Physical Activity, Screen-Based Behaviours and Obesity Among Fijian Adolescents

by

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Dedication

This thesis is dedicated to my mum, whose overwhelming love and support has enabled me to complete this study.
Abstract

The Pacific Islands, including Fiji, have the highest prevalence of adult obesity globally, as well as rising levels of childhood and adolescent obesity. Among Fijian youth, poor mental health and high suicide rates are also serious issues. The hypothesis for this overall PhD is that low levels of PA and high levels of SBB (including e-gaming) activities are associated to obesity and psychosocial problems among Fijian adolescents. Three studies were carried out with the following aims:

1. To describe the patterns of PA, SBB, and their associations with body mass index standardised for age (BMI-z) among Fijian adolescents.

2. To determine if baseline behaviours or changes in PA and SBB predict changes in BMI-z and if there is a reverse causal pathway of baseline BMI-z changes predicting changes in PA and SBB among Fijian adolescents.

3. To determine whether high e-gaming behaviour is related to psychosocial problems (low self-esteem, poor commitment to school, low academic achievement, poor relationships with parents, low health related quality of life, depression and aggression) among a sample of Fijian adolescents in Internet cafes in Suva City.

For the first two studies, demographic, anthropometric, self-reported PA and SBB data from adolescents (13–18 years) from 18 secondary schools in peri-urban areas in Viti Levu, Fiji, in 2005/2006 (n=6871; 45% iTaukei³, 55% Indo-Fijians⁴) were collected and followed up in 2008 (n=2781) as part of the Fiji component of the four-country Pacific Obesity Prevention in Communities (OPIC) project. In the final study, demographic, self-reported e-gaming, and psychosocial behaviour data were collected from a sample of 252 adolescents (126 high e-game users; 126 low e-game users) aged between 13-18 years from 18 Internet cafes in central Suva City, Fiji. The response rate

³ Indigenous Fijians.
⁴ Fijians of Indian descent.
was 87 per cent. In the first two studies, descriptive analyses summarised the measures and multiple linear regression analyses were used to assess the baseline and longitudinal relationships between PA and SBBs (independent variables) and BMI-z (dependent variable). Reverse causality was also tested. In the final study, descriptive analyses and multiple linear regression analyses were used to assess the relationships between e-gaming time (independent variable) and psychosocial problems (dependent variables). The significance level was set at 0.05 in the three studies.

In **Study 1** (cross-sectional relationships from OPIC data), almost a quarter (24%) of the OPIC study participants were overweight/obese with significant differences based on ethnicity (iTaukei 34%, Indo-Fijians 15%) and gender (males 20%, females 28%). PA levels among iTaukei and males were high after school but low during school recess and lunch breaks. Among Indo-Fijians and males, total screen-time was high, and physical inactivity during recess was positively associated (p< 0.05) with higher BMI-z. Among female iTaukei, high TV viewing time was positively associated (p< 0.05) with higher BMI-z. Conversely, for male iTaukei, high TV viewing time was associated with low BMI-z. This last result was unexpected and may be due to confounding, reverse causality or chance. Other behavioural activities including total screen-time had no significant association with BMI-z for all adolescents. Despite the poor overall PA and SBB patterns, there were few associations with BMI-z and little compelling evidence that PA and SBBs contribute greatly to obesity rates. Although the high prevalence of inadequate PA and the recognised benefits of PA support the continuation of PA interventions, expectations that they will help to reduce obesity must be modest.
Study 2 (longitudinal relationships from OPIC data) showed about 40–80 per cent of adolescents had changed various PA and SBBs over the approximately two-and-a-half years’ follow up. However, a mixed pattern of behaviour changes was seen with some increases and some decreases in the frequency of healthy behaviours. For example, more adolescents worsened rather than improved in e-gaming time (33% v. 23%), and activity during lunch break (24% v. 17%). As none of the longitudinal analyses (direct and reverse) showed significant relationships between behaviours and BMI-z, baseline behaviours and behavioural changes did not predict changes in BMI-z (direct pathway hypothesis); nor did baseline BMI-z predict changes in behaviours (reverse pathway hypothesis). This could be explained by the relatively weak impact that small to moderate changes in PA have on energy balance or potential behavioural or metabolic compensatory responses to changes in PA. Overall, some PA and SBB behaviours had worsened throughout adolescence. These findings reinforce the Study 1 conclusions that the BMI-z impact of PA programs are likely to be modest.

Study 3 (cross-sectional relationships of e-games study) examined the cross-sectional relationship between e-gaming and psychosocial problems. High e-game users (≥120 mins/day) had higher academic achievement (p<0.005) and aggression scores (p<0.05) than low e-game users (<120 mins/day). There were no differences in scores for depression, self-esteem, commitment to school, relationships with parents, and health-related quality of life. The significant findings could be due to self-selection bias (i.e. more aggressive students are more attracted to violent e-games and those who are doing well academically are more attracted to playing e-games) or a true cause-and-effect relationship (i.e. violent e-games promote aggression and e-games in general promote academic achievement). Both explanations are supported by previous research, but the negative effects of violent video games are well documented from
RCTs, which would support moves to limit the exposure of Fijian adolescents to such games. Conversely, some studies have reported the learning benefits of e-games for cognition (thinking, understanding, intellect, and perception), decision-making, creativity, reasoning and problem-solving. This is a fairly new, much-debated area that warrants further research, particularly RCTs and evaluations of policy interventions.

In summary, this research found low levels of PA and high levels of SBB among Fijian adolescents and some changes in activity behaviours when followed up, though very few associations were found with body weight in the first two studies. These patterns and relationships will help to guide PA interventions. Expectations of the BMI-z impact of PA programs should be low and programs need to be evaluated for other potential benefits of PA as well. Interventions to reduce adolescent obesity should include strategies to increase PA and reduce inactivity, but diet-related strategies should predominate. Despite concerns about the high level of e-gaming among Fijian adolescents, the only relationship of concern was the higher levels of aggression among high e-game users, which suggests violent games, could be moderated through licensing agreements. This research has extended the body of knowledge about relationships between PA/SBB and BMI-z and between e-gaming and psychosocial parameters. This is predominantly important for developing countries like Fiji, which are struggling with the problems of adolescent obesity and mental health.
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<td>ASAQ</td>
<td>Adolescents Sedentary Activities Questionnaire</td>
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<td>AVG</td>
<td>active video games</td>
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<td>BMI</td>
<td>body mass index</td>
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<td>BMI-z</td>
<td>body mass index standardized for age</td>
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<td>CBI</td>
<td>community-based intervention</td>
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<td>CHD</td>
<td>coronary heart disease</td>
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<td>CVD</td>
<td>cardiovascular disease</td>
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<td>C-POND</td>
<td>Pacific Research Centre for the Prevention of Obesity and Non-communicable Diseases</td>
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<td>E-games</td>
<td>electronic games played on standalone video game console (displayed on video or television screen), desktop computer or the Internet</td>
</tr>
<tr>
<td>E-gaming</td>
<td>time spent on electronic games (time spent playing computer/video/e-games)</td>
</tr>
<tr>
<td>FNRERC</td>
<td>Fiji National Research Ethics Review Committee</td>
</tr>
<tr>
<td>FSM</td>
<td>Fiji School of Medicine</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>HRQoL</td>
<td>health-related quality of life</td>
</tr>
<tr>
<td>HYHC</td>
<td>Healthy Youth Healthy Community</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>ICC</td>
<td>intra-cluster correlation coefficient</td>
</tr>
<tr>
<td>LMIC</td>
<td>low- and middle-income countries</td>
</tr>
<tr>
<td>LTPA</td>
<td>leisure-time physical activity</td>
</tr>
<tr>
<td>MET</td>
<td>metabolic equivalent unit</td>
</tr>
<tr>
<td>MVPA</td>
<td>moderate-to-vigorous-intensity physical activity</td>
</tr>
<tr>
<td>NCD</td>
<td>non-communicable disease</td>
</tr>
<tr>
<td>NNS</td>
<td>National Nutrition Survey</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>OPIC</td>
<td>Obesity Prevention in Communities</td>
</tr>
<tr>
<td>PA</td>
<td>physical activity</td>
</tr>
<tr>
<td>PDA</td>
<td>personal diary assistant</td>
</tr>
<tr>
<td>PE</td>
<td>physical education</td>
</tr>
<tr>
<td>PedsQL</td>
<td>Paediatrics’ Quality of Life</td>
</tr>
<tr>
<td>RCT</td>
<td>randomised controlled trial</td>
</tr>
<tr>
<td>SBB</td>
<td>screen-based behaviour</td>
</tr>
<tr>
<td>TEE</td>
<td>total energy expenditure</td>
</tr>
<tr>
<td>TV</td>
<td>television</td>
</tr>
<tr>
<td>TWSQ</td>
<td>Teens with Screens Questionnaire</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VPA</td>
<td>vigorous-intensity physical activity</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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</tbody>
</table>
Glossary

Adolescence     Young people aged between 12 and 18 years
BMI            ‘a crude population measure of obesity; a
                 person’s weight (kg) divided by the square of
                 his/her height (m)’
BMI cut point for Obesity   BMI of 30 kg/m² or more (adults)
BMI cut point for Overweight BMI of 25 kg/m² but less than 30 kg/m² (adults)
BMI-z cut point – Obesity   More than two standard deviations above zero
                            (Approximately equivalent to BMI 30 kg/m2 at
                            19 years)
BMI-z cut point – Overweight Between one and two standard deviation above
                            zero
                            (Approximately equivalent to BMI 25 kg/m2 at
                            19 years)
Indo-Fijians     Fijians of Indian descent
iTaukei         indigenous Fijians
Overweight and obesity  ‘abnormal or excessive fat accumulation that
                        presents a health risk’
Psychosocial health ‘a state of mental, emotional, social, and
                   spiritual well-being. The thinking portion of it is
                   known as mental health.’
Chapter 1: Introduction

1.1 Overview

Obesity is a major global public health issue among adults, leading to premature mortality and morbidity (1). The Pacific Islands have the leading prevalence of adult obesity and other non-communicable diseases (NCDs) globally, and there is evidence that rates are increasing (2). The increasing rates of obesity among children and adolescents are also a significant issue globally and in the Pacific (3), including Fiji. Adolescent obesity is known to predict adult obesity (2) because the period of adolescence is a critical time of growth and maturation and consequently for obesity development (4, 5). Research on the prevention of obesity is mounting, but less is known about adolescent obesity.

Other major issues for Fijian youth are high suicide rates (6) and poor mental health (7). Low physical activity (PA) (8), high screen-based behaviours (SBBs) including high electronic gaming (e-gaming) (9-12) are potentially contributing to escalating rates of obesity (13-15) and psychosocial problems such as low self-esteem (16), low academic achievement (17), poor relationship with parents (18-22), low HRQoL (23), aggression and depression (24-28).

Obesity and overweight are associated with an energy imbalance between caloric intake and expenditure. Changing dietary patterns including increases in energy intake (EI) are associated with epidemiological, nutritional and technological transitions. Conversely, reductions in PA are due to globalisation of markets and
technological advancements. While evidence from a number of studies has indicated that PA levels are declining (among children and adolescents) and are a significant cause of rising obesity levels (29), others indicate that increasing EI is the most critical (30). It is clear, however, that changes in dietary patterns and PA are occurring globally and simultaneously, and are linked with increasing obesity levels. Declining PA levels have been associated with a shift towards modern lifestyles, including increasing sedentary behaviour both during leisure time and work (31) and more use of transport, household electronic devices and computers, which have reduced the amount of physically active work across all age groups (29).

PA is often categorised as recreational or leisure time, occupational, transportation and incidental (i.e. household chores, activities in community or in school) (32). Sedentary behaviour includes activities such as sitting down quietly or reading, lying down, using a computer and playing passive e-gaming. A component of sedentary behaviour is SBB (for example, activities involving screen use, like viewing television (TV), Digital video disks (DVD) and time spent on e-gaming). Sedentary behaviours are increasing and active behaviours are declining, leading to overall reduced PA.

Evidence indicates that active travel declines with age in some countries, particularly during adolescence and in females (33). Active travel is an important component of PA. A 2011 review of children and adolescents by Lubans et al. found positive relationships between levels of active travel and health-related fitness (33), and between active travelling and enhanced body composition in youths. More robust research is necessary to find the factors affecting active travel such as distance to school and neighbourhood safety.
Together with the decline in active travel, leisure-time physical activity (LTPA) levels are also declining in Fiji as well as elsewhere. For example, the Fiji STEP Survey (2004) reported around 70 per cent of the individuals between 15–24-year-old had insufficient (nil and very low participation) levels of LTPA (34). Reports (2010) from Global School-based Student Health Survey about school children showed only around one-third of the secondary school students surveyed in Fiji had engaged in approximately 1 hour of PA on most days (5 or more days) (35). That is, two thirds had insufficient levels of PA. Also, this GSHS report further stated that only a minority (one third) were actively participating in physical activity programmes as part of PE classes in Fiji (35). These are indicative of overall low levels of PA in Fiji.

In parallel, the availability of home-based leisure-time technologies such as pay TV, DVD, electronic and computer games, and Internet have increased (3). The use of these forms of entertainment and communication is often termed SBB, but high levels of SBB are not necessarily indicative of high levels of sedentary behaviour as sedentary behaviour also includes activities like resting, reading, writing, sitting among others (whereas SBBs include screen use) (33); However, SBB is a major part of sedentary behaviour (but sedentary behaviour and PA are separate concepts and are somewhat independent of each other). Nevertheless, the preference of youth and children for new technologies has reduced time spent outdoors being physically active in many countries (36, 37).

Fiji, despite being a small developing island nation (with a population of around 870,000), has seen rapid expansion in access to TV in the last 20 years. Since the
introduction of TV broadcasting in Fiji in 1994, Fiji now has three free-to-air TV network companies and two pay TV networks, providing multiple channels. A recent survey found that 60 per cent of all households in Fiji owned a TV set (10). A recent local study among 14–18-year-old adolescents (2010), found that about two-thirds (63.1%) of secondary school students had watched TV on all school days, and in fact had a longer screen time (2–4 hours) than primary school participants during both school days and weekends (12). As studies elsewhere have found that viewing TV for more than two hours per day is related to poor academic performance, fitness and self-esteem, including unhealthy weight gain (38), the levels found in the above study are therefore of concern. From International studies, TV viewing in particular has been shown to be linked with obesity (26), although this probably mediated by high sedentary behaviour, dietary behaviour when watching TV and exposure to TV advertisements for unhealthy foods.

Another important contributor to SBB is the use of computers. In parallel with the increase in TV accessibility, computer use has also increased considerably. They have now become common in workplaces, schools and many homes. The popularity of Internet cafes in Fiji is of particular concern (39). Anecdotal evidence suggests that e-gaming in homes and the availability of Internet cafes and e-gaming parlours, especially around Suva City, is also increasing. In addition, more adolescents are visible in these Internet cafes in Suva, Nadi, Port Denarau and Lautoka (40). There were around 100,000 Internet subscribers in 2009 in Fiji (10), and the number is likely to have increased considerably since then. Use and access to e-games are also increasing. Evidence indicates that increased screen time from e-gaming may lead to many psychosocial and weight related problems including a risk of being overweight (41). However, there is a wide range of e-games including active video games (42,
43) and it is therefore important not to assume that video game use is automatically linked with sedentary behaviour. Hence, future research in this area should explore the links between different types of video games, LTPA and psychosocial problems associated with e-gaming.

This discussion highlights that levels of LTPA, active travel and SBB affect health significantly and declining levels of PA and increasing levels of SBB may both be independently associated with unhealthy weight gain and psychosocial problems, which are major problems in Fiji. Evidence indicates that PA levels among adolescents in Fiji are low, and further investigation is warranted to understand what factors underlie this problem. Effective interventions are needed to increase PA levels, and this has proven challenging (13-15). In particular, given the likely continuing increase in SBB, its impact on PA levels is an area that warrants further investigation for successful intervention strategies to be developed.

Studies from elsewhere suggest that high screen time (including e-gaming time) may expose adolescents to psychosocial problems such as depression (24-28), poor self-esteem (16), low academic performance (17), poor relationship with parents (18-22), low health-related quality of life (HRQoL) (23), and aggression (24-28).

1.2 Purpose of Present Research

The main purpose of this present research was to understand modifiable risk factors, specifically PA and SBB, for overweight Fijian adolescents. Non-TV SBB in obesity is an emerging issue of concern, as very little is known about it among adolescents in Fiji. Better understanding of SBBs related to body weight and psychosocial problems
will help improve and design effective prevention strategies in Fiji. This thesis will contribute to a greater understanding of predictors of change in PA/SBB patterns and body mass index standardized for age (BMI-z) in adolescents in Fiji. It will add on the little knowledge currently available on e-gaming patterns and psychosocial problems. Further, this study will determine the role of behavioural activity patterns and BMI-z/psychosocial problems that will be useful to guide next-generation of prevention activities in Fiji, and the potential for applying these principles and knowledge to other ethnic groups.

1.3 Research Aims and Questions

The overall aim of this research study was to examine whether PA and SBB (including e-gaming) activities were associated to obesity and psychosocial problems among Fijian adolescents. The specific research aims in each study in this PhD are presented in Table 1.1.

<table>
<thead>
<tr>
<th>Research Aims</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study 1</strong></td>
<td>4</td>
</tr>
<tr>
<td>1. To describe the patterns of PA, SBB, and their associations with BMI-z among Fijian adolescents.</td>
<td></td>
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<tr>
<td><strong>Study 2</strong></td>
<td>5</td>
</tr>
<tr>
<td>2. To determine if baseline behaviours or changes in PA and SBB predict changes in BMI-z; and if there is a reverse causal pathway of baseline BMI-z changes predicting changes in PA and SBB among Fiji adolescents.</td>
<td></td>
</tr>
<tr>
<td><strong>Study 3</strong></td>
<td>6</td>
</tr>
<tr>
<td>3. To determine whether high e-gaming behaviour is related to psychosocial problems (low self-esteem, poor commitment to school, low academic achievement, poor relationships with parents, low HRQoL, depression and aggression) among a sample of Fijian adolescents in Internet cafes in Suva City.</td>
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</tbody>
</table>

This thesis aims to describe patterns for each of the PA and SBB variables differentiated by ethnicity and gender and their associations with BMI-z. Specifically, it aims to find the PA and SBB patterns and their association with BMI-
z among Fijian adolescents and whether levels of low PA and high SBB levels predicted changes in BMI-z (and vice versa). It also aims to determine whether high e-gaming behaviour is related to psychosocial problems (low self-esteem, poor commitment to school, low academic achievement, poor relationships with parents, low HRQoL, depression and aggression) among a sample of Fijian adolescents in Internet cafes in Suva City.

The three research questions and their sub-research questions are summarised in Table 1.2. The hypothesis for this overall PhD is that low levels of PA and high levels of SBB (including e-gaming) activities are associated to obesity and psychosocial problems among Fijian adolescents.
### Table 1.2: Research Questions and Sub Research Questions In This Thesis

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Details of study</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STUDY 1 Cross-sectional analyses of PA and SBB on BMI-z</strong></td>
<td><strong>CROSS-SECTIONAL STUDY</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td><strong>RQ1. What are the PA and SBB patterns and associations with BMI-z among Fijian adolescents?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA + SBB behaviours (baseline) → BMI-z (baseline)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Do the PA and SBB patterns differ for adolescents by ethnicity and gender?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Are PA and SBB patterns associated with BMI-z and do they differ for adolescents by ethnicity and gender?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STUDY 2 Longitudinal analyses of PA and SBB on BMI-z</strong></td>
<td><strong>LONGITUDINAL STUDY</strong></td>
<td><strong>5</strong></td>
</tr>
<tr>
<td><strong>RQ2. What baseline behaviours or changes in PA and SBB predict changes in BMI-z and is there a reverse causal pathway of baseline BMI-z or changes in BMI-z predicting changes in PA and SBB?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA + SBB behaviours (baseline) → Δ BMI-z</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. What baseline behaviours (PA and SBB) variables ‘explain’ changes in BMI-z and vice versa?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Do baseline PA/SBB variables predict changes in BMI-z?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA + SBB behaviours (baseline) → Δ BMI-z</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. What changes in PA and SBB variables ‘explain’ changes in BMI-z and vice versa?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Are changes in BMI-z related to changes in PA and SBB variables?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ BMI-z → Δ PA + SBB behaviours</td>
<td><strong>DIRECT</strong></td>
<td></td>
</tr>
<tr>
<td>ii. Are changes in PA and SBB related to changes in BMI-z?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ PA + SBB behaviours → Δ BMI-z</td>
<td><strong>REVERSE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>STUDY 3 Cross-sectional analyses of e-gaming on psychosocial problems</strong></td>
<td><strong>CROSS-SECTIONAL STUDY</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td><strong>RQ3. What is the association between high e-gaming and psychosocial problems (low self-esteem, poor commitment to school, low school grades, poor relationships with parents, low HRQoL, depression and aggression) among a sample of Fijian adolescents in Internet cafes in Suva City?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-gaming time → Self-esteem score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-gaming time → Commitment to school score</td>
<td></td>
<td></td>
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<tr>
<td>E-gaming time → Academic achievement (final exam marks in categories)</td>
<td></td>
<td></td>
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<tr>
<td>E-gaming time → Relationship with parents score</td>
<td></td>
<td></td>
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<tr>
<td>E-gaming time → HRQoL score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-gaming time → Depression score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-gaming time → Aggression score</td>
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</tr>
</tbody>
</table>
1.4 Overview of Thesis

Following this introductory chapter, Chapter 2 critically reviews the literature exploring the definition, prevalence and epidemiology of obesity globally, within the Pacific Island region and in Fiji. It also reviews the background literature on modifiable risk factors of obesity, including PA and SBB. Chapter 3 describes the study design, general methods and instruments and methods of data analysis for the three studies in this thesis. Chapter 4 presents the major findings of Study 1, the descriptive cross-sectional study. The prevalence rates of obesity, along with anthropometric and demographic characteristics are described with descriptive statistics, and the findings of the regression analyses for association between BMI-z and other PA and SBB variables are given. Chapters 5 and 6 highlight the findings of Studies 2 and 3, respectively. Chapter 7 presents the overall general implications and conclusions of the three studies, and their strengths and limitations. The significance of the study for obesity prevention and its implications for practice and application are also discussed. It concludes with a summary of the research findings and various suggestions for improving policy implementation, as well as recommendations for the engagement of stakeholders in future research.
Chapter 2: Literature Review

2.1 Introduction

This chapter aims to review the existing body of literature pertaining to PA, SBB (including e-gaming) and obesity and psychosocial outcomes. It begins with focus on linking levels of PA and SBB activities with health outcomes in adolescents, particularly obesity. Sections 2.2 presents an overview of obesity and body mass index, including their definition, measurement, and trends among adults, children and adolescents around the globe, within the Pacific Islands and in Fiji. Section 2.3 reviews the health risks associated with obesity and PA/SBB. Section 2.4 discusses the modifiable risk factors of obesity, defines PA and its sub-domain, SBB, and reviews various activity measurements and determinants and Section 2.5 and 2.6 discuss the determinants and factors associated with PA and SBB, respectively. Section 2.7 reviews association between PA, SBB and obesity while section 2.8 reviews association between e-gaming and psychosocial outcomes. Then, PA and SBB modification strategies are discussed in section 2.9. Finally, obesity summary and gaps in the literature on adolescents are discussed in Section 2.10.

2.2 Overview of Obesity

2.2.1 Obesity and Body Mass Index

While obesity is defined as an excess of body fat, for adults, the most commonly available tool for monitoring the obesity epidemic is the Body Mass index (BMI) (44) used as a proxy for body fatness. BMI was first used by epidemiologists for
population health studies and is now widely used in health profession. BMI may be
used for clinical purposes (how much excess fat is a person carrying),
epidemiological studies (what is the prevalence of overweight and obesity),
monitoring (is the prevalence changing over time) and making comparisons across
populations (how do prevalence rates compare across populations). BMI is a
continuous variable so the cut off points along the continuum to define overweight
and obesity are somewhat arbitrary.

2.2.2 Defining and Measuring Obesity

According to the World Health Organisation (WHO), obesity is defined as ‘the
accumulation of excessive body fat that may impair health’ (45, 46). As defined in
the glossary, overweight and obesity are the two terms that are defined using BMI,
‘which is a person’s weight in kilograms divided by the square of the height in
meters (kg/m$^2$)’. WHO states that, ‘an adult with a BMI more than 25kg/m$^2$ is being
defined as being overweight and a BMI more than or equal to 30kg/m$^2$ is being
defined as obese (46). These standard BMI cut-off values for adults are now widely
used independent of age for both genders.

In children, the common standard measure is the BMI for age percentile. As weight
and height changes substantially with age and gender during childhood, BMI needs
to be adjusted to compare an individual child with others of different ages, as
children of different ages will have significant differences in BMI for the same
degree of fatness. Hence Cole and colleagues used mean BMI-for-age data cut-offs
for adults at age 18 from six countries to develop cut-offs between 2-18 years to
measure childhood and adolescent obesity (47). The mean BMI-for-age data came
from the following six countries: US, UK, Netherlands, Brazil, Hong Kong, and Singapore – Cole and colleagues back-extrapolated along the centile lines to create a smooth curve representing all country datasets of childhood equivalents’ for the adult cut-points of BMI 25 and 30.

Conversely, in 2007, the WHO growth reference was developed by De Onis et al. (48) for birth to five years then 5 to 19 years. Prospective international cohorts were used up to 5 years, and then the authors reconstructed the original 1977 National Centre for Health Statistics (NCHS) dataset and merged it with the under-fives 2006 WHO child references to create the adolescent reference values. However, these conventional cut-offs for BMI may not be culturally appropriate for Fijian population due to the following reasons: 1) Two major ethics groups living in the same population; 2) Different body size and frames – bigger body frame doesn’t necessarily mean being overweight or obese for adults (also considering fit and fat obesity paradox). Nonetheless, the WHO multi-centre study on young kids (under 5yrs) did not show much ethic differences. On the other hand a study by Professor Elain Rush from New Zealand in her study did show some ethic and differences on body composition in offspring at age 1-3 years in 2005-2009. Yet, it is important to highlight that at current point in time there are no specific cut off points for teenagers, and therefore for adolescents in studies 1 and 2 of this current PhD.

Also, even though there are internationally agreed definitions, it must be acknowledged that there are some on-going debates in this regards despite some consensus about it. Even though BMI is the most common standard measure of overweight and obesity, studies exploring the health risks of high BMI in adults are contradictory (49). A systematic review of 40 studies revealed that those who were obese were not at higher risk of total mortality and cardiovascular disease (CVD)
than those who were of normal weight. It further stated that these findings could be
explained by the lack of power of BMI to distinguish between lean mass and body fat
(49, 50). This is contrasted with many studies that link a high BMI with increased
mortality (51, 52). Stensel et al. point out that the lack of clarity and mixed findings
surrounding associations with high BMI and poor health in adults makes the linkage
(high BMI and poor health) with adolescents weaker by comparison. This is because
BMI for adolescents is a predictor of health risks in future. Moreover, to add to this
obesity paradox, Steven Blair argues that fit people comes in all sizes and shapes.
His study had an interesting finding that stated “Many people classified as obese by
current standards actually have a good health profile.” That is, 40% of their study
participants who were obese had normal cholesterol and blood pressure.
Nevertheless, it seems much debatable to say that being overweight - being a major
health problem in general, has less to do with social desirability, fitness and
psychosocial factors - is more of a metabolic issue only. However, regardless of
clarity, overweight and obesity in adolescents are powerful predictors of obesity into
adulthood, as indicated in many studies (49) and while there is debate about the
impact of BMI on total mortality, its association with increased risk of diabetes,
many cancers, gallbladder disease and several musculoskeletal conditions is much
more secure.

2.2.3 Obesity Trends

2.2.3.1 Global Trends Among Adults

Obesity is a major global health issue among adults with rising obesity rates in both
high and low- and middle-income countries (LMIC) (53). Globally, around 1.5
billion suffer with weight related problems, out of which there are more obese
females (300 million) than males (200 million) as predicted by WHO in 2008 (4). The WHO states that overweight and its related co-morbidities are expected to continue to rise and be an economic drain on many countries around the world (46, 53). In the US, rates was around a third in adult males and 36 per cent in adult females in 2008 (34), which was around 30 million obese males and 36 million obese females and an additional 74 million overweight adults (42 million men, 32 million women) (34). Reports predict that by 2015, two in every five adults in the US will suffer from weight related problems (which is where some Pacific countries are right now). Obesity rates are increasing globally, also around a 30% in some European territories and 70 per cent in Polynesia regions (54).

Obesity varies enormously across countries. Specifically, most Pacific Island countries top the charts – making the Pacific the fattest region in the world. The Figure 2.1 presents the global variation in obesity prevalence among adult women from selected countries – from less than two per cent in Bangladesh, to less than 40 per cent in Australia and the US, and over 80 per cent in Tonga. The variation can also be seen within countries, such as New Zealand (NZ), where Pacific Islanders have higher obesity rates than Europeans, and Fiji, where obesity is more prevalent among iTaukei than Indo-Fijians, though Indo-Fijians have higher rates than those in their country of origin, India. These huge differences may be accounted for by huge differences in economics, environment, and social and cultural determinants.
Figure 2.1: Global Variation in Obesity Prevalence Among Adult Women, adapted from COOPs website
2.2.3.2 Global Trends Among Children

The trend of childhood and adolescent obesity also appears to be escalating at an alarming rate in the United Kingdom (UK), US and other rich countries, as well as LMICs (49). In children (under 5 years) alone, 22 million globally were estimated to be overweight in 2007 (55). Of these, more than 75 per cent of overweight/obese children lived in LMICs. The obesity rates for children are continuing to rise in the USA. Moreover, Doak et al. state that childhood obesity is prevalent in most parts of the world and the need for effective strategies to curb this epidemic is urgent. Wang et al. also have similar views regarding the increasing rates of obesity among children, with major variations in secular patterns among many countries (13).

2.2.3.3 Global Trends Among Adolescents

Adolescence is a significant period of human growth and maturation (56). Obesity in adolescents is one of the major global health issue impacting the current generation of adolescents (57). In 2006, the prevalence of obesity among US adolescents aged 12 to 19 increased by more than four times to 17.6 per cent from 4.6% (1966), that is, 5.7 million (3.1 million boys, 2.6 million girls) overweight and obese adolescents (34).

2.2.3.4 Regional Trends Among Adults and Adolescents

The Pacific Island countries have the leading prevalence rate of adult obesity in the world (58, 59). Subsequently, the 1990s saw the Pacific region recording the highest rates of adult obesity in the world, with merely few countries recording less than 20
per cent prevalence (58, 60). For example, Samoa, Cook Islands, American Samoa, and French Polynesia adult obesity rates are as high as 75-80 per cent (58). There is lack of evidence on activity behaviour patterns among adolescents in the Pacific where obesity rates are high (61).

The Fijian arm of the Pacific (OPIC) Project (62) baseline data showed high overweight/obesity rates among 13- to 18-year-old adolescents (53% females, 31% males) in Tonga and NZ (58% females, 59% males) (61). As per this report, there were more females (15%) than males (7%) in Tonga who were obese. The Pacific Island adolescents in South Auckland, NZ had more males (36%) than females (32%) who were obese, with additional 36% females being overweight and 35% males being overweight. The Maori adolescents in NZ had comparable obesity rates among both the genders. That is more Maori females (23%) were obese than males (24%), with additional 30% female Maoris being overweight 30% male Maoris being overweight (61). Obesity is a huge burden among Pacific populations and especially increasing among adolescents. However, there is little information on obesity patterns among young children and adolescents in this region in terms of their levels of PA and SBB (61).

2.3 Health Risks Associated with low PA/high SBB and Obesity

The period of adolescence is critical, as young people are more receptive to changes and developing lifestyles behaviours. Among these changes, there are several health risk factors specific to this sub-population such as high levels of TV viewing, low levels of PA (in particular, active transportation), parents’ lack of PA, and ingestion of fatty foods and sugar sweetened beverages, poor sleeping patterns, ethnic origin,
and genetic variations (63, 64). All these contribute to weight related problems which contribute to many health problems such as diabetes, CVD, heart attack, sudden cardiac death, hypertension or high blood pressure, stroke, asthma, cancer, congestive heart failure, chest pain and other NCDs (5, 8, 12, 38, 45, 65-77).

There is increasing evidence that PA and sedentary behaviour levels are independently linked to increased health risks of cardio-vascular diseases, mortality from all causes, and many physiological and psychological problems (38). Lack of PA is the 4th leading health threat for deaths (6%) globally (78-80). Among children, around 2 million deaths globally are linked to lack of physical activity (81). Being physically inactive is a contributing factor for a lot of morbidities such as obesity. Dobbins et al. (82) suggest that doing regular exercise will help children overcome many of these long-term health risks through adulthood. Lack of PA and high levels of SBBs track into adulthood from childhood, meaning inactive and sedentary children and adolescents will be likely to continue having unhealthy behaviours as they grow into adults (83). Lavizzo-Mourey reports concerns regarding medical conditions, such as type 2 diabetes, that were once considered adult illnesses but are now increasingly becoming adolescent illnesses (5). However, even though studies have shown (63, 64) associations between these risk factors and overweight in adolescence, they have not proven causation. Associations between obesity and morbidity or mortality are influenced by age of onset, duration and threshold levels of obesity, rates of change in weight, and distribution of body fat (57, 60). According to CDC in 2010, there were approximately 300,000 American pre-mature deaths due to obesity, and the risk of pre-mature deaths for adults was reported to increase with weight gain (84).
Consequently, the main health risks associated with PA and obesity include diabetes, CVD, cancer, skeletal health and mental health. Of these, diabetes is a serious health consequence due to being overweight/obese in both adults and adolescents.

2.3.1 Diabetes

Diabetes, a chronic disease, occurs when not enough insulin is being produced by the pancreas or when the body is unable to effectively utilise the insulin being produced or both. There are two types of diabetes. Lack of insulin production by the body is called Type 1 diabetes that was once known as childhood-onset insulin-dependent diabetes (85). One major consequence of weight related problem is diabetes (Type-2), which used to be called non-insulin-dependent. The former term adult-onset diabetes (86) is now archaic due to its prevalence in children and adolescents as well. Diabetes (Type-2) occurs when the human body is not able to use the insulin hormones effectively and usually occurs from being overweight and lack of PA (85). A gain in weight of about 5-8kg may increase a person’s risk of getting Type 2 diabetes to double to that of a healthy weight person (87).

The fact that over 80 per cent of people diagnosed with diabetes are either overweight or obese has been coined ‘diabesity’ linking association between diabetes and increased weight (87). Story et al. (57) stated that two million US adolescents in 2009 had pre-diabetes, which is now also common in many other countries. They also mentioned that the best predictor of adult obesity is obesity in adolescence, as more young people are being diagnosed with illnesses once considered to be adult illnesses, such as diabetes of Type -2. Evidence is available to say that high levels of PA minimises the risk of diabetes and obesity (86, 88), but evidence on the link
between PA and diabetes is weak due to the paucity of randomised Controlled trials (RCT)s.

2.3.2 Cardiovascular Diseases

CVD is another health risk of obesity caused by heart and blood vessel disorders, and includes heart attacks (coronary heart disease [CHD]), strokes (cerebrovascular disease), high blood pressure among other heart diseases (89). CVDs can be prevented or treated, but according to the WHO it caused approximately 17.3 million global deaths (30% of all global deaths) in 2008, of which 7.3 million deaths were from CHD and 6.2 million deaths were from stroke. The WHO report stated that the risks increase with age and are greater for females than males (89).

Obesity is now believed to be a vital secondary risk factor for strokes. Narrowing of the arteries (or atherosclerosis – a condition for strokes) causes blood clots in the arteries. The process of atherosclerosis speeds up by raised pressure in the blood, physical inactivity, smoking behaviour and increased cholesterol levels (87). There is substantial evidence that CVD originates in childhood and tracks into adulthood (90), though there are no medical symptoms of it during childhood and adolescence (49). Lack of PA is independently related to CVD risk factors and reports show increased PA protects against CVDs. Obesity in children is an increasing global problem and PA may aid to minimize its effects. The main causes of CVDs are poor diet, physical inactivity, tobacco and alcohol use (89). These eating and behavioural risk factors are responsible for about 80 per cent of CHD and cerebrovascular disease and are shown as raised blood glucose, overweight and obesity among other
intermediate risk factors. The poorest people in LMICs are affected most, as 80 per cent of the world’s deaths occur in this region (89).

