007 study of 14- and 16-year-old Australian students found the prevalence of underweight to be approximately 5%[24] which is less than half that observed in this study (12%). Incidences of underweight have been found in environments that place an emphasis on health and wellbeing which have inadvertently led to undesirable outcomes in the thinness of some adolescents.[15] Underweight has also been associated with unhealthy weight control behaviors from exposure to images of ideally thin models in popular and social media.[15] With increasing exposure to social media in modern society, this is worth further investigation. Underweight is largely understudied and deserves further research attention due to its association with lower levels of physical fitness compared to ''normal'' weight adolescents[15] and poorer health outcomes.[24]

Family Influences

The families of students in this study were atypical compared to national norms, as evidenced by 74% of students indicating that they grew up in a family that had, at least, 1 Adventist parent. Knowledge and compliance by parents of the healthy holistic lifestyle espoused by the Adventist Church may see an adoption of healthy behaviors in their children. This phenomenon has been observed in other studies[28] where healthy behavior ''copying'' in parents, children and siblings has been reported. Behavior copying in family members demonstrates the influence parent modeling and sibling interaction can have on a child's evolving health behaviors. Bleich et al[28] reported that a higher socioeconomic status is also associated with lower BMI levels in adolescents. It is possible that Adventist schools attract more affluent families who can afford the financial burden of private education. The extent to which family dynamics affect adolescent BMI is worthy of further investigation.

School Influences

The Adventist health behaviors and beliefs are promoted and encouraged in Adventist schools. Only vegetarian meals are served in school canteens, and fruit or vegetable snacks are encouraged (and in some schools enforced) during recess breaks. Adventist schools are active in the implementation of needs-based health interventions such as school breakfast programs in underprivileged areas. Staff at Adventist schools is required to model Adventist lifestyle practices at school, which may strengthen the adoption of these behaviors in students. It is well-documented that behaviors linked to social learning and cultural norms influence adolescent health behaviors.[34]

Holistic approaches to chaplaincy programs in Adventist schools also promote positive life skills, spiritual development, and service models. A review by Rew and Wong[34] found that spirituality exerts a positive influence on health attitudes and behaviors. There may have been other unique elements about this study's cohort that were not captured but warrant further investigation.

Limitations

A limitation of this study is the use of self-reported BMI. BMI based on self-reported data has been found to be fairly reliable[35] and suitable for identifying valid relationships in epidemiological studies.[35,36] Several researchers have found self-reported BMI to produce lower prevalence estimates of overweight and higher prevalence estimates of underweight than those based on actual measured height and weight.[37-39] Notwithstanding, others have reported high accuracy for weight classification of on self-reported data.[35,36,40] In the present study, the students' responses were anonymous in order to negate a reporting bias associated with a desire to be socially accepted.

Conclusions

Students attending Adventist schools appear to be faring better than the secular Australian population with regards to overweight and obesity, although they display a higher prevalence of underweight. In response to the obesity epidemic presently observed among Australian adolescents, the factors responsible for the lower body weights observed among the adolescents in this study is worthy of further investigation although this study highlights the importance of diet and physical activity. While the adolescents in this study may be atypical in several ways, further research may identify additional school-based modifiable factors that could be replicated and introduced in other school settings.

IMPLICATIONS FOR SCHOOL HEALTH

Schools can play a leading role in addressing concerns over rising rates of overweight and obesity in school aged children,[2] as well as the associated comorbidities,[7-10] adverse affects on school performance,[12] and overall quality of life.[13] Hence, reducing overweight and obesity provides academic[12] and behavioral benefits[9] in students that are congruent with the priorities of school administrators and educators. This study identified several behaviors associated with lower rates of overweight and obesity: regularly eating breakfast, consuming less soft drink, having a regular exercise program, and consuming fruits, vegetables, and whole grains. Studies indicate that less than 1% of adolescents meet the national guidelines[24] for these health behaviors.

Schools could benefit their students by expanding on traditional health education and physical education pedagogy. Classroom education could be supported with nutrition and cooking classes across the school years teaching the benefits of healthy eating such as consumption of plant-based diets, breakfast eating and the disadvantages of soft drink consumption. Studies[41] have shown that when students participate in nutrition and cooking classes, the acceptability of healthy foods, such as vegetables, increases. Furthermore, as food awareness and food preparation skills increase, so does interest in home food preparation, essentially growing the students as agents of change within their family. Interestingly, students in this study considered that food allowed or available in school canteens and vending machines was healthy, further supporting the benefits of using the school environment to promote healthy behaviors.

Schools can also promote healthy eating behaviors by enforcing fruit/vegetable snacks for recess, as occurs in some of the schools involved in the present study, as well as reducing the offering of unhealthy foods and drinks at school canteens while increasing the offering of nutritious options. Further, schools may consider offering a healthy breakfast program, as occurs in some of the schools in this study, in underprivileged areas where students come to school without consuming breakfast resulting in midmorning hunger, loss of attention, and increased classroom discipline issues.

The benefits of student physical activity are widely discussed in the literature, however, reduction in time provisions in crowded curriculums and other barriers have seen school administrators cut physical education classes[42] and recess breaks. Schools can increase physical activity opportunities that compliment their physical education classes for all school aged students, not just those who are athletically inclined, with organized recess and lunchtime sports, physical activity clubs, interschool sports programs, and classroom lessons that incorporate physical activity to decrease sedentarism. An emerging strategy for increasing daily participation in physical activity in schools is the implementation of structured classroom-based physical activity breaks. A break of 10-15 minutes focused on moderate to vigorous physical activity has been found to be effective in significantly increasing physical activity levels students.[43] Studies[44] have found that sustained use of such breaks has show to decrease student BMI over a 2-year period. Programs such as Texas I_CAN[45] helped teachers incorporate physical activity by modifying lesson plans to include more active activities. These classes may help students learn how to weave physical activity into their daily routines. In the present study, we found some schools successfully ran ''get active'' after school care and vacation care programs for students to participate in a variety of sports to increase physical activity levels.

Unique to this study cohort is the high percentage of students reporting a vegetarian diet (29%) and, unremarkably, reporting family affiliation with the Adventist Church (74% reporting at least 1 Adventist parent). The influence of the health emphasis of the Adventist Church on both school and family domains highlight the need for schools to recognize the positive effect[34] school and family collaboration has on educating children. School students could benefit by schools facilitating health programing between school and community and between school and family. An example of how school community and family could collaborate is in organized active transport such ''bike bus'' or ''walking bus'' initiatives where volunteer parents escort children from pickup points or homes along fixed routes to school. Walking bus initiatives are popular in Europe and Australia and emerging in the United States.

Human Subjects Approval Statement

The Avondale College of Higher Education Human Research Ethics Committee (No:2011:21) approved this study.

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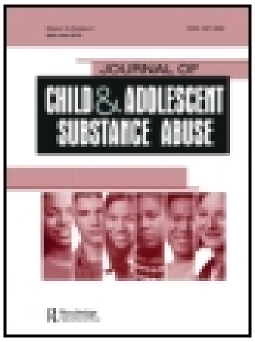

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Factors Predicting Alcohol Consumption in Adolescents Attending a Faith-Based School System in Australia: A Multigroup Structural Equation Analysis

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ABSTRACT

Structural equation modeling was used to explore the direct and indirect association of childhood experiences, attitudes, subjective norms, and intentions on the alcohol consumption of adolescents attending faith-based Seventh-day Adventist schools in Australia. Data were collected on 1,266 adolescents and the structural model developed explained 48% of the variance for alcohol consumption. Intentions had the highest degree of association with Alcohol Consumption Status (ACS) ($\beta = 0.52$). Attitudes were more strongly associated to ACS ($\beta_{total} = 0.36$) than subjective norms ($\beta_{total} = 0.17$). Adverse Childhood Experiences (ACEs) were associated with every variable in the model and had a combined direct and indirect association with ACS of $\beta_{total} = 0.14$. Multigroup analysis found significant pathway differences in the model for gender and age with regards to the association of intentions, attitudes, ACEs, and Childhood Family Dynamics with alcohol consumption status. The study fills a gap in the alcohol literature by presenting a model describing the complex network of factors that predict alcohol consumption in a low-ACS population. The outcomes of the study highlight the importance of early intervention for children and their families to delay or minimize alcohol consumption in adolescents.

KEYWORDS
adolescent alcohol consumption; adverse childhood experiences; attitudes toward alcohol; family dynamics; underage drinking

Introduction

The consumption of alcohol by adolescents is an issue of major public health concern globally as it is associated with an array of poor physical, psychological, and behavioral outcomes (Gore et al., 2011; National Health and Medical Research Council [NHMRC], 2009). Adolescent alcohol consumption is a leading cause of premature death and injury in adolescents (Gore et al., 2011) and is a key risk factor for early sexual debut (Coleman & Cater, 2005), depression (Fergusson, Boden, & Horwood, 2009), compromised brain function and development (Jacobus & Tapert, 2013; McQueeny et al., 2009), poor academic outcomes (Koch & McGeary, 2005), alcohol dependence (McCambridge, McAlaney, & Rowe, 2011) and adverse mental and physical health in adulthood (Andréasson, Romelsjö, & Allebeck, 1991).

Over the past few decades, there has been a steady decline in alcohol consumption in adolescent populations in many countries including England, the United States (Looze et al., 2015), Australia (Livingston, 2014), and a number of European countries (Looze et al., 2015). In Australia, these declines have occurred across a wide range of population subgroups defined by demographic, geographic, and socioeconomic factors (Livingston, 2014). Little attempt has been made to explore the factors driving the reduction in alcohol consumption in adolescent populations (Livingston, 2015; Pennay, Livingston, & MacLean, 2015) despite the potential public health benefits (Livingston, 2014).

Factors driving drinking behaviors in adolescents are wide-ranging, occurring on multiple levels. Behavior change theories such as the Theory of Reasoned Action (TRA; Ajzen & Fishbein, 1980) have been used extensively to predict, explain, and understand health-related behaviors such as alcohol consumption in adolescents (Laflin, Moore-Hirschl, Weis, & Hayes, 1994; Lorenzo-Blanco et al., 2016; Stoddard & Pierce, 2018). The TRA's premises are threefold. First, the TRA proposes that intentions are an important predictor of behavior. Second, intentions are directly determined by two motivational factors, namely attitudes and subjective norms. Attitudes refer to the evaluation of a particular behavior by the individual. Subjective norms capture social pressures that may influence an individual's intention to use alcohol (Ajzen & Fishbein, 1980). The literature on alcohol use suggests that attitudes toward alcohol use, normative influences, and intention to use alcohol are important predictors of adolescent alcohol consumption (Marcoux & Shope, 1997). Third, antecedent to attitudes and subjective norms are beliefs. Fishbein and Ajzen (2011) regard

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these beliefs as the psychological determinants that need to be altered to bring about behavior change.