In adults, Stensel et al. (49) mention that low levels of PA or physical fitness contributes to CVDs. This association is, however, not so established among adolescents as CVDs do not commonly arise until adulthood because long periods of follow up are required to obtain this evidence between PA and CVDs as an outcome. As a result, many studies of adolescents have examined associations between PA and risk of CVDs (49). Poor physical fitness is found to be related to CVD in young people. The authors further reported that sedentary behaviour, including SBB activities such as watching TV is related to obesity and CVD at aged 26. They further highlight that those children who are viewing TV for more than four hours each day almost five times elevated risk of having hypercholesterolemia (having excess cholesterol in bloodstream) than those viewing for less than two hours of TV each day (49). However, there is a lack of concrete evidence from RCTs to say that PA reduces CVD risk factors in young people.

2.3.3 Cancer

Weight related problems are also related to various types of cancers. Cancer of the kidney, prostate, colon, gall bladder, and uterus lining are some of the examples. Women have double the risks of getting post-menopausal breast cancer if they have put on a lot of weight compared to those women who maintain their weight.
2.3.4 Skeletal Health

Bone development is crucial stage during childhood and adolescence. Stensel et al. (49) state that PA is effective in enhancing bone health and attaining peak bone mass in children during and before puberty. They also mention that weight-bearing activity is useful in increasing mineral density in bones during childhood and adolescence. Musculoskeletal problems and disorders such as osteoarthritis that affects weight-bearing joints directly, particularly in the knees, are more common among severely obese individuals (91). Extra body weight exerts extra force on bones and joints, hence increasing the risk of developing osteoarthritis and joint replacements (92). There is evidence that obesity is related to high risk of osteoarthritis with every kilogram weight gain (91). Overweight females and males have four and five times the risk of knee osteoarthritis, respectively, than normal weight individuals. Doing a lot of exercise has been demonstrated in adults to lead to improved bone health, muscular fitness, weight control and lower risk of hip fractures (83, 93).

2.3.5 Mental Health

Mental health as defined by WHO is a state of well-being where an individual discovers their own potential, copes with normal stress in life, works effectively and industriously, and makes productive contributions to their community (94). According to WHO reports, almost 50 per cent of mental problems begin before the age of 14 and around 20 per cent comprise children and adolescents having mental disorders globally. The LMICs are affected the most where the maximum percentage of under-19 year olds have minimum access to mental health resources. Moreover, LMICs have only one psychiatrist to every one to four million in the population (94).
Mental wellbeing has an important role to play in obesity. Western societies place a lot of emphasises on body image and often links to being slim, mainly for women. As a result, these kind of messages place those with increased weight less attractive (84). There can be many psychological and social consequences of physical inactivity including an increased risk of depression, as obese adolescents are rejected more frequently by their peers, teased and ostracised because of their weight (5, 77, 95, 96). Depression, which is ranked as the global leading cause of disability, is illustrated by prolonged sadness and lack of interest together with behavioural, psychological and physical indicators that can act as risk factors for obesity (94). Other potential consequences are having abnormal body image, experiencing prejudice and discrimination and limitations in daily activities due to the increased body weight (97). Stigma from mental disorders and discrimination by peers and families can be fatal to adolescents with suicides as a major outcome. The WHO reports in a public survey in South Africa that many individuals thought that mental illnesses were linked to either stress or a lack of willpower instead of treating them as medical disorders. In addition the report stated that stigma was found to be higher in urban areas among people with a high education level (94). Biddle and Asare (97) in their review stated that there is evidence that PA and mental health are associated in young people and concluded that they are likely to have positive psychosocial measures with strongest for self-esteem (however short-term). High levels of PA increase a person’s immunity to getting a disease. It also enhances a person’s mental wellbeing and reduces emotional suffering such as depression. Moreover, increased levels of PA also help a person maintain self-esteem and boost a person’s sex appeal.
2.4 Modifiable Risk Factors of Obesity: PA and SBB

Obesity is a complex problem and various societal factors bring about behavioural changes in an individual, particularly contributing to this epidemic (98, 99). Economic growth, modernisation, urbanisation and the globalisation of food markets are just some of the forces contributing to this (82, 100). With an increase in income, societies become more urbanised and individuals become accustomed to changes in diet and the luxuries of machines acting as labourers within their daily life at home, at school and in work environments.

The many risk factors for obesity are smoking, lack of sleep, high EI, consuming fatty foods, high levels of TV viewing, low levels of PA, consumption of sweet drinks, age, race and genetic factors (63, 64). Factors such as gender, age, ethnicity, genes and family history are non-modifiable risks. Children and adolescents have higher risk of weight related problems as they age. Heredity can also increase the risk of obesity. Children are at risk if their parents are overweight and here both the genetic variation and lifestyle factors could act as a key role in children’s gain in weight. Ethnic background can also act as an influential factor but the relative contribution of genetic, socio-cultural or other determinants to these ethnic differences remain unclear (84).

Conversely, behaviours like dietary patterns, PA and SBB are modifiable risk factors. Adolescents who are inactive or less physically active or who are usually sedentary - SBB activities like viewing TV and e-gaming – have high risk of obesity (84).
Insufficient PA and high caloric intake leads to an energy imbalance, which is the fundamental contributor of overweight and obesity. Eating more and burning less energy has simply been the desired pattern for some time now with the use of automated transport, technology at home, and being more sedentary and passive leisure individuals. This section aims to review the current body of literature relating to PA and its sub-domain, SBB, because they are key modifiable risk factors in the total energy expenditure (TEE) equation. Both PA and sedentary behaviour (including SBB) cover both the extreme ends of the TEE equation.

2.4.1 Behavioural Epidemiology of PA and SBB

Combating the escalating rate of obesity requires an understanding of the epidemiology of the human population under study with interrelated components. Epidemiology is defined as ‘the study of the distribution and determinants of health-related events in a specified population over time’ (101). Studies have largely recommended the use of a behavioural epidemiology (defined as the etiology and distribution of behaviours that causes change in health and brings about diseases) (102) framework to help guide research that targets PA and SBB (32). The authors of the framework, Sallis and Owen, developed five phases of this research that can be applied to PA and SBB. The framework shows a clear understanding of the link between the health outcome and the activity behavioural exposures (3). For example, it explains why some adolescents are active while others are not. Marshall and Welk have demonstrated this by, applying the framework to the study of TV viewing as an SBB. Table 2.1 is an extract from their work. Phases I and III in particular are critical and applied to this research.
Table 2.1 Marshall and Welk’s Behavioural Epidemiology Framework, adapted from Smith and Biddle (2008)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Purpose</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Establish the links between physical (in)activity and health</td>
<td>Determine if a dose-response association between TV viewing and excess adiposity in youths</td>
</tr>
<tr>
<td>II</td>
<td>Develop methods for accurately assessing physical activity</td>
<td>Establish reliability and validity of measures of TV viewing that are self-reported</td>
</tr>
<tr>
<td>III</td>
<td>Identify factors that influence levels of physical (in)activity</td>
<td>Identify the descriptive epidemiology of TV viewing among adolescents</td>
</tr>
<tr>
<td>IV</td>
<td>Evaluate interventions to increase physical activity and reduce physical inactivity</td>
<td>Conduct a randomised controlled trial to reduce TV viewing among adolescents</td>
</tr>
<tr>
<td>V</td>
<td>Translate research into practice</td>
<td>Incorporate a new program into a school health promotion curriculum to help adolescents reduce their TV viewing between 3 PM and 6 PM</td>
</tr>
</tbody>
</table>

2.4.2 Defining Physical Activity (PA)

PA is defined by the WHO as any ‘bodily movement produced by skeletal muscles that result in energy expenditure which can be measured in kilocalories’ (79, 81, 103). Though this definition is widely accepted, some experts have argued that it is too broad and undermines the relevance of how much energy expenditure is required to combat ill health. Therefore some have included the words ‘substantial increase’ in terms of expanding energy in the definition (32). Terms such as ‘exercise’, planned and structured, is another word and a sub-component that can describe PA. Moreover, young children and adolescents are less likely to associate with planned or structured forms of PA or in other words may not relate to fitness and exercise (32).

2.4.3 Defining Physical Inactivity and Sedentary Behaviour

Physical inactivity is known as lack or absence of any PA (79), which can really only occur during sleep (32). Sedentary behaviour includes activities such as sitting down quietly or reading, sleeping or lying down, using a computer and playing passive e-
gaming. A component of sedentary behaviour is SBB (for example, activities involving screen use, like viewing TV, DVDs and time spent on e-gaming). Sedentary behaviours are increasing and active behaviours are declining, leading to overall reduced PA (104, 105).

Energy is measured by metabolic equivalent units (METs). The cost of energy for sedentary behaviour is between 1.0 to 1.5 METs and the cost of resting is 1.0 MET. Light PA has around 1.6 to 2.9 METs in terms of energy expenditure. Light PA are activities such as sitting down, walking slowly, reading or writing, doing dishes, cooking food, and folding clothes among others (105). In simple terms, sedentary behaviour activities cost of EE is not much higher than METs at rest.

2.4.4 Defining Screen –Based Behaviour (SBB)

SBB is a subset or sub-domain of sedentary behaviour associated with screen time, which is emerging as a highly likely determinant of overweight and obesity. SBBs are mostly classed as sedentary and include activities involving screen use, like viewing TV, DVDs and time spent on e-gaming devices. There have been new innovations in some of these, including motion-sensing e-games that do require PA, such as Nintendo Wii video console games. With technological advancements, adolescents are increasingly engaged in more electronic than physical games.
PA levels and patterns among individuals and populations are typically described by the five main characteristics or dimensions in which the activities occur: type, frequency, duration, intensity and domain (context and setting). Now, because the SBB (which is the subset of the sedentary behaviour) is a sub-domain of PA from the energy expenditure point of view, these dimensions can also be used to describe sedentary behaviour.

2.4.5.1 Type

There are many types of PA in different categories such as aerobic PA and PA for strength, flexibility or balance (106). In aerobic PA, or endurance activity, large muscles in the body move for a period of time in a rhythmic pattern, such as in walking and running. PA for strength includes exercises that improve muscle strength in the body. PA for flexibility includes exercises that improve joint flexibility in the body depending on the tightness of various muscles. PA as balance includes exercises that improve on a person’s ability to balance and avoid swaying by self-motion (106). Examples of PA for balanced training are walking, jumping, and running.

2.4.5.2 Duration

Duration is usually measured in minutes (or hours) and is basically the time it takes to perform an activity or exercise per day each session (106).
2.4.5.3 Intensity

Intensity is defined as the degree of exertion or magnitude of effort it takes for an exercise to be performed. Intensity is either absolute or relative. Relative is when the intensity or exertion level measured by physical vibrations during PA including heavy breathing, sweating, and pumping of heart beats and muscle tiredness. Examples are moderate-to-vigorous-intensity physical activity (MVPA) and vigorous-intensity physical activity (VPA) (106). During MVPA, the breathing and heart rate are faster yet one can still talk (e.g. brisk walking, raking the compound, digging, active play and casual cycling). During VPA, the heart rate is increased considerably and breathing is too fast and heavy for any continuous conversation (e.g. jogging, running, swimming, rollerblading, skiing, skipping and most competitive sports such as football and soccer). Alternatively, absolute is when the intensity or exertion level is measured by the rate of oxygen uptake, kilocalories or kilojoules, or METs (106).

2.4.5.4 Frequency

Frequency is the amount of intervals an activity is completed. It is usually measured in number of days, bouts, episodes, spells, sessions per day, week, month or year (106).
2.4.5.5 Domains

PA can be accessed through various domains (context or setting in which PA occurs) such as LTPA, occupational, household, community or school activity, or transportation (32). PA contexts refer to the purpose or circumstances under which activities are performed. Four main PA domains identified by the WHO—leisure-time/sport and recreation; occupation; transportation; and incidental (household chores or cultural activities)—can be relevant in understanding the intent behind an activity (103, 106). Figure 2.2 describes the different types of activities under various PA domains and its sub-domain, SBB (from the energy expenditure point of view).

Figure 2.2: Types of Activities Under PA Domains and its Sub-Domain, SBB
For five- to 17-year-old children and adolescents, PA mainly refers to games, play, sports, recreation, transportation, planned exercise or PE, within the community, school and family settings (93). Conversely, for 18-64 year olds, PA is mainly referred to as LTPA, transportation, occupational, household chores, games, play, planned exercise or sports within the setting of community, family and daily activities (93). LTPA is usually linked with sports, active games, exercise or hobby activities in one’s recreational time.

The second context in which PA can be carried out is occupational or work-related PA (e.g. logging, carpentry). The third domain of PA is transportation for the purposes of going somewhere (e.g. cycling, walking). The incidental domain involves activities related to household chores or cultural activities (e.g. housework, backyard work and cultural dance performances) (93, 107).

### 2.4.6 Recommendations for PA and SBB

Recommendations for PA and SBB vary across countries and regions for both adults and adolescents. Though it has long been assumed that young people need the same amount of PA as adults, anecdotal evidence suggests that they need separate guidelines but many countries lack such guidelines. The recommended levels of PA and SBB for individuals are outlined below.
2.4.6.1 Physical Activity

For children and adolescents at least one hour of moderate intensity PA is recommended for countries like the US and the UK per week. At least 3 sets of 20 minute session are recommended for MVPA per week. Both countries recommend adolescents to be active every day, engaging in games, sports, work, active travelling, recreation, physical education, and exercise in in all environmental contexts. Evidence suggests that young people would meet the recommended 30 minutes per day for adults and adolescents need more minutes to be healthy in adulthood (32). Therefore, WHO experts feel that 60 minutes of MVPA per day for five- to 17-year olds is reasonable to help improve health (108). PA greater than 60 minutes provides increased health benefits. However, some countries like Canada feel that this can be unrealistic for children and adolescents; hence they recommend that youth should increase their levels of PA gradually over a period of months. Notably, recent evidence suggests that 90 minutes of daily PA is needed to prevent insulin resistance in children (32).

Like the Pacific Island region, Fiji also lacks national PA guidelines specifically for adolescents. However, the national guidelines (109) adopted from the ‘Pacific Physical Activity Guidelines for Adults’ (110) urge people to ‘Move for Health’ every day, especially for those living a more sedentary lifestyle or are inactive. They suggest walking or cycling to shops instead of taking their car, using a staircase instead of using lifts at work places and walking across to the next office instead of just sending emails. The guidelines also recommend that at least 30 minutes of moderate intensity PA is required every day to combat ill health such as
cardiovascular diseases and hypertension and stroke. Examples include brisk walking, cycling, mowing, digging and swimming. In order to control weight, and achieve even greater health and fitness benefits, the guidelines further recommends a minimum of around half an hour of at least VPA four days each week, such as football, squash, netball, aerobics, jogging, weight lifting and fast cycling. Also, the Ministry of Health in Fiji recommends at least walking 10,000 steps per day (that is equal to walking about 8km each day) to achieve a physically fit population. An individual who walks 5 miles a day (equal to 10,000 steps a day) can reduce or expand around 2000 to 3500 calories each week, which promotes better health and a longer lifespan (111).

2.4.6.2 Screen-Based Behaviours

There are few specific guidelines for sedentary behaviour, particularly for SBB. However, there is evidence that extended periods of physical inactivity, sedentary behaviour or SBB promote weight gain and other adverse health conditions. Current recommendations have largely targeted TV viewing (or screen time and media use), limiting total e-gaming and TV viewing time for youths at least less than 2 hours. A few countries have formal sedentary behaviour guidelines for adolescents and children: Australian guidelines state that:

‘Children and young people should not spend more than 2 hours a day using electronic media for entertainment (e.g. computer games, Internet, TV), particularly during daylight hours’(32).

Canadian guidelines highlight that:
‘Physically inactive children should decrease the screen time they spend on TV, playing computer games, and surfing the Internet by at least 30 minutes per day and over several months, children and youth should decrease by at least 90 minutes per day the amount of time spent on non-active pursuits such as watching videos and sitting at a computer’ (32)

The US guidelines also state that:

‘children should only view TV between 1 to 2 hours per day’ (112).

Fiji and the Pacific Islands have no proper guidelines but have adopted the WHO recommendation of two hours or less per day.

2.4.7 Techniques for Measuring PA

There are many ways to measure PA with varying levels of sophistication and precision. Cost also varies; some can be invasive while others such as pedometers are less precise but cost effective and efficient. Due to the complexity of measuring intensity and assessing fitness levels, measurement techniques have evolved over time, with some limitations in validity (99, 113-116). Various sub-disciplines use different measurement tools. For example, an exercise physiologist would use oxygen consumption and energy expenditure. Children have unique behaviour patterns that vary from day to day, making the measurement techniques problematic.
Although sedentary behaviour patterns do not vary much, the issues remain somewhat the same. Often self-reported instruments are used among young people and understanding of their limited high-level cognitive skills and more concrete patterns than adults is important (32). Different children and adolescent may have different cognition or abstract reasoning, usually in self-reporting, and because these measurements provide only estimates of true behaviour, there can be some degree of bias (predictable variation) and random error (unpredictable variation). To ensure that a study has enough power to determine true association between an outcome of interest and measures of activity, it is important to minimise errors and biases from the study. High random error reduces precision of an estimate; high bias reduces the accuracy of the point estimate. That is for estimates like prevalence. For associations, high random error reduces the power to find the association, and a high bias may or may not affect the precision of the beta coefficient.

The typical measures for PA –objective and subjective – are outlined below.

2.4.7.1 Objective Measures

Measures are objective when there is no cognitive or perceptual participant involvement in data collection, that is, the data is available regardless of what the participant perceives about them. The measuring motion sensors are:

- **Pedometers**: These are commonly used in the community being small, cheap and easy to use in terms of data management, but they are not as accurate as accelerometers (113, 117-121). Pedometers are devices that quantify PA specifically when the main activity behaviour is walking (122, 123). It can be
utilised on any free-living individual to calculate the total amount of PA in a day (123-126), but it is not sensitive enough to step length, which varies significantly from person to person, so measuring PA can be challenging for population-level studies.

- **Accelerometers:** These are one of the more accurate ways of assessing body movement (a direct measure of body movement or acceleration) (34, 121). They have become the accepted standard for most field-based studies, as they can measure the duration, frequency, and, to some extent, unlike pedometers, intensity. Nevertheless they cannot detect the differences between various types of PA (113). Another limitation in waist-worn accelerometers is their inability to measure the upper body movement or energy cost while carrying a load. However, these devices provide valuable estimates of group comparisons than individual estimates of PA (32).

- **Heart-rate monitors:** These are personal devices that record heart rate and body movement to find cost of energy based on heart beat rates. While they can measure mean heart rate, other measures such as number of calories burnt, distance, speed, can be electronically input into the computer, they have calibration issues that may be problematic for data collection and field research (32).

- **Multichannel monitors:** These devices can use multiple sensors to incorporate PA data from accelerometers and heart-rate monitors.

Marshal and Welk (32) state that a combination of these devices provides more accurate estimates than each device on its own.
2.4.7.2 Subjective Measures

As opposed to objective measures, subjective measures involve participants’ cognitive or perceptual involvement in data collection, requiring them to think and record their level of PA.

The most common way to measure PA is self-reporting. When measuring PA at population level people tend to rely on self-reported activity. Many community-based studies have used self-administered questionnaires to yield information about PA patterns as more detailed information can be obtained compared to pedometers or accelerometers. However, the measurements can be very subjective. This approach is used to quantify the PA levels and patterns in the free-living population but the individual data obtained are an estimation to populate individuals by their PA level. The instruments used include questionnaires, activity diaries and recall interviews. Self-report instruments are easier to use and are cost effective for data collection in a large scale. It is usually used for screening and surveillance purposes. Such self-report instruments like questionnaires can be used to obtain PA measures (like household chores, baby sitting and small errands etc.) among sedentary populations, though recall biases can be a challenging issue (99, 116, 118). Recall-based approaches involve seeking information about the participants’ activity on a particular day or a number of days.
2.4.8 Techniques for Measuring SBB

Due to theoretical differences between physical inactivity, sedentary behaviour and SBB, the methods for estimating these constructs are different. For physical inactivity or sedentary behaviour, the PA measurement techniques above can be used. Precisely, an accelerometer can measure activities that are completely sedentary among individuals over many days, apart from measuring VPA. Despite some pitfalls, it has a significant advantage over other methods for measuring sedentary behaviour. The data obtained from accelerometers can be stored for long periods in short increments of time such as 30, 60, or 90 seconds. It can be used to measure PA intensity in various intervals. Hence, total PA time spent every day, be it for sedentary or vigorous intensity activity, all these intensities can be calculated (104, 105).

The measures most commonly reported in the literature on SBB that involves individuals watching TV, or using computer and Internet are presented below.

2.4.8.1 Objective Measures

Direct observation is a reliable and valid method, especially if the aim is to use screen-based media. However, major limitations are high costs, researcher burden and risk of participants changing their behaviour due to the awareness of being observed. It is impractical to directly observe the time adolescents spend on SBB activities. Marshal and Welk (32) point out that few participants want to be video
recorded due to issues of reactivity to being observed; hence, video capturing data can be challenging. Notably, only six studies have utilised direct observation techniques in this construct, and these investigators note a demand for less burdensome direct observational methods. Also, the vast evidence on sedentary behaviour measures seem to be objective with limited materials on hand to direct health professionals aptly choose these measurement tools.

2.4.8.2 Subjective Measures

TV viewing or screen-use time can be measured by every single count of minutes or hours spent per day or week (127). Subjective tools include time use diaries, log entries, surveys and self-administered questionnaires.

The screen time can be measured using blocks time (e.g. 15 minutes, 30 minutes or an hour) use diaries that contain detailed information about what children and adolescents do and for how long. Accounting for every minute can be very tedious, but it stands stronger validity quotient than recall-based methods and are likely to generate valid and reliable estimates of true behaviour in comparison to direct observation techniques. However, following Marshall and Welk (32), only two studies (Anderson et al. in 1985 and Bechtel in 1972) have used minute-by-minute time use diaries and a handful (35, 128, 129) have used similar less time-consuming diaries where adolescents are asked to mark off slots or blocks of each 30 minutes representing SBB activities they were engaged in. The latter, however, has limitations towards computing total screen time for activities regarding SBBs (32).
A low-cost substitute to measuring SBB by direct observation or time-use diaries is the use of self-reports. Examples of these include recall-based questionnaires and in-person interviews. Based on evidence (112), SBB activities defer during weekends than to that during weekdays. For this reason, data should be collected for both these periods to avoid any biases in the study. This tool is quite common for SBB measurement as evident in a systematic review of 88 published studies using self-reports of TV viewing of children and adolescents by Bryant et al. (51). However, in retrospective self-reports of sedentary pursuits, the majority of the measures are not effectively evaluated for validity and reliability. Hence this tool is recommended to be concurrently used with criterion standard, direct observation or reducing the recall period to over the previous day, for better estimation of true SBBs (32).
2.5 Determinants of PA and SBB

There are many determinants of LTPA among adolescents. Some broad determinants can be an individual’s personal characteristics such as past participation, past extra-program activity, participating in school athletics, having a blue-collar occupation, smoking, already being overweight, having knowledge and an attitude regarding health exercise, enjoyment of activity, perceived health, mood disturbance, age, perceived physical competence, self-motivation, and costs or benefits of a particular physical recreational activity or LTPA. Other determinants of LTPA would be environmental such as perceived available time, access to facilities, distractions in everyday routine, social reinforcement (e.g. staff, exercise partner, spouse support), activity characteristics, perceived exertion, spontaneous PA, family influences, peer influences and costs. Another determinant is activity intensity, such as MVPA and VPA (see Section 2.4.5.3), which varies from person to person. A number of factors determine the various levels of PA for example, a person’s age, their gender, smoking habits, being less educated, and poor living conditions.

Screen time use such TV viewing and e-gaming lowers EE (130). Some determinants of SBB can be past participation, past extra-program activity, participating in school athletics, having a white-collar occupation, persuasive advertisements, online social habits, already being overweight, enjoyment, mood disturbance, age, perceived peer competence, self-motivation, costs or benefits of an electronic device, accessibility of Internet cafes, Internet or video games, perceived available time, and access to electronic facilities, disruptions in routine, social reinforcement and gender. These determinants are better understood with a clear understanding of physiological,
developmental social, contextual factors in adolescents’ PA and sedentary behaviour. For an individual to achieve a substantial change in behaviour, interventions need to be multi-disciplinary and targeting socio-cultural, psychosocial and physical environmental factors collectively (131).

A recent review of determinants of PA and SBB reported poor methodological quality in general, and high quality evidence is needed from RCTs to find long term effects of PA and SBBs (83). The review found some evidence for associations between intention and PA in children and between age and older adolescents low levels of PA.

Moreover, the review of all determinants of sedentary behaviour led to the conclusion that there was some evidence for adolescents, including children. There was strong evidence for a link between males’ and adolescents’ level of PA. Also there were links between children’s sedentary behaviour (particularly TV viewing) and body weight. Overall, this review stated that many studies had included biological, demographic, psychological, behavioural and social determinants of PA, but there was sufficient evidence for some determinants. Prospective research on sedentary behaviour was scarce, particularly for adolescents indicating insufficient evidence for determinants of sedentary behaviour. Only a few studies focused on environmental determinants of PA and sedentary behaviour, confirming that little research on this association has been conducted (83).

### 2.6 Factors Associated with PA and SBB

This section introduces a spectrum of factors that are likely to be associated with PA and SBB among adolescents. It begins with the personal psychological and
developmental factors in adolescents dealing with issues related to growth and maturation in the bio-cultural view. Other personal factors such as attitudes, motivation, the roles of personal self, and disability in adolescents are also elaborated. Next, this section describes how social (family and peers) and physical environments (school and out-of-school community activities) and wider economic and cultural forces affect PA levels and SBB in an adolescent.

2.6.1 Psychological and Developmental Factors

The contributions of biology, culture and their influence on PA and SBB are biocultural factors in developing behaviours. Biological (growth and maturation) and behavioural (developmental) processes are the main tasks among children and adolescents. Malina (132) reports that the interaction of these processes influence the levels of PA and SBB and therefore studies of PA levels among adolescents should incorporate a bio-cultural perspective. These processes are interrelated and predominant for almost two decades of the everyday life of an adolescent. However, the interactions of biological and behavioural processes differ among individuals in different cultural groups (see Figure 2.3).
Youths grow, mature and develop within the complexity of these related and interrelated domains. However, cultural influences on PA levels need further study due to the enormous global movement (emigration and immigration) of culturally diverse people. There are many consequences of the stigma from weight related problems among adolescents, including children. The several variations in cultural lifestyles impact on PA and SBB. Moreover, Malina states that many sports are now talent based, which can be discriminatory. More studies of youth sports would enable
a better understanding of these issues. Culture-specific demands can act as barriers or constraints upon these processes and interactions. Many psychological, social, environmental and genetic factors are associated with PA and sedentary behaviour.

2.6.2 Psychosocial Factors

Psychosocial factors include many different domains, such as depressed mood, stress, and social support. The direction of the association between mood and weight is not very clear in the literature but much has been reported on the association. Napolitano and Hayes (133) point out that depressive symptoms were associated with major long-term loss in weight. Their work showed that depressive symptoms were negatively affecting weight over time but not direct affecting one’s mood. The authors further state that psychological factors like stress and depression can affect variables like self-efficacy to promote change in behaviour associated with loss in weight (133). Biddle and Asare (97) reported that adolescents who are physically active have an enhanced psychological well-being and cognitive functioning and reduced mental ill health and depression. Another positive psychological measure linked with PA and health is self-esteem. As their reviews were largely based on cross-sectional evidence with limitations such as smaller sample size and possible measurement errors, determining reverse causality was difficult. Conversely, their review also revealed that high sedentary levels, especially sitting, were linked to poor wellbeing (97). Attitudes, a psychological construct, play an important role in behaviours. Attitude-based theories of PA explain how behaviours are developed and modified in young people. Attitude-based models such as planned behaviour explain the significant variance in PA intentions and behaviour together with attitudes and perceived behavioural control in pivotal roles (134).
Motivation encompasses various attributes like choice, intensity, persistence and continuing motivation (135). Studies have tended to focus on children’s motives in sports and adult’s motives in exercise and recreation. Motivational factors for children and adolescents are levels of fun, fitness, skill building, challenge and success, and connection. Biddle and Mutrie (135) report that young adults are more motivated by challenge, skill development and fitness rather than health, relaxation and enjoyment. They point out that, in children and adolescents, factors such as lack of interest, fun, playing time and success, or increased competitive stress and injuries can cease participation. For an adult, there can be several barriers such as physical, emotional, motivational, availability and time constraints. Studies exploring self-motivational constructs and commitments have been useful, but lack theoretical focus (135). Understanding motivational factors in young people in the context of PA is very important to address PA and SBB issues. Many studies are based on cross-sectional designs associated with these psychological constructs and less on experimental or longitudinal ‘causes’ linkages with motivating good measurements of PA. Very little is known about motivation towards non-sedentary living (136).

Crocker et al. mention that global self-esteem is associated with PA even though the role of self is complex to determine activity behaviour that motives adolescents. Notably, the physical self, including body appearance, is most strongly associated with global self-esteem but is a weak predictor of PA behaviour. The authors, however, report the association between self-perceptions and PA is unclear and that culture plays an important role in developing and understanding the physical self. The literature on culture, PA and the role of self is very sparse and poses a challenge for researchers to better understand these constructs (137).
2.6.3 Social and Physical Environmental Factors

Apart from internal factors as seen in the previous section, children’s and adolescents’ activity levels and SBB are also influenced by macro-level factors such as family, peers, school and culture. There are two key social environments for an adolescent’s activity – family, peers and school – as shown in most ecological models and in Figure 2.4 depicting multilevel factors.

Figure 2.4: Contextual Factors Influencing Individual Levels of PA, adapted from Crocker, Kowalski, and Hadd (2008)
2.6.3.1 Family

Family, one of the most important factors, can have either passive or active influences on adolescents. Passive influences are parental modelling of PA and SBB, socio-economic rankings, and parents’ attitudes and beliefs towards activity behaviours. Conversely, active parental influences are logistic support with transportation to PA avenues and facilities, buying equipment, paying for fees to access facilities and providing encouragement to be active. Studies suggest a strong association between parental behaviour and child sport participation.

Others factors include family members’ attitudes and beliefs and rules placed upon adolescents regarding neighbourhood safety. Crime and injuries are two keys factors affecting levels of PA. Saelens and Kerr reported that walking and biking to school have decreased over the past 30 or 40 years and few children are allowed by their parents to go outdoors alone. However, Mendoza et al. (138) showed that an active mode of travel was related to higher levels of MVPA and less weight related problems among 12- to 19-year-old US adolescents. Neighbourhood environments may be barriers to PA if there are no proper or well-maintained walking trails, parks, or fitness clubs, inadequate lighting and sidewalks, and a heavy traffic volume (139).

2.6.3.2 Peers

Peers are individuals who are at or near the same age as the target(s) under study. For example, adolescents in the same grade, classroom or soccer team are considered peers. Young people can be constrained by rules and expectations of significant adults as well as by their dependence on adults for some modes of transportation, but
they are in a stronger position to negotiate expectations and exert personal control with peers. Also, they are constrained by where they live, go to school, and participate in sports, but have the freedom to choose their own same-age peers and close friends. Thus, their relationship with peers is very different to that with adults. There is substantial evidence that peers are important social agents in the context of adolescents’ PA. Smith and McDough report that close peers of adolescents highly engage themselves in PA and sedentary behaviours. However, peers have been under-studied by adolescent and youth PA and SBB researchers despite theory and human development research indicating that they are a key influence in the lives of young people. One of the most-studied peer constructs in adolescent PA research is peer support. Smith and McDough further state that peers can help support adolescents’ PA levels in the form of encouragement, watching, talking about the PA, praising, guiding, and being a training partner.

Other peer constructs with potential significance for adolescent PA and SBB are: peer network (i.e. group memberships, peer connections), peer acceptance or popularity (i.e. being liked or accepted by peers), peer rejection (clearly disliked by peers), friendship (i.e. young people believing they have friends, and the number and stability of friends), friend characteristics such as behaviours, beliefs and other qualities (i.e. closeness/warmth, reliable alliance, support, conflict) of friends, peer modelling such as the behavioural effects of adolescents observing their peers, social motives or goals, impression management where adolescents control their image of what others have of them, and subjective norms composed of perceptions and expectations of important others regarding adolescents’ engagement in PA and SBB. Nevertheless, having inactive peers, experiencing social intimidation, having social invitations that conflicts with workout time, lacking a training partner and having
negative experiences with peers within the PA can make an adolescent physically inactive or sedentary.

2.6.3.3 Schools

The school environment is ideal for PA promotion and interventions. It provides opportunities to increase adolescents’ daily PA as they are a captive audience confined to a specific location. Schools can provide tips on how to stay active and active messages about favourable and unfavourable behaviours. Sratton et al. (2008) highlight that children and adolescents spend 40-45 per cent of their waking hours at school and hence this setting acts as an important role in modifying of PA and SBBs.

![Figure 2.5: Percentage of PA Accumulated During a School Day, adapted from Sratton (2008)](image-url)
Furthermore, schools have students of a range of socioeconomic and ethnic statuses, and attending school for the majority of the school year, during and after school programs, can help them achieve maximum levels of PA. PA in relation to school has been considered in three contexts: active transportation to school, recess breaks, sports/PE.

Studies suggest that inactive transportation for those students living near school premises is largely a parental perception of neighbourhood safety, choice of transport to schools in younger children, and convenience in older teens. The prevalence of inactive transport is increasing.

2.6.3.4 Economic Factors

Economic factors can also affect levels of PA and SBB. Reports suggest that the chance an overweight adolescent growing up to an overweight adult is up to 80 per cent (5). Also, overweight and its related co-morbidities are likely to increase and impact the economic status of various countries (46). Poor diet (2.8 million), physical inactivity (2.0 million), and obesity/overweight (2.5 million) collectively contribute to approximately eight million deaths per year worldwide (140, 141). The Pacific Islanders including individuals from Fiji and NZ also suffer similar economic and social harms to their countries and communities, including their families (58).

2.7 Associations Between PA, SBB and Obesity
Evidence from a few reviews has shown that increased PA is related to less weight related problems (138, 142, 143). However, researchers agree that considering both correlates of PA and SBB in adolescents is important for understanding the factors associated with overweight and developing effective obesity prevention initiatives (131, 144). However, Wong and Leatherdale pointed out that intervention targeting an increase in PA may be ineffective for reducing obesity if levels of SBB remain high (144) – that is, in order to comprehend the linkages between Body weight and PA, it is important to study types and levels of SBB. Hypothetically, despite links between obesity and PA, not considering types and levels of SBB may lead some researchers to miss an association between PA and BMI in adolescents (144).

A systematic review of 57 studies by Van der Horst in 2007 provides evidence on correlates of TV viewing and PA among adolescents (131). It showed evidence for positive associations between PA and correlates such as: self-efficacy, parental modelling, PE, gender, parental education, attitude, motivation or goal orientation, family and peer support. Correlates such as BMI, depression, parental education and socioeconomic status were positively associated with sedentary behaviour including SBB. However, these associations were from cross-sectional studies in this review. No association with PA was found for self-perception, perceived benefits, depression, and fun or enjoyment. PE classes and PA levels have also shown positive association. There was no association found between TV or sedentary behaviour and PA (131). In a subsequent systematic review by Sallis et al. (145), no association was found between sedentary behaviour and PA.

Moreover, Sallis et al. (145) in their review suggest that there are inconsistencies in their finding as some researchers hypothesized that high levels of sedentary
behaviours may have been replaced by low-intensity PA behaviours (e.g. walking, playing as opposite to high intensity activity like running) (29, 146). The authors noted that evidence for associations among PA, its barriers, competitive sports and intent to play sports was unclear (131). In addition, studies have indicated that high viewing of TV commercials has links with poor dietary intake and lower PA levels in children (36, 147). A large percentage of adolescent leisure time is occupied while watching TV and e-gaming (148). TV commercials for food, beverages and electronic screen-based gadgets are usually persuasive and target youth (148).

Among other SBBs, TV viewing has been found in a number of studies to be associated with obesity among young children and youth (36, 146, 148). Among adults, the association between watching TV and weight related problems, diabetes, metabolic syndrome is well documented (36, 146, 148). For adolescents, watching TV and high screen time is related to obesity, poor physical health, and adverse lifestyle behaviours and cardio-metabolic risk. Increased use of new technologies have minimised time adolescents utilised being physically active in many countries (36, 37). Utter et al. (61) reported that nearly 40 per cent, 25 per cent and 15 per cent of urban adolescents in NZ, Fiji and Tonga spent over two hours each day viewing TV, respectively. Better understanding of e-gaming patterns and screen use behaviours among young people related to obesity can provided enhanced obesity prevention strategies (149).

A 2011 reviews state that association between sedentary behaviour and health measures among five- to 17-year-old children and adolescents (38). Its meta-analysis of RCT studies revealed a mean reduction in BMI-z in various sedentary behaviour interventions. The review showed quality evidence from various study designs from
cross-sectional to RCTs designs, that reducing the time spent on screen-use and other sedentary behaviours was related to better health among adolescents. In addition, they reported that TV viewing (≥ 2 hrs/day) was related to poor mental and physical health (38).

In Fiji, obesity is a major health concern among children and adults (53, 57, 150, 151). Fiji has a large young population (82) and like many other Pacific Island countries, the rates among adolescents has risen rapidly over the years. In Fiji reports from 2008 showed that prevalence rates for overweight/obesity were high for adolescents (61). According to the OPIC Project baseline data reports Indigenous adolescents between 13-18 years were mostly overweight/obese while Indo-Fijian students were mainly thin in 2008. Among the Indigenous who were overweight/obese, 39 per cent were females and 22 per cent were males. Among the mostly thin Indo-Fijians, 31 per cent were females and 35 per cent were males (61). Also, the report stated that male adolescents were more physically active than females. In 2006, Khan et al. reported that 18 per cent of adolescents between 13 to 17 years of age were overweight while 16 per cent were obese (152), though this result was not from a representative sample. Weight gain in teen years is closely linked to being overweight and obese in adulthood with strong predictors of diabetes and other NCDs. Findings by Coyne et al. (58) suggested that due to transitions in nutrition from locally grown food to imported foods compounded with the sedentary behaviours including SBBs of urban lifestyles in Fiji underlie the high rates of obesity in Fiji. The report further states that this pattern is more common among iTaukei than Indo-Fijians and more prevalent among women. Though these two major ethnic groups differ in their obesity level, both have been found to be increasing over the years (153). There have been similar findings by a national
survey, which reported that 76.1 per cent (NCD STEPS-2002) of Fiji’s population (15-64 years) had insufficient LTPA (154). In summary, obesity is on the rise among Fijian adolescents and effective prevention strategies are needed especially during adolescence.

Fiji, like the rest of the world, has been experiencing changes in lifestyles with an advancement in technology in the last decade (155), reflected in changes in their PA patterns and SBB. Changes have occurred in the types of motorized transportation, home-based leisure activities, modern technology and sedentary behaviour patterns that reflect a rapid shift towards reduced energy expenditures. For example, people are shifting away from agriculture and other energy-intensive occupations towards service-sector occupations (155). As such, people of Fiji have significant health problems associated with obesity. Areas of increasing concern are overweight among children and adolescents (8).

It is evident that high levels of TV viewing and computer use are linked to extended screen time, and obesity is considered to have displaced levels of LTPA and active travelling over the recent decades in Fiji. TV, computers and mechanised transport have been the three main mechanisms linked to obesity.

Firstly, it is well established that TV viewing is extensively associated with obesity in globally. Fiji saw its first permanent TV broadcast in 1994 (4, 148). In 1991, preceding this official launch of Fiji Television Limited, Rugby, a prominent sport in Fiji, gave birth to two temporary broadcasts of Rugby and Cricket World Cup matches on TV. To date, Fiji TV owns a free-to-view (Fiji One) and two pay TV (Sky Fiji; 3 channels and Sky Pacific; 16 channels) services. It’s other rival free-to
view commercial network TV companies are, Mai TV (started in 2008) (4) and Fiji Broadcasting Corporation TV Limited (131) that only began broadcasting in October, 2011. It is another rival, however, a pay TV network, Pacific Broadcasting Services TV that started its operations in 2005 (144). To date 60 per cent of all households in Fiji own a TV set.

Secondly, over the last two decades, computers have become more accessible in Fiji. It has eased a lot of manual physical work in recent times and has brought about major advancement in Fiji’s workforce, many schools and adolescents screen-based leisure avenues. Recent statistics report that six people per 100 in Fiji own a personal computer and approximately, two out of 100 have subscribed Internet (91,400 Internet users in Fiji as of June, 2009). Moreover, there have been a number of Internet cafes and mobile phone shops set up around the country that has elevated the SBB activities. Among these advancements, the recent introduction of ‘Webbox application’ (device where people can access Internet on their TV screens) by Vodafone network provider in Fiji has supplemented yet SBB activity for adolescents (10).

Thirdly, it must be pointed out that sport, particularly rugby and soccer, are prominent in Fiji. This has been evident in dramatic increase in TV access in rural areas in Fiji to watch live rugby and soccer matches (156). In 2006, Chand highlighted that Fiji had won a number of tournaments (6 Hong Kong Sevens Rugby and one International Rugby Series) and championships in the international arena. Interestingly, he mentioned that it is a common site to witness those inhabited in remote islands (with no electricity) flocking to town centre’s to purchase a TV set and small electricity generators to operate these TV during Rugby World Cup
tournaments. In addition, the author stresses that at least one TV set is available within a village among these remote islands that has no electricity but utilises generators to operate them.

Fijian national guidelines recommend at least 30 minutes of PA participation per day or meeting 10,000 steps per day to maintain a healthy weight (109). However, there are no proper guidelines established or documented for screen exposure in Fiji; but do acknowledge guidelines by other others including Australia - having 2 hours per day or less screen time (35).

Overall, despite having a growing body of evidence, the present understanding of knowledge regarding levels PA and SSB and availability of data in Fiji is far from dense. It is unclear whether PA and SSB patterns and associations with obesity are equivalent for different adolescent sub-populations. Due to rapid advancements in technology and wide variations in the cultures around food, PA and BMI-z perceptions, most information available maybe out of date.

However, barring the Pacific OPIC Project, no studies in Fiji have jointly investigated PA and SSB trends or have reported on associations with BMI and PA/SSB activities. In 1984, Taylor et al. reported associations with low PA but with diabetes as an outcome measure among 20-year-old Indo-Fijian and Indigenous Fijian men (129). Becker also reported on two relevant studies in 2002. The first was a mixed methods study with measures such as nutrient transition, TV and BMI for Indo-Fijian children and adolescent (5-16 years) girls sampled in two waves (1995: 63 girls, 1998: 65 girls) in an urbanising environment in Fiji (128). The other was qualitative study on the impact of TV introduction on a rural community in Western
Fiji and disordered eating patterns and body image among 30 secondary school (form 5 to 7; mean age of 16.9 years) Indigenous Fijian adolescent girls (148). Both studies found that adolescent girls were vulnerable to media exposure undergoing rapid social and economic transitions (128, 148). Several other studies in Fiji have focused on socio-cultural aspects of dietary behaviour, physical activity and body images (157-161).

More recently, almost two decades since the first broadcast of TV in Fiji, a local study (2010) on junk food advertising on TV was conducted (12). It aimed to obtain self-administered responses from 88 primary school children (11-13 years) and 103 secondary school adolescents (14-18 years) widely in Suva area with a good ethnic mix of Indigenous and Indo-Fijians. The findings, however not nationally representative, showed that 63.1 per cent secondary school students watched TV on all days from ‘Mondays to Fridays’ after school and were statistically (p=0.03) more likely to watch TV on more days of the week than the primary school participants in Suva area. This study also reported that secondary school participants watched TV longer (between 2-4 hours; with an average TV viewing of 2.1 hours per school; 4.3 hours/Saturday and 3.1/ Sunday) than primary school participants. Further, evidence can be found to support both the cases for high caloric intake and decreased PA as causes of this weight gain epidemic.

While PA is independent of SBB, both activities have many antecedents with the obesity epidemic (29, 35, 112, 162-164). The Fiji STEP Survey (2004) (34) states high levels of MVPA in the occupational and active transportation contexts but low levels of participation (30.7%) for recreation or leisure among 15–24-year-old individuals (males 33.4%, females 13.4%). Further, urban residents were less active
than rural ones, and few Indo-Fijians achieved adequate levels of PA than those of iTaukei or other ethnicities. In another study, though not nationally representative, Khan et al. (152) reported only 50 per cent participation in active travel among high school adolescents.

2.8 Association between e-gaming and psychosocial factors

Evidence from international literature has indicated that high screen time (including e-gaming time) (165, 166) may place adolescents at risk of a number of psychosocial problems including low self-esteem (16), low school grades (17), poor relationship with parents (18-22), low HRQoL (23), aggression and depression (24-28, 167). The negative effects of violent video games are well documented from several RCTs (168-173), suggesting concerns that the increasing presence of violent e-games may be adding to aggressive behaviours among the youth. The strong positive association between aggression and violent video games has been well documented by reviewers (168, 169, 174-179).

Conversely, while it is widely known that e-games is mainly sedentary (unless it is an active video games), a review (180) of research on the positive effects of video game play by Granic et al. in 2013 reports that use of e-gaming may enhance children’s learning, social skills and even health. They report that playing video games can actually reinforce a variety of cognitive skills such as enhanced memory, spatial or visual navigation, increase in reasoning power and perception. They further reported that playing shooter video games enhanced children’s ability to think about objects in three dimensions, just as well as academic courses to enhance these same skills. This review suggests important implications for future education and career
development in utilising the variety of spatial skills for enhancement in science, technology, engineering and mathematics, and maybe in medical fields.

There is also other evidence of the learning benefits of e-games from some RCT’s, such as cognition (thinking, understanding, intellectual, and perception), decision-making, creativity, reasoning, problem-solving skills (180-183). Decreasing the time spent on violent video games may be beneficial to mental health either through health promotion approaches (e.g. campaigns around Internet cafes) or regulatory approaches (e.g. licensing requirements). Playing video games may also help children develop problem-solving and increase educational benefits (181, 184). The Granic et al. review (2013) reports that the more adolescents reported playing strategic video games, the more they improved in problem solving, creativity and school grades the following year (180). Children’s creativity was also enhanced by playing any kind of video game, including violent games, but not when the children used other forms of technology, such as a computer or cell phone, other research revealed. These reviewers also highlighted the possibility that video games may be effective tools to learn resilience in the face of failure. By learning to cope with ongoing failures in games, the review suggested that children build emotional resilience they can rely upon in their everyday lives.

Also, while the negative effects of violent video games are well documented (168, 169, 174-179), aspects of cognition, decision-making, creativity, reasoning, problem-solving skills (that help academic performance and improve literacy) are some learning benefits (180, 181, 184-190) of playing e-games that have emerged only in the last 5 years and are much debated (170). Despite the evidence regarding high e-games indicating better academic performance areas (cognition, decision-making,
creativity, reasoning, problem-solving skills) are from high quality study designs, it’s only some RCTs carried out in the last few years – more research of this nature would cement the type of games that really benefit adolescents (168, 169, 174-180, 184) than those that do not. While the negative effects slightly weigh more than beneficial gains from e-gaming around the world, there are large gaps in literature about LMICs and the Pacific, especially when e-gaming has been an emerging issue only in the last 5 long years. While there are major concerns about the harms, use of e-games enhances good learning and aids adolescents and child cognitive reasoning and problem solving in this new 21st century digital world. As a result, parents knowing their child development habits well and reviewing the type of video games their children purchase may help counter negative effects of e-gaming. In sum, major misconceptions that needs to be cleared by studies regarding e-gaming is that e-gaming is not just harmful entirely, and if utilized properly with better treatment or management, children are more likely to reap more educational gains than its harms.

2.9 PA and SBB Modification Strategies

Behaviour can be modified in many ways to counter weight related problems. As behaviour plays a major role in obesity prevention, behaviour modification and PA are strongly and widely recommended in many studies across countries. For example, controlling the EI or changing one’s eating habits, doing a lot of MVPA, becoming well aware or educated about body nourishments, engaging in LTPAs or joining an organised sport, and most importantly, setting achievable weight control goals. Changing a routine lifestyle or behaviour requires family and peer support at school, especially for children and adolescents, to make a positive health impact.
Integrating PA and video game play with technology is another way to reduce ill health and excessive gain in body weight. Review of nine studies on active video games (AVGs) and energy expenditure concluded that AVGs have the capacity to generate energy expenditure (42). AVGs are very popular and an enjoyable game to play. In 2004, 83 per cent of American 8-18-year-old children and adolescents had a video game console at home, while 52 per cent had two or more consoles. The review further states that this medium that includes muscle and bone-strengthening activities, reaches a large number of adolescents. The AVGs involves physical movements in games and has the ability to match skill with task difficulty creating PA enhancing enjoyment that is beneficial to health. The reviewers emphasise that this mode of PA also caters to the barriers and concerns of various parents regarding unsafe neighbourhoods, as children and adolescents can engage in MVPA while remaining indoors mostly after school (42).

Combating the escalating rate of obesity requires a population-based multi-sectored, multi-disciplinary and culturally relevant approach. However, very few community-based intervention (CBI) studies have been carried out among adolescents using such approaches. Doak et al.’s review indicated that 17 studies showed positive decreases in BMI-z out of a total of 25 school based intervention studies (191). A different study by Foster et al. (2008) reveals that a school setting is an effective setting to counter increasing rates of obesity. The authors state that multi-sectoral effort is needed to curb this obesity crisis (53). Moreover, Brownell et al. (192) feel that in order to reverse the increasing prevalence of obesity, it’s important to take up a public health approach to counter conditions that cause obesity directly in adolescents. However they argue that there is an upward struggle with this age group, as the food or beverage industry and other political forces state that obesity has many
causes and no particular food or soft drinks or cereals, company or industry is to be blamed and that obesity is in itself a matter of personal responsibility and is attributable more to physical inactivity than to food (192).

Consequently, strategies and approaches that focus on obesity prevention among adolescents are urgently needed. However, the literature has largely ignored the adolescent group and rather has focused on younger school- or pre-school-aged children. Highlighting that there is a need to design, implement and evaluate obesity prevention initiatives among Pacific populations, to date there are very few well-designed and evaluated studies. Thus, it is important to build the evidence about what approaches that work and approaches that do not. Community-based approaches that focus on building capacity among local communities have shown promising results in other countries and this evidence-based approach is growing (193). To combat the upward trends for adolescent, strategies that are feasible and effective need to be identified (194). For example, wide availability and affordability of AVGs is one way to reduce screen time or sedentary behaviour and increase levels of PA inside homes or after school.
2.10 Summary of Literature and Gaps in Knowledge on Adolescent Obesity

Widespread evidence indicates that PA has decreased and overweight/obesity and its associated commodities have increased over the past several decades, especially for females and countries like Nauru, Tonga and Samoa have the leading prevalence of obesity globally. As adolescents are a captive audience and are mostly accessible in school for obesity prevention intervention, they are an ideal target age group for combating this epidemic. Also, this age-group tend to associate substantially with the increasing accessibility and popularity of screen-based technological advancements. However, they are under-researched. Screen-based media equipment and entertainment systems have become popular for handheld and portable devices. Sedentary multi-tasking, whereby an individual watching TV, and at the same time is talking or chatting on their smart phones or are e-gaming is becoming common among adolescents. Behaviour modification is necessary to bring about improvements in weight-related problems. For these high-strength evidences are needed to back health promotion methods.

However, the poor strength of evidence has been a limitation in many studies. A systematic review by Van der Horst (2007) reveals that most of the PA and SBB studies are cross-sectional in nature. Van der Horst suggests that more quality studies are needed in order to gain a better understanding of PA and SBB changing levels during adolescence. They point out that more robust research and information is needed on physical inactivity and SBBs to come up with effective strategies to reduce the rising rates of obesity. They forecast that being active during childhood is
one of the best ways to predict a better wellbeing during adulthood, including adolescence (131).

While the international literature on obesity largely focuses on children and adults, adolescents have been under-researched in comparison. In Fiji and even in the Pacific region as a whole, little is known about adolescent obesity. There is also very little evidence about levels of PA and SBB among Fijian and Pacific adolescent populations where rates of obesity are high. There is widely documented evidence that LTPA is on a decline globally, particularly a declining trend among adolescents (80, 127). At the same time, there is now clear evidence that unhealthy weight gain is increasing among the same age group (5). Additionally, no studies to date have investigated the association between PA/SBB patterns and weight status (and BMI-z) or studied the predictors of change in PA/SBB patterns and BMI-z among adolescents in Fiji. There is also little evidence about what factors are associated with PA and SBB among adolescents. This thesis, hence, intends to provide an insight and add to new knowledge in gaps in this area.
Chapter 3: General Context and Methods

3.1 Introduction

This chapter outlines the general context and overview of methods common to most of the work presented in this thesis, which consists of three separate studies. Studies 1 and 2 utilised data from the Fijian arm of the four-country Pacific OPIC project called Healthy Youth, Healthy Communities (HYHC), while Study 3 data was collected from a new survey described in Chapter 6. More specific methods can be found within the relevant individual chapters. The three studies were carried out in different parts of Fiji as outlined in Section 3.2:

3.2 Background of Fiji

3.2.1 Geographical Location

Fiji lies to the east of Australia with around 333 islands that is spread across 18,333 sq km of land area in the South Pacific (13) and with a population of about 837,271 (34) in 2007.
Figure 3.1: Location of Fiji and Map of the Fiji Islands, adapted from Bureau of Statistics, Fiji
3.2.2 Ethnic Breakdown

Fiji is a diverse country where multiple cultures and religions somewhat meet and merge (13). There are two main islands in Fiji and around 80 per cent of Fijians live on the largest island called Viti Levu as seen in Figure 3.1 (B). This is the island where Fiji’s capital city, Suva is located (19). The two major population subgroups in Fiji are iTaukei comprising of 57% of the population and Indo-Fijians comprising of 38% of the population as seen in Figure 3.2. From July 2010, Indigenous Fijians have been known as iTaukei. Indo-Fijians, on the other hand are now called Fijians of Indian descent. Their descendants came from various parts of India and South East Asia. This ethnic group was established from 1879 to 1916 during the arrival of labourers from India to work in sugar cane plantations. They were brought in by were Fiji’s British colonial rulers (34). These two ethnicities, despite living in the same environment, have very different cultures, body shapes (i.e. body frame sizes) and lifestyles, including PA and dietary patterns.

Figure 3.2: Ethnic Breakdown in Fiji
Of all the South Pacific Island countries, Fiji has the largest population (about 427,176 male, 410,095) (195). Fiji has a relatively young population with approximately 40 per cent below the age of 19 years (196), with an additional 10 per cent or so aged between 20 and 24 years (195) and 80 per cent of adolescents aged between 14 and 18 who were attaining secondary school education, according to the 1996 census (19, 20). The literacy rate in Fiji is about 94 per cent. Official language in Fiji is English with Fijian and Hindi languages for everyday use (13).

The distribution of rural (49%) and urban (51%) populations is almost half. The urban growth rate is 1.7 per cent (197). The mean growth rate per annum is 0.8 per cent (i.e. 1.2% natural increase less migration) with rates for iTaukei being higher than for the Indo-Fijian population. The last few years saw some population increases in the population particularly in the West and South (central division). However, due to a high migration rate and brain drain, Fiji’s population has been pretty stagnant between the last 2 census (13).

3.2.3 Economic Situation

Fiji is a LMIC with gross national income (GNI) per capita in 2012 of US$3720. Overall, Fiji’s annual economic growth rate has been weak with a gross domestic product (GDP) per capita growing at 1.9 per cent per annum between 1970 and 2012. This is usually attributed to a mixture of poor economic policies and political instability, with two coups occurring in 1987 and another two in 2000 and 2006. Yet, compared with other Pacific Island economies, Fiji’s social development indicators are high.
Fiji has a lot of land and housing resource problems. Unemployment is another problem, mainly due to high number of school drop outs complemented by poverty. Estimates of poverty (between 2008 and 2009) is around 31 per cent overall, with 43 per cent in rural and 19 per cent in the urban areas (195). According to the Fiji Health Situation Analysis report (2008), the living conditions for the poor have been termed unsafe with overcrowding as a major problem in these squatters. They are exposed to health hazards such as pollution and poor sanitation. As a result people have in turn have involved in risky behaviours such as staying hungry, consuming poor quality food like fatty food choices, smoking and drinking habits as a form of socialising, staying inactive due to lack of surrounding spaces, and living a stressful life (197). The report further states that’s around 68 per cent of the people who are working, earn around FJD $7000.00 annually, which makes healthy living even challenging. According to United Nations Development Programme Human Development Index ranking, there is poverty in Fiji but not as apparent as other Melanesian and African countries.

However, the current government who took to power during September, 2014 elections, has allocated several million dollars in the budget for the poor who those who earn below FJD$ 20,000.00 annually. They have waived the school fees for all children from pre-school to secondary school level. Also, they have increased the number for tertiary education scholarships and have introduced a loan scheme for all those who find it difficult to attain tertiary education. The government’s target is to target health sector and increase the GDP that is assigned to health by 0.5% annually until the next decade to attain a 7 per cent of the GDP overall. As a result they have increased the funding allocation for the health sector that will help with all the
developments demanded by MoH, Fiji to utilise its health service resources successfully (197).

Fiji’s economy is heavily reliant on tourism, gold, fishery, forestry, sugar exports and funds donated to the country (195). Further, this health situation report states that land leases have been expiring for many people in Fiji, complemented by prices for foods being increased. This, the authors of this report reveal that could have given birth to around over 200 squatter settlements that equates to over 100,000 people (one eight of Fiji’s population) in a small island country like Fiji.

Fiji has a substantially a well organised infrastructure to maintain its rapid developments; however the overall living standard has been reported to be weak. Fiji has been ranked 92nd out of the 177 countries in 2006 (that is a drop from position 46th in 1995) as per the Human Development Index rankings – termed to be a medium developed country (197).

### 3.2.4 Key Health Indicators

Table 3.1, adapted from the 2008 Fiji Health Situational Analysis Report, shows Fiji’s key population health indicators. In general, there has been less improvements in overall health with some improvements in contraceptive use and neo-natal mortality (197).
Table 3.1: Fiji’s Key Health Indicators, Extracted from Fiji Health Situational Analysis Report, 2008

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (Census Estimates)</td>
<td>866,099</td>
<td>848,647</td>
<td>849,361</td>
<td>868,488</td>
<td>868,107</td>
<td>879,301</td>
</tr>
<tr>
<td>Total Live Births</td>
<td>17,910</td>
<td>17,714</td>
<td>17,826</td>
<td>18,394</td>
<td>19,298</td>
<td>18,944</td>
</tr>
<tr>
<td>Crude Birth Rate/1000 Population</td>
<td>20.68</td>
<td>20.87</td>
<td>20.99</td>
<td>21.20</td>
<td>22.2</td>
<td>21.5</td>
</tr>
<tr>
<td>Crude Death Rate/1000 Population</td>
<td>7.06</td>
<td>6.63</td>
<td>7.02</td>
<td>7.1</td>
<td>9.8</td>
<td>7.4</td>
</tr>
<tr>
<td>Rate of Natural Increase</td>
<td>1.36%</td>
<td>1.42%</td>
<td>1.4%</td>
<td>1.4%</td>
<td>1.2%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Under-5 Mortality Rate/1000 Live Births</td>
<td>23.73</td>
<td>22.52</td>
<td>25.81</td>
<td>25.8</td>
<td>22.4</td>
<td>23.6</td>
</tr>
<tr>
<td>Infant Mortality Rate/1000 Live Births</td>
<td>18.87</td>
<td>17.84</td>
<td>20.76</td>
<td>19.5</td>
<td>18.4</td>
<td>13.1</td>
</tr>
<tr>
<td>Peri-natal Mortality (Stillbirth &amp; Early Neonatal Deaths/1000 Live Births)</td>
<td>16.4</td>
<td>19.3</td>
<td>22.05</td>
<td>19.4</td>
<td>15.8</td>
<td>15.4</td>
</tr>
<tr>
<td>Early Neonatal Deaths (0-7 days)/1000 Live Births</td>
<td>7.54</td>
<td>8.13</td>
<td>10.43</td>
<td>8.0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Neonatal Mortality (Deaths 0-28 days)/1000 Live Births</td>
<td>9.27</td>
<td>10.05</td>
<td>15.37</td>
<td>11.3</td>
<td>11.9</td>
<td>9.0</td>
</tr>
<tr>
<td>Maternal Mortality Ratio/100,000 LBs</td>
<td>22.3</td>
<td>33.9</td>
<td>50.5</td>
<td>43.5</td>
<td>31.1</td>
<td>31.7</td>
</tr>
</tbody>
</table>

Comparing data with that of other Pacific Island countries (Table 3.2), Fiji tracks behind its two neighbouring countries, Samoa and Tonga. Other differences include Fiji having doubled the rate of urbanisation than other Pacific Islands. Interestingly, teenage (15-19 years) pregnancy is also high for Fiji; this could be somewhat due to a lot of young marriages of many Indo-Fijians (13).

Table 3.2: Selected Regional Comparative Indicators, Extracted from Fiji Health Situational Analysis Report, 2008

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Fiji</th>
<th>Samoa</th>
<th>Solomon Islands</th>
<th>Tonga</th>
<th>Vanuatu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Development Index rank</td>
<td>92</td>
<td>77</td>
<td>129</td>
<td>55</td>
<td>120</td>
</tr>
<tr>
<td>% population urbanised</td>
<td>51</td>
<td>23</td>
<td>17</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Under-5 mortality rate 2006</td>
<td>18</td>
<td>28</td>
<td>73</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>Life expectancy at birth 2006 (years)</td>
<td>69</td>
<td>71</td>
<td>63</td>
<td>73</td>
<td>70</td>
</tr>
<tr>
<td>% of pop. using improved drinking water sources 2004</td>
<td>47</td>
<td>88</td>
<td>70</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>% of pop. using improved adequate sanitation 2004</td>
<td>72</td>
<td>100</td>
<td>18</td>
<td>96</td>
<td>50</td>
</tr>
<tr>
<td>Age-specific fertility rate (15-19) births per 1000 women</td>
<td>45</td>
<td>23</td>
<td>69</td>
<td>42</td>
<td>38</td>
</tr>
</tbody>
</table>
The Table 3.3 shows a three times the burden of morbidity largely from injuries, NCDs and communicable diseases while diabetes was the major cause of deaths in Fiji in 2008. Also, NCDs top the mortality list in Fiji in 2008 (197).

Table 3.3: The 10 Major Causes of Morbidity and Mortality in Fiji in 2007,

Extracted from Fiji Health Situational Analysis Report, 2008

<table>
<thead>
<tr>
<th>No</th>
<th>MORBIDITY Cause</th>
<th>MORTALITY Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Injury</td>
<td>1 Diabetes mellitus</td>
</tr>
<tr>
<td>2</td>
<td>Influenza and pneumonia</td>
<td>2 Other forms of heart diseases</td>
</tr>
<tr>
<td>3</td>
<td>Intestinal and infectious disease</td>
<td>3 Ischemic heart diseases</td>
</tr>
<tr>
<td>4</td>
<td>Infection of skin &amp; subcutaneous tissues</td>
<td>4 Hypertension</td>
</tr>
<tr>
<td>5</td>
<td>Ischemic heart disease</td>
<td>5 Septicaemia</td>
</tr>
<tr>
<td>6</td>
<td>Other conditions originating in peri-natal period</td>
<td>6 Cerebrovascular Disease</td>
</tr>
<tr>
<td>7</td>
<td>Chronic lower respiratory disease</td>
<td>7 Other conditions originating in peri-natal period</td>
</tr>
<tr>
<td>8</td>
<td>Other forms of heart diseases</td>
<td>8 Chronic lower respiratory disease</td>
</tr>
<tr>
<td>9</td>
<td>Hypertension</td>
<td>9 Renal failure</td>
</tr>
<tr>
<td>10</td>
<td>Diabetes mellitus</td>
<td>10 Influenza and pneumonia</td>
</tr>
</tbody>
</table>

3.2.5 Key Behavioural Lifestyle and Transitions Impacting Health

3.2.5.1 Demographic Transition: Reduction in Key Health Indicators

As seen from the key health indicators in Table 3.1, Fiji has undergone several demographic transitions such as reduced fertility, mortality and life expectancy rates.

3.2.5.2 Epidemiological Transition: Burden of NCD in Fiji

Major cause of many deaths in Fiji is due to NCDs replaced by infectious diseases. Diseases such as hypertension, heart diseases and diabetes have surpassed communicable and parasitic diseases. NCDs including obesity in Fiji are serious public health issues; 82 per cent of mortality are directly contributed by diabetes, heart attacks, strokes caused by high blood pressure (198). Other 10 per cent and 8
74

per cent were contributed by communicable/ maternal / prenatal diseases and injury/ poisoning, respectively. According to the NCD Steps survey in 2002, the proportion of overweight (29%) and obese (18%) among the 15-64 year people were almost half (199). Overall, females had a higher BMI-z than males. The same was reported for iTaukei being bigger in size than Indo –Fijians. Both genders showed a spiked increase in the percentage of obesity for those less than 30 years according to the NCD Steps report in Fiji (198).

Results from waist-hip ratio measurement showed more females (45%) than males (40%) at risk of obesity. The risk of diabetes was 16 per cent for those who were between 25 and 64 years. The proportion of newly diagnosed diabetes cases was 53.2 per cent. Indo-Fijians (21.2%) had a twice the percentage of diabetes than iTaukei (11.5%). In terms of setting, urban dwellers (24.7%) had higher diabetes rate than rural dwellers (12.8%) (198). The risk of hypertension was 19.1 per cent for those who were between 25 and 64 years. The proportion of newly diagnosed diabetes cases was 63 per cent. iTaukei (21%) had higher percentage of hypertension rate than Indo-Fijians (16%), with additional uncontrolled cases of hypertension that was diagnosed earlier were higher among iTaukei (81%) as compared to Indo-Fijians (58%)

3.2.5.3 Technological Transition: ICT Developments

Fiji is fast catching up with the rest of the world. Apart from lifestyle and sociocultural changes, there have been changes in movement to urban settings and changes in diets from farm produce to being reliant on processed and imported goods that have all contributed to a number of NCDs including obesity in Fiji over the two
decades. Secular changes and screen–time activity patterns that have strong influence on adolescents, for example consuming fast foods and technological advancements.

2.5.3.1 PA and Screen-based Media Use Transition

Fiji, like the rest of the world, has been experiencing changes in lifestyles with an advancement in information and communication technology in the last decade (155), reflected in changes in children’s and young adults’ PA and SBB patterns. Reports show generally low levels of PA, but sport, particularly rugby and soccer, are quite prominent in Fiji. This has been evident in the dramatic increase in TV access in rural areas to watch live matches (156). The availability and accessibility of TV have only grown in the past decade. Changes in types of motorised transportation, home-based leisure activities, modern technology and sedentary behaviour patterns also reflect a rapid shift towards reduced energy expenditure. For example, people are shifting away from agriculture and other energy-intensive occupations towards service-sector occupations (155).

3.2.5.3.2 TV and Videos

As noted in Chapter 1, Fiji has seen rapid expansion in access to TV in the last 20 years. In 1991, preceding the official launch of Fiji TV, there were two temporary broadcasts of Rugby and Cricket World Cup matches on TV. Since the introduction of TV broadcasting in Fiji in 1994 (4, 148), Fiji now has three free–to-air TV network companies and two pay TV networks, providing multiple channels. Specifically, Fiji TV owns a free-to-view (Fiji One) and two pay TV (Sky Fiji; 3
channels and Sky Pacific; 16 channels) services. Its other rival free-to-view commercial network TV companies are Mai TV (started in 2008) (4) and Fiji Broadcasting Commission TV (131), which only began broadcasting in October 2011. Its rival pay TV network, Pacific Broadcasting services started its operations in 2005 (144). A recent survey found that 60 per cent of all households in Fiji owned a TV set (10). A 2010 local study among 14- to 18-year-old adolescents found that less than two-thirds of (63.1%) secondary school students had watched TV on all school days, and had a longer screen time (2-4 hours) than primary school participants during both school days and weekends (12). Studies have found that watching TV for over two hours each day is related with poor academic performance, reduced fitness, lower self-esteem and unhealthy weight gain (38). TV viewing in particular has been shown to be linked with obesity globally (26) although it is linked to both sedentary and dietary behaviour when watching TV.

3.2.5.3.3 Computers, Internet and Mobile Phones

Over the last two decades, computers have become more and more accessible in Fiji. It has eased a great deal of manual physical work in recent times and has brought about major advancements in Fiji’s workforce, many schools and adolescents’ screen-based leisure avenues. Recent statistics report that six out of 100 people in Fiji own a personal computer and approximately two out of 100 have subscribed to Vodafone Internet services (91,400 Internet users in Fiji as of June 2009) (10). Two other Internet service providers, Connect and Unwired, had 19,996 and 1337 Internet subscribers in 2009, respectively. Moreover, a number of Internet cafes and mobile phone shops have been set up around the country. In 2009, Vodafone Fiji mobile phone company alone had 698,279 prepaid and 26,796 post-paid users (195).
Another mobile phone service provider, Digicel Fiji, which started its business in 2010 in Fiji, has its own set of mobile-phone users. Among these advancements, the recent introduction of Webbox Application (device where people can access Internet on their TV screens) by Vodafone network provider in Fiji has supplemented yet another SBB activity for adolescents (10).

3.2.5.3.4 Vehicles and transportation

The first highway was built in the late 1970’s between Suva and Nadi, with additional 888km of roads in rural settings. According to the Fiji Bureau of Statistics report (195), there were a total of 19,173 vehicles in Fiji including private and public service transportation (see Table 3.4) Since then, there has been steady increases in motor vehicles in Fiji. From 1996, on average vehicle sales have been around 100,000 per year. Since 2002, there was 3,440 km of main roads in Fiji, out of which 1,692 km were tar sealed. In 2012, there were a total of 176,598 vehicles registered with the Land transport Authority in Fiji. Of these, 92, 717 were registered private cars (195). There is private railway system of about 597km to transport sugarcane from farms to the mills in Western and Northern division in Fiji. Major sea port of entries is in Suva, Lautoka, Levuka, Nabawalu and Savusavu among many other jetties around the several islands in Fiji. In 2005, there were a total of seven large ships for transportation of people and goods between islands. In terms of airports, there were a total of 28 airports, with two international airports based in Suva and Nadi on the main island of Fiji. Of the 28 airports, 3 runner ways were paved in 2005. In 2010, there was 631, 868 tourist arrival in Fiji (195). In general, Fiji has seen a major transition in terms of transportation in Fiji.
Table 3.4: Distribution of Vehicles Registered in Fiji from 1970 to 31st
Period

Private Car

Taxis

Rental And
Hire Cars

Goods*
Vehicles

Buses***

Tractors

Motor Cycles

All Other
Vehicles**

Total

373
451
779
588
521
552
888
1,057
1,120
1,293
1,454
1,674
1,868
2,092
2,339
2,559
2,736
2,882
2,944
3,280
3,466
3,616
3,815
4,024
4,234
4,360
4,486
4,631
4,786
4,983
5,087
5,167
5,402
5,583
5,844
6,055
6,330
6,434
6,591
6,777
7,063
7,603
8,036

4,123
4,915
5,571
6,091
6,965
7,840
8,785
10,212
11,387
12,782
14,471
16,332
17,600
18,995
20,222
21,539
22,443
23,029
23,523
24,548
26,259
27,858
29,487
30,805
31,994
32,850
33,577
34,320
34,802
35,658
36,326
36,985
37,731
38,645
39,632
40,805
41,918
42,732
43,297
43,723
44,342
45,556
46,687

611
1,654
972
781
19,173
661
1,921
1,136
1,001
22,697
776
1,925
1,000
1,097
26,643
736
2,034
999
923
26,873
770
2,156
1,115
966
28,258
804
2,278
1,231
1,008
29,657
777
2,690
1,242
1,243
32,536
841
2,942
1,522
1,491
36,337
907
3,167
1,750
1,667
39,294
988
3,388
2,091
1,905
43,026
1,058
3,710
2,546
2,140
47,290
1,123
3,965
3,069
2,350
52,421
1,158
4,075
3,254
2,516
55,961
1,216
4,180
3,467
2,620
59,782
1,245
4,298
3,656
2,743
63,202
1,260
4,366
3,826
2,843
66,287
1,280
4,450
3,924
2,957
68,654
1,289
4,499
3,984
3,025
70,206
1,294
4,540
4,040
3,116
71,408
1,302
4,685
4,090
3,226
75,340
1,330
4,826
4,107
3,364
80,139
1,367
5,045
4,124
3,475
83,881
1,412
5,136
4,169
3,627
87,810
1,507
5,225
4,243
3,737
91,654
1,596
5,271
4,305
3,923
95,664
1,678
5,307
4,337
4,015
98,730
1,768
5,341
4,377
4,149
101,782
1,821
5,368
4,398
4,260
104,365
1,846
5,399
4,447
4,338
106,630
1,899
5,472
4,526
4,509
111,146
1,955
5,538
4,579
4,704
114,743
1,980
5,567
4,625
4,854
118,072
2,016
5,594
4,674
5,124
123,266
2,063
5,615
4,708
5,318
129,542
2,099
5,671
4,749
5,743
136,501
2,170
5,731
4,850
6,317
144,377
2,231
5,811
4,921
6,851
151,235
2,257
5,889
4,955
7,227
155,372
2,288
5,979
5,051
7,538
158,936
2,309
6,044
5,081
7,777
162,144
2,323
6,157
5,165
7,984
165,749
2,388
6,157
5,165
8,466
171,157
2,461
6,157
5,165
8,819
176,598
Light and heavy goods vehicles including vans, trucks, pick-ups, ambulances and fire engines.
Includes trailers, cranes, loaders, forklifts, etc.
As of 2005 Minibuses are included with the Buses.