While numerous theories explain the development of beliefs, Bronfenbrenner's (2005) Bioecological Systems Theory (BST) suggests that the environment in which a child grows, particularly the family environment, contributes to a child's developing beliefs and ultimately their behavior. Many studies (Kelly et al., 2011; Laghi, Baiocco, Lonigro, Capacchione, & Baumgartner, 2012; Yap, Cheong, Zaravinos-Tsakos, Lubman, & Jorm, 2017) confirm that an adolescent's family dynamics, including relationship quality, may predict adolescent drinking beliefs. However, little research has investigated the relationship between early childhood family dynamics (CFD) and ACS later in the adolescent years. Other childhood experiences that may influence the development of beliefs are Adverse Childhood Experiences (ACEs; Felitti et al., 1998). ACEs refer to stressful or traumatic experiences that a child may encounter in early life such as physical, psychological and sexual abuse, neglect, and family dysfunction. These traumatic, stressful experiences have been established as factors that predict alcohol consumption in adolescents (Dube et al., 2006; Felitti et al., 1998; Gonçalves et al., 2016). Studies that have applied the TRA to alcohol consumption have largely overlooked the influence of important antecedent beliefs (Pabian & Vandebosch, 2014). This study attempts to address this gap in the literature by including both the TRA and antecedent beliefs measured through the influence of ACEs and CFD when exploration of predictors of ACS are assessed.

Our population of interest is the faith-based Seventh-day Adventist (Adventist) population, which has been the subject of extensive health research. Adventists tend to consume significantly lower rates of alcohol than the general population (Orlich et al., 2013). Indeed, the Adventist faith proscribes alcohol consumption and advocates positive family dynamics (Ministerial Association of Seventh-Day, 1988). A previous study on Adventist adolescents suggested that the Adventist faith influenced the impact family dynamics have on adolescent attitudes toward alcohol consumption and alcohol consumption status. In the study, adolescents with no Adventist parents compared to adolescents with one or both parents who were Adventist had increasingly negative attitudes toward alcohol consumption and lower rates of consuming alcohol (Gane, 2012).

The present study employed structural equation modeling (SEM) and applied the TRA and the antecedent childhood experiences ACEs and CFD to examine the direct and indirect association of alcohol consumption operationalized as ACS among adolescents attending Adventist schools in Australia. In addition, multigroup SEM analyses were used to more extensively explore gender and age variations in these relationships.

Methods

Study participants

In 2012 a survey was administered in 21 private Adventist secondary schools across Australia which cater for both Adventist and non-Adventist students. At the time there were 28 Adventist secondary schools in Australia, with seven electing not to participate. A total of 4,674 students attended Adventist secondary schools in 2012; completed responses were received from 1,266 students (27%) in years seven to 12. Participation in the study was voluntary and anonymous, and written consent was collected from the students as well as their parents or guardians. The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No:2011:21). Approximately 41% of adolescents in Australia attended private secondary schools at the time of the survey, with 0.9% attending the Adventist school system (Australian Bureau of Statistics, 2017).

Survey instrument

The survey instrument recorded the participants' ACS as well as intentions to consume alcohol, attitudes toward alcohol consumption, subjective norms, CFD, ACEs, and personal demographics.

Alcohol consumption

Current ACS was measured using an item used in previous Australian adolescent studies (Bowden, Delfabbro, Room, Miller, & Wilson, 2017; White & Bariola, 2012; White, Hill, & Segan, 1997) that asked, "At the present time, do you consider yourself: 1. Non-drinker. 2. Occasional Drinker. 3. Light Drinker. 4. Party Drinker. 5. Heavy Drinker?" For the purpose of this study, this item was trichotomized to Nondrinker (response 1), Light Drinker (responses 2 and 3) and Heavy Drinker (responses 4 and 5). The authors acknowledge the absence of quantification of this measure; however, differences in consumption according to gender and age using this measure in the aforementioned studies are in line with other studies (AIHW, 2014; Livingston, 2014) measuring alcohol consumption with quantifiable measures.

Intentions to consume alcohol

Intention to consume alcohol was measured with the single item asking the participants to respond to the statement "I plan to drink alcohol at my current age" with a choice of five options ranging from "Strongly Disagree" to "Strongly Agree."

Attitudes toward alcohol consumption

Attitudes toward alcohol consumption were measured by asking participants to respond to the following statements: "It is okay to drink alcohol at my age," "Alcohol is harmful to my relationships," and "Alcohol is harmful to my health," with a choice of five options for each statement ranging from "Strongly Disagree" to "Strongly Agree." The attitudinal items were not combined into a scale so that the individual relationship of each item with ACS could be examined as previously assessed elsewhere (Marcoux & Shope, 1997).

Subjective norms surrounding alcohol consumption

Subjective norms relating to alcohol consumption were measured using three items. The first item asked respondents, “In the past month would any of your close friends have used alcohol?” with response options “Yes, some of my friends” (scored as 1) and “No, none of my friends” (scored as 2). Items 2 and 3 used to measure subjective norms asked participants to respond to the following statements: “It is okay for me to say ‘no’ to drinking if friends offer me a drink” and “It is okay for me to say ‘no’ to drinking if family members offer me a drink.” Responses for these items included five options ranging from “Strongly Disagree” to “Strongly Agree.” The subjective norm items were not combined in a scale so that the individual relationship of each normative item with ACS could be examined as previously assessed elsewhere (Marcoux & Shope, 1997).

Childhood family dynamics

Childhood family dynamics were assessed by creating a CFD score used in a previous study (Craig et al., 2018) from six items: “As a child, my parents showed me love”; “As a child, my parents understood me”; “While I was a child my family had a lot of fun”; “As a child, my parents didn’t trust me”; “As a child, my parents didn’t care what I did”; and “As a child, I enjoyed being at home with my family.” Each item included five options ranging from “Strongly disagree” to “Strongly agree.” Each response was given a corresponding value from 1 to 5, with higher scores representing increasingly positive outcomes. Responses from each item were summed to calculate an overall CFD score.

Adverse childhood experiences

In this study, an adapted ACEs score as described elsewhere (Felitti et al., 1998) and used in a prior study (Craig et al., 2018) was generated by collating the responses from the following nine items: “One or both of my parents were in trouble with the law”; “My parents were separated or divorced”; “One or both my parents died”; “One or both parents were absent from home for long periods”; “There were times when family violence occurred”; “There were times when I was physically abused”; “There were times when I was sexually abused”; “One or both parents smoked tobacco”; and “One or both parents drank alcohol weekly or more often.” Each item included no/yes response options which were given a corresponding value of 0 or 1. Responses from each item were summed to calculate an overall ACEs score. It is acknowledged that the item asking about parents’ consumption of weekly alcohol may not equate to an ACE directly; however, it may be associated with parental absence or other potential harms.

Religious affiliation

Religious affiliation was included in this study due to the special nature of the sample. Religious affiliation was assessed by asking the participants, “Which of the following best describes your religious belief now?” Options were 1. Seventh-day Adventist Christian; 2. Other Christian; 3. Other Religion; 4. No Formal Religion; and 5. Don’t Know. For the purpose of this study, this item was dichotomized to Adventist (response 1) and not Adventist (responses 2–4).

Analysis

The objective of this study was to examine the direct and indirect predictors of alcohol consumption employing SEM. A hypothesized model informed by the literature and the TRA (Ajzen & Fishbein, 1980) is presented in Figure 1 for analysis. The most proximal explanatory variables were intentions to consume alcohol followed by attitudes toward alcohol consumption and subjective norms. The distal variables included childhood experiences. The data were imported into SPSS (Version 24; IBM, Armonk, NY, USA) to calculate means, standard deviations, distributions, and internal reliability. Structural equation modeling using AMOS (Version 24; Amos Development Corporation, Crawfordville, FL, USA) was conducted to estimate the model fit of the data in the hypothesized model (Figure 1) and simultaneously analyze the direct and indirect effects of the explanatory variables on the outcome variable (Bucy & Holbert, 2014). This was done using techniques developed by Jöreskog and Sörbom (1989) which involved an iterative process of inspection of the statistical significance of path coefficients, and theoretical relevance of the constructs in the model to derive an optimal SEM that best fit the data set, and was theoretically meaningful. Overall model fit was examined using multiple goodness-of-fit indices, namely: relative X^2 (CMIN/DF), baseline comparisons fit indices of normative fit index (NFI), relative fit index (RFI), incremental fit index (IFI), Tucker-Lewis Index (TLI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). A CMIN/DF statistic below 3 is considered good model fit (Kline, 2010) as are baseline comparisons fit indices above 0.9 (Bentler, 1990). The RMSEA value was less than 0.06, which indicated a close fit between the data and the model (Hu & Bentler, 1999). Bootstrapping (Preacher & Hayes, 2008) was applied to verify the statistical significance of indirect effects at $p < .05$. Multigroup analysis was employed to test for gender and age variations among the pathways in the study, as age and gender differences have been observed in previous TRA and alcohol consumption studies (Cooke, Dahdah, Norman, & French, 2016). The critical ratios for differences test was applied to assess for regression weight differences in the gender and age groups within the SEM (Ho, 2013).

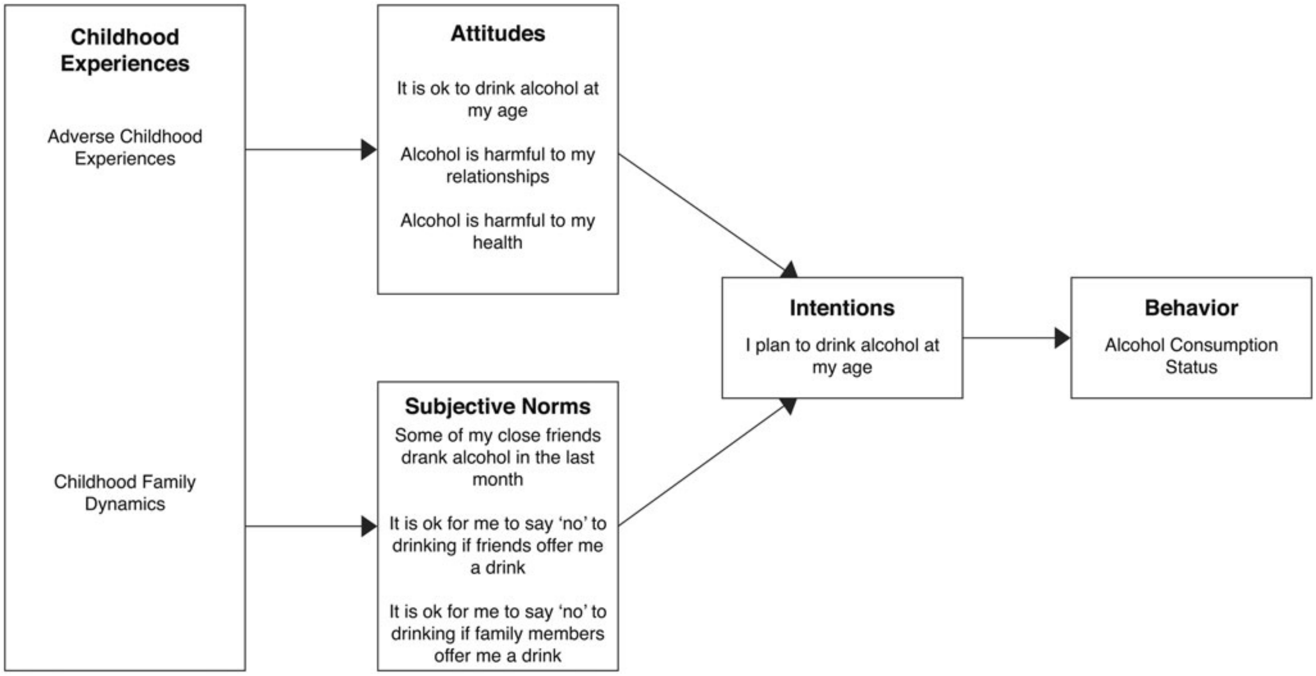

Figure 1. Hypothesized model predicting alcohol consumption status.