Yearly
1970
9,476
1,183
1971
11,184
1,428
1972
14,234
1,261
1973
14,545
957
1974
14,655
1,110
1975
14,815
1,129
1976
15,713
1,198
1977
17,008
1,264
1978
17,908
1,388
1979
19,086
1,493
1980
20,246
1,665
1981
22,066
1,842
1982
23,500
1,990
1983
25,152
2,060
1984
26,555
2,144
1985
27,699
2,195
1986
28,646
2,218
1987
29,262
2,236
1988
29,713
2,238
1989
31,924
2,285
1990
34,415
2,372
1991
35,955
2,441
1992
37,665
2,499
1993
39,461
2,652
1994
41,553
2,788
1995
43,322
2,861
1996
45,141
2,943
1997
46,579
2,988
1998
48,003
3,009
1999
50,955
3,144
2000
53,294
3,260
2001
55,501
3,393
2002
59,210
3,515
2003
63,828
3,782
2004
68,686
4,077
2005
74,073
4,376
2006
78,291
4,882
2007
80,712
5,166
2008
82,986
5,206
2009
85,049
5,384
2010
87,222
5,493
2011
89,756
6,066
2012[p]
92,717
6,556
Notes: *
**
***
Data has been revised from 1993 to 2010.
Source:

Land Transport Authority

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3.3 Overview of Data Sources and Methods

The main data source used in Studies 1 and 2 is from the Fiji arm of the four-country Pacific OPIC Project (HYHC). Throughout this PhD, data for studies 1 and 2 will be referred to as OPIC data. The second data source, used in Study 3, is from a new survey carried out in Suva City, Fiji, among a cluster of 18 Internet cafes. Full details of the survey methods are presented in Chapter 6. This section describes the two sources of data.

3.3.1 Studies 1 and 2: The Fiji Arm of the OPIC Project

Figure 3.3 shows the overall organization of four the country Pacific OPIC Project and its key components of various studies emerging from it.

* Inform Interventions, * Cost effectiveness, QoL = Quality of Life

**Figure 3.3: Overall Structure of the OPIC Project, Extracted from Fiji OPIC Report, 2010**
The rationale for establishing the various study designs were can be found in the Fiji OPIC Report, 2010 (15). As shown in Figure 3.4, the OPIC study in Fiji had four different components. The first component was the community based school intervention study, followed by sociocultural, policy and economic components. All these components of the Pacific OPIC Project were carried out in the four countries seen in the Figure 3.3. In Fiji the first component, the community based intervention study, was known as the HYHC Project in Fiji – this is where data from study 1 and 2 in this PhD had been obtained from. Detailed information about the Pacific OPIC Project can be found in the Fiji OPIC Report, 2010 (15).

3.3.1.1 Overview of HYHC Project

As mentioned above, the HYHC project was one arm of the four-country OPIC project that undertook a CBI approach among a large sample size (2005/2006, n=7237, response rate: 75%) with baseline (2008, n=2948, response rate:73%) and follow-up measures. This project aimed to find out how effective were the CBI strategies for prevention of obesity with baseline and follow-up studies in Fiji. It focused on developing the capacity in schools and communities by promoting better and healthier eating and activity options to reduce excessive weight gain from unhealthy eating and activity behaviours (32, 62, 200). Its action plan is presented in Table 3.5:
### Table 3.5: Action Plan for the Fiji ‘Healthy Youth Healthy Communities’, Extracted from Fiji OPIC Report, 2010

<table>
<thead>
<tr>
<th>Behavioural &amp; Innovative Objectives</th>
<th>Key Strategies</th>
</tr>
</thead>
</table>
| 1. To significantly reduce the proportion of adolescents who skip breakfast on school days. | • Promote breakfast with students and parents – pamphlets & school assembly morning talks  
• School canteen providing breakfast  
• Develop school policies for canteens to support water, fruit and vegetable consumption  
• Curriculum development with Home Economics and Agricultural Science |
| 2. To improve the healthiness of food at school by significantly decreasing the consumption of high sugar drinks and promoting the consumption of water and by significantly increasing fruit and vegetable consumption. | • Social marketing, include fruits (& vegetables) for snacks and benefit of F & V; what constitutes a healthy snack  
• Student information on healthy snacks, F & V snacks  
• ‘Walking buddies’  
• Road safety skills |
| 3. To significantly decrease the consumption of energy dense snacks and significantly increase consumption of fruit as afternoon snacks. | • School policy on physical education classes  
• Partnership with organisations to provide sports equipment such as, hoops and ropes.  
• House rules on screen time and outside play time  
• School walkathon |
| 4. To significantly increase the proportion of adolescents living within walking distance to school to walk to and from school with a sense of safety. | Food Preparation Skills  
• Budgeting skills |
| 5. To support physical education teachers to conduct physical education classes effectively. | |
| 6. To significantly increase the amount of active play after school/ weekends; significantly decrease time spent watching TV & playing computers or e-games. | |
| 7. To develop a program for promoting healthy eating & physical activity within churches, mosques & temples. | |

#### 3.3.1.2 Study Design and Setting

The Pacific OPIC project utilised a study design called longitudinal quasi-experimental study design– having two groups; comparison and an intervention group. The Fiji component of the Pacific OPIC project, called HYHC project was carried out on the main island of Viti Levu between Suva and Nausori corridor called Nasinu. Nasinu is a peri-urban area with a population around 200,000 as per the 2007 census data. The main setting involved seven secondary schools with other important settings such as church or religious groups and homes particularly because of influences on adolescents’ behaviours. A comparison group of 11 secondary schools
was taken from Nadi, Sigatoka, Lautoka area in the western side of Viti Levu with about the same size and ethnic mix. The intervention in Fiji had no significant impact on changes in BMI. Therefore the two OPIC intervention groups were combined into one group, and this dataset was treated as a single longitudinal cohort for the purpose of my study analyses in studies 1 and 2.

3.3.1.3 Participants and Selection Criteria

This project’s participants were adolescents aged between 13 to 18 years from the above-mentioned schools and geographic location. The seven schools comprised of mixed ethnic groups with around 67% iTaukei and 33% Indo-Fijians. The selection criterion was based on ease of accessibility to various communities so interventions could be carried out properly and appropriateness of the geographical location was taken into consideration. Same criteria were followed for the comparison school in Western Viti Levu. Of the 80 religious organisations in Fiji, six were chosen from around Nasinu. The selection criteria for these were ease of access and the presence of the most common religious organisation and the most youth groups. Figure 3.4 is a flow diagram showing participation in Fiji. Since the intervention (HYHC) had no significant impact on changes in BMI-z, the intervention and comparison populations were combined into a single population for the purposes of analyses for study 1 and 2.
Nasinu area selected as intervention region (target group children 13-19 yo). Secondary schools (n=7)

Secondary schools (n=11)

Three towns on western Viti Levu (Sigatoka, Nadi, Lautoka) selected as comparison region.

All children in Nasinu area received intervention. 2670 of 3530 children consented to data collection (response rate: 75%)

Children from comparison towns received background activities only. 4567 of 6255 children consented to data collection (response rate: 73%)

First exit survey: 440 children surveyed

First exit survey: 644 children surveyed

Final exit survey: 439 children surveyed

Final exit survey: 1425 children surveyed

Lost to follow-up:
- Child refused (n=0)
- Child not available for measurement (n=373)
- Child moved elsewhere (n=1418)

Lost to follow-up:
- Child refused (n=2)
- Child not available for measurement (n=431)
- Child moved elsewhere (n=2075)

Intervention analysed: n=879; follow-up rate: 32.7%

Comparison analysed: n=2069; follow-up rate: 45.1%

Excluded from analyses:
- All follow-up analyses because child moved into comparison area (n=5)
- Anthropometric measures because of equipment problems, measurement or data entry error (n varies)
- Knowledge, attitudes, behaviours and quality of life measures because of equipment problems (n varies)

Excluded from analyses:
- All follow-up analyses because child moved into intervention area (n=7)
- Anthropometric measures because of equipment problems, measurement or data entry error (n varies)
- Knowledge, attitudes, behaviours and quality of life measures because of equipment problems (n varies)

Figure 3.4: Flow Diagram Showing Participation in the Fiji Healthy Youth Healthy Communities Intervention Study, Extracted from Fiji OPIC report, 2010

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3.3.1.4 Survey Methods

Adolescents were recruited for a baseline study in 2005 and followed up in 2008 at the above-mentioned schools using a standard interview process and the Adolescent Behaviours’, Attitudes and Knowledge Questionnaire (ABAKQ), which included the following measures: anthropometric data such as height and weight of students, demographic variables, dietary behaviours, PA/SBB behaviours, health related quality of life, data on family, home, school environments, and attitudes and perceptions towards BMI-z. Of these, the following specific questions from ABAKQ were used in study 1 and 2 as seen in the table below:
<table>
<thead>
<tr>
<th>Specific questions from ABAKQ used for analysis in study 1 and 2</th>
<th>Data Type</th>
<th>Variable name (Time 1, Time 2)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Which ethnic group do you most associate with?</td>
<td>Categorical</td>
<td>ethnicf1</td>
<td>1-Fijians 2-Indo Fijians 3-Others</td>
</tr>
<tr>
<td>2 What is your gender?</td>
<td>Categorical</td>
<td>gender1</td>
<td>1-Males 2-Females</td>
</tr>
<tr>
<td>4 In the last 5 school days, how many times did you walk or bike to or from school?</td>
<td>ordinal</td>
<td>walk2sc1, walk2sc2</td>
<td>1-0 2-1 3-2 4-11 5-10</td>
</tr>
<tr>
<td>5 How long does it take you to walk to your school from home?</td>
<td>Categorical</td>
<td>Length1, length2</td>
<td>1-Less than 15 minutes 2-15-30 minutes 3-More than 30 minutes 4-Don’t walk</td>
</tr>
<tr>
<td>7 Over the last 5 school days, what did you do most of the time at recess (apart from eating)?</td>
<td>Categorical</td>
<td>recessa1, recessa2</td>
<td>1-Mostly just sat down 2-Mostly stood and walked around 3-Mostly played active game</td>
</tr>
<tr>
<td>8 Over the last 5 school days, what did you do most of the time at lunchtime (apart from eating)?</td>
<td>Categorical</td>
<td>luncha1, luncha2</td>
<td>1-Mostly just sat down 2-Mostly stood and walked around 3-Mostly played active game</td>
</tr>
<tr>
<td>9 In the last 5 school days, on how many days after school did you do sports, dance, and cultural performances or play games in which you were active?</td>
<td>Categorical</td>
<td>activit1, activit2</td>
<td>1-0 days 2-1 day 3-2 days 4-3 days 5-4 days 6-5 days</td>
</tr>
<tr>
<td></td>
<td>Average hours TV viewing per day (out of 7 days)</td>
<td></td>
<td>0 0.1 0.2</td>
</tr>
<tr>
<td>10</td>
<td>Continuous</td>
<td>avtv1, avtv2</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

- On an average school day, how many hours do you usually spend watching TV, videos or DVDs (in your free time)?
- On an average Saturday, how many hours do you spend watching TV, videos or DVDs (in your free time)?
On an average Sunday, how many hours do you spend watching TV, videos or DVDs?

Average hours played video/electronic/computer games per day
(out of 7 days)

- On an average school day, how many hours do you usually spend each day playing video games or using the computer (not for homework)?

- On an average Saturday, how many hours do you usually spend playing video games or using the computer (not for homework)?

- On an average Sunday, how many hours do you usually spend playing video games or using the computer (not for homework)?

Total Screen time per day
(out of 7 days)

BMI-z

Personal diary assistants (PDAs), designed using the WHO e-STEPS, were used to collect information on dietary (20 variables), PA, SBB (19 variables), and other
behavioural measures. Height was measured using a stadiometer to the nearest 0.1 cm. For this students were asked to remove their socks and shoes. Weight was measured using a Bioelectrical Impedance machine to the nearest 0.05 kg without any adjustments for clothing. Waist circumference was measured using a figure finder tape from the same level as the umbilicus. All protocols were followed for consistency in data recording. Training on measurement and sensitivity issues was provided to all staff (32). Demographic information was obtained via paper questionnaires. The detailed methods used can be found in Kremer et al. (14) and Swinburn et al. (62, 201).

3.3.1.5 Procedures

Parents and guardians of adolescents provided written consents for participation and Ethical approval for the HYHC (including pilot study) was obtained from the following ethics committees in Fiji and Australia:

- National Health Research Council (NHRC) in Fiji
- Fiji National Research Ethics Review Committee (FNRERC; Submission 3 – 020-2004).
- Deakin University Human Research Ethics Committee (DUHREC; EC-22-2005).
3.3.2 Study 3: Survey

Study 3 was a new survey carried out in Suva City, Fiji and involved adolescents recruited from 18 Internet cafes aged between 13 to 18 years who were surveyed using a newly developed questionnaire (Appendix A.2). The aims, objectives and methods for Study 3 can be found in Chapter 6.

3.3.3. Measures and Data Management

For the purposes of this thesis, demographic, anthropometric, and self-reported PA (including travel to/from school) and SBB data collected from adolescents were utilised in Studies 1 and 2. The main outcome variables were BMI-z score and weight status. The other main categories of independent variables included in this study are LTPA, active travel and SBBs. The PA variables included: active during recess, active during lunch, active after school and active travel. The SBB variables were: hours watched TV/video/DVD, hours played video/computer/e- games, and total screen time. Covariates were age, gender and ethnicity. Age, which ranged from 13 to 18 years, was categorised into two age groups: less than or equal to 15 years, greater than 15 years. Ethnicity was coded according to two major ethnic groups in Fiji: Indigenous Fijians and Indo-Fijians. Hence ‘Other’ ethnic (e.g. Chinese and Pacific islanders) sub population (n = 366 in baseline and n= 167 in follow up) were dropped from this database. Variables specific to individual studies can be seen under the respective sections.

Analyses for anthropometric outcome (BMI-z and weight status) and independent variable measures were performed in all three studies. For, anthropometric variables,
weight status was categorised into four levels as follows: thin, healthy weight, overweight and obese using WHO cut-off points, BMI was calculated as: weight in kg/[height in m]² while BMI-z score was calculated with the use of references from WHO (2007) (15). Missing and outlier values were checked. All incidents of outliers (> 3 SD from mean) > 3 SD from the mean were removed from analyses of the anthropometric measures at baseline and follow-up. Baseline analyses for mean anthropometric measures, T-tests (continuous variables) and Chi-square (categorical variables) were used to find significant difference by subgroups. Follow-up measures had the following covariates: baseline variable, age at follow-up, gender, ethnic subgroup, and the clustering by schools. Multiple linear regression analyses were used for continuous outcome (BMI-z) and controlled by gender, age at follow-up, ethnicity, and clustering by schools. PA and SBB measures were controlled for gender, ethnicity, age at follow up, duration between measurements and clustering by schools. Change in BMI-z was also computed and analysed by sub-groups into the regression model. All analyses were conducted using Stata SE 11, with adjustment for clustering by school, and statistical significance set at P < 0.05.

The Pacific OPIC project used the lms Growth Macro to compute Weight Status and BMI-z (15). To generate the weight status (using BMI-z) WHO macro (Stata, SPSS, SAS) was used. WHO also provided weight classification status in a reference table format using the BMI-z calculated from height and weight. These reference tables can also be used to manually generate weight status classification (15).

Differences in weight classification status can occur by using the two different methods. The differences in these cases can be explained by the different level of accuracy of the two methods (i.e. two decimals applied by the macro and three in the
tables). Thus, the macro generates slightly less accurate classifications compared to the classifications based on the tables.

### 3.3.4 Methods of Analyses

Data analyses were done using Stata SE statistical software (version 11.0), SPSS (version 20.0) and EPI Info (version 3.5.3). All participants from the intervention and comparison regions in the OPIC study were combined for studies 1 and 2 (there were no significant impacts of the HYHC intervention) for the main analyses with adjustments and sib group analyses for the covariates of gender, age and ethnicity. Methods of analysis, study designs and data source specific to Studies 1 to 3 are as presented in Table 3.6.
<table>
<thead>
<tr>
<th>Study</th>
<th>Research Questions</th>
<th>Data source</th>
<th>Study design</th>
<th>Methods of analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RQ1. What are the PA and SBB patterns and associations with BMI-z among Fijian adolescents?</td>
<td>OPIC – baseline data</td>
<td>Cross-sectional study</td>
<td>Descriptive statistics ✔ Binary logistic regression* ✔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(n = 7237)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RQ2. What baseline behaviours or changes in PA and SBB predict changes in BMI-z, and is there a reverse causal pathway of baseline BMI-z or changes in BMI-z predicting changes in PA and SBB?</td>
<td>OPIC– follow-up data</td>
<td>Longitudinal study</td>
<td>Descriptive statistics ✔ Binary logistic regression* ✔</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(n = 2948)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RQ3. What is the association between high e-gaming and psychosocial problems (e.g. low self-esteem, poor commitment to school, low school grade, poor relationships with parents, low HRQoL, depression and aggression) among a sample of Fijian adolescents in Internet cafes in Suva City?</td>
<td>New survey – 18 clusters of Internet cafes in Suva City</td>
<td>Cross-sectional study</td>
<td>Descriptive statistics ✔ Binary logistic regression* ✔</td>
</tr>
</tbody>
</table>

Note. * Binary logistic regression (BLR) analysis that reported coefficients (instead of BLR odds ratio) even though the dependent variable is a dichotomised categorical variable
3.3.5 Study Instruments and Tools

3.3.5.1 Adolescent Behaviours, Attitude, and Knowledge Questionnaire

Studies 1 and 2 used the ABAKQ (see Appendix A.1), which consists of two sections: a demographics survey and a behaviours, attitudes and knowledge survey. The survey was prepared using a Questionnaire Designer software program called e-STEPs. The new questionnaire was then loaded on to PDAs electronically.

The first part of the questionnaire was about demographic information such as gender, name of school, form level, and date of birth. A separate paper was also used to capture more detailed demographic information such as date of PDA testing, birthdate, ID number, student name in full, their home address including details of street and house number.

The ABAKQ had a section about behaviours, attitudes and knowledge. The questions in these sections were used across all four countries in the Pacific OPIC project. The ABAKQ had a total of 87 questions that was completed in approximately 30-40 minutes. The type of questions in these sections included physical activity, screen-based behaviours, dietary practices, perceptions and attitudes in schools and home environments.

The behaviour, attitudes and knowledge questions were developed and used across the four sites of the OPIC study. The survey comprised 87 questions that took approximately 30-40 minutes to complete and focused on key behaviours such as: nutrition/dietary practices, amount of PA, perceptions of the school, home and neighbourhood environments. School environments included questions about...
teachers, participation in sport and canteen while home environment included questions about parents and sibling roles, neighbourhood environments. Community/church roles about various eating and physical activity practices, perceptions of food within their culture was also included.

Several questions in the survey instrument, the ABAKQ, were adopted from the following sources: National Health and Medical Research Council Dietary Key Indicators Study (1996), Australian National Nutrition Survey (1995), and NZ National Children’s Survey (2002) (15). These questions in the above mentioned studies had good reliability data that provided enough scope to generate questions well suited to objectives of the Fiji OPIC study.

The survey was initially piloted among high school students in Fiji. The questionnaire was further modified based from the feedback and responses obtained from piloted students keeping in mind both the age and ethnically appropriateness. The students could easily understand, comprehend and produce relevant and reasonable answers after being measured at baseline (15).

In the first section of the questionnaire included demographic questions (Q1-Q12) Students did not require validity or reliability testing due to their widespread and common use. Question on student’s ethnicity was taken from Fiji Census. Most questions were adopted from existing large surveys.

Three questions (Q15, Q17 and Q19) were obtained from Fiji National Nutrition Survey (1993). Instead of asking in the last week, the question on frequency of breakfast intake per week was modified to ask about the frequency of breakfast
intake in the last five school days and was applied to morning tea and lunch breaks. In the Fiji National Nutrition Survey only less than 0.5% was unable to recall their frequency of breakfast intake.

Two questions (Q20 and Q21) were directly obtained from Fiji National Nutrition Survey (1993) and 99% respondent had provided practical answers. Questions 27, 33, 35-41 and 46-49 were adopted or slightly modified from NZ National Children’s Survey (2002). Most modification to questions involved asking specific time periods such as asking ‘in the last 5 school days’ instead of frequency of days, ‘On the last school day…’ instead of ‘how much time do you normally spend…’). The ABAKQ allowed more specific responses when these slight changes was made change, however the basis of questions were same but ensured a friendlier way to recall their behaviours.

Question 28 to 32 was adopted from National Health and Medical Research Council Dietary Key Indicators Study (1996). The basis of questions were same, however it was modified to ask about ‘after school’ and varied food items were included so that better qualitative responses could be obtained. The questions from the National Health and Medical Research Council Dietary Key Indicators Study (1996) provided this good spread of practical answers. The rest of the other questions in this survey were specially designed for this OPIC study and hence were piloted with high school students. In general, comprehensibility and repeatability of the survey questions was of key importance and there were tested for (15) despite fewer questions were responsive real validity testing.

The PDA’s used made it easier to gather survey data from students as they were eager to use the PDA’s and were more engaging while filling out the questionnaire.
on their hand held portable devices. These PDA’s ruled out issues of long and tiring completion of the paper format questionnaire with multiple and complex jump or skip controls for on-applicable questions programmed within. Nevertheless, there were few technical problems faced while utilising the PDA which later received attention by technicians.

3.3.5.2 *Teens with Screens Questionnaire*

The second data source of this thesis came from a new survey carried out in 18 Internet cafes in Suva, Fiji using the Teens with Screens Questionnaire (TWSQ) (Appendix A.2) that is structured as follows:

1. Background Information
2. SECTION A: Average time spent on TV, video, computer games etc.
3. SECTION B: Thoughts about yourself
4. SECTION C: School work
5. SECTION D: View of closeness with parents
6. SECTION E: Feelings in the last 30 days
7. SECTION F: Statements about things that might be a problem to you
8. SECTION G: Your thoughts about aggression

The first section of the questionnaire used in Study 3 included a short demographic survey that included questions about the child’s date of birth, gender, school, year level, etc. The survey comprised 73 questions that took approximately 20-30 minutes to complete and focused on key outcomes and behaviours such as: HRQoL, attitude towards schools, relationship with parents, aggression, depression and screen time.
The TWSQ included the following scales: the PedsQL™ (Paediatrics’ Quality of Life) Questionnaire for adolescents (13-18 years), Attitudes Toward School-Denver Youth Survey, Attachment to Parents – Seattle Social Development Project, Beliefs about Aggression and Alternatives, Depression, Low Self-Esteem – Weinberger Adjustment Inventory and Modified Adolescents Sedentary Activities Questionnaire (ASAQ) (see Appendix A). Several scales were considered and only those that were highly reliable, valid and widely used were chosen for this questionnaire. Table 3.7 shows the reliability and validity of the various scales used.

3.3.6 Ethical Issues

Studies 1 and 2 analyses pre-existing non-identifiable data (OPIC -Fiji) and has negligible risk. Hence, exemptions from ethics review was requested and granted on 2 August 2010 by DUHREC, with reference number 2010-167. Study 3 was granted ethical approval from the FNRERC (reference no. 201260) in Fiji and DUHREC (reference no. 2012-259) in Australia (see Appendix B).
### Table 3.8: Measuring Instruments in Study 3

<table>
<thead>
<tr>
<th>Construct</th>
<th>Scale/Assessment</th>
<th>Characteristics</th>
<th>Target Groups</th>
<th>Reliability/Validity</th>
<th>Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ATTITUDE AND BELIEF ASSESSMENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggression</td>
<td>A5. Beliefs about aggression and alternatives; 12 items</td>
<td>Measures students beliefs about the use of aggression and endorsement of non-violent response to hypothetical situations</td>
<td>Middle school-schools, grades 6-8</td>
<td>Internal consistency: Beliefs about aggression .72; Use of non-violent strategies .72.</td>
<td>Multisite Violence Prevention Project, 2004</td>
</tr>
<tr>
<td><strong>PSYCHOSOCIAL AND COGNITIVE ASSESSMENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>D2. Modified Depression Scale; 6 items</td>
<td>Measures the frequency of depressive symptoms in the past month</td>
<td>Students aged 10-18</td>
<td>Internal consistency: .74.</td>
<td>Orpinas, 1993</td>
</tr>
<tr>
<td>Self-Esteem</td>
<td>Q7. Self-Esteem-Rochester Youth Development Study; 9 items</td>
<td>Measures a youth’s agreement with statements about his or her self-concept.</td>
<td>Youths initially in grades 7-8 in 1988, followed into adulthood.</td>
<td>Internal Consistency: .78.</td>
<td></td>
</tr>
<tr>
<td>Parent-Child Relationship</td>
<td>Attachment to Parents- Seattle Social Development Project; 4 items</td>
<td>Measures students’ perceptions of how close they feel to their fathers and mothers</td>
<td>Students aged 11-18</td>
<td>Internal consistency: .76.</td>
<td>Arthur, Hawkins, Pollard, Catalano &amp; Baglioni, 2002</td>
</tr>
<tr>
<td>Health-Related Quality of Life</td>
<td>PedsQL™ (Paediatrics’ Quality of life) questionnaire for adolescents (13-18 years)</td>
<td>Measures adolescents Physical and psychosocial health (Emotional, Social and School functioning)</td>
<td>Students aged 11-18</td>
<td>Total Scale Score: 0.88 Child Self-Report; 0.90 Parent Proxy-Report</td>
<td>James W. Varni</td>
</tr>
<tr>
<td><strong>SCREEN-BASED BEHAVIOUR ASSESSMENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(computer/ Video/e games)</td>
<td>Sedentary Activity Questionnaire (ASAQ). -tuition, homework, reading, homework using computer were removed</td>
<td>time spent in a comprehensive range of sedentary activities, among school-aged young people.</td>
<td>aged 11-15 years correlations for time total spent in sedentary behaviour were (\geq 0.70)</td>
<td>Booth &amp; Okely, 2007</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4: Study 1 – Cross–Sectional Analyses of PA and SBB on BMI-z

4.1 Introduction

This chapter introduces the first of three studies carried out for this thesis. As outlined in Chapter 2, obesity or unhealthy weight gain is a global problem and particularly in the Pacific and Fiji (53, 57, 150, 151). Prevalence rates in Fiji have escalated over the last couple of decades and preventative strategies are being informed and developed (152). As previously indicated, this thesis focuses only on the PA component of obesity development, and the issue of poor diets is also critical (202, 203).

The associations between the various components of daily physical activities and BMI are complex and the literature, which is predominantly from high-income countries, gives a mixed pattern of these associations (173). Low levels of PA appear to contribute to an increased risk of overweight and obesity (143, 204-207), although PA is more closely related to BMI-z in cross-sectional studies than in longitudinal studies (165). At the same time, the availability of modern leisure-time technologies such as DVDs, electronic and computer games have increased, resulting in a shift in increased sedentary behaviour (208) and reduced incidental PA (209, 210). The trend found in the current generation, especially among young people, is the increased use of information and communication technologies (211). TV viewing is related to BMI-z (29, 38, 212) but computer and other e-games are a fairly new phenomenon that requires more research.
Targeted prevention is vital at all age levels. While a lot of evidence is available on childhood and adult obesity (213-216), adolescents have been under-researched. Adolescence is a significant period of human growth and maturation and adolescents are suggested to be more receptive to new ideas and changes in environment (217, 218) as compared to adults. It is when lifestyle behaviours (e.g. PA and SBB) are developed and reinforced, and adolescents have the potential to motivate others. During adolescence, however, PA levels have been found to decline (mainly in the US), especially in girls (217, 219, 220), while SBB such as e-games, especially in boys (221) have been found to increase. It is also the peak time for growth spurts and unhealthy weight gain during this period predicts adult obesity (218, 220). Therefore, targeting this age group would help combat escalating rates of obesity in Fiji.

In Fiji and the Pacific, while the rates of obesity are high, there is little evidence about levels of PA and SBB, especially during adolescence. Evidence regarding PA is needed to guide priorities in behavioural targets for interventions. It is also unclear whether PA and SBB patterns and associations with obesity are equivalent between different adolescent sub-populations in Fiji. Hence, it is the general levels of PA and SBB patterns and their associations with BMI-z that may help to determine behaviours associated with overweight and obesity in Fiji.

Therefore, this first study in this PhD aims to describe PA and SBB patterns among adolescents in Fiji and report on associations with BMI-z and highlight major differences in adolescents’ PA and SBB patterns across population subgroups such as by ethnicity and gender.
Specifically, because the international literature is very consistent in showing that males have higher PA and SBB levels this study hypothesises that:

1. Male adolescents will report higher prevalence of PA and SBB, with girls being less physically active and

Moreover, international literature is also consistent in that high TV viewing is associated with a high BMI-z. However, this is potentially driven by watching TV and EI in front of TV, with junk food advertisements adding further to this problem. Hence the same is hypothesised in this study, specifically that:

2. Those adolescents who report high levels of TV viewing are more likely to have a higher BMI-z.

4.2 Methods

4.2.1 Study Design

This is a descriptive cross-sectional study utilising the combined intervention and comparison group baseline data from the HYHC project, which was the Fiji component of the Pacific OPIC project.

The HYHC project targeted schools on the main island of Viti Levu, over a three-year period from 2005 to 2008 (32, 62, 200). The intervention community was in Nasinu area, a peri-urban area between Suva and Nausori (a population of about 100,000 - Fiji Census, 2007). The primary setting for the intervention was seven high schools, along with associated settings such as church and religious groups. The
comparison group of 11 high schools was drawn from three towns in Western Viti Levu (Nadi, Sigatoka, and Lautoka) with a similar population size and ethnic mix. Additional details for the study design have been published elsewhere (14, 32, 62, 201) and also presented in Chapter 3. The HYHC (including the pilot study) had ethics approval from the National Health Research Council (NHRC) in Fiji and the FNRERC (020-2004) as well as the DUHREC (EC-22-2005). Parents and guardians of adolescents had provided written consents for their participation.
4.2.2 Sample Size

All students in Forms 3-7 (aged 13-18 years) attending the 18 schools were invited to participate (as mentioned in chapter 3). The 74 per cent total baseline response rate was calculated by dividing the number of participating students (n=7237) by the number of eligible students (determined by the school roll, n= 9785).

4.2.3 Data Management, Treatment and Analyses

Adolescents were surveyed in 2005/06 including the administration of the ABAKQ which included the following information (see Table 3.6): demographic variables, perception and attitudes of body size, food and nutrition behaviours, PA and leisure-time activities, SBBs, family, home, school and neighbourhood environments, and quality of life. The questionnaire was answered electronically by students on PDAs and in total there were 19 variables collected on PA and SBB. Anthropometry (weight and height) measurements were taken by trained researchers.

Adolescents self-reported their activity during and after school, active transport to/from school and time watching TV and playing e (video/computer) games using the ABAKQ. Four questions were assessed pertaining to PA during recess, lunch, after school and mode of active transport to/from school on the five school days prior to the date of survey. For the question on recess and lunch-time activity, participants could indicate they were sedentary (mostly sat down), moderately active (mostly stood and walked around), and mostly active (mostly played active games). A third question about after-school PA asked about number of days adolescents had engaged in active sports, dance, cultural performances or playing active games. The question
about the mode of active transport to/from school asked about how many times adolescents had either walked or cycled to/from school.

SBB activities were assessed using two different questions related to hours spent on TV/video/DVD viewing and playing computer/video/e games (excluding hours spent on homework) on each of the five days prior to the date of survey. Students’ responses on hours spent on TV and computer were used to calculate average daily TV viewing and playing computer or video game hours. The primary outcome variable was BMI-z. Weight status was coded using WHO BMI cut-offs (15) for children as either ‘thin’, ‘healthy weight’, ‘overweight’ or ‘obese’. These variables are summarised in Table 4.1.

Table 4.1: Baseline Variables

<table>
<thead>
<tr>
<th>Baseline variables</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body weight variable</strong></td>
<td></td>
</tr>
<tr>
<td>BMI-z</td>
<td>Continuous</td>
</tr>
<tr>
<td>Weight status</td>
<td>Categorical</td>
</tr>
<tr>
<td><strong>SBB variables</strong></td>
<td></td>
</tr>
<tr>
<td>Average computer/video games hours</td>
<td>Continuous</td>
</tr>
<tr>
<td>Average TV hours</td>
<td>Continuous</td>
</tr>
<tr>
<td>Average Total screen time (TV and computer usage)</td>
<td>Continuous</td>
</tr>
<tr>
<td><strong>PA variables</strong></td>
<td></td>
</tr>
<tr>
<td>Active travel</td>
<td>Categorical</td>
</tr>
<tr>
<td>Active during recess</td>
<td>Categorical</td>
</tr>
<tr>
<td>Active during lunch</td>
<td>Categorical</td>
</tr>
<tr>
<td>Active after school</td>
<td>Categorical</td>
</tr>
<tr>
<td><strong>Covariates</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Continuous</td>
</tr>
<tr>
<td>Gender</td>
<td>Categorical</td>
</tr>
<tr>
<td>Ethnicity (iTaukei; Indo-Fijian)</td>
<td>Categorical</td>
</tr>
<tr>
<td>Cluster by school</td>
<td>Categorical</td>
</tr>
</tbody>
</table>
Demographic variables were: age in years from 13 to 18; gender; and ethnicity. Ethnicity was coded as the two main sub-populations under focus, iTaukei and Indo-Fijians, while participants from other ethnic groups (n=366) were removed. Hence the sample size for the final analyses was 6871. Descriptive statistics (means, frequencies, proportions, standard deviations, and 95% confidence interval) were computed for the sample separately by gender and ethnicity. T-tests were used to assess ethnicity and gender differences amongst continuous variables such as age, TV viewing, playing video/computer games, total screen time, BMI, BMI-z. Chi-square analysis was used to test significant differences in categorical variables such as walk/cycle to/from school, activity during recess, lunch and after school by ethnicity and gender. Chi-square test was also performed to find difference of weight status by age group (13 to 15 years versus 16 to 18 years).