Results

Descriptive statistics

A summary of descriptive statistics and reliability estimates is shown in Table 1. Students' ages ranged from 12 to 8 years, mean age 14.6 years with 56% males. Forty-seven percent of students identified as belonging to the Adventist faith, 26% identified as other Christian faith, 6% identified as other religion, 8% identified as no formal religion, and 13% did not know. Eighty-two percent of the adolescents in the study reported "nondrinker" status, 12% reported "light drinker" status, and 6% reported "heavy drinker" status. Chi-square analysis indicated a significant difference in the proportion of adolescents belonging to the ACS categories with less older adolescents (15–18 years) belonging to the nondrinker category and more belonging to the light drinker and heavy drinker categories compared to younger adolescents (12–14 years; $X^2 = 101.6$, $p < .01$). Furthermore, fewer non-Adventist students belonged to the nondrinker category and a greater number belonged to the light drinker and heavy drinker category compared to Adventist students ($X^2 = 44.2$, $p < .01$).

The model predicting alcohol consumption status

A final structural model is presented in Figure 2 and describes the associations of childhood experiences (ACES and CFD), attitudes toward alcohol consumption, subjective norms relating to alcohol consumption, and intentions to consume alcohol with alcohol consumption status, along with their interactions. The final structural model fitted the data very well, as indicated by the goodness-of-fit indices (CMIN/DF = 2.365; NFI = 0.997, RFI = 0.978; IFI = 0.998; TLI = 0.987, CFI = 0.998 and RMSEA = 0.033). The subjective norm items asking "It is okay for me to say 'no' to drinking if friends offer me a drink" and "It is okay for me to say 'no' to drinking if family members offer me a drink" were removed from the model due to their non-significant contributions generating the final structural model (Figure 2). Standardized path coefficients are presented as single-headed arrows in the final model. All shown paths are statistically significant including all indirect and combined total pathways. The squared multiple correlation calculated for ACS of 0.48 indicates that the model explained 48% of the variance for alcohol consumption status. The attitudinal variable "Alcohol is harmful to my health" and the subjective norm variables "It is okay for me to say 'no' to drinking if friends offer me a drink" and "It is okay for me to say 'no' to drinking if family members offer me a drink?" were removed from the final structural model because of their non-significant contributions to ACS.

The combined direct and indirect association (β_{total}) of the two attitudinal variables ("It is okay to drink alcohol at my age," "Alcohol is harmful to my relationships") with ACS was $\beta_{total} = 0.36$. This compared with the combined direct and indirect association of the subjective norms variable ("Some of my close friends drank alcohol in the past month") with ACS which was $\beta_{total} = 0.17$. Of the childhood factors measured in the model, the combined direct and indirect association of ACEs with ACS was $\beta_{total} = 0.14$ compared to the combined direct and indirect association of CFD with ACS which was $\beta_{total} = -0.10$.

Multigroup analysis for gender (Figure 3) found a significant difference in the path coefficient between CFD and "Alcohol is harmful to my relationships" with this association stronger for males ($\beta = 0.15$) than for females ($\beta = 0.01$). A significant difference in the path coefficient was also found between "It is okay to drink alcohol at my age" and "I plan to drink alcohol at my age" with this

Table 1. Descriptive statistics and scale reliability of variables used in the analysis.

Variables	*N* (%)	Mean ± *SD*	Min	Max	Scale Reliability (α)
Age	1,266	14.64 ± 1.59	12	18	
Younger Adolescents (12–14-year-olds)	597 (47.2%)				
Older Adolescents (15–18-year-olds)	669 (52.8%)				
Gender					
Males	557 (44%)				
Females	709 (56%)				
Adverse Childhood Experiences Score	1,266	1.39 ± 1.62	0	9	.69
Childhood Family Dynamics Score	1,266	24.20 ± 4.73	5	30	.84
It is okay to drink alcohol at my age[a]	1,266	1.92 ± 1.19	1	5	
Alcohol is harmful to my relationships[a]	1,266	3.94 ± 1.26	1	5	
Alcohol is harmful to my health		4.25 ± 1.13	1	5	
Some of my close friends drank alcohol in past month	1,266	1.52 ± 0.50	1	2	
It is okay for me to say "no" to drinking if friends offer me a drink[a]	1,266	4.56 ± 1.04	1	5	
It is okay for me to say "no" to drinking if family members offer me a drink[a]	1,266	4.52 ± 1.07	1	5	
I plan to drink alcohol at my age[a]	1,266	1.75 ± 1.20	1	5	
Alcohol Consumption Status	Males, *N* (%)	Females, *N* (%)	Younger Adolescents, *N* (%)	Older Adolescents, *N* (%)	Total, *N* (%)
A nondrinker	460 (82.6%)	575 (81.1%)	556 (93.1%)	479 (71.6%)	1035 (81.8%)
An occasional drinker	54 (9.7%)	75 (10.6%)	26 (4.4%)	103 (15.4%)	129 (10.2%)
A light drinker	10 (1.8%)	11 (1.6%)	8 (1.3%)	13 (1.9%)	21 (1.7%)
A heavy drinker	33 (5.9%)	48 (6.8%)	7 (1.2%)	74 (11.1%)	81 (6.3%)

Note. α = Cronbach's alpha.
[a]Data derived from the five-point Likert scale scored from "strongly disagree" = 1 to "strongly agree" = 5.

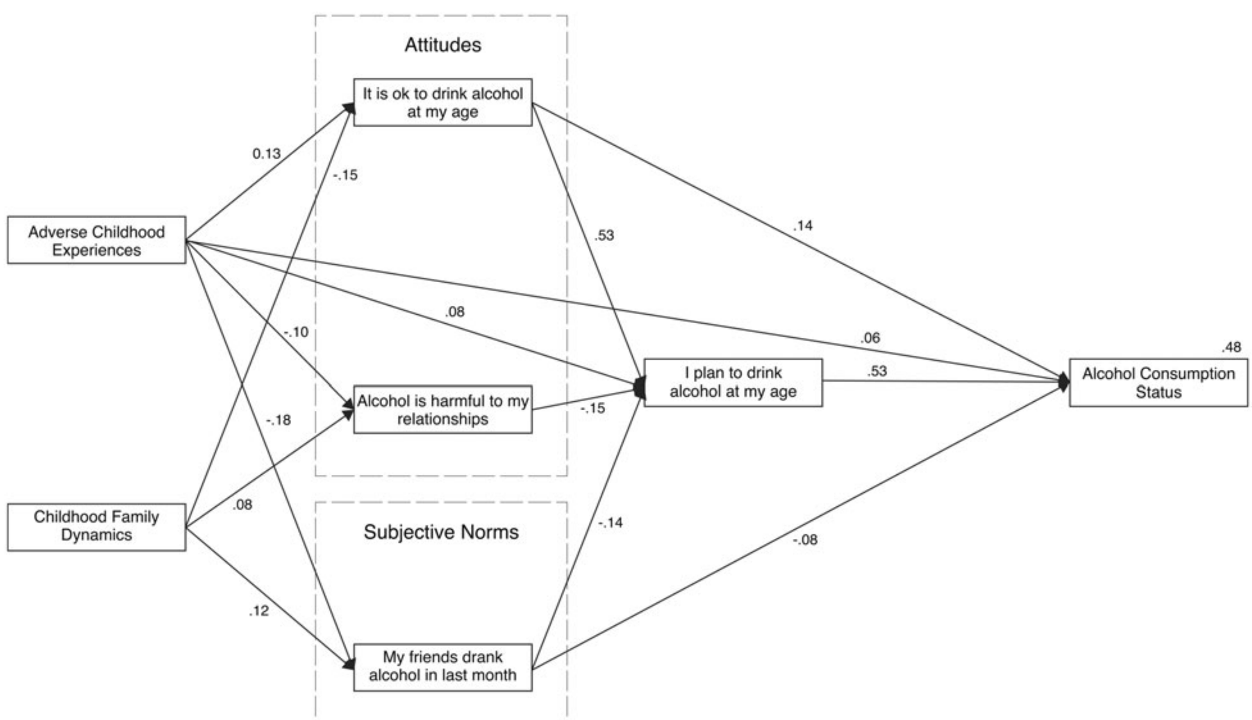

Figure 2. Structural equation model predicting alcohol status in adolescents.

association stronger for males ($\beta = 0.58$) than for females ($\beta = 0.49$).