Multiple linear regression analyses were used to evaluate associations between BMI-z and PA/SBB variables. WHO’s recommended guidelines (15) were used as cut-off points for dichotomising the PA variables (109) while the SBB measures were coded based on recommended guidelines for TV viewing (32), similar to how it was coded in Pacific OPIC studies by Kremer et al. (32) and Swinburn et al. (62). In other words, the data were split in such a way to give balance of numbers in two categories. Variables were dichotomized such that those meeting the recommended guidelines were coded as ‘1’ while those that did not were coded as ‘0’. Levels of variables stating mostly inactive during recess and lunch and least active after school, and ‘walked/cycled to/from school less than 5 times per week out of a total of 10 trips per school week’ (for those adolescents who lived within 15 minutes walking distance from school), and ‘watching TV or playing computer games for 2 and more hours’ were considered as obesogenic or unhealthy in nature based on guidelines.
Average total screen time was also calculated combining average hours spent watching TV and playing computer/video games. This variable was dichotomised in such a way that average total screen times exceeding two hours were considered as obesogenic. Analyses were corrected by adjusting for design-effects of clustering for school sampling and for confounding effects of age, gender and ethnicity. All statistical analyses were conducted using STATA (version 11.0) and statistical significance was set at p<0.05. Below is a summary of dichotomised measures used for data analysis:

**Table 4.2: Summary of Dichotomised Measures (showing unhealthy behavioural activities only)**

<table>
<thead>
<tr>
<th>PA – Physical Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mostly Inactive – Recess (sat/stood/walked)</td>
</tr>
<tr>
<td>2. Mostly Inactive – Lunch (sat/stood/walked)</td>
</tr>
<tr>
<td>3. Least active - After school (0-2 days)</td>
</tr>
<tr>
<td>4. Active travel (walked/cycled &lt; 5times/wk)*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SBB – Screen-based behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Average TV viewing time (≥ 2hrs/d)†</td>
</tr>
<tr>
<td>6. Average time playing Computer / Video Games (≥ 2hrs/d)†</td>
</tr>
<tr>
<td>7. Average Total Screen Time (≥ 2hrs/d)</td>
</tr>
</tbody>
</table>

Outcome measure

| 8. BMI-z |

---

* Only those adolescents living within 15 minutes walking distance from school; maximum trips were 10 per week to or from school

† Average time watching TV, videos, DVDs per day

† Average time playing video games, e games or using computer (not for homework) per day
4.3 Results

4.3.1 Descriptive Characteristics

There were 6871 eligible students (between 13 and 18 years) from 18 different schools surveyed in Fiji during the 2005-2006 baseline data collection period. Of these, the majority were of healthy weight, but almost a quarter (24%) was overweight or obese as seen in Figure 4.1. Specifically, 6.2% were obese and 17.2% were overweight. There was no significant difference (p-values > 0.05) of weight status by age group (13 to 15 years versus 16 to 18 years).

![Figure 4.1: Prevalence of Weight Status](image)
Table 4.2 shows the descriptive characteristics of the study participants. The mean age of the participants was 15.6 years. Significantly, more iTaukei were overweight or obese than Indo-Fijians and more females were overweight or obese than males.
Table 4.3: Descriptive Characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All</th>
<th>iTaukei</th>
<th>Indo-Fijians</th>
<th>P (^*)</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>6781 (100)</td>
<td>3077 (44.8)</td>
<td>3794 (55.2)</td>
<td>0.000</td>
<td>Males: 3271 (47.6) Females: 3600 (52.4)</td>
</tr>
<tr>
<td>Age, years (Mean ±SD(^1))</td>
<td>15.6 ± 1.37</td>
<td>15.8 ± 1.50</td>
<td>15.4 ± 1.24</td>
<td>0.000</td>
<td>NS</td>
</tr>
<tr>
<td>(95% CI(^2))</td>
<td>(15.3-15.8)</td>
<td>(15.6-15.9)</td>
<td>(15.3-15.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI(^3), kg/m(^2) (Mean ±SD(^1))</td>
<td>21.1 ± 4.28</td>
<td>22.9 ± 3.75</td>
<td>19.6 ± 4.12</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>(95% CI(^2))</td>
<td>(20.9-21.2)</td>
<td>(22.8-23.0)</td>
<td>(19.5-19.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI-z(^4), kg/m(^2) (Mean ±SD(^1))</td>
<td>-0.02 ± 1.37</td>
<td>0.63 ± 0.97</td>
<td>-0.55 ± 1.42</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>(95% CI(^2))</td>
<td>(-0.06-0.01)</td>
<td>(0.60-0.67)</td>
<td>(-0.59--0.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight Status(^5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thin %</td>
<td>8.3</td>
<td>0.5</td>
<td>14.6</td>
<td>11.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Healthy weight %</td>
<td>67.9</td>
<td>65.1</td>
<td>70.1</td>
<td>69.1</td>
<td>66.8</td>
</tr>
<tr>
<td>Overweight %</td>
<td>17.6</td>
<td>26.9</td>
<td>10.1</td>
<td>13.9</td>
<td>21.0</td>
</tr>
<tr>
<td>Obese %</td>
<td>6.2</td>
<td>7.5</td>
<td>5.2</td>
<td>5.7</td>
<td>6.8</td>
</tr>
</tbody>
</table>

\(^1\) SD: Standard deviation  
\(^2\) 95% confidence interval (95% CI)  
\(^3\) BMI: body mass index  
\(^4\) BMI-z: body mass index standardised for age  
\(^5\) Weight status classification based on WHO international reference cut points for children, 2010  
\(^6\) Significant differences between ethnicities (p < 0.05) are bolded. T-test were used for continuous measures while chi-square tests for categorical variables  
\(^7\) Significant differences between genders (p < 0.05) are bolded. T-test were used for continuous measures while chi-square tests for categorical variables
4.3.2 Distribution of Measures

Figure 4.2 presents the distribution of BMI-z scores for iTaukei and Indo-Fijians. iTaukei have a high mean (+0.63) but a narrow, normal distribution, whereas the mean for Indo-Fijians is much lower (-0.55) but their distribution appears wider and skewed to the right.

![Figure 4.2: Ethnic Differences in BMI-z Distribution](image)

Figure 4.3 shows that the distribution of BMI-z scores for females are far more right-shifted than males, but the normality and wideness of the distributions appear similar.
Figure 4.3: Gender Differences in BMI-z

4.3.3 PA and SBB Patterns

Figure 4.4 shows an overall proportion of unhealthy behavioural activities among adolescents in Fiji. In this graph, the higher bars represent adolescents having a higher unhealthy or obesogenic activity behaviours during and after school. For instance, more adolescents were inactive than they were active during school breaks than after school. Also, two-thirds of the participants self-reported a high average total screen time ($\geq$ 2 hours/day) and high average time watching TV, video, DVDs. Average total screen time collectively includes average time watching TV, video, DVDs and average time playing e-games.
Figure 4.4: Proportion of Unhealthy Behavioural Activities

*Only those adolescents living within 15 minutes walking distance from school; maximum trips were 10 per week to or from school
Figure 4.5: Proportion of Unhealthy Behavioural Activities by Ethnicity

* Significant difference between ethnicities, p<0.05; T-test were used for continuous measures while chi-square tests for categorical variables
Figure 4.5 shows that more Indo-Fijians reported obesogenic activity behaviours than iTaukei. Significantly more Indo-Fijians had a high total screen time (including high TV viewing time), were mostly inactive (i.e. mostly sitting down, standing or walking) during recess school breaks and least active after school (i.e. engaging in LTPAs such as in some sort of active games or structured sports, cultural performances, dance for only 0-2 days) than iTaukei.

Figure 4.6 shows that significantly more females were physically inactive than males. That is, more females were mostly inactive during recess and lunch breaks and after school. In contrast, significantly more males had a high average total screen time per day (including a high e-gaming time) than females.
Figure 4.6: Proportion of Unhealthy Behavioural Activities by Gender

* Significant difference between gender, p<0.05; T-test were used for continuous measures while chi-square tests for categorical variable
Table 4.3 presents unadjusted proportions of PA and SBB by gender within ethnicity. The majority of adolescents were generally inactive (~81%) or mostly stood, walked or sat down during school period than after school. Over a third were least active after school (0-2 days) after school.

Females in both ethnic groups showed similar PA patterns during and after school – more females than males were mostly inactive during and after school. Males in both ethnic sub-groups were more likely than females to be mostly physically active during and after school.

Among those living within 15 minutes’ walking distance from school, 37 per cent reported having active travel or at least walking/cycling less than five times to/from school out of a total of 10 trips in one week. More Indo-Fijian males (than Indo-Fijian females) and iTaukei females (than iTaukei males) reported unhealthy activity behaviour such as using less active modes (i.e. walking or cycling to/from school <5 times/wk) of transport.

Approximately two-thirds of the adolescents had high total screen time or had spent two or more hours per day (weekends included) watching TV/videos/DVD combined with playing e-games in the previous five school days. More males than females of both ethnic sub-groups had a high total screen time per day.
Table 4.4: Proportion of Unhealthy Behavioural Activities by Gender Within Ethnic Groups

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>All</th>
<th>iTaukei</th>
<th>Indo-Fijians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (n)</td>
<td>6871</td>
<td>3077</td>
<td>3794</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender %</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>48</td>
<td>52</td>
<td>100</td>
<td>49.3</td>
<td>50.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Recess</th>
<th>Lunch</th>
<th>After school</th>
<th>Active travel</th>
<th>Avg. TV viewing</th>
<th>Avg. Computer games</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (n)</td>
<td>Mostly Inactive (%)</td>
<td>Total (n)</td>
<td>Mostly Inactive (%)</td>
<td>Total (n)</td>
<td>Mostly Inactive (%)</td>
</tr>
<tr>
<td></td>
<td>2769</td>
<td>81</td>
<td>2270</td>
<td>82.6</td>
<td>1033</td>
<td>37.3</td>
</tr>
<tr>
<td></td>
<td>3071</td>
<td>86.9</td>
<td>3071</td>
<td>90.5</td>
<td>1487</td>
<td>48.5</td>
</tr>
<tr>
<td></td>
<td>5840</td>
<td>84.1</td>
<td>5841</td>
<td>86.7</td>
<td>2520</td>
<td>43.2</td>
</tr>
<tr>
<td></td>
<td>1121</td>
<td>81.4</td>
<td>1122</td>
<td>83.9</td>
<td>1363</td>
<td>34.6</td>
</tr>
<tr>
<td></td>
<td>1363</td>
<td>83.2</td>
<td>1363</td>
<td>89.5</td>
<td>2485</td>
<td>47.3</td>
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<tr>
<td></td>
<td>2484</td>
<td>82.4</td>
<td>2485</td>
<td>86.9</td>
<td>1648</td>
<td>41.6</td>
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<tr>
<td></td>
<td>1648</td>
<td>80.8</td>
<td>1648</td>
<td>81.7</td>
<td>1708</td>
<td>39.2</td>
</tr>
<tr>
<td></td>
<td>1708</td>
<td>89.8</td>
<td>1708</td>
<td>91.3</td>
<td>3356</td>
<td>49.4</td>
</tr>
<tr>
<td></td>
<td>3356</td>
<td>85.4</td>
<td>3356</td>
<td>86.6</td>
<td>1030</td>
<td>44.4</td>
</tr>
</tbody>
</table>

* Active travel: <5 times/wk (%)
† Avg. TV viewing: ≥2 hrs/day (%)
‡ Avg. Computer games: ≥2 hrs/day (%)
Table 1. Average Total Screen Time by School Location and Time Watching TV, Videos, DVDs and Playing Video Games, e-games or Using Computer (not for homework) per Day

<table>
<thead>
<tr>
<th>Avg. Total screen time</th>
<th>Total (n)</th>
<th>1382</th>
<th>1282</th>
<th>2664</th>
<th>507</th>
<th>555</th>
<th>1062</th>
<th>875</th>
<th>727</th>
<th>1602</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥2 hrs/day (%)</td>
<td></td>
<td>69.1</td>
<td>64.7</td>
<td>67</td>
<td>64.3</td>
<td>60.2</td>
<td>62.1</td>
<td>71.9</td>
<td>68.2</td>
<td>70.2</td>
</tr>
</tbody>
</table>

* Only those adolescents living within 15 minutes’ walking distance from school; maximum trips were 10 per week to or from school
†Average time watching TV, videos, DVDs per day
‡Average time playing video games, e-games or using computer (not for homework) per day
4.3.4 Weight Status and Unhealthy Behavioural Patterns

Tables 4.4 and 4.5 show unadjusted proportions of unhealthy behavioural activities by weight status within ethnicity and gender subgroups, respectively. Overall, there were statistically major differences between the two ethnic groups’ weight status, with iTaukei having a significantly higher prevalence of overweight and obesity than Indo-Fijian (see Table 4.4).

Of all behaviours, inactivity during recess was significantly higher for overweight and obese Indo-Fijians than overweight and obese iTaukei. The rest of the results in Table 4.4 did not show any significant difference between ethnicities by weight status.

In terms of overall gender differences, females had significantly higher prevalence of overweight and obesity than males (see Table 4.5).

Those overweight and obese males (who were mostly inactive during recess and had viewed TV more than two hours) were significantly different from overweight and obese females. More overweight and obese females were significantly different during lunch school break than overweight and obese males.
Table 4.5: Proportion of Unhealthy Behavioural Activities by Weight Status Within Ethnic Groups

<table>
<thead>
<tr>
<th>Activity</th>
<th>Ethnicity</th>
<th>All (n)</th>
<th>iTaukei (n)</th>
<th>Indo-Fijians (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6871</td>
<td>3077</td>
<td>3794</td>
</tr>
<tr>
<td>Weight Status</td>
<td>UW</td>
<td>HW</td>
<td>OWO</td>
<td>UW</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recess</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>493</td>
<td>3994</td>
<td>1352</td>
<td>5</td>
</tr>
<tr>
<td>Mostly Inactive (%)</td>
<td>81.3</td>
<td>84.0</td>
<td>85.4</td>
<td>80</td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>493</td>
<td>3994</td>
<td>1353</td>
<td>5</td>
</tr>
<tr>
<td>Mostly Inactive (%)</td>
<td>84.2</td>
<td>87.5</td>
<td>85.6</td>
<td>80</td>
</tr>
<tr>
<td>After School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>492</td>
<td>3992</td>
<td>1353</td>
<td>5</td>
</tr>
<tr>
<td>0-2 days (%)</td>
<td>43.1</td>
<td>42.7</td>
<td>44.6</td>
<td>80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Ethnicity</th>
<th>All (n)</th>
<th>iTaukei (n)</th>
<th>Indo-Fijians (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6871</td>
<td>3077</td>
<td>3794</td>
</tr>
<tr>
<td>Active Travel*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>159</td>
<td>1197</td>
<td>469</td>
<td>4</td>
</tr>
<tr>
<td>&lt;5 times/wk (%)</td>
<td>35.2</td>
<td>38.1</td>
<td>37.0</td>
<td>50</td>
</tr>
<tr>
<td>Avg. TV Viewing†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>354</td>
<td>3253</td>
<td>1119</td>
<td>3</td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>65.0</td>
<td>63.0</td>
<td>58.7</td>
<td>66.7</td>
</tr>
<tr>
<td>Avg. Computer Games‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>243</td>
<td>1944</td>
<td>615</td>
<td>0</td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>37.0</td>
<td>37.4</td>
<td>35.5</td>
<td>0</td>
</tr>
<tr>
<td>Avg. Total Screen Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>227</td>
<td>1858</td>
<td>579</td>
<td>0</td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>69.6</td>
<td>67.7</td>
<td>63.9</td>
<td>0</td>
</tr>
</tbody>
</table>

* Only those adolescents living within 15 minutes walking distance from school; maximum trips were 10 per week to or from school
† Average time watching TV; videos, DVDs per day
‡ Average time playing video games, e games or using computer (not for homework) per day
UW = underweight; HW = healthy weight; OWO = overweight and obese

Significant differences between weight status for each ethnic sub-group, p < 0.05 are bolded; T-test were used for continuous measures while chi-square tests for categorical variables.
Table 4.6: Proportion of Unhealthy Behavioural Activities by Weight Status Within Gender Groups

<table>
<thead>
<tr>
<th>Gender</th>
<th>All</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (n)</td>
<td>6871</td>
<td>3271</td>
<td>3600</td>
</tr>
<tr>
<td>Weight Status</td>
<td>UW</td>
<td>HW</td>
<td>OWO</td>
</tr>
<tr>
<td>%</td>
<td>8.3</td>
<td>67.9</td>
<td>23.8</td>
</tr>
<tr>
<td>Activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recess</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>493</td>
<td>3994</td>
<td>1352</td>
</tr>
<tr>
<td>Mostly Inactive (%)</td>
<td>81.3</td>
<td>84.0</td>
<td>85.4</td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>493</td>
<td>3994</td>
<td>1353</td>
</tr>
<tr>
<td>Mostly Inactive (%)</td>
<td>84.2</td>
<td>87.5</td>
<td>85.6</td>
</tr>
<tr>
<td>After School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>492</td>
<td>3992</td>
<td>1353</td>
</tr>
<tr>
<td>0-2 days (%)</td>
<td>43.1</td>
<td>42.7</td>
<td>44.6</td>
</tr>
<tr>
<td>Active Travel*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>159</td>
<td>1197</td>
<td>469</td>
</tr>
<tr>
<td>&lt;5 times/wk (%)</td>
<td>35.2</td>
<td>38.1</td>
<td>36.9</td>
</tr>
<tr>
<td>Avg. TV Viewing†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>354</td>
<td>3253</td>
<td>1119</td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>65.0</td>
<td>62.9</td>
<td>58.7</td>
</tr>
<tr>
<td>Avg. Computer Games‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>243</td>
<td>1944</td>
<td>615</td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>37.0</td>
<td>37.4</td>
<td>35.5</td>
</tr>
<tr>
<td>Avg. Total Screen Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (n)</td>
<td>227</td>
<td>1858</td>
<td>579</td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>69.6</td>
<td>67.7</td>
<td>63.9</td>
</tr>
</tbody>
</table>

* Only those adolescents living within 15 minutes walking distance from school; maximum trips were 10 per week to or from school
† Average time watching TV, videos, DVDs per day; ‡ Average time playing video games, e games or using computer (not for homework) per day; UW – underweight; HW – healthy weight; OWO – overweight and obese; † Significant differences between weight status for each gender sub-group, p < 0.05 are bolded; T-test were used for continuous measures while chi-square tests for categorical variables
4.3.5 Unhealthy Behavioural Activities and Their Associations with BMI-z

Figure 4.7 shows that adolescents who were mostly inactive (e.g. sitting or standing) during recess had a high BMI-z, while Figures 4.8 and 4.9 show that it was Indo-Fijian and male adolescents who were mostly inactive (i.e. sitting or standing) during recess who had a high BMI-z, respectively.
Adolescents who were mostly inactive (e.g., sitting or standing) during recess had a high BMI-z.

Figure 4.7: Unhealthy Behavioural Activities Associated with BMI-z
Indo Fijian adolescents who were mostly inactive (i.e., sitting or standing) during recess had a high BMI-Z.

**Figure 4.8: Unhealthy Behavioural Activities Associated with BMI-Z By Ethnicity**

*adjusted for age, gender, ethnicity, and clustering by school*
Figure 4.9: Unhealthy Behavioural Activities Associated with BMI-Z by Gender

*adjusted for age, gender, ethnicity, and clustering by school
Figure 4.10 shows unhealthy behavioural activities associated with BMI-z by gender nested within ethnicity. Unexpectedly, male iTaukei who had high average TV viewing time had low BMI-z. That is, high average TV viewing time by male iTaukei was negatively associated with BMI-z. This figure also shows that male Indo-Fijian students who were mostly inactive during recess had a high BMI-z.
Figure 4.10: Unhealthy Behavioural Activities Associated with BMI-Z by Gender Within Ethnic Groups

* adjusted for age and clustering by school
4.3.6 Summary of Key Findings

Table 4.6 summarises all the key proportions by ethnicity and gender. In summary, significantly more Indo-Fijians reported obesogenic activity behaviours (high total screen time and inactive during recess and after school) than iTaukei. Also, significantly more females were physically inactive than males, while significantly more males reported a high average total screen time per day (including a high time playing computer/video games) than females.

Table 4.7 summarises the key associations with BMI-z by ethnicity and gender. Only one unhealthy behavioural activity (inactivity during recess) was positively associated with BMI-z. In terms of sub-group analyses, Indo-Fijians and male adolescents who were least active during recess had a positive association with high BMI-z.
Table 4.7: Summary of Key Proportions by Ethnicity and Gender

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All</th>
<th>iTaukei</th>
<th>Indo-Fijians</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>6781 (100)</td>
<td>3077 (44.8)</td>
<td>3794 (55.2)</td>
<td>3271 (47.6)</td>
<td>3600 (52.4)</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recess</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mostly Inactive (%)</td>
<td>84.1</td>
<td>82.4</td>
<td>85.4</td>
<td>81.0</td>
<td>86.9</td>
</tr>
<tr>
<td>Lunch</td>
<td>86.7</td>
<td>87.0</td>
<td>86.6</td>
<td>82.6</td>
<td>90.5</td>
</tr>
<tr>
<td>After School</td>
<td>43.2</td>
<td>41.6</td>
<td>44.4</td>
<td>37.3</td>
<td>48.5</td>
</tr>
<tr>
<td>Avg. TV Viewing†</td>
<td>62.0</td>
<td>58.2</td>
<td>65.3</td>
<td>63.0</td>
<td>61.2</td>
</tr>
<tr>
<td>Avg. Computer Games†</td>
<td>37</td>
<td>38.1</td>
<td>36.2</td>
<td>41.0</td>
<td>32.7</td>
</tr>
<tr>
<td>Avg. Total Screen Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥2 hrs/day (%)</td>
<td>67</td>
<td>62.2</td>
<td>70.2</td>
<td>69.1</td>
<td>64.7</td>
</tr>
</tbody>
</table>

* Only those adolescents living within 15 minutes’ walking distance from school; maximum trips were 10 per week to or from school
†Average time watching TV, videos, DVDs per day
Average time playing video games, e games or using computer (not for homework) per day
Significant differences between the two levels in each sub-group, $p < 0.05$ are bolded
### Table 4.8: Summary of Key Associations with BMI-z by Ethnicity and Gender

<table>
<thead>
<tr>
<th>Activities</th>
<th>iTaukei</th>
<th></th>
<th>Indo-Fijians</th>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β (95% CI)</td>
<td>SE</td>
<td>P</td>
<td>β (95% CI)</td>
<td>SE</td>
<td>P</td>
<td>β (95% CI)</td>
<td>SE</td>
</tr>
<tr>
<td>Recess</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mostly inactive</td>
<td>0.03</td>
<td>0.04</td>
<td>0.498</td>
<td>0.21</td>
<td>0.08</td>
<td>0.013</td>
<td>0.19</td>
<td>0.06</td>
</tr>
<tr>
<td>[Ref: mostly active]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td>-0.06</td>
<td>0.05</td>
<td>0.230</td>
<td>0.06</td>
<td>0.07</td>
<td>0.371</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>[Ref: mostly active]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After School</td>
<td>-0.03</td>
<td>0.03</td>
<td>0.464</td>
<td>0.02</td>
<td>0.06</td>
<td>0.794</td>
<td>-0.01</td>
<td>0.07</td>
</tr>
<tr>
<td>Least active (0-2 days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Ref: 3-5 days]</td>
<td>-0.11</td>
<td>0.07</td>
<td>0.138</td>
<td>-0.007</td>
<td>0.1</td>
<td>0.941</td>
<td>-0.12</td>
<td>0.07</td>
</tr>
<tr>
<td>Active Travel†</td>
<td>-0.005</td>
<td>0.02</td>
<td>0.722</td>
<td>-0.009</td>
<td>0.03</td>
<td>0.743</td>
<td>-0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>To/from school (&lt;5 times/wk)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Ref: ≥5 times/wk]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. TV Viewing‡</td>
<td>0.02</td>
<td>0.02</td>
<td>0.494</td>
<td>0.02</td>
<td>0.04</td>
<td>0.433</td>
<td>-0.001</td>
<td>0.03</td>
</tr>
<tr>
<td>Average time watching TV, videos, DVDs per day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. Computer Games†</td>
<td>0.002</td>
<td>0.01</td>
<td>0.852</td>
<td>0.01</td>
<td>0.02</td>
<td>0.575</td>
<td>-0.0003</td>
<td>0.01</td>
</tr>
<tr>
<td>Average time playing video games, e games or using computer (not for homework) per day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. Total Screen Time‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Only those adolescents living within 15 minutes walking distance from school; maximum trips were 10 per week to or from school
† Average time watching TV, videos, DVDs per day
‡ Average time playing video games, e games or using computer (not for homework) per day
§ Significant differences between sub-groups, p < 0.05 are bolded.
4.4 Discussion

This descriptive cross-sectional study investigated PA and SBB patterns among adolescents in Fiji and reported on associations with BMI-z and highlighted major differences in adolescents’ activity patterns across population subgroups such as ethnicity and gender. A discussion about main the findings on the obesogenic patterns in activity behaviours will be presented followed by a discussion of associations (or lack of them) with BMI-z. Strengths and limitations will then be discussed, leading onto study implications and future research.

4.4.1 Description Behavioural patterns

The main findings in this study showed almost a quarter (24%) of the HYHC study participants were overweight/obese with significant differences based on ethnicity (iTaukei 34%, Indo-Fijians 15%) and gender (males 20%, females 28%). PA levels among iTaukei and males were high after school but low during school recess and lunch breaks. Overall, the major finding from this study was the high prevalence of obesogenic activity behaviours amongst the Fijian adolescents (especially, among iTaukei and Males).

4.4.1.2 Patterns during School Breaks

iTaukei and males were active after school as opposed to generally low levels of PA during school morning and lunch breaks. However, schools in Fiji have the capacity to offer multiple opportunities for increasing PA during the school day as adolescents spend a lot of structured time at school; yet this study reported less than a fifth were engaging in active games during morning and lunch school breaks. Despite schools
being a valuable setting for PA accumulation where daily recommended guidelines can be easily met, few studies (61, 200) have focused on adolescents’ PA during school breaks to aptly utilize this avenue. Research by Gavarry et al. (222) showed that adolescents’ heart rates were greatest during PE classes, followed by LTPAs and then during lunch school breaks. Gavarry study showed that PA during this time (school breaks) declines with age. Moreover, in 2010 a national survey in NZ (37), found a similar low levels of PA with age during morning school break. Similarly, the findings in the present study are consistent with other studies internationally, especially a high prevalence of obesogenic behaviours among females (26, 34, 37, 119, 122-124, 130, 223).

4.4.1.3 Patterns after School

PA patterns after school were in contrast to those during school breaks. The majority of adolescents were mostly active after school. Within this less restricted time, adolescents were more likely to engage in a wide variety of activities outside of school environments (224), such as sports, active games, dance and cultural performances. A study that compared school-based and out-of-school-based PA levels in NZ revealed that children were more active outside of, rather than during, school hours (224). This is similar to the findings in the present study.

4.4.1.2 Active Travel Patterns

The proportion of adolescents who actively travel to/from school is generally declining in several countries (12, 225, 226). This study also showed a similar pattern with more than a third of those living close to the school walked to/from
school less than five times a week out of a total of 10 trips in one week. Active transport among Pacific adolescents in NZ was slightly less than in Fiji with 45% walking to/from school less than five times in the last five school days (227). There are no studies on reasons for choice of transport mode to school carried out in Fiji. Perhaps Fiji’s usual warm and humid climate may be keeping adolescents from walking or cycling during mornings. Heavy school bags could also explain why the other two-third of adolescents’ maybe opting for non-active transport. It is also important to note that most schools in Fiji do not have locker storage facilities for students. Heavy traffic with air pollution and lack of proper footpaths in certain places could also be acting as barriers. Also, there is no general cycling culture in Fiji and certainly no infrastructure to support cycling. Hence, even though walking to/from school may be ideal for adolescents to accumulate their daily PA, these barriers make it difficult. Various studies elsewhere (149, 228) show that these barriers act as a primary reason for this obesogenic pattern. Some options to increase active travel to school are infrastructure changes such as good footpaths for safe walking, social marketing campaigns, partnerships between councils and schools to identify other strategies to suit the active lifestyles for adolescents.

4.4.1.2 Total Screen Time Patterns

With technological advancements (78), adolescents now are inclined to spend more sedentary time using e-games than playing physical games (57, 78, 148). Adolescence is a period usually linked with unstructured games, LTPAs or active games external to school environments, including high levels of TV viewing and e-gaming (35, 97, 164, 229). The present study also showed a similar pattern with around two thirds engaging 2 hours or more watching TV and playing e-games.
More particularly, males tended to spend more time in e-gaming and watching TV than females (148). However, adolescents can also be physically active and have high levels of screen time as was shown by Olds et al.’s study among 10- to 13-year-old Australian children (230). In contrast, another study by Cragg et al (231) reported that adolescents who were not active after school were highly likely to view TV for more than four hours per day than those who were active during sport or LTPAs during each week. Barring the Pacific OPIC project, studies on PA, especially on SBB, are lacking in Fiji.

4.4.2 Main Findings on the Associations

Despite high prevalence of unhealthy behaviours, there were very few associations between the level of these behaviours and BMI-z with the only exceptions being among Indo-Fijians and males, where total screen-time was high, and physical inactivity during recess was positively associated (p< 0.05) with higher BMI-z. Among female iTaukei, high TV viewing time was positively associated (p< 0.05) with higher BMI-z. Conversely, for male iTaukei, high TV viewing time was associated with low BMI-z. This unexpected result may be deceptive or need to be treated with caution or further explored. It may potentially relate to confounding, reverse causality or compensatory responses. There can be several ways to explain this unexpected direction. Firstly, it could be due to reverse causation, meaning that these males of iTaukei sub-group maybe already big students, and hence maybe trying to lose weight by exercising more and watching less TV. Secondly, it could be due to biased reporting by this sub-group of big students who might selectively under-report their TV viewing behaviour. Finally, this result could be simply due to chance alone, given the level of significance (0.05), it maybe that out of the total 28
associations tested, one (high TV viewing by male iTaukei) maybe due to chance (5% of 28 = 1.4).

Other behavioural activities including total screen-time had no significant association with BMI-z for all adolescents. The large number of null findings in the associations between behaviours and BMI-z was not expected and it could be due to a number of reasons. The first reason is that the study was cross-sectional and this design may not be as powerful in identifying cause and effect relationships such as in longitudinal studies. Therefore this is the reason for carrying out longitudinal analyses presented in the next chapter. The other potential reasons for the null findings will be discussed at the end of that chapter.

4.4.5 Strengths and Limitation

The strengths in this study are its large sample size (n= 7237), the measured BMI, the measuring of multiple different behaviours, the comparisons with other OPIC countries. The fairly wide coverage of the sample across the main island of Viti Levu indicates that the findings are probably representative of the urban/peri-urban Fijian adolescents.

Also, the target group was adolescents, a group where effective interventions are really needed for the following reasons: Firstly, obesity rates in the Pacific really accelerate in adolescents bridging the relatively low rates in younger children with very high rates in adults. Secondly, adolescents are a captive audience, as they are accessible in school for obesity prevention intervention. Thirdly, adolescents have a critical growth period in height and can still ‘grow into their weight’ if they are overweight. Fourthly, adolescents are responsive to changes in environment as compared to adults and during this period develop PA and SBB habits.
Furthermore, this study had the ability to examine the behavioural patterns of two cultures living in the same physical environments (meaning that major ethnic differences are likely to have a socio-cultural basis). That is, this study had enough diversity in the sample to give insights into the moderating effects that ethnicity has in either accentuating or attenuating the impacts of physical environments on population behaviours and risks factors.

There were some limitations in this study. Even though the cross-sectional nature of the study provided some information about activity behaviours and their associations at one point in time, the few associations obtained do not imply causality. Patterns over time could not be possible due to the nature of cross-sectional design. Other limitations include design issues such as non-representativeness (i.e. not inclusive of rural Fiji or outer islands) of the data utilised.

Moreover, instrument issues like using snapshot behaviour questions rather than comprehensive PA assessments or objective measures like accelerometers can be another limitation in this study. The instrument (ABAKQ) used in HYHC project measured only a self-recall of small part of the total PA, that is, not all PA domains were measured using this instrument. Hence the association between the PA/SBB and BMI-z may not have fully captured the total PA levels in adolescents to show any effect. For example, incidental activity at home was not measured and most of the adolescents may have been engaged in backyard gardening, weeding, digging or doing other household chores that also require energy expenditure. Moreover, unlike SBB variables measured for the last seven days, the activity behaviour measure in the questionnaire captured only weekday activities.
Therefore, the findings of this study should be treated with caution and interpreted in the light of these limitations. The study instrument may not be that accurate due to errors (e.g. random and recall bias) to detect a large effect size, that is, the bluntness of the instrument may have allowed a low sensitivity to detect any changes in this study. PA and SBB measures may have been influenced by reporting biases. The other potential limitations will be discussed at the end of next chapter, which uses the same dataset as the current study.

In conclusion, despite the poor overall PA and SBB patterns, there were few associations with BMI-z and little compelling evidence that PA and SBBs contribute greatly to obesity rates. Although the high prevalence of inadequate PA and the recognised benefits of PA support the continuation of PA interventions, expectations that they will help to reduce obesity must be modest.
Chapter 5: Study 2 – Longitudinal Analyses of PA and SBB on BMI-z

5.1 Introduction

While the information obtained in chapter 4 is important and valuable, it restricts our understanding mainly on cross-sectional associations between activity behaviours and obesity. Cross sectional studies (like the last chapter) have limitations and to investigate cause-effect relationships, researchers turn to longitudinal studies to see if putative exposures can predict outcomes. This weight related problem is complex especially in LMICs, including a culturally-centred country like Fiji, who are going through more rapid transitional changes in modern technology (among various other transitions) at a population level that affect changes in BMI-z. Some of these may be explained decrease in PA levels and increase in SBB levels, but this has been difficult to confirm. As seen in Chapter 4, Study 1 also had similar unhealthy behavioural activity patterns (PA and SBB) in the OPIC sample of adolescents. Fijian adolescent’s PA and SBB patterns were generally poor, but there were no compelling, consistent association between PA/SBB and BMI-z.

In recent decades, low levels of PA (219, 232, 233) and significant growth in the accessibility of screen-based media (155, 234, 235) such as TV and video games have become a major issue with adverse health effects (236-238). Unhealthy weight gain is a multifaceted problem as various societal and behavioural changes are contributing towards this epidemic. The availability of facilities for leisure activities, public transport, public safety, urbanisation, and development of buildings are just a
handful of these contributing factors. In terms of energy expenditure, most obesity prevention initiatives have centred mainly on promoting PA; however, recent studies targeting screen time have shown promise (239). A greater understanding about sedentary lifestyle, particularly screen time, is important for the formulation of obesity prevention strategies (240). The current worldwide trends demand less physical work with more machine-dependant work (78). The increasingly mechanised transportation, household electronic devices, and advancements in computer technology have reduced the workload for people (97). Evidence from systematic reviews have shown that many children nowadays dedicate less time to various levels of PA (41, 97, 155) and there is great concern that it declines with age during adolescence through adulthood (239).

Therefore, more evidence is needed from longitudinal studies to understand the link between body weight and activity behaviours among adolescents so that they can maintain a healthy body weight through adulthood. There is some evidence from systematic reviews of longitudinal studies (241, 242) regarding specific changes in PA and SBB and changes in BMI-z in children and adolescents; however, there is an absence of such data from the Pacific Islands, including Fiji.

Hence, this longitudinal study will examine what behavioural activities predict changes in BMI-z, which would be helpful in establishing appropriate association to help make decision on prioritizing weight related health problems in Fiji. This study aims to determine whether baseline levels or changes in PA and SBB predict changes in BMI-z among Fijian adolescents; and test a potential reverse causal pathway of baseline BMI-z predicting changes in behaviours.
Moreover, this study hypothesises two vicious cycle approaches to weight gain paradox. First, is a direct approach, where an individual is being less PA and has high screen-time leading to higher BMI. Second, is a reverse approach, where it can be a vicious cycle of high BMI leading to less PA which leads to higher BMI or it can be that having a high BMI stimulates the person to go out and exercise more.
5.1.1 Approach 1: Baseline Behaviours Modelled onto Change in BMI-z (and its Reverse association)

Research question 1
Do baseline physical activity/screen-based behaviour variables predict change in (delta) BMI-z among Fijian adolescents?

HYPOTHESIS: Low levels of physical activity/high levels of SBBs predict an increase in BMI-z.

Figure 5.1: Direct Causal Pathway Model

Research question 2
Does baseline BMI-z predict changes in (delta) physical activity/screen-based behaviour variables among Fijian adolescents?

HYPOTHESIS: Having a higher BMI-z predicts decreases in levels of PA and increased levels of TV viewing/ e-gaming.

Figure 5.2: Reverse Causal Pathway Model
5.1.2 Approach 2: Change in Behaviours Modelled onto Change in BMI-z (and its Reverse association)

**Research question 3**
Do changes in physical activity and screen-based behaviour variables ‘explain’ variation in change in BMI-z?

HYPOTHESIS: Low levels of physical activity/high levels of SBBs predict an increase in BMI-z

**Figure 5.3: Direct Causal Pathway Model**

**Research question 4**
Do changes in BMI-z ‘explain’ variation in changes in physical activity and screen-based behaviour variables?

HYPOTHESIS: Having a higher BMI-z promotes further lower levels of PA and high levels of TV viewing/ e-gaming

**Figure 5.4: Reverse Causal Pathway Model**
5.2 Methods

5.2.1 Study Design

This was a longitudinal study utilising the baseline and follow-up data from the HYHC project (32, 62, 200). Additional details for the study design have been published elsewhere (14, 62, 201) and also presented in Chapter 3. The HYHC project had ethics approval from the FNRERC (3-020-2004) as well as the DUHREC (EC-22-2005). Parents and guardians of adolescents provided written consent for participation.

5.2.2 Sample Size

A total of 2781 students in Forms 3-7 (aged 13-18 years) attending the 18 schools (as mentioned in Chapter 3) were followed up after approximately two years. This comprised all students followed up across the intervention and comparison group between 2006 and 2008.

5.2.3 Data Management, Treatment and Analyses

Adolescents had self-reported their demographic information via a paper-based survey (ABAKQ; see Section 3.3.6 and Appendix A.1). All the demographic, body weight and activity behavioural measures were presented in Table 4.1. Demographic variables were age, gender and ethnicity. Ages ranged from 13 to 18 years. Participants from other ethnic (n=167) groups were removed. Hence the sample size for the final analyses was 2781. The main outcome measure in this study was BMI-z.
Standard protocols (62) were followed by trained researchers in the HYHC project to collect anthropometry data. Weight status and BMI were defined using the WHO recommendations (243) (see Chapter 3).

Activity behavioural measures were PA and SBB variables. PA variables were activity during recess, lunch and after school, and walking/cycling to/from school five times per week out of a total of 10 trips per school week (for those adolescents who lived within 15 minutes walking distance from school). SBB variables were TV viewing and playing e-games. Average hours of TV viewing and playing e-games were summed to generate an average total screen time variable. Baseline and follow-up categorical variables were dichotomised (see Table 5.1). All categorical change variables had three levels: 1. No change at follow up; 2. Increased frequency at follow up; 3. Decreased frequency at follow up. Raw data were cleaned through several variable checks, re-coding and data manipulations, and analysed using statistical software called STATA.

Data were analysed descriptively (means, standard deviations and proportions) and goodness of fit one-sample chi-square tests were used to find statistical differences between the three levels in all change variables. The association between baseline PA/SBB variables and BMI-z at follow up was analysed using MLR for measures with continuous dependent variables (BMI-z at baseline; Change in BMI-z) and binary logistic regression for categorical outcome variables (change in recess, lunch, active travel, activity after school) controlling for covariates as outlined in Table 4.1. Change in BMI-z variables including change in PA and SBB variables were also computed. Analyses were corrected for design-effects of clustering by school sampling and confounding effects of age, gender, ethnicity, condition (which
included comparison and intervention groups) and duration of measurements. Level of statistical significance was set at 0.05.

There were two analytical approaches used in this longitudinal study. In the first approach, the baseline behaviours (PA and SBB) were mapped onto change in BMI-z (and its reverse association). This has been depicted separately in Figures 5.1 (direct model) and 5.2 (reverse model), which also addressed the first two research questions in this study: RQ1. Do low levels of PA and high screen time predict increases in BMI-z; RQ2. Does a higher BMI-z promote further reductions in PA or increases in screen time?

In the second approach, the changes in behaviours were mapped onto the change in BMI-z (and its reverse association). Figures 5.3 (direct model) and 5.4 (reverse model) depict predictions of changes between two time frames, that is, in two separate research questions: RQ3. Do changes in PA and SBB predict changes in BMI-z; RQ4. Do changes in BMI-z predict changes in PA and SBB?
Table 5.1: Longitudinal Measures in Study 2

<table>
<thead>
<tr>
<th>Variables</th>
<th>Data types</th>
<th>3-levels of proportional changes in activities</th>
<th>Dichotomised unhealthy behavioural activities</th>
<th>Dichotomised healthy behavioural activities</th>
<th>Types of Analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body weight (dependent) variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI-z at baseline</td>
<td>Continuous</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Descriptive; MLR</td>
</tr>
<tr>
<td>BMI-z at follow up</td>
<td>Continuous</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Descriptive; MLR</td>
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<tr>
<td>Change in BMI-z</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Descriptive; MLR</td>
</tr>
<tr>
<td><strong>SBB (Independent) variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average computer/video games’ hours at baseline/follow up per day</td>
<td>Continuous</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
</tr>
<tr>
<td>Change in average computer/video games’ hours per day</td>
<td>Continuous</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
</tr>
<tr>
<td>Average TV1 hours at baseline/follow up per day</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
</tr>
<tr>
<td>Change in average TV1 hours per day</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
</tr>
<tr>
<td>Average total screen time (TV1+Computer/video games*) per day</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
</tr>
<tr>
<td>Change in average total screen time (TV1+Computer/video games*) per day</td>
<td>Continuous</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
</tr>
<tr>
<td>Change in average total screen time (TV1+Computer/video games*) per day</td>
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<td>N/A</td>
<td>Descriptive</td>
</tr>
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<td></td>
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<td>Active during recess at baseline/follow up</td>
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<td>Mostly active – Recess (played active games)</td>
<td>Descriptive; MLR</td>
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<td>Active during lunch at baseline/follow up</td>
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<td>Mostly active – Lunch (played active games)</td>
<td>Descriptive; MLR</td>
</tr>
<tr>
<td>Active after school at baseline/follow up</td>
<td>Ordinal</td>
<td>No change; IF*, DF**</td>
<td>Least active - After school (0-2 days)</td>
<td>Mostly active - After school (3-5 days)</td>
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<td>Active travel at baseline/follow up</td>
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<td>No change; IF*, DF**</td>
<td>Active travel (walked/cycled &lt; 5 times/wk)</td>
<td>Active travel (walked/cycled ≥ 5 times/wk)</td>
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<td>N/A</td>
<td>N/A</td>
<td>MLR</td>
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146
<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
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<th>N/A</th>
<th>Method</th>
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<td>MLR</td>
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<td>Condition (Intervention; Comparison)</td>
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</tr>
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<td>Duration (at follow up)</td>
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<td>N/A</td>
<td>MLR</td>
</tr>
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<td>Cluster by school (18 clusters)</td>
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<td>N/A</td>
<td>MLR</td>
</tr>
</tbody>
</table>

Notes. *IF = increased frequency at follow up; **DF = Decreased frequency at follow up; ***MLR = Multiple linear regression

1 Only those adolescents living within 15 minutes walking distance from school; maximum trips were 10 per week to or from school
2 Average time watching TV, videos, DVDs per day
3 Average time playing video games, e games or using computer (not for homework) per day
5.3 Results

5.3.1 Descriptive Characteristics

There were 2781 adolescents (aged 13-18 years) who were followed up from 18 schools after approximately two years from when they took part in the HYHC baseline survey. Of these, the majority were of healthy weight, but one in five adolescents were (20.6%) was overweight or obese, as seen in Figure 5.5. Table 5.2 shows the descriptive characteristics of the study participants at baseline and follow up by ethnicity. Table 5.3 compares the same by gender.

Figure 5.5 presents adolescents’ changes in frequencies of activity behaviours from baseline to follow up. Overall, about 40-80 per cent of adolescents had changed their PA and SBB. However, a mixed pattern of behaviour changes was seen with some increasing and some decreasing in the frequency of healthy behaviours. For example, more adolescents worsened rather than improved in e-gaming time (33% v. 23%), and activity during lunch break (24% v. 17%).
Table 5.2: Descriptive Characteristics of Participants at Baseline and Follow Up by Ethnicity

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Baseline</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>iTaukei</td>
</tr>
<tr>
<td>n (%)</td>
<td>2781 (100)</td>
<td>956 (34.4)</td>
</tr>
<tr>
<td>Age, years</td>
<td>15.3 ± 1.1</td>
<td>15.4 ± 1.2</td>
</tr>
<tr>
<td>(Mean ±SD)</td>
<td>(Mean ±SD)</td>
<td>(Mean ±SD)</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(15.2-15.3)</td>
<td>(15.3-15.5)</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>21.6 ± 4.6</td>
<td>22.5 ± 3.5</td>
</tr>
<tr>
<td>(Mean ±SD)</td>
<td>(Mean ±SD)</td>
<td>(Mean ±SD)</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(20.4-20.7)</td>
<td>(22.3-22.8)</td>
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<tr>
<td>BMI-z², kg/m²²</td>
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</tr>
<tr>
<td>(Mean ±SD)</td>
<td>(Mean ±SD)</td>
<td>(Mean ±SD)</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(-0.2-0.1)</td>
<td>(0.6-0.7)</td>
</tr>
<tr>
<td>Weight Status⁵</td>
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<td>0.000</td>
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<tr>
<td>Thin %</td>
<td>9.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Healthy weight %</td>
<td>69.9</td>
<td>67.7</td>
</tr>
<tr>
<td>Overweight %</td>
<td>15.4</td>
<td>25.6</td>
</tr>
<tr>
<td>Obese %</td>
<td>5.6</td>
<td>6.6</td>
</tr>
</tbody>
</table>

¹ SD: Standard deviation
² 95% confidence interval (95% CI);
³ BMI: Body mass index
⁴ BMI-z²: Body mass index standardised for age
⁵ Weight status classification based on WHO international reference cut points for children, 2010
Table 5.3 Descriptive Characteristics of Participants at Baseline and Follow Up by Gender

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Gender</td>
<td>Males</td>
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<tr>
<td>n (%)</td>
<td>2781 (100)</td>
<td>3271 (47.6)</td>
<td></td>
</tr>
<tr>
<td>Age, years (Mean ±SD)</td>
<td>15.6 ± 1.37</td>
<td>15.6 ± 1.40</td>
<td>NS</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(15.5-15.6)</td>
<td>(15.6-15.7)</td>
<td></td>
</tr>
<tr>
<td>BMI, kg/m² (Mean ±SD)</td>
<td>21.1 ± 4.28</td>
<td>20.4 ± 4.04</td>
<td></td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(20.9-21.2)</td>
<td>(20.3-20.7)</td>
<td></td>
</tr>
<tr>
<td>BMI-z, kg/m² (Mean ±SD)</td>
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<td>-0.21 ± 1.42</td>
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</tr>
<tr>
<td>(95% CI)</td>
<td>(-0.06-0.01)</td>
<td>(-0.26- -0.17)</td>
<td></td>
</tr>
<tr>
<td>Weight Status</td>
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</tr>
<tr>
<td>Thin %</td>
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<td>11.4</td>
<td></td>
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<tr>
<td>Healthy weight %</td>
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<td>69.1</td>
<td></td>
</tr>
<tr>
<td>Overweight %</td>
<td>17.6</td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td>Obese %</td>
<td>6.2</td>
<td>5.7</td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard deviation

95% CI: 95% confidence interval

BMI: Body mass index

BMI-z: Body mass index standardized

Weight status classification based on WHO international reference cut points for children, 2010
Figure 5.5: Change in Frequencies of Activity Behaviours from Baseline to Follow up

‡ Screen-based behaviour variables: Changes in all continuous variables recording < 30 minutes of increases or decreases in frequency were grouped as 'Minimum change'. A change of more than 30 minutes of screen time was considered as enough change to bring about a change in behaviour. Hence, changes of ≥ 30 minutes of increases and decreases in frequency were grouped as 'Increased frequency at follow up' and 'Decreased frequency at follow up', respectively.

† The physical activity variables: Changes in all categorical variables showing no change between the two time frame were grouped as 'No change'; Behaviours that had improved or worsened at follow up were grouped as 'Increased frequency at follow up' and 'Decreased frequency at follow up', respectively.

* Chi-square goodness of fit test was done to find out if there were significant differences between 3 levels of proportional changes in each variable based on the null hypothesis that all proportions were equal. All the 3 levels of proportional changes in each variable were statistically different from each other at p < 0.001.
5.3.2 Activity Behaviours Associated with BMI-z

While there were mixed patterns of proportional changes seen in behaviours, all longitudinal analyses (direct and reverse) showed no significant associations between baseline behaviours and follow up (or change in) BMI-z as depicted in Figures 5.6 to 5.9.
5.3.2.1 Research Question 1: Do baseline physical activity/screen-based behaviour variables predict change in (delta) BMI-z among Fijian adolescents?

Figure 5.6: Baseline Behavioural Activities Associated with Change in BMI-z

*adjusted for age, gender, ethnicity, clustering by school, condition (intervention and comparison groups) and duration (at follow-up)
5.3.2.2 Research Question 2: Does baseline BMI-z predict changes in (delta) physical activity/screen-based behaviour variables among Fijian adolescents?

*Figure 5.7: BMI-z at Baseline Associated with Change in Behaviours*

*adjusted for age, gender, ethnicity, clustering by school, condition (intervention and comparison groups) and duration (at follow-up)
5.3.2.3 Research Question 3: Do changes in physical activity and screen-based behaviour variables ‘explain’ variation in change in BMI-z?

Figure 5.8 Change in Behaviours Associated with Change in BMI-z

*adjusted for age, gender, ethnicity, clustering by school, condition (intervention and comparison groups) and duration (at follow up)
5.3.2.4 Research Question 4: Do changes in BMI-z ‘explain’ variation in changes in physical activity and screen-based behaviour variables?

Figure 5.9: Change in BMI-z Associated with Change in Behaviours

*adjusted for age, gender, ethnicity, clustering by school, condition (intervention and comparison groups) and duration (at follow up)
5.4 Discussion

This study investigated whether baseline levels or changes in PA and SBB predicted any changes in BMI-z among Fijian adolescents and tested a potential reverse causal pathway of baseline BMI-z predicting changes in behaviours over two years using OPIC longitudinal data. A discussion about main findings on the proportional changes in activity behaviours will be presented followed by a discussion of predictors of change related to changes in BMI-z (and its reverse association). Strengths and limitations will then be discussed, leading onto study implications and future research.

5.4.1 Description of Behavioural Changes

About 40-80 per cent of adolescents had changed (either improved or worsened) their behavioural activities; a mixed pattern of behavioural changes was observed with some increasing and some decreasing in the frequency of healthy behaviours. Some disparities were seen between the findings on changes in activities during and after school hours. During the school breaks, the majority (~60%) of the adolescents either did not change their activity behaviour or had remained mostly inactive, mainly sitting, standing or having light movements during recess or and lunch school breaks. Whereas, less than 30% adolescents did not change their after school activity (meaning around 70% had either increased or decreased their activity behaviour after school).
More adolescents had walked/cycled (among those who lived 15 minutes walking distance from school) to/from school for more than five times a week at the end of two years than those mostly not engaging in active travel. Overall mixed proportions of changes were made, meaning the changes were fairly evenly split.

5.4.2 Main Findings on the Associations

Despite having sufficient numbers and having enough proportional changes seen among activity behaviours, there were no associations detected between changes in activity behaviours and changes in BMI-z (though one would have thought there are chances of detecting an association) and its reverse association. As none of the longitudinal analyses (direct and reverse) showed significant associations between behaviours and BMI-z, baseline behaviours and behavioural changes did not predict changes in BMI-z (direct pathway hypothesis); nor did baseline BMI-z predict changes in behaviours (reverse pathway hypothesis). Adjusting for clustering by various school or those who had changed schools did not alter any improvements in the overall findings of this study as well.

This could be explained by the relatively weak impact that small to moderate changes in PA have on energy balance or potential behavioural or metabolic compensatory responses to changes in PA.

The first potential explanation is that physical activity may have a small effect on body weight. This explanation is partially supported by Metcalf et al.’s (244) systematic review in 2012 on the effectiveness of PA interventions in children. Their review highlighted that there was strong evidence that PA interventions to date had
very small effect size (that is, running or walking for about four minutes each day) on overall PA levels for adolescents and that the reasons have been unclear. They concluded that this is probably why there has been limited success in reducing BMI-z in most studies. This findings is consistent with that of Kamath et al. (245), who found a very low effect size as well. In terms of SBB, the Study 2 findings partly oppose those of Middlebeek and Breda that while TV viewing is a strong predictor for body weight, there is no such clear association from studies measuring computer and other e-games, highlighting that only a few studies are available on SBB and obesity. Overall, it maybe that PA/SBB is a weak determinant of energy balance (TEE plus EI), therefore BMI-z. In terms of body physiology and energy balance there are two aspects that need to be considered to explain the null findings.

Frist is the contribution of PA to TEE. How much of TEE is explained by PA? The PA component of total energy expenditure (TEE) - thermal effect of PA (EAT-exercise-associated thermogenesis ; and NEAT-non-exercise thermogenesis ) - accounts for a daily energy expenditure between 15-20% only (246-249), thereby maybe a poor single strategy to use for obesity prevention, which in fact should be used in conjunction with healthy dietary prevention measures alongside other factors. The other components of TEE are resting metabolic rate (70%) and thermic effect of food (~5-10%) (249). So it is usually 15-20% EE by PA (249) and this is just not a big enough ‘dose effect’ to impinge markedly on TEE (and therefore energy balance) (see Figure 7.1). Meaning PA is a relatively small (~15 -25%) contributor to TEE, especially compared to food intake which contributes 100% of total EI (249).

This implies dealing with a very small percentage of the total EE. While there may quite big differences within that, between extremes or range of the percentage (~15-
20%), most Fijian adolescents may have clustered around the middle so that there may only be a few percentage differences in EE from PA between most of the adolescents. This means that the ability to detect a difference in actual kJ/day between average high and average low PA kids will be weak (250, 251).

Second are the compensation issues and mechanisms that could explain the null findings. It is essential to understand the primary determinant of energy imbalance, especially the interaction between PA and diet, in relation to the regulation of body weight. Examples of these potential complex biological and behavioural compensatory responses to low PA and high SBB are discussed in the next few paragraphs.

\[ PA \rightarrow \text{compensated by non-measured PA} \]

Changes in measured PA are compensated for by other non-measured PA and/or dietary intake. This null finding could be due to compensation in PA variables (other PA that were not measured in Fiji OPIC project like, incidental activities/domestic duties in and around homes; and the questionnaire used did not find the right data) and/or it is during EI that most of the energy is being compensated for. Other measures like PE and energy expenditure were not measured, and students were not asked about their LTPA or domestic duties during weekends. All these unmeasured PA may have compensated for low levels of PA measured, hence giving a null finding with BMI-z.

For example, while adolescents might not have been active during school hours, they seemed to have compensated for this after school. The present study found out that
more adolescents (around 40%) had improved their activity behaviour after school (i.e. more students had actively took part cultural performance, dance, or active games or organised sports, dance) than those active during school hours.

Dale et al.’s study (252) in 2000 pointed out that if children are deprived of PA opportunities during school hours, it could be detrimental to their health. Their study supported some theoretical evidence by Rowland (253) who had hypothesised that children do tend to compensate for restricted periods activity in school by increasing PA levels at a later time. He further adds that when children are limited in PA opportunities, they might compensate due to an urge to stimulate the central nervous system, which in turn is mainly met by engaging in PA. However, Dale et al. point out that this urge can also be substituted by computer games instead of PA due to a drive for sensory stimulation. The authors raise concern over the impacts of cognitive play (i.e. computer games) ‘making up’ or replacing the physical play. They explain that when the children were restricted in their use computers, they were more restless than the days when they had full access to computers. Having said this, the research around amount of PA time spent being compensated for by computer games is sparse.

Dale et al. provided insight into several limitations that could help understand the issue of non-compensation finding in their study such as lack of enough severity of restriction in PA opportunities during the school day, and dietary and energy expenditure was not recorded. The time required to elicit compensation in PA was unknown, and it may be possible that compensation by PA occurs within shorter periods only. Moreover, Dale et al. speculate that restriction on EI could compensate for PA lost during a non-active day by increasing PA after school. Nevertheless,
more studies are needed in future on considering both the EI and expenditure side of the equation with relation to compensation. It would be wrong to assume that children do compensate for restricted PA during schools by other forms of PA after school only, which in turn could be substituted or replaced by EI or cognitive play. More evidence is needed in this area of research.

*Increased PA Æ compensated by high levels of energy Intake (EI)*

Moreover, high levels of PA may result in high levels of EI, which could then form an energy balance regulating the body weight, hence not showing any association with BMI-z in Fijian adolescent. Low levels of PA may not have the same effect on EI (or BMI-z). Anecdotal evidence suggests that Fijian adolescents may be increasing their food intake due to increased PA or energy expenditure in their daily lives. While adolescents still maintain that body weight and high levels of PA, they may also be increasing other food micronutrients like vitamins and minerals that drain with increased PA. However, this scenario may be well suited for lean adolescents.

Bleich et al. in their systematic review looked at the comparative influence of EI and EE among adolescents. They found out that based on existing evidence it is unclear what the main contributor of global patterns and trends on obesity are (247). Despite the complexity of several environmental, behavioural and social factors contributing to obesity, the key cause is that when EI surpasses EE, the outcome over prolonged period is excess unhealthy weight gain. The authors mention that even though modern-day unhealthy environment shapes adolescents unhealthy dietary and activity behaviour, their specific relative role in contribution to this epidemic is
largely debatable (247). This review (247), in 2012, states that while some studies reported that EI has been fairly stable and it’s mainly due to differences in energy expenditure and technological change (254-260) leading to higher rates of obesity, there are a number of others having contradicting views arguing that the high prevalence is largely due to excess caloric intake (261-266).

Echoing along the same lines, Melzer et al. (2005) in their paper raise two questions: ‘Does short-term exercise have the same effect on EI as long-term exercise?’; and ‘Does the eventual increase in food intake due to increased PA follow the same pattern in obese as in lean individuals?’ Likewise, the null findings in this study suggest the importance of having a clear understanding of PA on food intake for better health management approaches;

Increased PA $\rightarrow$ compensated by increased sedentary and SBB’s

In addition, this study may not have been sufficient changes in PA or SBB to show any association with body weight as seen in the results from this study. It may be due to a high proportion of individuals who were both physically active and at the same time had high SBB. For example, this study saw high proportion of adolescents who were both walking more than five times a week as well as had average total screen time of more than equal to two hours. Likewise as seen in this study, those adolescents who were physically active for more than three to five days a week after school also had a high average total screen time of more than equal to two hours. This finding is consistent with a 2013 systematic review by Middlebeek and Breda stating that in individuals can both have high SBB levels (including e-gaming) and high PA levels in one day (267)
Another possibility could be that there were changes in PA and SBB but they may be counted as normal changes within a daily routine in an individual. These could be counted as small changes in energy expenditure. For example, junk food advertising may be compensated for by advertisements related to active living and sports or sporting gear. That is, while there are advertisements regarding junk foods, there also advertisements on national TV showing healthy eating (e.g. reducing fat, heart blockage pictures), low sat and low sugar (diabetes amputation pictures) and active living advertisements such as walking for more than 30 minutes a day. Recently, Kleef et al. (268) in 2011 reported that exercise messages on TV have a powerful effect on both exercise and healthy eating behaviour. Their study revealed that when exposed to exercise commercials, participants had reductions in their EI in the meals that followed. Moreover, despite a higher rating of hunger, participants had restricted themselves from eating unhealthy after watching exercise benefits on TV commercials. This may be similar case with Fijian adolescents as well, in the sense that exercise messages on national TV may be outdoing the effects of junk food advertising on TV.

Moreover, SBB, which is mainly snacking while watching TV, may not be related to body weight due to lack of interest in locally made advertisements, switching channels or doing something else during advertisements. A report in Fiji showed that 30 per cent of adolescents usually switch channels during advertisements on TV (12).
5.4.4 Strengths and Limitations

As mentioned in chapter 4, the strengths in this study are its large numbers to detect important effect sizes and rich date set of two diverse ethnic groups living in the same physical environment; the reasonable follow up period (2y) is was enough to see changes in BMI-z in response to changes in behaviours, its longitudinal study design, the inclusion of several indictors of PA and SBB within the study. For additional and detailed strength of OPIC see section 4.4.5.

Some limitations in this study regarding the instrument (ABAKQ) used in Fiji OPIC project measured only a self-recall or self-report of small part of the total PA, that is, not all PA domains were measured using this instrument. Hence the association between the PA/SBB and change in BMI-z may not have fully captured the total PA levels in adolescents show any effect. For example, incidental activity at home was not measured and most of the adolescents may have been engaged in backyard gardening, weeding, digging or doing other household chores that also require energy expenditure. Majority of the literature reviewed had significant findings arising from self-reports as there have been far too many studies on self-reports than objectively measured studies. Many self-reports too have shown null findings. As for objectively measured predictors, the results have been mixed.

Moreover, unlike SBB variables measured for the last seven days, the activity behaviour measure in the questionnaire captures only during weekday activities that is more likely to reflect an individual’s long-term physically active lifestyle.
Furthermore, knowing that this study assessed the BMI-z changes over a 2-year period, it could be possible that the routine PA/SBB pattern is more predictive over a long-term period to show any changes in BMI-z. Ding et al. supports this statement as their four-year follow-up study (269) measuring active transport and TV viewing also could not show any changes in weight in that short period.

Although longitudinal design is a major strength, the results of this current study should be treated with caution and interpreted in the light of some limitations. The study instrument may not be that accurate due to errors (e.g. random and recall bias) to detect a large effect size, that is, the bluntness of the instrument may have allowed a low sensitivity to detect any changes in this study. PA and SBB measures may have been influenced by reporting biases.

In conclusion, the baseline or changes in behaviours did not predict changes in BMI-z (direct pathway hypothesis); nor did baseline BMI-z predict changes in behaviours (reverse pathway hypothesis). Potential explanations for these null findings include:

1. PA/SBB (the certain domains that were tested – not all domains were measured) is a weak determinant of energy balance, therefore BMI-z;
2. Changes in measured PA (and SBB) are compensated for other non-measured PA/SBB and/or dietary intake.

These findings reinforce the Study 1 conclusions that the BMI-z impact of PA programs are likely to be modest. Nevertheless, increasing PA has many proven health benefits and decreasing SSB may be beneficial (for TV but uncertain for e-
games) but expectations of the BMI-z impact of PA programs should be low and programs need to be evaluated.
Chapter 6: Study 3 – Cross-Sectional Analyses between E-Gaming and Psychosocial Problems

6.1 Introduction

The studies described in Chapters 4 and 5 examined cross-sectional and longitudinal associations between PA/SBB and BMI-z using the OPIC dataset among adolescents in Fiji. Overall, neither study 1 nor 2 showed any significant associations with BMI-z. Despite the lack of association of SBBs with BMI-z, there are concerns that some aspects of SBB – playing computer/video/electronic games (e-gaming) – may have other negative consequences.

This chapter describes the findings from a survey carried out in central Suva City, Fiji, which formed the third study for this thesis. Study 3 was built on findings from the two previous studies that a high proportion of adolescents were physically inactive and had high SBBs. Chapter 5 showed that of the 50 per cent who had changed their e-gaming behaviour, a third of the adolescents had worsened (increased frequency at follow up) their e-gaming behaviour over two years. But there are no specific studies carried out in Fiji that focused specifically on e-gaming behaviour and their associations with BMI-z. There have been, however, a couple of qualitative studies (see Chapter 2) focusing on snacking in front of the TV (128, 148) or ‘junk food’ advertisements on TV in Fiji (12).

The popularity of Internet cafes in Fiji is of particular concern (39). Internet services have been particularly popular in urban areas like Suva, Nadi and Port Denarau (40).
Data from 2009 showed that there were around 100,000 Internet subscribers (10) in Fiji, and this is likely to have increased considerably since then. The prevalence of e-gaming time (2 hours or more per day) in a sample of 7237 adolescents from OPIC baseline data in Fiji was about 40 per cent (15). Anecdotal evidence suggests that e-gaming in homes and the availability and popularity of Internet cafes (including 24-hour Internet cafes) and e-gaming parlours around Suva City as a hub are increasing.

Evidence from elsewhere has indicated that high screen time (including e-gaming time) may place adolescents at increased threat of a number of psychosocial issues including low self-esteem (16), low academic achievement (17), poor relationship with parents (18-22), low HRQoL (23), aggression and depression (24-28). The negative effects of violent video games are well documented from several RCTs (168-172), suggesting concerns that the increasing presence of violent e-games may be adding to aggressive behaviours among the youth. The strong positive association between aggression and violent video games has been well documented by reviewers (168, 169, 174-179).

Conversely, while it is widely known that e-games is mainly sedentary (unless it is an active video games), a review (180) of research on the positive effects of video game play by Granic et al. in 2013 reports that use of e-gaming may enhance children’s learning, social skills and even health. They report that playing video games can actually reinforce a variety of cognitive skills such as enhanced memory, spatial or visual navigation, increase in reasoning power and perception. They further reported that playing shooter video games enhanced children’s ability to think about objects in three dimensions, just as well as academic courses to enhance these same skills. This review suggests important implications for future education and career
development in utilising the variety of spatial skills for enhancement in science, technology, engineering and mathematics, and maybe in medical fields.

There is also other evidence of the learning benefits of e-games from some RCT’s, such as cognition (thinking, understanding, intellectual, and perception), decision-making, creativity, reasoning, problem-solving skills (180-183). Decreasing the time spent on violent video games may be beneficial to mental health either through health promotion approaches (e.g. campaigns around Internet cafes) or regulatory approaches (e.g. licensing requirements). Playing video games may also help children develop problem-solving and increase educational benefits (181, 184). The Granic et al. review (2013) reports that the more adolescents reported playing strategic video games, the more they improved in problem solving, creativity and school grades the following year (180). Children’s creativity was also enhanced by playing any kind of video game, including violent games, but not when the children used other forms of technology, such as a computer or cell phone, other research revealed. These reviewers also highlighted the possibility that video games may be effective tools to learn resilience in the face of failure. By learning to cope with ongoing failures in games, the review suggested that children build emotional resilience they can rely upon in their everyday lives.

Study 3, therefore, aimed to determine whether the sub-population of Fijian adolescents in Internet cafes in Suva City exposed to high e-gaming time were also at risk of psychosocial problems. It is important to do a preliminary study on the popularity of Internet and Internet parlours in Fiji to assess associations between e-gaming and its potential negative outcomes. The hypothesis was therefore that e-gaming is related to a number of psychosocial problems. To investigate this
hypothesis, this study was designed to examine the association between psychosocial problems and e-gaming in a sample of adolescents. Significant associations could either mean a direct (e-games causing problems), reverse (escaping these problems by playing more e-games) or common third-factor (that high e-games and psychosocial problems are related to third factors e.g. domestic strife) relationship. While many young people largely congregate in Internet cafes (39), this sub-population may or may not be at an increased risk of psychosocial problems than other teenagers with low levels of screen time.

The findings from this study are relevant as video games and game parlours rapidly increase in Fiji and other Pacific countries. As evidence on successful approaches within Fiji is lacking, this study will inform Fiji (and the Pacific region) on potential approaches to improve the effectiveness of intervention for adolescents, aiding policy development regarding Internet cafe access hours and effective social marketing strategies for children, parents and Internet cafes.

6.2 Methods

6.2.1 Aims

The aim of this study was to examine whether the sub-population of Fijian adolescents in Internet cafes in Suva City exposed to high e-gaming time were potentially at risk of psychosocial problems (low self-esteem, poor commitment to school, low academic achievement, poor relationships with parents, low HRQoL, depression and aggression).
6.2.2 Setting

This study was set in Suva City, which has a population of 172,399 (according to the 2007 census) including the Greater Suva urban area. Suva including nearby towns such as Nausori, Nasinu and Lami, has around 330,000 urban population that is more than a third of the country’s population (195). The population for children and adolescents aged between 10 and 19 years according to the 2007 census data was 66,215.

Internet cafes in Suva City were the most convenient setting as high school adolescents were seen in and around video game parlours and Internet cafes. Anecdotal evidence from Internet cafes operators suggested that many young people including high school children congregated in these cafes. In most cases, these Internet cafes had groups of people (e.g. youths, adolescents, young children) who were expected to facilitate identification of suitable participants for the study. This convenience sampling also helped the study to be centrally located around the study site where Internet cafes were largely concentrated in the central business district (CBD) of Suva City. Internet cafes housed within the CBD boundaries were identified from 2012 Fiji telephone directory. All were included as only 18 were found in the telephone directory.

Suva is largest and Capital city of Fiji. In recent decades, Suva has witnessed rapid technological advancements, including the availability and accessibility of Internet cafes and (video) gaming parlours. Hence, the potential significance of this study was the identification of a group of adolescents at Internet cafes in Suva City who were potentially considered at risk of psychosocial problems such as low self-esteem,
poor commitment to school, low academic achievement, poor relationships with parents, low HRQoL, depression and aggression.

6.2.3 Sample Size Calculation

In sampling, it is often more practical to randomise clusters or groups of people than doing so individually. However, cluster-based sampling requires accounting for a design effect due to similarities among participants within a cluster, hence reducing the variability of their responses. In this study, it would mean a loss in statistical power to detect a difference between high and low computer/video game users. Therefore, to maintain the power, an increase in sample size is required. This study used a cluster sampling method to obtain the required sample size.

6.2.3.1 Determining the Effect Size of Outcome

A cluster sampling method requires a hypothesised effect size of the outcome. In this study, given the hypothesis, based on previous literature (including OPIC Project work (62) in Fiji) that the effect size for a comparison of high and low computer game use on the outcome variable HRQoL was 0.4. Below is the formula for the effect size of the outcome variable (HRQoL), where the value of ES (0.4), mean of HRQoL (0.73) and SD (0.13) are already known from the Fiji OPIC study:

\[
ES = \frac{m1 - m2}{SD}
\]

Where, \(ES\) = Effect size

\(m1\) = Known mean of outcome variable

\(m2\) = Reduction in mean after exposure to predictor variable
(m1 – m2) = Mean difference

SD = Standard deviation

6.2.3.2 Determining the reduction in mean after high e-gaming behaviour

Hypothesis: that high e-gaming behaviour will reduce the known mean (m1) of HRQoL from 0.73 to a reduced mean (m2) in adolescents. The reduced mean (m2) is simply based on the hypothesis that high e-gaming behaviour will decrease the known mean (0.73) of HRQoL by some number (that is the difference in means) in adolescents. Therefore, to calculate the reduction in mean after hypothesised high e-gaming behaviour, m2 needs to be calculated by making it the subject of the above formula. The formula to calculate the reduction in mean outcome was:

\[ m2 = m1 - (ES*SD) \]

\[ = 0.73 - (0.4*0.13) \]

\[ = 0.68. \]

6.2.3.3 Determining the Mean Difference of Outcome

Having calculated the alternate mean as 0.68, the following formula can be used to calculate the mean difference in HRQoL units as 0.05:

\[ \text{Mean difference} = m1 - m2 \]

\[ = 0.73 - 0.68 \]

\[ = 0.05 \]
With all the required details, sample size was computed for two groups of high and low computer/video game users using the following four steps in STATA 11.0 statistical software:

**Step 1: Base Sample-size Calculation (USING STATA 11.0 software)**

Using all the information above, the following output was generated (see Table 6.1).

<table>
<thead>
<tr>
<th>Mean 1 HRQoL</th>
<th>SD1=SD2</th>
<th>Difference in HRQoL units</th>
<th>Mean 2 HRQoL</th>
<th>Alpha (α)</th>
<th>Power (1-β)</th>
<th>n1, n2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.73</td>
<td>0.13</td>
<td>0.02</td>
<td>0.71</td>
<td>0.05</td>
<td>0.8</td>
<td>664, 664</td>
</tr>
<tr>
<td>0.73</td>
<td>0.13</td>
<td>0.03</td>
<td>0.70</td>
<td>0.05</td>
<td>0.8</td>
<td>295,295</td>
</tr>
<tr>
<td>0.73</td>
<td>0.13</td>
<td>0.04</td>
<td>0.69</td>
<td>0.05</td>
<td>0.8</td>
<td>166,166</td>
</tr>
<tr>
<td>0.73</td>
<td>0.13</td>
<td>0.05</td>
<td>0.68</td>
<td>0.05</td>
<td>0.8</td>
<td>107,107</td>
</tr>
<tr>
<td>0.73</td>
<td>0.13</td>
<td>0.06</td>
<td>0.67</td>
<td>0.05</td>
<td>0.8</td>
<td>74,74</td>
</tr>
</tbody>
</table>

From the output produced a mean difference of 0.06 was considered feasible for this study (as opposed to the calculated mean difference of 0.05) and was selected (as bolded) as the base sample size needed in the four-step cluster sampling method. Therefore, base sample size (n) was equal to the sample size determined by software for the two groups, (74 + 74)148.