Multigroup analysis for age groups (12–14 years versus 15–18 years; Figure 4) found a significant difference in three path coefficients. First, the association between ACEs and "Alcohol is harmful to my relationships" was significantly stronger for older adolescents ($\beta = -0.16$) than for younger adolescents ($\beta = -0.03$). Second, the association between "It is okay to drink alcohol at my age" and "I plan to drink alcohol at my age" was stronger for older adolescents

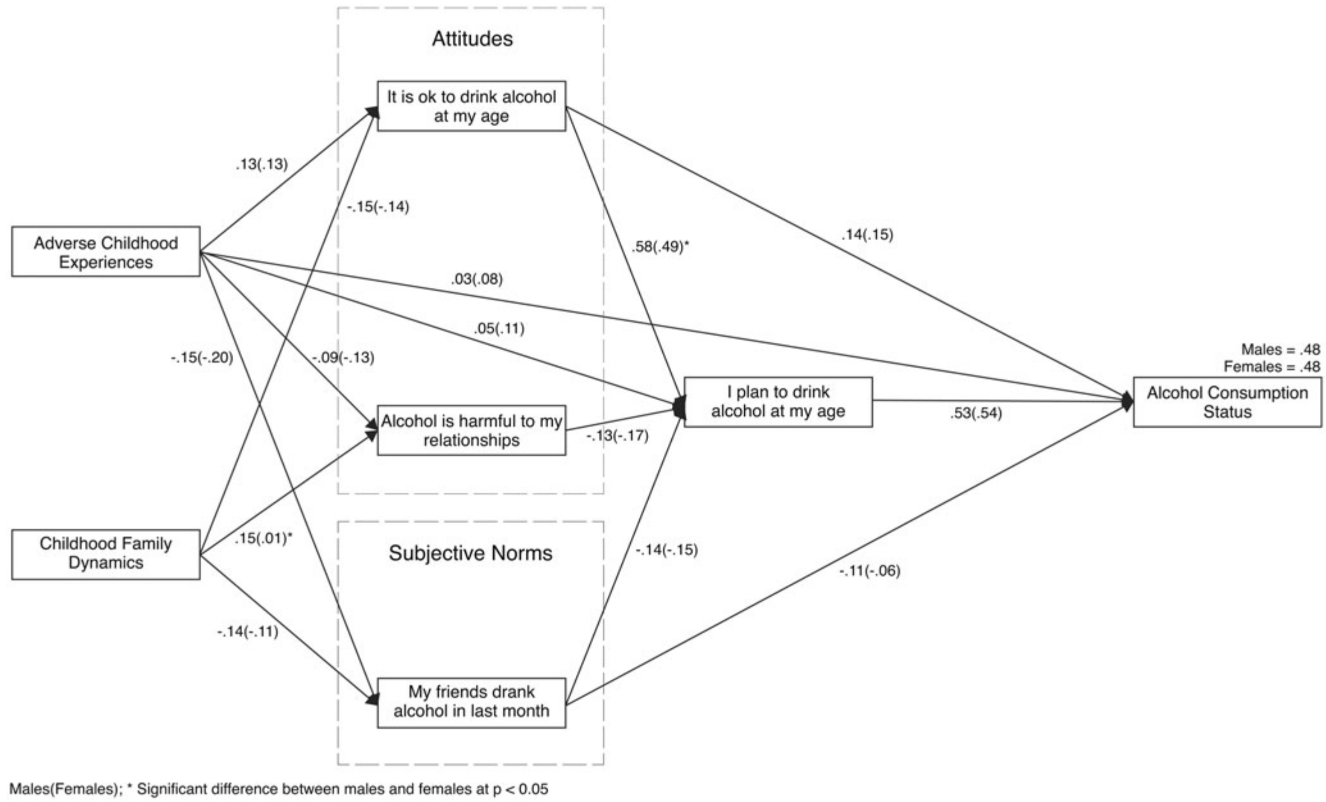

Figure 3. Structural equation model multigroup analysis for gender. *Significant difference between males and females at $p < 0.05$.

($\beta = 0.57$) than for younger adolescents ($\beta = 0.36$). Third, the association between "I plan to drink alcohol at my age" and ACS was stronger for older adolescents ($\beta = 0.51$) than for younger adolescents ($\beta = 0.46$).

Discussion

This study explored a complex network of factors predicting alcohol consumption status in Adventists attending Adventist schools in Australia. The study was unique in that it simultaneously measured the association of both negative and positive childhood experiences, current attitudes, and subjective norms with intentions to consume alcohol and alcohol consumption status.

Eighty-two percent of adolescents in this study reported that they were nondrinkers compared to 66% in a 2011 national study (White & Bariola, 2012) and 69% in a South Australian study (Bowden et al., 2017). These previous studies utilized the same item to measure ACS. The lower rates of alcohol consumption in this study may be due to the high percentage (47%) of adolescents in this study that identify as Adventist. Indeed, more students identifying as Adventist reported belonging to the ACS nondrinker category compared to non-Adventist students. Previous research links religion with lower rates of alcohol consumption in adolescents across multiple measures of religiosity (Sinha, Cnaan, & Gelles, 2007). However, other research has suggested that the protective effect of religion operated more strongly for some religions compared to others (Marsiglia, Kulis, Nieri, & Parsai, 2005). How the Adventist faith may influence predictors of adolescent alcohol consumption is worth further investigation.

The study supports the TRA's (Ajzen & Fishbein, 1980) ability to enhance understanding of the factors associated with alcohol consumption in adolescents. Intention to consume alcohol had the strongest association with ACS ($\beta = 0.52$), which is in line with other TRA and alcohol consumption studies (Cooke et al., 2016). Interestingly, the attitudinal variable "It is okay to drink alcohol at my age" ($\beta = 0.13$) and the social norm variable "Some of my close friends drank alcohol in the past month" ($\beta = 0.07$) was not only associated with intentions to consume alcohol as theorized in the TRA, but was also directly associated with ACS (Figure 2).

Examination of the relative importance of the attitudinal and subject norm variables revealed that the combined direct and indirect association of the attitudinal variables ("It is okay to drink alcohol at my age" and "alcohol is harmful to my relationships," $\beta_{total} = 0.36$) were more predictive of ACS than the subjective norm variable ("In the past month would any of your close friends have used alcohol?," $\beta_{total} = 0.17$). This may be expected considering two subjective norm items were removed from the model during analysis. This result is in line with other studies (Cooke et al., 2016) in adult cohorts; however, TRA and alcohol research (Marcoux & Shope, 1997; Stoddard & Pierce, 2018) in adolescent groups have found that subjective norms were more predictive of adolescent alcohol consumption than attitudes. Widespread agreement in the literature (Donovan, 2004; Janssen, Mathijssen, van Bon-Martens, van Oers, &

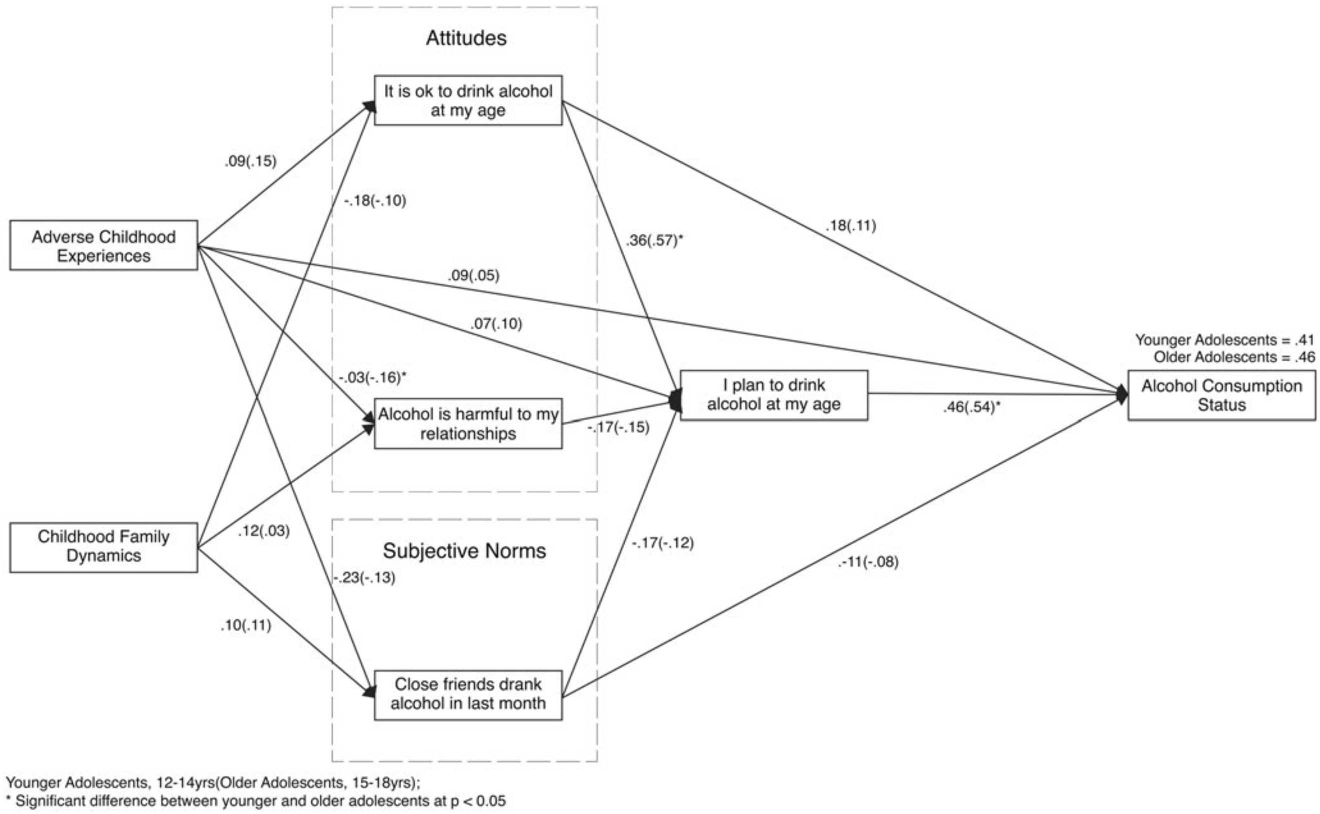

Figure 4. Structural equation model multigroup analysis for age groups. Younger Adolescents, 12–14yrs (Older Adolescents, 15–18ys); *Significant difference between younger and older adolescents at $p < 0.05$

Garretsen, 2014; Kuntsche et al., 2015; Ryan, Jorm, & Lubman, 2010) recognizes the powerful influence of social pressures on adolescent drinking behaviors. The lack of importance of subjective norms in the model in this study may be related to overall low prevalence of drinking in this cohort, and in turn, faith. Further study could explore this as a faith-based phenomenon. Minimal research has targeted attitudinal constructs as predictors of ACS in adolescent cohorts. This study would suggest that this too is worth further investigation.

The non-significant association of the attitudinal variable "Alcohol is harmful to my health" with intention to consume alcohol or ACS was surprising. By comparison, the majority of adolescents in a study by Harvey and McKay (2017) did not consider the health consequences of alcohol consumption in their decision to consume alcohol. While health education is important in any age group, the literature suggests that attitudes toward health in adolescent populations may not be firmly established until later adolescence (Marcoux & Shope, 1997).

Many studies have highlighted the influence of peer and family pressure on adolescent drinking behaviors (Donovan, 2004; Janssen et al., 2014; Kuntsche et al., 2015; Ryan et al., 2010). Accordingly, it was surprising in the present study that subjective norm items did not significantly predict intentions to consume alcohol or alcohol consumption status. The non-significant association of these subjective norm items may be attributable to the atypical nature of this cohort resulting in lower rates of exposure to alcohol-drinking peers and parents. Further investigation into this social phenomenon and its influence on alcohol consumption in adolescents exhibiting low rates of drinking might be worthwhile.