**Step 2: Design Effect**

The second step was to calculate the design effect (DE) (270) as below:

\[
DE = 1 + (n-1) \rho
\]

Where, \( n = \text{average cluster size} \)

\[ \rho = \text{Intra-cluster Correlation Coefficient (ICC) for the desired outcome} \]
\[ ICC = \text{Estimated mean scores (between subjects)} - MS (\text{within subjects}) \]

\[ Estimated \text{ mean scores (between subjects)} + MS (\text{within subjects}) \]

\[ \rho = 0.05 \text{ is the estimation of ICC using OPIC data (for HRQoL)} \]

The STATA calculations in Step 1 indicate that a total of \((74 + 74) = 148\) participants, giving an average cluster size of 15 for each of the 10 Internet cafes (thus making a total of 150 participants). Thus, \(\rho = .05\); average cluster size= 15, number of clusters = 10;

\[
DE = 1 + (15 - 1)0.05 \\
DE = 1 + 14(0.05) \\
DE = 1.7
\]

Correction for clustering was then calculated:

Adjusted (for DE) sample size = \(n \times DE\)

Where,

\[ n = \text{sample size determined by STATA} \]

\[ DE = \text{design effects} \]

\[ = n \times DE \]

\[ = 148 \times 1.7 = 251.6 \]

**Step 3: Contingency**

The sample is further increased by five percent to account for contingencies such as non-response or recording error.
n + 5% = 251.6 x 1.05 = 264.2 ~ 265

**Step 4: Distribution of Observations**

The calculated result was then rounded up to 270, which matches well with average cluster size (15). Having adjusted for design effect and accounting for contingency, with an average sample size of 15 per cluster, the number of clusters needed was: 270/15 per each cluster = 18 clusters needed. Thus there were 18 clusters, 15 samples in each Internet café, with 135 in each of the high and low e-game user group. The final sample size was therefore 270 adolescents from a cluster of 18 Internet cafes with 15 per each cluster.

**6.2.4 The Survey Questionnaire**

A paper-based survey questionnaire was used to obtain self-report information from adolescents. The questionnaire instrument, TWSQ, was developed in consultation with local advisors and research supervisors. It consisted of an introductory statement, a background information section and seven other sections pertaining to SBBs and psychosocial factors (see Appendix A).

The background information section included basic demographic questions on age, gender, ethnicity, form (year) level at school, residency status, as well as academic achievement, whereby participants self-reported the total marks achieved in their latest final or national exams they sat. Participants had the following choices to select
from: <200 marks; 201–250 marks; 251–300 marks; 301–350 marks; 351–400 marks; ≥401 marks.

In the first section, participants self-reported their time spent on SBB activities for each day of the week for a typical (school) week in hours/minutes. These questions were adapted from the ASAQ developed by Hardy et al. (271). The ASAQ assessed five domains of sedentary activities: small screen recreation, education, travel, cultural activities and social activities. Of these, only small screen recreation was retained, contributing three items (time spent on watching TV, playing e-games and browsing social networks) in this TWSQ instrument. Sedentary activities such as tuition, homework, reading and homework using computer were omitted as it was not considered to be screen-based leisure-time behaviour. The ASAQ instrument is a widely used measure of sedentary behaviours among adolescents and has a good reliability (test-retest r ≥ 0.70) and construct validity compared with accelerometers (271). The ICCs for the ‘small screen recreation’ domain was also found to be high (between 0.7 and 0.84 for Grades 8 and 10) (271).

The second section of the TWSQ focused on self-esteem, which was measured using the Self-Esteem – Rochester Youth Development Study Scale (test-retest r ≥0.78) that was originally developed by Rosenberg (272) and called the Rosenberg Self-Esteem Scale (272). The original instrument is a widely used measure of self-esteem among adolescents and has a good reliability (internal consistency: 0.92 and test-retest r = 0.85 and 0.88 over a period of 2 weeks) and predictive, concurrent and construct validity using known ethnic groups (272) and has also been validated for cross-cultural contexts (273). The Self-Esteem – Rochester Youth Development Study Scale consists of nine items where participants were asked to report on how
they felt about themselves. They used rating scale ranging from 1 (strongly disagree) to 4 (strongly agree). Example items included ‘At times you think you are no good at all’, and ‘You feel useless at times’.

The third section of the TWSQ measured adolescents’ commitment to school using the Commitment to School Scale from the Rochester Youth Development Study developed by Thornberry et al. in 1991 (274). The instrument is a widely used measure of commitment to school among adolescents and has been found to have good reliability (internal consistency: 0.81) and validity (274). It is a 10-item scale that asks about students’ views on the value of school work. The first nine items are measured using a four-point rating scale ranging from 4 (strongly agree) to 1 (strongly disagree). Example items include ‘You like school a lot’, ‘You usually finish your homework’ and ‘School is boring’. The last question had a slightly different scale. It asked participants if they could choose on their own between ‘studying to get a good grade on a test’ or ‘going out with their friends’ using the following four-point rating: 1- definitely go out with friends, 2 - probably go out with friends, 3 - probably study, 4 - definitely study.

The fourth section of the TWSQ focused on attachment to parents and was measured using Attachment to Parents - Seattle Social Development Project Scale, originally called the Family Attachment Scale by its developers, Arthur et al. (275). The instrument has been found to have both good reliability (internal consistency: 0.76) and valid measures of attachment to parents from adolescents from Grades 6 through 12 across various ethnic groups (275). The Family Attachment Scale consists of four items where respondents indicate their view of closeness with their parents using a four-point rating scale. Participants indicate how much they agree or disagree with
the statements or questions related to their parents by circling: ‘NO!’ if it is very false; ‘no’ if it is somewhat false; ‘yes’ if it is somewhat true; and ‘YES!’, if it is very true. Example items include ‘Do you feel very close to your mother?’ and ‘Do you share your thoughts and feelings with your father?’

The fifth section of the TWSQ measured depression as an outcome using the six-item Modified Depression Scale developed by Orpina in 1993 (276). This instrument has been widely used in studies (277-284) to measure depressive symptoms and has been found to have good reliability (internal consistency: 0.74) and validity. It is a self-report measure with questions answered on a five-point rating scale ranging from 1 (Never) to 5 (Always). Respondents indicate how they have been feeling during the past 30 days. Example items include ‘In the last 30 days, how often were you very sad?’ and ‘In the last 30 days, how often did you feel hopeless about the future?’

The sixth section of the TWSQ measured adolescents’ HRQoL. PedsQL™ is an instrument for adolescents (13-18 years) developed by Varni et al. (285) and it gives an overall measure of HRQoL. This self-report measure consists of 23 items answered on a five-point rating scale ranging from ‘never’ (1) to ‘almost always’ (5). This scale is divided into sub-domains of two core aspects of HRQoL called physical health (8 questions) and psychosocial health (15 questions). The psychosocial functioning is divided into emotional, social, and school functioning (5 questions each). Respondents self-report how much of a problem each one of the statements has been for them in the last month. Items include ‘In the last month, how much of a problem has this been for you …It is difficult for me to run’, ‘In the last month, how much of a problem has this been for you …I forget things’ and ‘In the last month, how much of a problem has this been for you …I feel sad’. This instrument has been
found to have good internal consistency reliability (Cronbach alphas of 0.88, 0.80, and 0.83 for the overall HRQoL Score, Physical Health Summary Score and Psychosocial Health Summary Score, respectively) and validity using known ethnic groups (285).

The last section of the TWSQ focused on aggression and was measured by a scale on beliefs about aggression and alternatives from the Multisite Violence Prevention Project (2004) adapted from Farrell, Meyer and White (286). It is a self-report measure that consists of 12 items (in 2 sub-domains called ‘beliefs about aggression’ and ‘use of non-violent strategies’) answered on a four-point rating scale ranging from 1 ‘Strongly agree’ to 4 ‘Strongly disagree’. The instrument is a widely used measure of student beliefs about the use of aggression and endorsement of nonviolent responses to hypothetical situations. Example items include ‘I feel big and tough when I push someone around’, ‘When my friends fight, I try to get them to stop’ and ‘If I get crazy with anger, it’s OK to hit someone’. This scale has been found to have both good reliability and validity (ref). The Cronbach alphas for the two domains are 0.72 (beliefs about aggression) and 0.72 (use of non-violent strategies).

**6.2.5 Participant Inclusion and Exclusion Criteria**

All adolescents between 13 and 18 years old and who use video/computer games for \( \leq 2 \) hours/day (low gaming group) or \( >2 \) hours/day (high gaming group) in Internet cafes in Suva City were included in the study. All participants who did not attend schools or were not living in Fiji (i.e. non-school students, non-residents) were excluded from the study.
6.2.6 Data Collection and Recruitment

All identified (through telephone directory) Internet cafes were approached by the Principal Investigator in person with a written letter for permission to conduct this study (Appendix B.1). All Internet cafes were included for recruitment once all the owners (or managers) had provided permission to carry out the study. Recruitment of participants occurred at the Internet cafes sites. The Principal Investigator approached and invited potential participants for the study. They were informed about the research study as outlined in the Plain Language Statement for Participants (Appendix B.4). When they indicated possible willingness to participate, their eligibility for inclusion was checked. The potential participants filled out a brief recruitment form indicating their interest by providing their names and contact details (Appendix B.2). The eligible participants also answered four brief questions to help the Principal Investigator screen the participants using the above-mentioned study inclusion criteria (age, school attendance and nationality). The screening process and the detailed participant recruitment process are presented in Figure 6.1. This screening process also ensured equal numbers of high versus low group numbers (that enabled a maximal chance of finding an effect difference into two groups of high (>2 hours/day) and low (≤2 hours/day) video/computer game users).

Those eligible were then given an envelope containing the Plain Language Statements for Parents and Participants (Appendices B.4 and B.5), consent/assent forms (Appendices B.6 and B.7) and the questionnaire to take home to their parents. A suitable time and date to call them was requested in the recruitment form.
The Principal Investigator then contacted the eligible participants via the telephone contacts provided in their recruitment forms after a week to ensure that the respondents including the parents/guardians understood the nature of their involvement in the project. This opportunity was also used to explain to the parents or guardians the consent processes and deal with any queries they had regarding this study. Since the eligible participants were 13-18 years old, one of the parents or guardians had to sign the Consent Form and each participant also had to sign an Assent Form before they could participate in the survey. All documents were provided in English as this is the main and official language used in Fiji for all national examinations. The literacy rate in Fiji is high and it was expected that all parents in Suva City would have adequate English language skills. A time to return the completed questionnaire and consent/assent forms to the Principal Investigator at the Internet cafe was then arranged. Upon returning the questionnaire at the Internet cafe, the participants received a pre-paid two-hour Internet voucher in appreciation for their time and effort in the survey.

6.2.7 Participants

A total of 252 participants were recruited out of the 290 students approached (20 extra were approached in addition to the initial 270 due to participants could not be followed (no responses, wrong contact details etc) up with their completed questionnaires) giving a response rate of 86.9%.
Figure 6.1: Participant Recruitment Plan Flow Diagram
6.2.8 Data Treatment and Manipulations

Raw data were cleaned through several variable checks, re-coding and data manipulations, using the STATA 11.0 statistical software. All outcome variables were tested for normality. The skewness /kurtosis (sktest score) tests were done using numerical methods in STATA software. All of these were normally distributed with p-values more than 0.05 in all cases. For all statistically significant results between e-gaming and seven outcomes in this study, Bonferroni correction method was applied to adjust for P-values.

6.2.8.1 Recoding Independent Variables (SBB variables)

All SBB variables were recorded in hours and minutes; hence all these were converted to minutes. In order to calculate average time spent on TV viewing, playing e-games and utilising social networks, all the time responses in minutes were summed for all the days (Monday to Sunday) then divided by seven. To calculate the average total screen time per day, the time responses from average TV viewing, playing e-games and using social networks were summed.
6.2.8.2 Recoding and Analysis of Dependent CATEGORICAL Variables

6.2.8.2.1 Academic Achievement

Participants self-reported the total marks achieved in their latest final or national exams they sat. Participants had the following choices to select from: <200 marks; 201–250 marks; 251–300 marks; 301–350 marks; 351–400 marks; ≥401 marks. These were dichotomised as: 0 - < 300 Final exam marks; 1 - ≥ 300 Final Exam Marks

6.2.8.3 Recoding, Scoring and Analysis of Dependent CONTINUOUS Variables

All scale-scoring calculations were according to the standard process provided for each scale. If a high score were given to high self-esteem, for example, and scores were low for a high outcome, standard criteria provided were to reverse all these coding (see sections on each study scale).

6.2.8.3.1 Self-Esteem

The Self-esteem Scale consisted of nine items where respondents were asked to report on how they feel about themselves using a four-point rating scale ranging from 1 ‘strongly disagree’ to 4 ‘strongly agree’. Each item was assigned a point value ranging from 1 to 4 in line with each response in the four-point rating scale. Items 2, 5, 6, 8 and 9 were reverse coded as a standard use of the tool; for example, if the value in the four-point rating scale was 2, then its reverse coding would be 3. The point values were then summed and divided by the total number of items (9) to
calculate an average self-esteem score. Higher scores indicated greater sense of self-esteem.

6.2.8.3.3 Commitment to School

The Commitment to School Scale consisted of 10 items where respondents were asked to report on their beliefs about the importance of school work using a four-point rating scale ranging from 1 ‘strongly disagree’ to 4 ‘strongly agree’. Items 1-9 were assigned a point value ranging from 1 to 4 to each response in the four-point rating scale. Point values for item 10 were assigned as follows: Definitely go out with friends = 1; probably go out with friends = 2; probably study = 3 and definitely study = 4. Items 2, 3, 4, 5 were reverse coded; for example, if the value in the four-point rating scale was 2, then its reverse coding would be 3. The point values were then summed and divided by the total number of items (10) to calculate an average commitment to school score. Higher scores indicated greater commitment to school.

6.2.8.3.2 Family Attachment

The Family Attachment Scale consists of four items where respondents self-reported their view of closeness with their parents using a four-point rating scale. Participants indicated how much they agreed or disagreed with the statements or questions related to their parents by circling: A ‘NO!’ if it was very false; ‘no’ if it was somewhat false; ‘yes’ if it was somewhat true; and ‘YES!’ if it was very true. The scoring point values were: YES! = 4; yes = 3; no = 2; NO! = 1. The point values for all four items are added. Higher scores indicated higher levels of parental/family attachment.
6.2.8.3.4 Depression

The Modified Depression Scale (276) consisted of six items where respondents self-reported how they had been feeling during the past 30 days using a five-point rating scale ranging from 1 (Never) to 5 (Always). The scoring point values were: Never = 1, Hardly ever = 2, Sometimes = 3, Often = 4 and Always = 5. The point values for all six items are added. Higher scores indicated more depressive symptoms.

6.2.8.3.5 Health-Related Quality of Life

The PedsQL™ consisted of 23 items where adolescents self-reported their HRQoL (285) or information on the physical, emotional, social and school functioning during the previous one month using a five-point rating scale from 1 (never) to 5 (almost always). Based on a five-point response scale for each item, these point values of 1 to 5 were summed and mean scores were calculated. These scores were then transformed into a 0 to 100 scale with a higher score representing better HRQoL. Three summary scores were calculated: a total HRQoL scale score, a physical health summary score, and a psychosocial health summary score. Other sub-domain scales scores were also computed as follows: physical functioning, emotional functioning, social functioning and school functioning. The total score was computed by averaging the responses from all 23 items. The psychosocial summary score was computed by averaging the responses from the individual items in the emotional, social, and school functioning scales. The physical health summary score was computed by averaging the responses from individual items in the physical functioning scale and is the same as the physical functioning score. Based on the developers’ recommendations and standard use of the tool (287), all the missing
items were accounted for in the computations. In cases where more than 50 per cent of the items in the scale were missing, the scale scores were not computed as per the scoring guidelines (287).

6.2.8.3.6 Beliefs About Aggression and Alternatives

The Beliefs about Aggression and Alternatives Scale (286) is a self-report measure that consists of 12 items answered on a four-point rating scale ranging from 1 ‘Strongly agree’ to 4 ‘Strongly disagree’. All items in this scale were reverse coded before adding. There were subscales: Beliefs about aggression (items 3, 4, 6, 10, 11, and 12) and use of non-violent strategies (items 1, 2, 5, 7, 8 and 9). The point values for the responses in these two sub-scales were added and then divided by the number of items in the subscale. A high score in the Beliefs about Aggression Subscale indicated a more favourable belief supporting the use of aggression while a high score in the ‘use of nonviolent strategies’ indicated a higher levels of support for using nonviolent strategies.

After all scoring analyses was completed, each of the SBB variables (computer/video game user groups, average TV viewing, average social network use, average total screen time) were modelled onto individual dependent psychosocial variables controlled for covariates such as age, gender, ethnicity and clustering by Internet cafes using MLR analyses.
6.2.9 Data Analysis and Interpretation

Data were analysed descriptively (means, standard deviations and proportions) and the association between SBB and psychosocial factors was investigated using the following statistical tests: Chi-square tests were used to find statistical differences between categorical variables while t-tests were used to assess differences in continuous variables; MLR for measures with continuous outcomes (for dependent continuous variables) and independent variables onto covariates such as age, gender, ethnicity and clustering by Internet cafes. Scatter plots and normality tests were also performed to account for any ceiling effects. Gender and closeness to parents were considered to have potential moderating effect on the association between aggression and e-gaming. Hence two interaction terms that were generated and tested as follows: gender * e-gaming; and closeness to parents * e-gaming. These interaction terms were insignificant with all p-values above 0.05. Data was analysed using statistical software called STATA. Table 6.2 provides the detailed analysis plan.
### Table 6.2 Analysis Plan of Various Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Data Type</th>
<th>Measuring Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health-Related Quality of Life (HRQoL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Physical health or functioning</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>• Psychosocial health or functioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Emotional functioning</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>o Social functioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o School functioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commitment to School</td>
<td>Continuous</td>
<td>Commitment to School – Rochester Youth Development Study Scale</td>
</tr>
<tr>
<td>Academic Achievement</td>
<td>Categorical</td>
<td>Question on last national exam result out of 400</td>
</tr>
<tr>
<td>Attachment to Parents</td>
<td>Continuous</td>
<td>Attachment to Parents–Seattle Social Development Project Scale</td>
</tr>
<tr>
<td>Aggression</td>
<td>Continuous</td>
<td>Beliefs About aggression and Alternatives Scale</td>
</tr>
<tr>
<td>Depression</td>
<td>Continuous</td>
<td>Depression Scale</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>Continuous</td>
<td>Self-Esteem – Rochester Youth Development Study Scale</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBB Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-gaming</td>
<td>Continuous</td>
<td>Modified ASAQ (Adolescents’ sedentary activities questionnaire)</td>
</tr>
<tr>
<td><strong>Covariates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Categorical</td>
<td></td>
</tr>
<tr>
<td>Ethnicity (iTaukei; Indo-Fijian; others)</td>
<td>Categorical</td>
<td></td>
</tr>
<tr>
<td>Cluster by Internet cafe</td>
<td>Categorical</td>
<td></td>
</tr>
</tbody>
</table>

**Notes.** Statistical tests
Means, SDs, Proportions
Multiple linear regression for measures with continuous outcomes: DV [continuous] IVs with CVs [Age, gender, Ethnicity, cluster by Internet cafe]
Binary logistic regression for measures with categorical outcomes: DV [categorical] IVs with CVs [Age, gender, Ethnicity, cluster by Internet cafe]
6.2.10 Ethical Considerations

This study was granted ethical approval from the FNRERC (reference no. 201260) and the DUHREC (reference no. 2012-259).

6.3 Results

The response rate was 86.9 per cent. Table 6.3 shows the descriptive characteristics of participants by computer/video game users. Overall, the mean age of adolescents was 16.6 years and almost three-quarters were males. Two-thirds of the sample was iTaukei. In addition, of the total 252 adolescents, two out of five students had a membership at an Internet cafe. There were significant differences (P<0.05) between high and low computer/video game users for gender, membership at Internet cafes, TV viewing, use of social networks, and total screen-time behaviour.

Table 6.4 shows the basic psychometric descriptors of the psychosocial outcomes using the TWSQ for SBBs and psychosocial outcomes reporting Cronbach’s alpha. Overall findings for all scales, the Cronbach’s alpha values calculated in this study were similar to those of the developers.

Table 6.5 shows the unadjusted means of psychosocial outcomes by e-game users. High e- game users had a significantly higher mean aggression score (including a higher mean score for beliefs about aggression) than those of low e- game users.

Table 6.6 shows adjusted beta coefficients of associations between e- game users and psychosocial outcomes and partial r-squared values to demonstrate strength of
associations and overall model characteristics. The high e-gaming group was significantly associated with a higher aggression score (and higher beliefs about aggression score) than those in the low e-gaming group. An unexpected finding was that the high e-gaming group were significantly associated with a higher academic achievement score than those in the low e-gaming group.
Table 6.3: Descriptive Characteristics of Participants by E-Game Users

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All</th>
<th>E-game users (avg. minutes/day)</th>
<th>E-game users (avg. minutes/day)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>High (≥ 120 avg. mins/day)</td>
<td>Low (&lt; 120 avg. mins/day)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-game users</td>
<td>e-game users</td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>252 (100)</td>
<td>126 (50)</td>
<td>126 (50)</td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
<td></td>
<td>0.1257</td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>16.6± 1.7</td>
<td>16.5± 1.7</td>
<td>16.8 ± 1.7</td>
<td></td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(16.4-16.8)</td>
<td>(16.2-16.8)</td>
<td>(16.4-17.1)</td>
<td></td>
</tr>
<tr>
<td>Gender, n (%)</td>
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<td></td>
<td></td>
<td>0.021</td>
</tr>
<tr>
<td>Males</td>
<td>188 (74.6)</td>
<td>102 (54.3)</td>
<td>86 (45.7)</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>64 (25.4)</td>
<td>24 (37.5)</td>
<td>40 (62.5)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.066</td>
</tr>
<tr>
<td>iTaukei</td>
<td>173 (68.7)</td>
<td>78 (45.1)</td>
<td>95 (54.9)</td>
<td></td>
</tr>
<tr>
<td>Indo-Fijians</td>
<td>22 (8.7)</td>
<td>14 (63.6)</td>
<td>8 (36.4)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>57 (22.6)</td>
<td>34 (59.7)</td>
<td>23 (40.3)</td>
<td></td>
</tr>
<tr>
<td>Membership at Internet cafe, n (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Yes</td>
<td>105 (41.7)</td>
<td>68 (64.8)</td>
<td>37 (35.2)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>147 (58.3)</td>
<td>58 (39.5)</td>
<td>89 (60.5)</td>
<td></td>
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<tr>
<td>Form level at school, n (%)</td>
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<td></td>
<td>0.501</td>
</tr>
<tr>
<td>Form 3</td>
<td>32 (12.7)</td>
<td>12 (37.5)</td>
<td>20 (62.5)</td>
<td></td>
</tr>
<tr>
<td>Form 4</td>
<td>39 (15.5)</td>
<td>20 (51.3)</td>
<td>19 (48.7)</td>
<td></td>
</tr>
<tr>
<td>Form 5</td>
<td>51 (20.2)</td>
<td>27 (52.9)</td>
<td>24 (47.1)</td>
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<td>Form 6</td>
<td>47 (18.7)</td>
<td>27 (57.5)</td>
<td>20 (42.6)</td>
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<tr>
<td>Form 7</td>
<td>83 (32.9)</td>
<td>40 (48.2)</td>
<td>43 (51.8)</td>
<td></td>
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<tr>
<td>Avg. TV viewing behaviour, mins/day</td>
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<td></td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>150.6 ± 99.6</td>
<td>188.2± 108.6</td>
<td>113.0 ± 72.8</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at p < 0.05
<table>
<thead>
<tr>
<th></th>
<th>(95% CI)</th>
<th>(Mean ±SD)</th>
<th>(Mean ±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Avg. e-gaming behaviour, mins/day**</td>
<td>(138.2-163.0)</td>
<td>143.3 ± 127.8</td>
<td>232.5 ± 124.8</td>
</tr>
<tr>
<td></td>
<td>(169.1-207.3)</td>
<td>(210.5-254.5)</td>
<td>(210.5-254.5)</td>
</tr>
<tr>
<td>Avg. Social network browsing behaviour, mins/day</td>
<td>0.000</td>
<td>126.0 ± 114.9</td>
<td>164.4 ± 126.7</td>
</tr>
<tr>
<td></td>
<td>(111.7-140.2)</td>
<td>(142.1-186.7)</td>
<td>(142.1-186.7)</td>
</tr>
<tr>
<td>Avg. Total screen time behaviour, mins/day</td>
<td>0.000</td>
<td>419.9 ± 275.5</td>
<td>585.1 ± 275.1</td>
</tr>
<tr>
<td></td>
<td>(385.7-454.0)</td>
<td>(536.6-633.6)</td>
<td>(536.6-633.6)</td>
</tr>
</tbody>
</table>

*Standard deviation (SD);
† 95% confidence interval (95% CI);
‡ Significant results (p < 0.05) are bolded. T-test were used for continuous measures while chi-square tests for categorical variables.
Table 6.4: Basic Psychometric Descriptors of Psychosocial Outcomes Variables

<table>
<thead>
<tr>
<th>Existing psychosocial tools used</th>
<th>Possible Score ranges</th>
<th>Total items</th>
<th>Mean ± SD</th>
<th>Cronbach’s alpha**</th>
<th>Cronbach’s alpha***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosenberg Self-Esteem Scale</td>
<td>1-4</td>
<td>9</td>
<td>2.8± 0.4</td>
<td>0.78</td>
<td>0.56</td>
</tr>
<tr>
<td>Modified Depression Scale</td>
<td>6-30</td>
<td>6</td>
<td>16.3± 3.7</td>
<td>0.74</td>
<td>0.59</td>
</tr>
<tr>
<td>‘Attachment to Parents-Seattle Social development Project’ Scale</td>
<td>4-16</td>
<td>4</td>
<td>11.4± 2.8</td>
<td>0.76</td>
<td>0.68</td>
</tr>
<tr>
<td>‘Commitment to School-Rochester Youth Development Study’ scale</td>
<td>1-4</td>
<td>10</td>
<td>3.1± 0.5</td>
<td>0.81</td>
<td>0.78</td>
</tr>
<tr>
<td>‘Beliefs about aggression and alternatives’ scale</td>
<td>1-4</td>
<td>12</td>
<td>2.6± 0.4</td>
<td>0.72</td>
<td>0.76</td>
</tr>
<tr>
<td>-beliefs about aggression scale</td>
<td>1-4</td>
<td>6</td>
<td>2.3± 0.7</td>
<td>0.72</td>
<td>0.76</td>
</tr>
<tr>
<td>-use of non-violent strategies scale</td>
<td>1-4</td>
<td>6</td>
<td>3.0± 0.5</td>
<td>0.72</td>
<td>0.55</td>
</tr>
<tr>
<td>PedsQL™ (Pediatric Quality of Life)*</td>
<td>1-100</td>
<td>23</td>
<td>72.1± 16.0</td>
<td>0.88</td>
<td>0.90</td>
</tr>
<tr>
<td>-physical scale</td>
<td>1-100</td>
<td>8</td>
<td>78.8± 19.0</td>
<td>0.80</td>
<td>0.83</td>
</tr>
<tr>
<td>-emotional scale</td>
<td>1-100</td>
<td>5</td>
<td>64.8± 20.9</td>
<td>0.83</td>
<td>0.75</td>
</tr>
<tr>
<td>-social scale</td>
<td>1-100</td>
<td>5</td>
<td>75.1± 21.1</td>
<td>0.83</td>
<td>0.79</td>
</tr>
<tr>
<td>-school scale</td>
<td>1-100</td>
<td>5</td>
<td>66.3± 19.9</td>
<td>0.83</td>
<td>0.74</td>
</tr>
<tr>
<td>Modified ASAQ (adolescents sedentary activities questionnaire)</td>
<td>-</td>
<td>3</td>
<td>419.9± 275.5</td>
<td>0.7-0.84</td>
<td>0.72</td>
</tr>
</tbody>
</table>

† Scores from lowest to highest
*Inventory for adolescents (13-18 years)
**Cronbach’s alpha in the original scale
***Cronbach’s alpha in this study population
Table 6.5: Unadjusted Means and Proportions of Psychosocial Outcome Variables by E-Game Users

<table>
<thead>
<tr>
<th>Characteristics of psychosocial outcomes</th>
<th>E-game users (avg. minutes/day)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High (≥ 120 avg. mins/day) e-game users</td>
<td>Low (&lt; 120 avg. mins/day) e-game users</td>
</tr>
<tr>
<td>Self-Esteem score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>2.8± 0.4</td>
<td>2.8± 0.4</td>
</tr>
<tr>
<td>(95% CT)</td>
<td>(2.7-2.9)</td>
<td>(2.7-2.8)</td>
</tr>
<tr>
<td>Depression score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>16.3± 3.8</td>
<td>16.4± 3.7</td>
</tr>
<tr>
<td>(95% CT)</td>
<td>(15.6-17.0)</td>
<td>(15.7-17.0)</td>
</tr>
<tr>
<td>Attachment to parents score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>11.4± 2.9</td>
<td>11.5± 2.7</td>
</tr>
<tr>
<td>(95% CT)</td>
<td>(10.8-11.9)</td>
<td>(11.0-12.0)</td>
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<tr>
<td>Commitment to school score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>3.1± 0.5</td>
<td>3.2± 0.5</td>
</tr>
<tr>
<td>(95% CT)</td>
<td>(3.0-3.2)</td>
<td>(3.1-3.3)</td>
</tr>
<tr>
<td>Academic Achievement, n (%)</td>
<td></td>
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</tr>
<tr>
<td>&lt;200 marks</td>
<td>2 (20.0)</td>
<td>8 (80.0)</td>
</tr>
<tr>
<td>201-250 marks</td>
<td>11 (44.0)</td>
<td>14 (56.0)</td>
</tr>
<tr>
<td>251-300 marks</td>
<td>28 (41.2)</td>
<td>40 (58.8)</td>
</tr>
<tr>
<td>301-350 marks</td>
<td>34 (54.0)</td>
<td>29 (46.0)</td>
</tr>
<tr>
<td>351-400 marks</td>
<td>28 (59.6)</td>
<td>19 (40.4)</td>
</tr>
<tr>
<td>&gt;401 marks</td>
<td>22 (59.5)</td>
<td>15 (40.5)</td>
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<tr>
<td>Aggression score</td>
<td></td>
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</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>2.7± 0.5</td>
<td>2.6± 0.4</td>
</tr>
<tr>
<td>(95% CT)</td>
<td>(2.6-2.8)</td>
<td>(2.5-2.7)</td>
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<tr>
<td>-beliefs about aggression scale</td>
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<td></td>
</tr>
<tr>
<td>(Mean ±SD*)</td>
<td>2.4± 0.7</td>
<td>2.2± 0.7</td>
</tr>
<tr>
<td>(95% CT)</td>
<td>(2.3-2.6)</td>
<td>(2.1-2.3)</td>
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<tr>
<td>-use of non-violent strategies scale</td>
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</tr>
<tr>
<td></td>
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<td>0.3333</td>
</tr>
<tr>
<td></td>
<td>Mean ±SD*</td>
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<tr>
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<td>-----</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
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<tr>
<td>Total Health-Related Quality of Life Score</td>
<td>2.9± 0.5</td>
<td>(2.9-3.0)</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
<td></td>
</tr>
<tr>
<td>Physical Health Summary Score</td>
<td>71.8± 16.0</td>
<td>(69.0-75.0)</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
<td></td>
</tr>
<tr>
<td>Psychosocial Health Summary Score</td>
<td>78.7± 19.0</td>
<td>(75.3-82.0)</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
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<tr>
<td>-emotional scale</td>
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<td>(65.1-71.1)</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
<td></td>
</tr>
<tr>
<td>-social scale</td>
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</tr>
<tr>
<td></td>
<td>(95% CI)</td>
<td></td>
</tr>
<tr>
<td>-school scale</td>
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<td>(70.1-78.0)</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
<td></td>
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</table>

* Standard deviation (SD); † 95% confidence interval (95% CI); ‡ Total aggregated marks scored by participants in their last Final/National examination sat at school; †† Existing tools used; linear regression analyses were performed on continuous dependent variables; ‡‡ sub-scale score within the tool used.

Significant results, p < 0.05 are bolded.
<table>
<thead>
<tr>
<th>Psychosocial outcomes</th>
<th>High (≥ 120 avg. mins/day) e-game users</th>
<th>Adjusted version of $R^2$</th>
<th>SE</th>
<th>P-Value</th>
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<tr>
<td></td>
<td><strong>Squared semi partial correlation effects</strong></td>
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<td></td>
<td>β (95% CI)</td>
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<tr>
<td>Academic achievement (≥ 300 Final Exam Marks)**</td>
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<td>0.0002</td>
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</table>

*Reference group in this model are the “low e-gamers”; Model adjusted by age, gender, ethnicity, and clustering by Internet cafes.
** Total marks scored by participants in their last Final/National examination (out of 500 marks) sat at school dichotomised as ‘0’ <300 Marks and ‘1’ ≥300 marks

***Binary logistic regression analysis was used to report coefficients (instead of odds ratio) even though the dependent variable is a dichotomised categorical variable

†Existing tools used. Multiple linear regression analyses were performed on continuous dependent variables

-Sub-scale score within the tool used: Significant results, p < 0.05 are bolded
6.4 Discussion

This study was conceptualised from findings arising from Studies 1 and 2 – PA and SBB having few associations with body weight – and aimed to determine whether a sub-population of Fijian adolescents in Internet cafes in Suva City exposed to high e-gaming were potentially at higher risk of psychosocial problems than in the low e-gaming group. Overall, there were no differences between groups for most of the outcomes assessed. There were, however, two significant findings with the high e-gaming group having higher aggression scores and higher academic achievement scores.

The lack of associations between e-gaming and scores on most psychosocial scales surprisingly did not match with similar studies from the literature (41, 97, 242). For example, scores for depression, self-esteem and relationships with parents and HRQoL were not found to be significant in this study. The two significant differences between groups could be a true cause and effect relationship, a self-selection bias or could be associated through common third factor. There is evidence from the literature to support somewhat likely both sets (positive and negative effects) of explanations of the effects of e-gaming. The literature very likely supports the negative psychosocial effects (aggression) from e-gaming in this study. On the other hand, the literature somewhat likely supports educational benefits of e-gaming as well. However, the significant findings in this Fiji study could be due to self-selection bias (i.e. more aggressive students are more attracted to playing violent video games and those who are doing well academically are more attracted to playing e-games) or it could be a true cause-and-effect relationship as found in the literature (i.e. violent e-games promote aggression and e-games in general promote
better achievements academically). This thesis does give an indication that cognitive benefits have somewhat likely links to e-gaming despite results from this study not being representative. Moreover, this study was a cross-sectional study design which is why this study could not distinguish between these possibilities but the other studies in the literature might be able to do so.

The findings from this study of high levels of e-gaming time being positively associated with aggression well supported by the literature. The negative effects of violent video games are well documented from several RCTs (168-172), so the association found in the Fiji study are of concern that the increasing presence of violent e-games may be adding to aggressive behaviours among Fijian youth. The strong positive association between aggression and violent video games have been well documented by reviews (168, 169, 174-179) elsewhere. This positive finding in this study is similar to finding from reviews (168, 169, 174-179) internationally.

Conversely, while it is widely known that e-games is mainly sedentary (unless it is an active video games), a review (180) of research about beneficial effects of e-gaming by Granic et al. in 2013 reports that use of e-gaming may enhance children’s learning, social skills and even health. This review contained some RCTs to support some of the cause and effect relationship arising from this study. They report that playing e-games can actually reinforce a range of cognitive skills such as enhanced memory, spatial or visual navigation, increase in reasoning power and perception. They further reported that playing shooter video games enhanced children’s ability to think three dimensionally about objects which could aid in academic achievement in school. This review supports the finding of this study and may have important implications for future education and career development in utilising the variety of
spatial skills for enhancement in mathematics, engineering, medical and science and technology fields.