A key objective of the present study was to simultaneously measure the association of childhood experiences, and the TRA constructs of attitudes, subjective norms, and intentions, on alcohol consumption. Notably, ACEs were associated with every variable in the model, thus further expanding upon the work of others who have reported a connection between ACEs and alcohol consumption in adolescents (Dube et al., 2006). Interventions intended to delay the onset of drinking alcohol in adolescents may be enhanced from understanding the contribution that ACEs have on the lives of children, not only directly, but indirectly through attitudes, social pressures, and intentions. As the ACEs score accessed early life experiences, this study highlights the importance of gathering information about the early lives of children and their families in order to design preventive strategies targeting ACEs for children and families as early as possible. For adolescents suffering ACEs, advances in neuroeducation-based interventions (Leitch, 2017) may enable ACEs-affected adolescents to respond in a healthy way to stress caused by ACEs. Although children may have no choice in the ACEs they experience, this study reinforces the necessity for childhood human rights and protection to be at the forefront of global policy and intervention development. Further research examining the mechanism through which ACEs in early childhood contribute to the development of beliefs that drive attitudes and subjective norms would be valuable.

The association of CFD with adolescent alcohol consumption observed in this study is not surprising given that interventions targeting family dynamics have been shown to be the most effective prevention and treatment for adolescent alcohol use (Foxcroft, Ireland, Lister-Sharp, Lowe, & Breen, 2003; Livingston, 2015). Understanding how family dynamics not only influence alcohol use directly but indirectly through attitudes, social pressures, and intentions may benefit intervention development. The originating role of family dynamics in early childhood and alcohol consumption later in the adolescent years points to the potential value of family-based alcohol prevention programs promoting positive family dynamics in early childhood. Comparisons of the CFD experienced by this faith cohort compared to other populations and ACS warrants further investigation.

The multigroup analysis in this study demonstrated several significant pathway differences between gender and adolescent age groups. The stronger association between intention to consume alcohol and alcohol consumption in older adolescents compared to younger adolescents was expected. The attitude that it is okay to drink alcohol had a stronger association with intention to consume alcohol for males and older adolescents, which may also explain the higher ACS in older adolescents compared to younger adolescents. Interventions addressing this attitude in males and older adolescents may decrease alcohol consumption in these groups. The gender and age differences in the pathways between ACEs and CFD and the attitudinal variable "alcohol is harmful to my relationships" also highlight the importance of age- and gender-appropriate intervention development in these areas.

Strengths and limitations

The strength of this study is that it simultaneously measured the association of the childhood experiences, ACEs and CFD and the key TRA constructs of attitudes, subjective norms, intentions on alcohol consumption. However, it is acknowledged that the model presented in this study, although strong, does not represent all factors that are related to adolescent alcohol consumption. For example, individual characteristics, policy, pricing, advertising, and higher densities of alcohol outlets are also associated with ACS (Livingston, 2014). Although the item measuring ACS has been used in previous studies (Bowden et al., 2017; White & Bariola, 2012; White et al., 1997), its subjective nature is acknowledged. Future studies may benefit from an alcohol consumption frequency measure in an attempt to gain a more objective measure of alcohol consumption. The cross-sectional nature of this study means that only associations could be measured and hence it is not possible to conclude causality. Future studies may also benefit from employing the Theory of Planned Behavior, which extends on the TRA by positing that the construct perceived behavioral control also influences intentions and subsequent behaviors.

Conclusion

This study presents a model describing a complex network of factors associated with alcohol consumption in adolescents that exhibit lower rates of drinking than the general population. The results confirm the association of intentions, attitudes toward alcohol consumption, subjective norms surrounding alcohol consumption, and childhood experiences with alcohol consumption status. The study fills a gap in the literature relating to factors predicting alcohol consumption in a low-ACS population. The findings highlight the importance of designing age- and gender-appropriate interventions for children and families as early as possible in order to delay or minimize alcohol consumption in adolescents.

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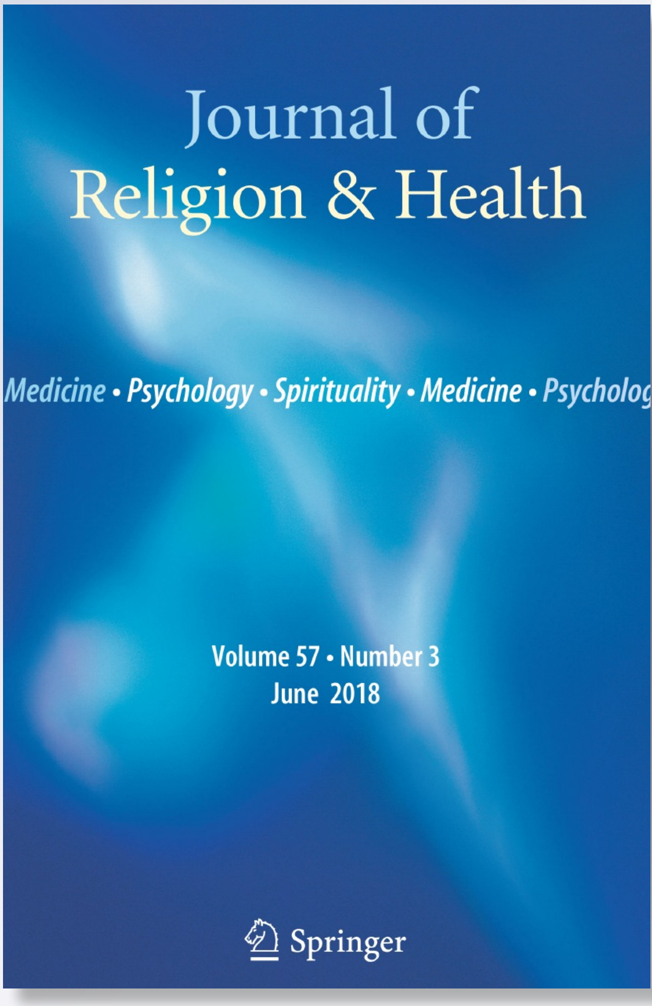

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ORIGINAL PAPER

Religious Affiliation Influences on the Health Status and Behaviours of Students Attending Seventh-Day Adventist Schools in Australia

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Abstract Students attending Seventh-day Adventist (Adventist) schools in Australia have been shown to have better health status and behaviours compared to secular norms, yet these schools cater for a high percentage of non-Adventist students. The purpose of this study was to investigate the influence of religious affiliation (Adventist/non-Adventist) on the health status and behaviours of students attending Adventist secondary schools in Australia. The sample included 1734 students who responded to a health and lifestyle survey that captured demographic details, self-reported height and weight, self-reported health status, mental health and select health behaviours. Students who identified themselves as Adventist reported significantly better health behaviours than the non-Adventist students in several behavioural domains, especially among the male students. However, this did not translate to a difference in health status. Further research is needed to understand the causal mechanisms responsible for the potential health advantage of Adventist students, which may include family or church religious influences.

Keywords Adolescent health status · Adolescent health behaviours · Religious affiliation · Seventh-day Adventist

Introduction

Adolescent health is a major worldwide concern and central to a number of current and urgent global health challenges (Patton et al. 2014; Sawyer et al. 2012). In developed countries such as Australia, adolescents have the highest growth rate of chronic disease

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prevalence of all population cohorts (Australian Institute of Health and Warfare [AIHW] 2008). Of concern, health behaviours and attitudes realised in adolescence flow through to adulthood and largely determine adult health (Eckersley 2007).

Over the past few decades, theorists have begun to argue that in order to better understand and improve adolescent health, a shift in focus is needed. This shift moves upstream from individual to social factors (Viner et al. 2012). Commonly referred to as the social determinants of health approach, the World Health Organization (WHO) (WHO 2008) defines these as "the conditions in which people are born, grow, live, work and age". These conditions can be proximal to the individual, structural or both and are supported by behaviour change theories (Ajzen 2011; Bandura 2001). Viner et al. (2012) suggested religion moderates the social determinants of health and ultimately the health of the individual.

It is now generally accepted among social and health scientists that there is an association (both positive and negative) between religion and health (Levin 2015). The association is unaffected when controlling for demographic variables (Ellison and Levin 1998) and is similar to other well-established predictors of health such as physical activity, diet, smoking and alcohol consumption (Cotton et al. 2006, 2010; Rew and Wong 2006). More specifically, religion has been shown to have positive relationships in adolescent diet (Wallace and Forman 1998), physical activity (Wallace and Forman 1998), alcohol consumption (Beyers et al. 2004), tobacco usage (Sinha et al. 2007), illicit drug usage (Cotton et al. 2006) and health status (Zullig et al. 2006). Religion has also been positively and negatively associated with adolescent obesity (Craig et al. 2017; Dewes et al. 2013) and mental health, including depression (Cotton et al. 2006).

The Adventist religion places a strong emphasis on healthful living within their denomination and has been the subject of extensive health research. The Adventist Church is a worldwide religion with over 18 million members ("Seventh-day Adventist World Church Statistics", 2014) making up 0.3% (over 50,000 people) of the Australian population (Australian Bureau of Statistics [ABS] 2011). From its inception in 1863 in the USA, the Adventist religion has emphasised the role lifestyle plays in promoting health and well-being (Fraser 2003). Adventist health philosophy advocates good health practice as a valuable spiritual discipline and aligns with the dietary health laws in Leviticus and the biblical teaching in 1 Corinthians 6:19. The human body is considered the temple of the Holy Spirit and as such should be cared for meticulously. In essence, Adventists recognise that the body, mind and spirit are integrally interconnected and interrelated in so for as what affects one affects the other and indeed the functioning of the whole being (Fraser 2003). The Adventist religion encourages adopting a healthy lifestyle that includes adequate physical activity, rest and an unprocessed vegetarian diet, whereas "unclean foods" (as described in Leviticus), alcohol, caffeine, tobacco and illicit substances are proscribed (Fraser 2003).

Adventist schools promote and encourage Adventist religious practice and lifestyle. The school culture, values and programmes are built around these beliefs, which are actively communicated to present and new enrolling students and their families. School staffs are encouraged to actively model Adventist lifestyle and beliefs. Vegetarian meals are served in school canteens, and plant-based fruit or vegetable snacks are encouraged (and in some schools enforced) during recess breaks. Schools advocate physical activity, development of positive life skills, life balance and well-being.

Studies suggest that Adventists tend to experience good health characterised by significantly lower rates of many chronic diseases, total mortality and better mental health (Beezhold et al. 2010; Ellison and Levin 1998; Grant et al. 2008; Willett 1999). Further, it has been observed that adolescents attending Adventist schools in Australia have better health behaviours and outcomes than the national norms (Craig et al. 2017). However, Adventist schools in Australia cater for both Adventist and non-Adventist students. The purpose of this study was therefore to assess the influence of religious affiliation on the health status and health behaviours of adolescents attending Adventist schools in Australia.

Methods

Study Design and Participants

A health and lifestyle survey was administered in Adventist secondary schools in Australia ($N = 21$ in 2012). A total of 4674 students attended Adventist secondary schools at the time, and valid responses to the survey were obtained from 1734 (37%) students. The age range of the participants was 12–18 years (mean = 14.5) with 46% males. For the purpose of this study, age was stratified into "early adolescence" (age 13–15 years, 51%) and "late adolescence" (age 16–18 years, 49%). The study was approved by the Avondale College of Higher Education Human Research Ethics Committee (No: 2011:21), and participation in the study was voluntary and anonymous.

Survey Instrument

Health Status

The survey instrument recorded the participant's age and gender. Self-reported health status was assessed with a single-item five-point Likert scale ranging from "Excellent", "Very Good", "Good", "Fair" and "Poor". The self-reported health status item is used in the validated Short-Form 36 Health Survey (SF-36) ("RAND Health, 36-Item Short-Form Survey", n.d.). The self-reported health status item is hypothesised to be a robust indicator of health status because it spans the past, present and future physical, behavioural, emotional and cognitive aspects of health (Sehulster 1994). An extensive body of the literature supports self-reported health as predictive of morbidity and mortality (Breidablik et al. 2009), the presence or absence of chronic disease, emotional problems (Fosse and Haas 2009), life satisfaction (Meireles et al. 2015), overweight or obesity (Fosse and Haas 2009), underweight, consumption of fruit (Meireles et al. 2015), consumption of vegetables (Goodwin et al. 2006), physical activity (Piko 2000), and use of alcohol (Johnson and Richter 2002) and tobacco (Wang et al. 2012) in adolescents. Height and weight were self-reported and used to calculate body mass index (BMI) using the standard equation: BMI = weight in kg/(height in m)^2.

Mental Health

Mental health and vitality were measured using the validated and reliable five-item mental health and four-item vitality subscales from the SF-36 ("RAND Health, 36-Item Short-Form Survey", n.d.). These subscales measure general mental health status and energy and fatigue status. Each item in the mental health and vitality subscales has six alternative answers ranging from "All of the time" to "Not at all". Scores from these subscales were linearly transformed to a 0–100 scale according to the standard procedure for calculating the mental health and vitality scores (Ware et al. 2000). Subjects with two or more missing values were excluded from the analysis. High scores indicate good mental health and vitality. It is not clear which cut-off point is optimal for predicting mental disorder as assessed by clinical interviews. Some authors (Holmes 1998) suggest a score of 52 for major depression, while others (Shaw et al. 2000) a score of 56. It is less clear what cut-offs are appropriate for the prediction of other mental health conditions. With respect to vitality and fatigue, scores less than 45 on the vitality subscale have been established as representing clinically significant fatigue (Donovan et al. 2008).

Diet and Physical Activity

Dietary intake was measured using food frequency questions adapted from questions previously used in a number of adolescent studies (Kolodziejczyk et al. 2012). In measuring overall diet, an item asked: "How would you describe your usual diet? (i.e. What you eat at least weekly or more often)". There were four options to select from: 1. Vegetarian (no red meat, chicken, fish, eggs or milk/dairy products), 2. Lacto-ovo-vegetarian (no red meat, chicken or fish, but diet excludes eggs and/or milk/dairy products), 3. Pesco-vegetarian (diet includes fish but no red meat or chicken, but may include eggs and/ or milk/dairy products) and 4. Non-vegetarian (diet includes red meat, chicken, fish). For the purpose of this study, this item was dichotomised for vegetarian (response 1 or 2) or non-vegetarian diet (response 3 or 4).

Physical activity was measured by an item that asked: "How many times per week do you USUALLY do any vigorous or moderate physical activity for at least 30 min?", with seven alternative answers ranging from "none" to "6 or more times" (Centre for Epidemiology and Research [CER], NSW Department of Health 2004). Sedentary behaviour was assessed using frequency questions measuring hours per day watching television, videos and DVDs, playing computer games and surfing the Internet. The mean scores for these items were calculated to compute an overall sedentary behaviour score. Sleep was assessed by an item that asked: "How many hours do you usually sleep per night?"

Alcohol, Tobacco and Illicit Substances

Alcohol consumption and tobacco use were assessed with frequency questions ranging from "none" to "40+" for cigarettes smoked or alcoholic drinks consumed over the last 4 weeks.

The use of marijuana, ecstasy, hallucinogens, heroin, cocaine, amphetamines and glue sniffing were assessed by items that asked about lifetime use of these substances. For example, the item relating to glue sniffing specifically asked: "How many times, if ever, have you deliberately sniffed (inhaled) from spray cans or deliberately sniffed things like glue, paint, petrol or thinners in order to get high or for the way it makes you feel?" The lifetime time frame was used as illicit substance use rates in Australian adolescents are very low (AIHW 2014). The mean scores for the hard drugs ecstasy, hallucinogens, heroin, cocaine and amphetamines were calculated to compute a hard drug overall score. For the purpose of this study, all items relating to illicit substance use were dichotomised into yes/ no responses.

Religion

Religious affiliation was assessed by asking the participants: "Which of the following best describes your religious belief now?" Options ranged from: 1. SDA (Adventist) Christian, 2. Other Christian, 3. Other Religion, 4. No Formal Religion and 5. Don't Know. This item was trichotomised to "Adventist" (response 1), "Other Christian" (response 2) and "No Religion" (response 4). Religious affiliation has been used by an extensive body of the literature and reviews to evaluate health status and behaviour (Cotton et al. 2006, 2010).

Statistical Analysis

The data were analysed using SPSS (version 20; IBM, Armonk, NY). Descriptive statistics involved mean ± standard deviation and percentages. For continuous variables, one-way ANOVAs were used to assess differences between students in the trichotomised religious affiliation groups (Adventist, Other Christian and No Religion). Effect size was calculated as partial eta squared, where 0.01 represents a small effect size, 0.06 a medium effect size, and 0.14 a large effect size. For significant models, post hoc comparisons were made for further examination of group differences (Tables 1, 3 and 5). For categorical variables, Pearson's Chi-square tests were used to assess differences between adolescents in the trichotomised religious affiliation groups. Main effects are reported as F values and p values. For significant models, post hoc comparisons were made to produce adjusted residuals (z-scores) from which p values were calculated for each cell (MacDonald and Gardner 2000). To adjust for inflation of type I error due to multiple comparisons, a Bonferroni correction was applied (MacDonald and Gardner 2000) (Tables 2, 4 and 6).

Results

Demographics and Religion

The total sample of 1380 students consisted of 635 males (46%) and 745 females (54%). When the religious affiliation item was trichotomised, 788 (57%) students reported affiliation with the Adventist religion, 435 (32%) reported affiliation with another Christian religion, and 157 (11%) reported no affiliation with religion. From the total sample, 74% of students indicated they had grown up in a family that had at least one Adventist parent. One-way ANOVA indicated no significant difference in the mean age ($F(2,1376) = .497$, $p = .609$) between the Adventist, Other Christian and No Religion groups. Chi-square analysis indicated a significant difference in the gender distribution ($X^2 = 9.63$, $p = .008$) between the religious affiliation groups with more males than expected belonging to the Other Christian and No Religion groups.

Health Status

No significant difference was observed in the self-reported health status of students in the Adventist, Other Christian and No Religion groups ($F(2,1367) = .056$, $p = .945$). Further, no significant difference was observed in the mean BMI of students in the three groups ($F(2650) = 2.119$, $p = .121$). Analysis of mental health indicated no significance differences between the three groups in the mental health scale ($F(2,1330) = .213$, $p = .808$) or the vitality scale ($F(2,1305) = .032$, $p = .968$) in the three groups.

Table 1 Comparisons between health behaviours in Adventist, non-Adventist and no religion students (one-way ANOVA)

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Daily serves of vegetables	6.52	.001	.01	2.75 ± 1.43	2.47 ± 1.37[a]	2.49 ± 1.19[a]
Daily serves of fruit	5.56	.004	.01	2.68 ± 1.43	2.48 ± 1.32[a]	2.33 ± 0.11[a]
Daily serves of whole grains	2.16	.118	.01	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	2.00	.138	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	6.35	.002	.03	5.38 ± 3.18	5.87 ± 3.30[a]	6.30 ± 3.44[a]
Cups of coffee per day	11.03	<.001	.03	1.55 ± 1.19	1.85 ± 1.53[a]	2.03 ± 1.80[a]
Cups of high energy drinks per day	8.27	<.001	.02	0.49 ± 1.21	0.62 ± 1.30	0.95 ± 1.58[a]
Breakfast meals per week	0.19	.831	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	1.92	.147	.01	4.46 ± 1.81	4.25 ± 1.80	4.32 ± 1.94
Sedentary behaviour hours per day	4.88	.008	.02	12.93 ± 3.50	13.28 ± 3.31	13.85 ± 3.46[a]
Sleep hours per night	5.60	.004	.01	8.07 ± 1.24	7.84 ± 1.37[a]	7.80 ± 1.40[a]
Alcoholic drinks (last four weeks)	8.80	.001	.03	1.80 ± 0.40	1.76 ± 0.43	1.58 ± 0.50[a,b]
Cigarettes smoked (last four weeks)	6.61	.025	.03	1.90 ± 0.30	1.90 ± 0.31	1.73 ± 0.45[a,b]

Data were presented as mean ± SD

F F statistic, η_p^2 partial eta squared

[a] Denotes post hoc analyses are significantly different from the "Adventist" group

[b] Denotes significantly different from the "other Christian" group at $p < .05$ level

Table 2 Comparisons in illicit substance use between Adventist, non-Adventist and students with no religion (Pearson Chi-square test of independence)

Variable	Adventist yes/no (%yes)	Other Christian yes/no (%yes)	No Religion yes/no (%yes)	X^2 (sig)
Ever taken marijuana	42/735 (5.4%)[a]	28/400 (6.5%)	26/131 (16.6%)[a]	25.05 (<.001)
Ever sniffed glue/paint/petrol/thinners	176/603 (22.6%)	99/331 (23.0%)	36/115 (23.8%)	.120 (.924)
Ever taken or consumed hard drugs	33/755 (4.2%)	23/412 (5.3%)	15/142 (9.6%)[a]	7.75 (.021)

X^2 Pearson's Chi-square

[a] Categories with standardized adjusted residuals significant at a Bonferroni-corrected $\alpha = 0.00833$

Health Behaviours

Table 1 shows comparisons in dietary behaviours, physical activity, sleep and alcohol and tobacco consumption between the Adventist, Other Christian and No Religion groups. Significant differences were observed between the groups with Adventist students reporting better health behaviours in ten of the sixteen items measured. The greatest differences were observed between the Adventist and No Religion groups. Compared to the No Religion group, the Adventist students reported: consuming more daily serves of fruit and vegetables and fewer cups of soft drink, coffee and high-energy drinks; more hours of sleep per night; less hours of sedentary behaviour; less alcoholic drinks; and less cigarettes smoked in the last 4 weeks. The effect size, however, for these differences was small (partial eta squared < 0.06). There were no differences between Adventist students and students in the No Religion group in the reported consumption of whole grains, fast food meals or breakfast meals per week, and 30-min sessions of MVPA per week. Adventist students also reported more serves of fruit and vegetables, fewer cups of coffee and soft drink, and more hours of sleep than students belonging to the Other Christian group.

Table 2 shows comparisons in illicit substance use between the Adventist, Other Christian and No Religion groups. Chi-squared analysis indicated a significant difference in the proportion of students taking marijuana ($X^2 = 25.05$, $p < .001$) and hard drugs ($X^2 = 7.75$), $p = .021$). Post hoc residual analysis indicated the proportion of Adventist students reporting "ever using marijuana" was significantly lower than expected (adjusted residual $= -2.7$, $p = .0063$), and non-religious students reporting "ever using marijuana" was significantly higher than expected (adjusted residual $= 5.0$, $p < .0001$). The proportion of students in the No Religion group reporting ever using hard drugs was significantly higher than expected (adjusted residual $= 2.7$, $p = .0079$). No differences were observed between the groups in having ever sniffed glue, paint, petrol or thinners. Chi-squared analysis indicated a significant difference ($X^2 = 115.5$, $p < .001$) in the proportion of Adventist students who reported a vegetarian diet (23.8%) compared with the Other Christian group (3.1%) and the No Religion group (2%).

Gender Influences on Health Status and Health Behaviours

When the data were stratified for gender, no significant difference was observed in the self-reported health status, BMI, mental health scale or vitality scale between the males or females within the Adventist, Other Christian and No Religion groups.

Adventist males reported significantly better health behaviours (Tables 3, 4) compared to the males in the No Religion group in four of the sixteen items measured including: daily serves of fruit, cups of soft drink per day, hours of sleep per night and consumption of alcoholic drinks in the last 4 weeks. Adventist males also reported better health behaviours in two of the health behaviour measures compared to males in the Other Christian group, namely daily serves vegetables and hours of sleep per night. Adventist females reported significantly better health behaviours compared to females in the No Religion group in three of the sixteen items measured including: daily serves of vegetables, daily cups of coffee and daily cups of high-energy drinks. Adventist females also reported less cups of coffee per day compared to females in the Other Christian group.

Age Influences on Health Status and Health Behaviours

When the data were stratified for the two age groups (early adolescence 13–15 years and late adolescence 16–18 years), no significant difference was observed in the self-reported health status, BMI, mental health scale or vitality scale between the Adventist, Other Christian and No Religion groups for students in either age category.

Table 3 Comparisons between health behaviours in Adventist, non-Adventist non religious students by gender (one-way ANOVA)

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Males						
Daily serves of vegetables	4.67	.012	.01	2.88 ± 1.57	2.46 ± 1.45[a]	2.61 ± 1.33
Daily serves of fruit	7.70	.027	.02	2.77 ± 1.55	2.51 ± 1.34	2.35 ± 1.40[a]
Daily serves of whole grains	1.62	.157	.02	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	1.51	.223	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	4.68	.010	.06	1.94 ± 1.73	2.37 ± 1.80	2.51 ± 1.85[a]
Cups of coffee per day	3.02	.063	.04	1.60 ± 1.35	1.87 ± 1.53	1.95 ± 1.67
Cups of high energy drinks per day	3.10	.057	.03	0.65 ± 1.46	0.89 ± 1.66	1.09 ± 1.66
Breakfast meals per week	0.48	.617	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	2.06	.129	.02	4.46 ± 1.81	4.25 ± 1.80	4.32 ± 1.94
Sedentary behaviour hours per day	2.69	.178	.05	13.34 ± 3.81	13.91 ± 3.15	14.21 ± 3.36
Sleep hours per night	8.58	<.001	.03	8.24 ± 1.21	7.83 ± 1.42[a]	7.78 ± 1.31[a]
Alcoholic drinks (last four weeks)	6.64	.008	.04	1.82 ± 0.38	1.80 ± 0.40	1.57 ± 0.50[a,b]
Cigarettes smoked (last four weeks)	5.03	.109	.04	1.94 ± 0.24	1.94 ± 0.25	1.76 ± 0.44
Females						
Daily serves of vegetables	3.23	.014	.03	2.66 ± 1.30	2.49 ± 1.32	2.29 ± 0.96[a]
Daily serves of fruit	2.14	.118	.01	2.66 ± 1.31	2.46 ± 1.31	2.31 ± 1.21
Daily serves of whole grains	0.33	.717	.01	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	1.90	.151	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	1.75	.175	.03	1.88 ± 1.46	1.68 ± 1.52	1.69 ± 1.41
Cups of coffee per day	8.61	.001	.04	1.49 ± 1.00	1.84 ± 1.54[a]	2.07 ± 1.96[a]
Cups of high energy drinks per day	6.10	.036	.03	0.34 ± 0.89	0.44 ± 0.97	0.79 ± 1.49[a]
Breakfast meals per week	0.33	.720	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	1.65	.193	<.01	4.46 ± 1.81	4.25 ± 1.80	4.32 ± 1.94
Sedentary behaviour hours per day	2.28	.103	.03	12.56 ± 3.18	12.85 ± 3.24	13.45 ± 3.58
Sleep hours per night	0.39	.667	<.01	7.91 ± 1.25	7.83 ± 1.34	7.81 ± 1.52
Alcoholic drinks (last four weeks)	2.61	.129	.02	1.78 ± 0.42	1.75 ± 0.44	1.59 ± 0.50
Cigarettes smoked (last four weeks)	1.61	.334	.01	1.86 ± 0.35	1.85 ± 0.36	1.71 ± 0.46

Data were presented as mean ± SD

F F statistic, η_p^2 partial eta squared

[a] Post hoc analyses are significantly from "Adventist" group

[b] Significantly different from the "other Christian" group at $p < .05$ level

Table 4 Comparisons in illicit substance use between Adventist, non-Adventist and students with no religion by gender (Pearson Chi-square test of independence)

Variable	Adventist yes/no (%yes)	Other Christian yes/no (%yes)	No Religion yes/no (%yes)	X^2 (sig)
Males				
Ever taken marijuana	20/336 (5.6%)	13/161 (7.5%)	15/70 (17.6%)[a]	13.84 (.001)
Ever sniffed glue/paint/petrol/thinners	83/274 (23.2%)	45/128 (26.0%)	18/62 (22.5%)	.592 (.744)
Ever taken or consumed hard drugs	16/347 (4.4%)	13/162 (7.4%)	11/74 (12.9%)[a]	8.76 (.013)
Females				
Ever taken marijuana	22/385 (5.4%)	15/232 (6.1%)	10/60 (14.3%)[a]	7.87 (.020)
Ever sniffed glue/paint/petrol/thinners	92/316 (22.5%)	54/196 (21.6%)	18/51 (26.1%)	.623 (.732)
Ever taken or consumed hard drugs	17/394 (4.1%)	10/243 (4.0%)	4/66 (5.7%)	.438 (.803)

X^2 Pearson's Chi-square

[a] Categories with standardized adjusted residuals significant at a Bonferroni-corrected $\alpha = 0.00833$

With regard to health behaviours, early adolescents in the Adventist group reported significantly more daily serves of fruit than those in the No Religion group and Other Christian group (Table 5). Among the late adolescents, Adventist students reported significantly better health behaviours than students in the No Religion group in seven of the sixteen items measured, including daily serves of whole grains, cups of soft drinks per day, cups of coffee per day, cups of high-energy drinks per day, sleep hours per day, alcoholic drinks in the last 4 weeks and lower than expected percentage of student adolescents reporting ever taking marijuana (Table 6). Adventist students in the late adolescence age group also reported significantly better health behaviours in five of the health behaviours measured compared to students in the Other Christian group, including daily serves of whole grains, cups of soft drink per day, cups of coffee per day, cups of high-energy drinks per day and hours of sleep per night.

Discussion

This is the first Australia-wide study to examine the influence of religious affiliation on the health status and health behaviours of adolescents attending Adventist schools. The findings indicate that there is no difference in the self-reported health status, BMI, mental health or vitality between those students attending Adventist schools in Australia who claim to be or not to be affiliated with the Adventist Church. Paradoxically, Adventist-affiliated students reported better health behaviours in several domains than those students not affiliated with the Adventist Church and this was most prominent in late adolescence.

The lack of influence of religious affiliation on the health statuses measured in this study is not consistent with other studies. In a small study of the Adventist population involving five schools in the Sydney and Hunter region, Grant (2008) found that students consuming a predominantly vegetarian diet (as encouraged by the Adventist religion) had significantly lower BMIs than students who were not vegetarian. Reviews in adolescent populations have also reported an influence of religion on BMI, self-reported health status and mental health (Cotton et al. 2006; Dewes et al. 2013; Zullig et al. 2006).

Table 5 Comparisons between health behaviours in Adventist, non-Adventist non religious students by age group (one-way ANOVA)

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Younger adolescents (12–13 years)						
Daily serves of vegetables	3.99	.019	.02	2.73 ± 1.51	2.47 ± 1.37[a]	2.49 ± 1.19
Daily serves of fruit	4.92	.008	.02	2.68 ± 1.43	2.80 ± 1.49[a]	2.32 ± 1.19[a]
Daily serves of whole grains	0.18	.837	.02	3.13 ± 2.08	2.90 ± 1.69	2.92 ± 1.67
Fast food meals per week	0.90	.409	<.01	1.42 ± 1.27	1.53 ± 1.40	1.29 ± 1.15
Cups of soft drink per day	0.79	.454	.04	1.81 ± 1.73	1.93 ± 1.68	2.00 ± 1.46
Cups of coffee per day	3.24	.110	.02	1.48 ± 1.14	1.62 ± 1.33	1.91 ± 1.80
Cups of high energy drinks per day	0.09	.919	.02	0.53 ± 1.35	0.49 ± 1.20	0.56 ± 1.04
Breakfast meals per week	1.27	.282	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	1.46	.233	.02	4.61 ± 1.89	4.35 ± 1.81	4.50 ± 1.92
Sedentary behaviour hours per day	0.57	.565	.03	12.76 ± 3.62	12.93 ± 3.51	13.25 ± 3.79
Sleep hours per night	0.91	.403	<.01	8.26 ± 1.26	8.15 ± 1.40	8.36 ± 1.18
Alcoholic drinks (last four weeks)	1.41	.246	<.01	1.88 ± 0.33	1.87 ± 0.34	1.75 ± 0.44
Cigarettes smoked (last four weeks)	3.19	.308	.01	1.97 ± 0.18	1.98 ± 0.14	1.86 ± 0.35
Older adolescents (15–18 years)						
Daily serves of vegetables	2.90	.055	.01	2.78 ± 1.34	2.56 ± 1.36	2.48 ± 1.25
Daily serves of fruit	1.08	.340	<.01	2.56 ± 1.36	2.45 ± 1.25	2.34 ± 1.41
Daily serves of whole grains	5.33	.004	.03	3.30 ± 2.09	2.84 ± 1.56[a]	2.77 ± 1.63[a]
Fast food meals per week	1.20	.302	.01	1.48 ± 1.32	1.60 ± 1.40	1.34 ± 1.16
Cups of soft drink per day	7.48	<.001	.07	1.59 ± 1.46	1.98 ± 1.68[a]	2.25 ± 1.86[a]
Cups of coffee per day	8.81	<.001	.04	1.62 ± 1.24	2.10 ± 1.69[a]	2.11 ± 1.80[a]
Cups of high energy drinks per day	14.33	<.001	.05	0.45 ± 1.06	0.75 ± 1.37[a]	1.25 ± 1.82[a]
Breakfast meals per week	1.17	.313	<.01	3.40 ± 0.98	3.42 ± 0.93	3.37 ± 1.02
30 min sessions of MVPA per week	0.58	.147	<.01	4.31 ± 1.83	4.16 ± 1.81	4.17 ± 1.96
Sedentary behaviour hours per day	5.35	.561	.03	13.11 ± 3.36	13.64 ± 3.05	14.33 ± 3.12
Sleep hours per night	8.35	<.000	.02	7.87 ± 1.89	7.54 ± 1.27[a]	7.38 ± 1.41[a]
Alcoholic drinks (last four weeks)	4.77	.017	.02	1.72 ± 0.45	1.71 ± 0.46	1.51 ± 0.50[a,b]

Table 5 continued

Variable	F	p (ANOVA)	η_p^2	Adventist	Other Christian	No Religion
Cigarettes smoked (last four weeks)	2.06	.202	.02	1.80 ± 0.40	1.80 ± 0.40	1.64 ± 0.49

Data were presented as mean ± SD

F F statistic, η_p^2 partial eta squared

[a] Post hoc analyses are significantly from "Adventist" group

[b] Significantly different from the "other Christian" group at $p < .05$ level

Table 6 Comparisons in illicit substance use between Adventist, non-Adventist and students with no religion by age group (Pearson Chi-square test of independence)

Variable	Adventist yes/no (%yes)	Other Christian yes/no (%yes)	No Religion yes/no (%yes)	X^2 (sig)
Younger adolescents (12–13 years)				
Ever taken marijuana	11/382 (2.8%)	6/210 (2.8%)	4/64 (5.9%)	1.94 (.378)
Ever sniffed glue/paint/petrol/ thinners	101/ 294 (25.6%)	56/161 (25.8%)	14/51 (21.5%)	.531 (.767)
Ever taken or consumed hard drugs	15/386 (3.7%)	12/209 (5.4%)	2/66 (2.9%)	1.31 (.520)
Older adolescents (15–18 years)				
Ever taken marijuana	31/352 (8.1%)[a]	22/190 (10.4%)	22/67 (24.7%)[a]	20.56 (<.001)
Ever sniffed glue/paint/petrol/ thinners	75/308 (19.6%)	43/170 (20.2%)	22/64 (25.6%)	1.57 (.456)
Ever taken or consumed hard drugs	18/368 (4.7%)	11/203 (5.1%)	13/76 (14.6%)[a]	12.99 (.002)

X^2 Pearson's Chi-square

[a] Categories with standardized adjusted residuals significant at a Bonferroni-corrected $\alpha = 0.00833$

There are several factors that may account for lack of difference observed in self-reported health status between the Adventist and non-Adventist students in this study. Firstly, this study sample is not typical of the Australian population. We have previously reported this study cohort to have lower rates of obesity than the national norms, trending approximately 20 years behind the wider population in the obesity epidemic (Craig et al. 2017). Hence, the study participants were already a healthier sample, which would make it more unlikely to observe differences within the cohort. It is possible that Adventist schools attract families with high socio-economic status who can afford private education, once again making the study cohort more atypical. High socio-economic status has also been linked to better physical and mental health outcomes (Viner et al. 2012). Finally, it is possible that the Adventist students potentially underscored their self-reported health status compared to the non-Adventist students due to the high health ideals advocated by the religion resulting in them perceiving and judging "Very Good" or "Excellent" health against a more rigorous standard.

The differences observed in the health behaviours of the Adventist and No Religion students are consistent with reviews that have examined the influence of religious affiliation on health behaviours (Cotton et al. 2006, 2010; Rew and Wong 2006). Interestingly, differences were observed in the health behaviours of Adventist students compared to Other Christian students in six of the sixteen health behaviours measured. It is possible that Adventist lifestyle may be more influential than Other Christian religions on the health behaviours of this cohort because of the emphasis the Adventist religion places on healthy living. When stratified for gender, Adventist males reported significantly better health behaviours compared to males in the No Religion group in four of the sixteen health behaviours measured. This compared to Adventist females who reported significantly better health behaviours compared to females in the No Religion group in three out of sixteen health hehaviours measured. Evidence is lacking on gender differences in the influence of religion on health behaviours; however, a study of Slovakian adolescents reported religiosity was more strongly associated with moderating smoking, drunkenness and marijuana use in females than in males (Pitel et al. 2012). Pitel et al. (2012) also reported no gender differences in the effect of religiosity on fruit, vegetable, soft drink and breakfast consumption or physical activity.

It is interesting that the health behaviour differences were more prominent in the older adolescents. It would seem that Adventist schools are having a greater impact on older adolescent students compared to younger adolescents. This is of interest as reviews (Patton et al. 2016) indicate that as adolescents increase in age, health behaviours in a number of domains decrease.

The students reporting affiliation with the Adventist religion in this study may be influenced by Adventist health beliefs not only because of their affiliation with the Adventist religion, but also through Adventist schooling and family dynamics that embrace Adventist health beliefs. Unique to the cohort in this study is also the fact that 74% of students reported growing up in a family with at least one Adventist parent. It is possible that Adventist health values were an influential aspect of their family dynamic. It is known that nutritional and physical activity behaviours stem from childhood (Pitel et al. 2013) and are heavily influenced by parents and family background (Pitel et al. 2013; Xie et al. 2003). Bandura (2001) proposed that being part of a social phenomenon such as experienced by the Adventist students in this study would help them adhere to the health behaviours espoused by the Adventist religion that are not practiced by mainstream society.

While the health behaviours of students affiliated with the Adventist Church are encouraging, on average students in this study did not meet national recommendations for adolescents in any health behaviour except daily serves of fruit. The negative side effects of poor dietary behaviour, physical inactivity, lack of sleep and substance abuse are well documented. While recommendations may vary, the following provides a reference point. The National Health and Medical Research Council (NHMRC) (2013) of Australia recommends adolescents consume fives serves of vegetables, seven serves of whole grains and two serves of fruit each day. Further, adolescents should avoid beverages containing caffeine such as high-energy drinks or coffee and limit the intake of soft drinks and fast foods high in sugar and saturated fats. Adolescents should consume a nutritious, energy-appropriate breakfast on a daily basis (Rampersaud 2009). Recommendations for physical activity include participating in 60 min of physical activity every day and limiting sedentary behaviour to no more than 2 h per day (NHMRC 2013). Students in this study on average did not even meet half of what is recommended for daily serves of vegetables, whole grains, breakfast meals per week or physical activity and engaged in up to one and a half hours above what is recommended for sedentary behaviours. The National Sleep Foundation (Hirshkowitz et al. 2015) recommends adolescents to get 8–10 h of sleep per night. On average, the student group in this study reported sleeping 8 h or less per night. Alcohol consumption, smoking and illicit substance use are not recommended for adolescents (NHMRC 2013). Fifty-three percentage of students in the non-Adventist group reported ever consuming alcohol, 14.4% reported ever smoked cigarettes, 9.5% reported ever using marijuana, 24.6% reported ever sniffing glue, and 5.9% reported ever using hard drugs. Although observing significantly better health behaviours in Adventist students compared to non-Adventist students, the overall status of health behaviours reported by students in this study highlights the concerns (Patton et al. 2014; Sawyer et al. 2012) surrounding adolescent health.

Understanding the mechanism through which religious affiliation influences better health behaviours in Adventist students warrants investigation. In particular, the larger influence religious influence had on the older adolescent age group is interesting. The evidence that social determinants of health influences adolescent health (Viner et al. 2012) may help to understand the mechanisms that influence adolescent health including religious affiliation. Adolescence is second only to early childhood as a crucial period of psychological and biological change occurring in a complex web of family, peer, societal and cultural influences that affect present and future health (Viner et al. 2012). It is now understood that crucial to adolescents attaining their best health are upstream factors such as safe supportive school, family and community elements like religious communities, together with positive and supportive peers. Addressing risk and protective factors within the context of these environments and networks is a key to improving adolescent health worldwide (Viner et al. 2012). Longitudinal studies in the social network effect phenomenon suggest that domains such as physical activity, healthy eating (Ball et al. 2010), obesity (Christakis and Fowler 2007) and mental health (Fowler and Christakis 2008) appear to spread through social ties, in some instances up to three degrees of separation. Exploiting this phenomenon in order to spread positive health behaviours is worth investigation.

A strength of this study is the focus on a single religious denomination. Single denominational studies eliminate the need to control for potential confounders such as variability of beliefs between denominations. Stratifying for gender and age groups allows for more in-depth analysis of adolescent health as modifiable health risks change rapidly across adolescence (Patton et al. 2016). The use of one dimension in measuring religion, which is a multidimensional construct, is a limitation. It is noted that daily minimum recommendation for MVPA for adolescents is 60 min per day (NHMRC 2013). This was not possible in this study as this measure was not included in the survey. The study is cross-sectional, and no causal association could be indicated.

Conclusion

Our findings have identified that students who regard themselves as Adventist reported significantly better health behaviours than students who identify with Other Christian denominations or have No Religion, especially among the older adolescent age group (16–18 years). However, this did not translate to a difference in the health status of the students. Despite the apparent advantage for older Adventist students, it is, nonetheless, disconcerting that the results of this study indicated that on average the adolescents did not meet the national recommendations in any assessed health behaviour except daily serves of fruit. Further research is needed to understand the causal mechanisms responsible for the potential health advantage of Adventist students, which may include family or religious influences.

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Compliance with Ethical Standards

Conflict of interest Authors Bevan Adrian Craig, Darren Peter Morton, Lillian Marton Kent, Alva Barry Gane and Paul Meredith Rankin declare that they have no conflicts of interest.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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