There is also other evidence of the learning benefits of e-games from some RCT’s, such as cognition (thinking, understanding, intellectual, and perception), decision-making, creativity, reasoning, problem-solving skills (180-183). Decreasing the time spent on violent video games may be beneficial to mental health either through health promotion approaches (e.g. campaigns around Internet cafes) or regulatory approaches (e.g. licensing requirements). E-gaming may also enhance problem solving skills in children and increase educational benefits (181, 184). Granic et al. review (2013) reports that the more adolescents reported playing strategic video games, the more creative they became along with enhanced problem solving skills and better grades in school the following year (180). Granic and colleagues further reported in their review that e-games may become an influential tool to overcome student facing failures in all aspects of life. They report, students learn to cope with repeated failures in during e-game play and hence develop an emotional resilience that can be helpful in their daily life.

Also, while the negative effects of violent video games are well documented (168, 169, 174-179), aspects of cognition, decision-making, creativity, reasoning, problem-solving skills (that help academic performance) are some learning benefits (180, 181, 184-186) of playing e-games that has emerged in the last 5 years and is much debated (170).

The findings of high e-games indicating better performance academically in this study is in line with the literature from various reviews (168, 169, 174-179) however
the quality and level of evidence obtained in the last few years were form some RCTs only. Also it is important to highlight that this finding in present study comes from a cross-sectional unrepresentative sampled study and an advanced study design like a RCT would elucidate more information in Fiji. Thus, more evidence is needed to match the level from such trials presented in the current reviews (180, 184).

Strengths and Limitations

Strengths in this study are the well validated tools used in several studies in the literature, high response rates, wide separation in e-game time between the 2 groups, several ethnic groups. Moreover, the lack of representativeness in this study still does nothing to discount the internal validity of the findings – while they may not be representative of the whole Fijian population they probably are pretty representative of the e-gaming population (few places with video parlours, not wide home e-game use, all Suva video parlours included, high response rate).

Even though literature suggests links between e-gaming and aggressive behaviour and recent links between educational benefits and e-gaming, evaluation of possible methodological errors in the literature cannot be ignored in those findings. This study was designed and executed perfectly even though the results are showing some uncertainty with the literature. While the significant findings in this study – aggression score positively associated with high e-gaming time – is similar to international literature, there could be a possibility that these positive findings maybe a result of adolescents playing games violent in nature, a trait available in adolescents prior to the exposure to these violent video games or a mixture of these with many other factors not measured. This mean it could be due to self-selection
bias (i.e. more aggressive students are more attracted to playing violent video games and those who are academically doing well are more attracted to playing e-games) or they both could be associated with a common third factor (similar to self-selection bias but not totally – e.g. higher income household may be able to afford both better schooling and more video gaming) or it could be a true cause and effect relationship (i.e. violent e-games promote aggression and e-games in general promote better achievements academically). Evidence from other studies (288, 289) also highlights similar results as could be the case with the findings from this study.

Another limitation was that the sample being unrepresentativeness of the general Fijian population. Moreover, the findings reported in this study maybe subject to participants’ recall biases of their activity behaviours. Also, it may be subject to biases due to social desirability where adolescents may not be keen to respond to questions regarding depression and aggression, self-esteem and academic achievement among other psychosocial problems. Also, participants may have over or under estimated the hours they had actually spent on e-gaming.

Nevertheless, the totality of the results is that there are mainly no associations and of the significant associations, one is potentially good and one is potentially bad. Both these results are supported by literature and they do provide an important insight into mental health issues for health professionals to be aware of these potentially important effects of e-gaming. More robust long term trials and evaluation of policy intervention is warranted. However, educational benefits being a new phenomenon, future research particularly from more randomised controlled trials is necessary. Moreover, future research could look at the type of video game genres–such as
action, adventure, role playing, driving, simulation, and puzzle – to find which genres provide more harms than benefits.

Overall, whether the harmful effect outweighs the beneficial effects of e-gaming remains unclear. However, communicating to Internet cafe owners and parents is important. This can be either through policy in Internet cafes or through educational materials in schools is important. That is, these current state of knowledge needs to be effectively communicated with school children and their parents; to Internet cafe owners and policy makers through educational materials, licensing, warning, age restrictions to name a few that could be applied.

Therefore, these findings appear to be real (for at least academic achievement scores as adjusted p-value after Bonferroni correction also gave significant results) and somewhat likely to be supported by the RCTs in the literature. However, when the other major fining was adjusted for p-value, it did not produce significant results, meaning aggression score may have simply concurred just by chance. Therefore in general these results should be treated with a little caution as even though there are statistically significant results it perhaps can be of very least clinical importance.

Nevertheless, moderation in e-gaming can help counter the well-established harms of e-gaming over its emerging learning, health and social benefits. This can be done certainly around communication of the results, perhaps around government or parlour policies/licenses and certainly around where future research needs to head and acted upon.
Chapter 7: Overall Implications and Conclusions

7.1 Introduction

This thesis offers important insights into PA, SBB, obesity and psychosocial problems among adolescents in Fiji. This chapter summarises the findings of the three studies, draws their conclusions together and places them in the context of the existing literature. It also discusses the strengths and weaknesses of the studies, their overall implications for understanding the role of PA and SBB in obesity and psychosocial outcomes and their translation into policy and practice.

7.2 Summary of Main Findings

The main findings of each study are summarised in this section, addressing the three main research questions outlined in Table 1.2.

Study 1 was a cross-sectional analysis of a large sample of adolescents in Fiji, which examined their PA and SBB patterns and associations with BMI-z. Almost a quarter (24%) of the study participants was overweight/obese with significant differences between ethnicity (iTaukei 34%, Indo-Fijians 15%) and gender (males 20%, females 28%). PA levels among iTaukei and males were high after school but low during school recess and lunch breaks. Among Indo-Fijians and males, total screen time was high. Physical inactivity during recess was associated (p< 0.05) with higher BMI-z. Other behavioural activities, including total screen time had no significant
association with BMI-z for all adolescents. Overall, there were unhealthy
behavioural activity patterns in this sample. Despite these poor PA and SBB patterns,
there were few associations with BMI-z and little compelling evidence that PA and
SBB have a major impact on obesity rates in Fiji.

Study 2 explored the longitudinal associations between PA and SBB in a large
sample of adolescents in Fiji. It examined whether the baseline behaviours or
changes in PA and SBB predict changes in BMI-z, and whether there is a reverse
causal pathway of baseline BMI-z predicting changes in PA and SBB. Follow-up
analysis showed about 40–80 per cent of adolescents had changed PA and SBB.
However, a mixed pattern of behavioural changes was seen. For example, more
adolescents worsened rather than improved in e-gaming time (33% v. 23%), and
activity during lunch break (24% v. 17%). None of the longitudinal analyses showed
any significant associations between behaviours and BMI-z: the baseline behaviours
or changes in PA and SBB did not predict changes in BMI-z (direct pathway
hypothesis); nor did baseline BMI-z predict changes in behaviours (reverse pathway
hypothesis).

Study 3 examined the cross-sectional associations between e-gaming and
psychosocial problems (e.g. low self-esteem, poor commitment to school, low
academic achievement, poor relationships with parents, low HRQoL, depression and
aggression). In a sample of 252 Fijian adolescents from Internet cafes in Suva city,
this study found high levels of e-gaming time to be positively associated with
aggression and academic achievement score. High e-game users (≥ 120 mins/day)
had higher academic achievement (p<0.005) and higher aggression scores (p<0.05)
compared to low e-game users (<120 mins/day). There were no differences in scores
for self-esteem, commitment to school, relationships with parents, HRQoL or depression.

7.3 Contextualising this Research: Evidence from Other Studies

7.3.1 The Extent of the Problems in Fiji

The problem of obesity has been known in the Pacific and Fiji (53, 57, 150, 151) for some time and the patterns of higher prevalence among iTaukei and among women have been well described. Fiji has a large young population (82) and like many other Pacific Island countries, the obesity rates among children and adolescents have escalated over the years (see Section 2.7), and effective prevention strategies are needed especially during adolescence. Only about 20% (during school breaks) and 40% (after school) of the adolescent studied in this PhD are physically active and this is similar to comparisons with other surveys in Fiji, other Pacific and international prevalence patterns (53, 57, 150, 151). That is, Fijian adolescent’s inactivity rates are high and comparable with other adolescents in NZ and other Pacific Island countries.

Fiji, like the rest of the world, has been experiencing changes in lifestyles with an advancement in technology in the last decade (155) As noted in Chapter 2, TV in Fiji started only 20 years ago but since then there are many pay TVs with multiple channels. Computers, Internet service providers and smart phones have also become more accessible in Fiji. The wide availability of TV, computers and mechanised transport, which reflect a rapid shift towards reduced PA, as well as changes in SBB patterns, would logically be expected to be contributing to the increase in obesity in Fiji, but this PhD found no supporting evidence for this (see Section 2.7).
The prevalence for e-games and average total screen-time in this studies 1 and 2 of this PhD is high (67%) and is comparable to studies done in Australia, New Zealand and Tonga under the Pacific OPIC project. However the prevalence of e-games in study 3 of this PhD cannot be generalised to the whole of Fiji since this study did not have a representative sample and the gaming parlour are concentrated in only a few areas in Fiji. Fijian adolescents are certainly following closely behind their counterparts in wealthier countries in picking up e-games as a major pastime.

Fijian national guidelines have recommended that children and adolescents should engage in at least 30 minutes of moderate intensity PA or complete 10,000 steps per day to maintain a healthy weight (109). However, there are no proper guidelines for screen exposure in Fiji (35). While PA is independent of SBB, both activities have many common antecedents (such as playing non-active video games or prolonged hours of watching TV or not participating in P.E classes at school, among many others) which are contributors to obesity epidemic (29, 35, 112, 162-164).

PA and SBB also play important roles on mental health apart from obesity, as noted in Section 2.3. Mental health has an effect on individuals’ ability to discover their own worth and be able to handle stress. Also, to be able to work productively industriously, and effectively in their community (94). First, the size of the youth mental health problem is significant in Fiji, particularly noting low mental health quality of life. The average HRQoL scores (73 in a 0-100 scale) reported in Fiji OPIC study (290) is hugely lower than in countries like US, UK, Brazil, Norway, Australia and many others (being 5 to 15 points lower than 13 comparison countries ) but similar to Tonga (70 in a 0-100 scale) (291). The average HRQoL scores (71.8
in the high e-gaming group versus 72.7 in the low e-gaming group) measured in the e-games study in this PhD is similar to that of the Fiji OPIC study, which was somewhat more representative than study 3 in this PhD. Second, when comparing some of the other psychosocial factors, youth suicide rates (and thus mental health problems) is high in Fiji (292-294). Western Pacific Region, including Fiji and Western Samoa, have higher suicide rates than the rest of the world (295). When both the high suicide and low mental health quality of life problems are combined together, it poses a high concern for real mental health issues for adolescents in Fiji and the LMICs.

According to WHO reports, almost 50 per cent of mental problems begin before the age of 14 and around 20 per cent of children and adolescents have mental disorders globally. The LMICs are affected the most where many under-19 year olds have minimum access level to mental health resources. Not only this, LMICs have only one psychiatrist to every one to four million in the population according to the WHO report (94). While there is a vast growing body of evidence on levels PA and SBB in high income countries, the Pacific OPIC Project has helped to contribute information and insights in this area in LMICs like Fiji. The Pacific OPIC Project was the first to investigate PA, SBB and obesity in Fijian adolescents and this study reported on these patterns and associations with BMI-z (see examples of specific studies in Section 2.7). This complements other studies in Fiji on the socio-cultural aspect of dietary behaviour, PA and body image (157-161). This thesis has delved deeper around cross-sectional and longitudinal associations in Fiji.
7.3.2 Associations between PA/SBBs and BMI-z

Evidence from cross-sectional studies sometimes shows a association between PA/SBB and BMI-z, but longitudinal studies only occasionally show a association. Very few studies examine the potential association of reverse causation (i.e. having a high BMI stimulates behavioural action to increase PA and decrease SBBs). Most evidence arising RCTs from various systematic reviews (296-300) showed that PA is associated with body weight. However PA made little effect on body despite it having other beneficial effects (298) on mental, bone and overall health. RCTs of PA alone on BMI generally show a weak long-term effect but much of that is attributed to compliance with the programs – which means if people do the increased exercise it has some effect on body weight but maintaining PA programs is a challenge.

So what might explain the null findings between PA and SBB and body weight in Studies 1 and 2? The first consideration is whether the null findings are real or whether it is masked by measurement tools that are too blunt to measure PA and SBBs accurately enough. The assumption is that the null association is real and not just measurement bluntness as these tools were sensitive enough to find differences as other studies (14, 301) which have found differences between groups using these tools. Also, the sample size was certainly adequate enough to detect even modest associations if they were present.

Thus, if the null findings are real, the two potential explanations are that differences in PA and SBBs across this adolescent population have a relatively weak impact on overall energy expenditure or that behavioural or metabolic compensatory responses may have occurred in response to changes in PA. Physical activity also changes TEF.
and BMR, and therefore has a wider influence on TEE. The following sections discuss these two potential explanations in detail:

7.3.2.1 Physical Activity May Have a Small Effect on Body Weight

The first potential explanation for these null findings could be that PA is a relatively small (15-20%) contributor to TEE, especially compared to food intake which contributes 100% of total EI (249). Other main components of energy expenditure are basal metabolic rate (70%) and thermic effect of food (~5-10%) (249). Thus, while there may be quite big differences between extremes of PA, total PA contribution to TEE is relatively small, and besides most individuals will be clustered around the mean so that the spread of energy expenditure differences across most of the adolescents will possibly only be a few percentage points of TEE. This means that the ability to detect a difference in actual kJ/day between average high and average low PA adolescents will be weak. In other words, there is just not a big enough ‘dose effect’ to impinge markedly on TEE (and therefore energy balance) (see Figure 7.1).
7.3.2.2 Compensation Issues and Mechanisms

The second potential explanation could be that the differences in PA and SBB are large enough to give meaningful differences in TEE from those behaviours but are not large enough to affect overall energy balance because of compensatory changes. The compensation could be due to other non-measured PA (e.g. household chores, gardening, PE and PA during weekends) – for example, those who are more active in school and after school sport (which was measured) did less in the way of non-measured PA at other times of the day. The compensation could also be in relation to EI – an adolescent who exercises more, may also eat more in response to normal appetite signals, and thus end up no different in terms of energy balance. Similarly for EI, while skipping meals decreases EI at that meal, there may be compensatory responses of over-eating during other meal times within the same day a meal was
Figure 7.2: Some of the potential Complex Biological and Behavioural Compensatory Responses to Low PA and High SBB

Overall, some changes in behaviours over time among the Fiji OPIC sample had worsened. This provides some insight into which particular PA and SBBs get worse throughout adolescence. It reinforces the conclusions of the cross-sectional studies that expectations of the BMI-z impact of PA programs should be modest and such programs need to be evaluated for impacts on BMI-z and other potential benefits.

The small effect size and barriers to weight loss such as metabolic biological and behavioural compensatory responses (as seen in Figure 7.2) are contributing to no change in body weight when followed up. Very little weight loss has been observed in RCT studies from various reviews done. This thesis also has similar findings to those of most recent systematic reviews in the literature (249, 297, 302).
7.3.3 Associations between e-gaming and psychosocial outcomes

Although this thesis was not able to link PA and SBB behavioural activities with BMI-z, Fijian adolescents had a low prevalence of PA and a high prevalence of SBB. In particular, e-gaming behaviour is becoming very conspicuous among them. This thesis found that high e-gaming was not associated with most psychosocial parameters measured but it was associated with higher aggression and higher academic achievement (or higher school grades). It may be somewhat likely that while youths are potentially benefiting academically, they may also develop an aggressive behaviour from high levels of e-gaming.

7.3.3.1 Do E-gaming Benefits Outweigh its Harms?

One question arising from this study is whether e-gaming’s benefits outweigh its harms. The findings from this cross-sectional study of high levels of e-gaming time being positively associated with aggression and academic achievement scores are commonly supported by the literature. The negative effects of violent video games are well documented from several RCTs (168-172), so the association found in the Fiji study are of concern that the increasing presence of violent e-games may be adding to aggressive behaviours among Fijian youth.

The findings from this cross-sectional study about the potential benefits of e-gaming are somewhat comparable to other similar results from cross-sectional studies. There is also evidence of the learning benefits of e-games from some RCT’s, such as cognition (thinking, understanding, intellectual, and perception), decision-making,
creativity, reasoning and problem-solving skills (180-183). Decreasing the time spent on violent video games may be beneficial to mental health either through health promotion approaches (e.g. campaigns around Internet cafes) or regulatory approaches (e.g. licensing requirements). More advanced study designs are needed in this area, particularly RCTs on educational benefits from e-gaming and evaluations of policy interventions, to prove this emerging hypothesis and provide insight into the learning, health and social benefits of video games.

In sum, evidence exists from the literature elsewhere to support both positive and negative effects of the effects of e-gaming. The literature highly supports the negative psychosocial effects (aggression) from e-gaming in this Fiji study. On the other hand, the literature equally supports educational benefits of e-gaming as well. However, the significant findings in this Fiji study maybe due to self-selection bias (i.e. more aggressive students are more attracted to playing violent video games and those who are doing well academically are more attracted to playing e-games) or it could be a true cause-and-effect relationship as found in the literature (i.e. violent e-games promote aggression and e-games in general promote better achievements academically). This thesis does gives an indication that cognitive benefits have somewhat likely links to e-gaming despite results from study 3 not being representative.

Overall, the role of e-gaming patterns and aggressive behaviour and better academic results among Fijian adolescents will be important for mapping out mental health interventions in schools and society at large in Fiji.
7.4 Strengths and Limitations

This thesis has a number of strengths in terms of its study design and target groups. Its major strength is that it consisted of both cross-sectional and longitudinal study designs in Studies 1 and 2, respectively, which were based on large sample sizes (n=7237 cross-sectional, n=2948 longitudinal) with measured anthropometry giving it the power to detect important effect sizes.

In addition, this thesis had enough diversity in the sample studied. It focused on adolescents, a group for whom effective interventions are really needed for the following reasons: Firstly, obesity rates in the Pacific really accelerate in adolescents bridging the relatively low rates in younger children with very high rates in adults. Secondly, adolescents are a captive audience, as they are accessible in school for obesity prevention intervention. Thirdly, adolescents have a critical growth period in height and can still ‘grow into their weight’ if they are overweight. Fourthly, adolescents are responsive to changes in environment and during this period develop PA and SBB habits.

Furthermore, having two major ethnic groups who are quite different to each other but living in the same physical environment gave insights into the moderating effects that ethnicity has in either accentuating or attenuating the impacts of physical environments on population behaviours and risks factors. Lastly, apart from exploring linear associations, polynomial associations on the main models were also tested. That is, to find out if there were any major improvements on the linear relationship, a next level polynomial regression (quadratic and cubic regression models) analyses were performed as a check to see how the data best fits into the
parabolic and S-shaped curves. However, none of the polynomial variables that were recoded and generated were statistically significant, with all p-values more than 0.05.

The potential limitations of this thesis were its low response rate in the follow-up phase, the self-report nature of PA/SBB variables in the OPIC data in Studies 1 and 2, and the self-rating of the SBB variables in Study 3. Moreover, incidental PA like domestic chores and gardening, which is an important PA domain, was not captured in the OPIC data.

In addition, the sample chosen in Study 3 was not representative of the general Fijian population. The findings reported in Studies 1 and 2 may be subject to participants’ recall biases of their activity behaviours and influenced by social desirability biases. However, associations between weight status and PA and SBB have arisen both from predictors measured objectively and self-reported. Majority of the literature reviewed had significant findings arising from self-reports as there have been far too many studies on self-reports than objectively measured studies. Many self-reports too have shown null findings. As for objectively measured predictors, the results have been mixed not having objectively measured results is a limitation in studies 1 and 2.

The findings in Study 3 could also be due to self-selection bias. For example, those who are already aggressive in nature may be drawn to playing violent video games and the brighter, sharper adolescents who are doing well in school may be more drawn to spending more time playing e-games compared to those who are not doing so well academically. Yet while it is essential to treat the results reported here with some caution, they do provide an important insight into public health issues like obesity and psychosocial problems.
7.5 Implications and Conclusions

The results of this research have several implications for adolescents, their parents and the society at large even though the behavioural activities measured do not seem to be closely linked to body weight or psychosocial outcomes in Fijian adolescents. It should be emphasised that the null findings in relation to PA and SBB do not mean that increasing PA and decreasing SBB are not important and that they should be disregarded. It is especially recommended that sufficient levels of PA are attained for adolescents for its many well-described health benefits. The overall statistically significant findings for study 3 should be treated with a little caution as even though there are statistically significant results (for academic achievement score after Bonferroni correction was applied) it perhaps can be of very least clinical importance due to small effect size. Nevertheless, PA in general has its own health benefits and moderation in e-gaming is nonetheless suggested due to its widely documented other negative effects.

So what do the results mean to parents, video game parlour owners, society and the government? This thesis found a high prevalence of total screen time and moderate levels of PA in Fiji. For parents, these findings should encourage commitment towards their children’s LTPAs and monitoring TV viewing and e-gaming time (less than 2 hours per day, following international guidelines) and the type of e-games they play. It is suggested that parents encourage their children to engage in more games that require cognition, decision-making, creativity, reasoning and problem-solving skills than those that are violent in nature. A moderation in time spent with e-
games seems sensible and appropriate, and restricting the playing of violent video games would be beneficial to adolescents.

The high prevalence of unhealthy PA/SBB behaviours and overweight/obesity among adolescents is a concern for the future health of the Fijian population, health budget, loss of productivity from diseases like diabetes, loss of quality of life, and stagnant gains in life expectancy. There is also concern about the prominence of violent video games – especially with the high prevalence of domestic violence in Fiji.

Finally, there are implications for the government and policy makers. Some potential government responses to high e-gaming time could be to monitor the current situation and educate game parlour owners about the potential effects of violent video games through educational posters or videos. Owners could be encouraged to install more creative and educational games that are not violent. If the number of violent e-games rises, the government could consider some kind of licensing arrangement (or amendment to existing licenses if they are required for operating a game parlour). Government agencies could also consider PA in their obesity prevention programs – educational messages to encourage participation, especially among girls who drop off PA in adolescence – for all-round health benefits. However, the main focus for government policy makers in relation to obesity prevention should be on food and diet side of the energy balance equation.
7.6 Suggestions for Future Research

There is a significant amount of research needed in this whole field of obesity and mental health. The obvious critical question to ask from this study is why the associations of PA and SBBs with BMI are so weak and to answer this it will require detailed and advanced research methods (some of the future research questions are listed below). To be more solution-oriented, interventions to address the high levels of inactivity are important – and based on the OPIC intervention these will need to address the major socio-cultural barriers identified in the OPIC interventions. Measuring outcomes other than BMI from PA interventions will be important e.g. mental health and academic achievement. Evaluating the wider community-based interventions and policy interventions for obesity is important because PA programs will probably not make much impact on reducing obesity, as supported in the literature. Perhaps some trials of the educational approaches to reducing the use of violent e-games would be useful to see if non-regulatory approaches would work. However, it is also important to extend the study on the important follow on research in Fiji.

Similarly, social marketing techniques could be used to identify options for Fijian adolescents to be more physically active and less motivated to play video games. There is also scope for future research on options around effects of playing sports and academic achievement specifically targeting parents who may have a prior set mind about the driving forces behind their children’s (especially, girls”) physical inactivity.
Further, this thesis poses the following three critical unanswered research questions arising from three studies in this PhD:

1. Are high levels of SBBs and low levels of PA related to other health outcomes not measured in this PhD?
2. Can the null association between PA/SBB and BMI-z be explained by other non-measured compensatory health variables in this PhD?
3. Is e-gaming related to other health outcomes not measured in this PhD?

Strategies and approaches that focus on obesity prevention among adolescents are urgently needed (191, 192), as the literature has largely ignored this group and focused on younger school- or pre-school-aged children. There is a need for comprehensive, culturally-centred approaches to reducing obesity. Hence there is a need to design, implement and evaluate obesity prevention initiatives among Pacific populations and build evidence about what approaches work or do not work. Community-based approaches that focus on building capacity among local communities have increasingly shown promising results in other countries (193). To combat the upward trends for adolescents, strategies that are feasible and effective need to be identified (194).
7.7 Research Contributions

This thesis contributes to a greater understanding of predictors of change in PA/SBB patterns and BMI-z in adolescents in Fiji. It further discusses the role of PA/SBB patterns and BMI-z, which is important for obesity prevention among adolescents in Fiji. In addition, it highlights the need to explore the opportunities to influence the population’s eating and PA behaviours, which are both important to help reverse escalating obesity rates. The final study adds to knowledge on the role of e-gaming patterns and psychosocial problems among the digital generation of Fijian adolescents. Overall, this thesis shows the size and magnitude of obesity and psychosocial problems and the weak associations between them and the levels of PA/SBB/e-games. While this is well described in high-income countries, there are few studies of this type in countries undergoing rapid technological and social transitions such as Fiji and in the Pacific.

This thesis also contributes to knowledge in the sense that it targets adolescents, a group for whom effective intervention is really needed. Adolescents are accessible in school for obesity prevention intervention. This thesis contributes to a repository of essential information for the Ministries of Education and Health in Fiji to refer to for targeted prevention in various schools. It also provides information on the complex association among the two distinct ethnic groups of adolescents in Fiji. Thus, the findings of this research may be used to guide the next generation of obesity prevention interventions and mental health in Fiji, with potential application of principles and knowledge to other ethnic groups. Though the studies reported in this thesis largely showed null results, it still adds to the literature, especially on LMICs in transition. The fact that obesity is driven by global changes but shaped by local
factors means that each country needs to understand its local data in order to formulate its responses.

In conclusion, this thesis offers evidence and insights into obesity and psychosocial problems in Fiji for comparison with the Pacific and LMICs worldwide. It fills in some of the gaps in the literature on obesity and mental health problems in Fiji, and draws important practical implications for Fiji, the Pacific and other LMICs as they struggle to understand and find solutions for their mounting obesity and mental health problems among their adolescent population.
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Appendix A: Study Tools and Instruments

A.1 Studies 1 and 2 Questionnaire: ABAKQ

Demographic Questions

ID __________
DOB __/__/__

1. Today’s date __/__/__
2. Your name ____________________________ ____________________________ ____________________________
   (first name) (middle name) (last name)
3. What is your home address?
   a. Street number ______
   b. Street name ______________________________
   c. City name ______________________________
   d. Post code __ __
4. What is your home phone number? __________
5. What is the name of your mother/stepmother/female caregiver living with you?
   ____________________________ ____________________________
   (first name) (last name)
6. What is the name of your father/stepfather/male caregiver living with you?
   ____________________________ ____________________________
   (first name) (last name)
Adolescent Behaviours, Attitudes and Knowledge Questionnaire (ABAKQ)

1. What is the name of your school?  
2. Do you board at this school?  
   Yes  
   No
3. What year are you in?  
   Form 3  
   Form 4  
   Form 5  
   Form 6  
   Form 7
4. What is your gender?  
   Male  
   Female
5. What is your date of birth?  
6.Were you born in Fiji?  
   Yes  
   No
7. How long have you lived in Fiji?  
8. Which ethnic group do you most associate with?  
9. Do you belong to a Church, Temple or Mosque?  
   No  
   Yes, Church  
   Yes, Temple  
   Yes, Mosque
10. Which Church, Temple or Mosque do you usually go to?  
11. How often have you gone to Church, Temple or Mosque activities (including services, Sunday school, youth groups and choir practice) in the past 12 months?  
   Usually weekly or more often  
   2-3 times a month  
   Once a month  
   Less than once a month
12. Who do you usually live with during the school week?  
   2 parents (including step parents)  
   1 parent  
   No parents (boarding)  
   No parents (relatives/friends)
13. How many people usually live at your home including yourself during the week?  
14. In the last 5 school days, on how many days did you eat breakfast before school started?  
   0 days  
   1-2 days  
   3-4 days  
   5 days
15. Where do you usually get your breakfast from?  
   Home  
   School canteen  
   Shop (outside school)  
   From friends  
   I don’t have breakfast
16. In the last 5 school days, on how many days did you eat at recess?  
   0 days  
   1-2 days  
   3-4 days  
   5 days
17. Where do you usually get what you eat at recess from?  
   Home  
   School canteen  
   Shop (outside school)
18. In the last 5 school days, on how many days did you eat at lunchtime? 0 days
   1-2 days
   3-4 days
   5 days

19. Where do you usually get your lunch from?
   Home
   School canteen
   Shop (outside school)
   From friends
   I don’t have lunch

20. In the last 5 school days, on how many days did you buy snack food from a shop or takeaway after school? 0 days
   1-2 days
   3-4 days
   5 days

21. How often do you usually eat fruit after school? All days
   Often
   Hardly ever

22. How often do you usually eat bread/rolls/buns/sandwiches/breakfast crackers etc. after school? All days
   Often
   Hardly ever

23. How often do you usually eat potato chips/samosa/fried peas and packaged snacks after school? All days
   Often
   Hardly ever

24. How often do you usually eat pies/takeaways and fried foods such as French fries after school? All days
   Often
   Hardly ever

25. How often do you usually eat food from a takeaway, for example, McDonald's, KFC, fried chicken, fish and chips, hamburgers? Once a month or less
   2-3 times a month
   Once a week
   2-3 times a week
   Most days

26. In the last 5 school days, on how many days did you eat fresh fruit? 0 days
   1-2 days
   3-4 days
   5 days

27. In the last 5 school days, how many serves of fresh fruit did you have? (1 serve is a handful, or an apple, a mango or an orange)

28. In the last 5 school days, on how many days did you have regular soft drinks? (e.g. Coke, Sprite, Fanta) 0 days
   1-2 days
   3-4 days
   5 days

29. On the last school day, how many glasses or cans of soft drinks did you have? 0-more than 2 litres

30. In the last 5 school days, on how many days did you have fruit drinks or cordial drinks (e.g. Sunquick)? 0 days
31. On the last school day, how many glasses of fruit drinks or cordial drinks did you have? 0-9 glasses

32. In the last 5 school days, how many times did you walk or bike to or from school? 1-10 times

33. How long does it take you to walk to your school from home? Less than 15 minutes
15-30 minutes
More than 30 minutes
Don’t walk

34. Over the last 5 school days, what did you do most of the time at recess (apart from eating)? Mostly just sat down
Mostly stood or walked around
Mostly played active games

35. Over the last 5 school days, what did you do most of the time at lunchtime (apart from eating)? Mostly just sat down
Mostly stood or walked around
Mostly played active games

36. In the last 5 school days, on how many days after school did you do sports, dance, cultural performances or play games in which you were active? 0 days
1-2 days
3-4 days
5 days

37. Do you have a TV in your home? Yes
No

38. In the last 5 school days, how many days did you watch TV, videos or DVDs (in your free time)? 0 days
1-2 days
3-4 days
5 days

38. On an average school day, how many hours do you usually spend watching TV, videos or DVDs (in your free time)? 0 - >4 hours

39. During the average school week, do your parents (or caregiver) limit the amount of TV (including videos and DVDs) you are allowed to watch? No limits, I can watch as much as I want
Yes, but they are not very strict limits
Yes, they are strict limits

40. In the last 5 school days, how many times did you watch TV whilst eating your evening meal? 0 days
1-2 days
3-4 days
5 days

41. On an average Saturday, how many hours do you spend watching TV, videos or DVDs? 0-10 hours

42. On an average Sunday, how many hours do you spend watching TV, videos or DVDs? 0-10 hours

43. Do you have a TV in your bedroom? Yes
No
44. In the last 5 school days, how many times did your family living in your house eat an evening meal together?

- 0 days
- 1-2 days
- 3-4 days
- 5 days

45. Do you have video games, electronic games or a computer in your home?

- Yes
- No

46. In the last 5 school days, how many days did you play video games, electronic games or use the computer (not for homework)?

- 0 days
- 1-2 days
- 3-4 days
- 5 days

47. On an average school day, how many hours do you usually spend each day playing video games or using the computer (not for homework)?

- 0 - >4 hours

48. On an average Saturday, how many hours do you usually spend playing video games or using the computer (not for homework)?

- 0 - >5 hours

49. On an average Sunday, how many hours do you usually spend playing video games or using the computer (not for homework)?

- 0 - >5 hours

50. How strongly do you agree or disagree with the following statement:

I feel good about myself

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

51. How happy are you with your weight and size?

- Very happy
- Happy
- In between/OK
- Unhappy
- Very unhappy

52. How happy are you with your body shape?

- Very happy
- Happy
- In between/OK
- Unhappy
- Very unhappy

53. How would you describe your weight?

- Very underweight
- Slightly underweight
- About the right weight
- Slightly overweight
- Very overweight

54. Which of these statements most closely applies to you?

I am…

- Trying to lose weight
- Trying to gain weight
- Trying to stay at the same weight
- Not trying to change my weight

55. Which of the following statements most closely applies to you?

I am…

- Trying to gain muscle size
- Trying to maintain muscle size
- Trying to change muscle size
- Not trying to

56. How much support do you get from your mother or female caregiver to eat healthy foods?

- A lot
57. How much support do you get from your father or male caregiver to eat healthy foods?

A lot
Some
Very little

58. How often each week are green leafy vegetables served at dinner?

Most nights
3-4 nights
1-2 nights
< 1 night

59. How often is food from a takeaway shop served at dinner?

More than once a week
About once a week
2-3 times a month
Once a month or less

60. How often is fruit available at home for you to eat?

All the time
Some of the time
Occasionally

61. How often are potato chips or similar snacks available at home for you to eat?

All the time
Some of the time
Occasionally

62. How often are chocolates or sweets available at home for you to eat?

All the time
Some of the time
Occasionally

63. How often are soft drinks available at home for you to drink?

All the time
Some of the time
Occasionally

64. In the last 5 school days, how much money did you spend on food or drinks for yourself at takeaway shops or snack bars (not including school canteens)?

65. How much support do you get from your mother or female caregiver to be physically active and play sports?

A lot
Some
Very little

66. How much support do you get from your father or male caregiver to be physically active and play sports?

A lot
Some
Very little

67. How much support do you get from your older brother or male cousins to be physically active and play sports?

A lot
Some
Very little

68. How much support do you get from your older sister or female cousins to be physically active and play sports?

A lot
Some
Very little

69. How much does your school encourage all students to be physically active?

A lot
Some
70. How much does your school encourage all students to play organised sport?  
  Very little  
  A lot  
  Some  
  Very little

71. How much does your school encourage all students to be physically active at recess and lunchtime?  
  Very little  
  A lot  
  Some  
  Very little

72. How do you rate the teachers in your school as role models for being physically active?  
  Excellent  
  Good  
  OK  
  Not very good  
  Poor

73. How do you rate the teachers in your school as role models for healthy eating?  
  Excellent  
  Good  
  OK  
  Not very good  
  Poor

74. How do you rate the food and drink choices available at your school canteen?  
  Almost all healthy  
  Mostly healthy  
  Some healthy/some unhealthy  
  Mainly unhealthy  
  Almost all unhealthy

75. How much opportunity does your school provide you for physical activity outside of school?  
  Very little  
  A lot  
  Some  
  Very little

76. How much does your school encourage students to make healthy food choices?  
  Very little  
  A lot  
  Some  
  Very little

77. How safe is it for you to be out alone in your neighbourhood during the day?  
  Very safe  
  Safe  
  Unsafe  
  Very unsafe  
  Don’t know

78. How safe do your parents (or caregivers) think it is for you to be out alone in your neighbourhood during the day?  
  Very safe  
  Safe  
  Unsafe  
  Very unsafe  
  Don’t know

79. How safe is it for you to be out with a group of friends in your neighbourhood during the day?  
  Very safe  
  Safe  
  Unsafe  
  Very unsafe  
  Don’t know
80. How safe do your parents (or caregivers) think it is for you to be out with a group of friends in your neighbourhood during the day? 

- Very safe
- Safe
- Unsafe
- Very unsafe
- Don’t know

81. How much are dogs a safety problem for youth in your neighbourhood? 

- Very little
- Sometimes
- A lot

82. How much is traffic a safety problem for youth in your neighbourhood? 

- Very little
- Sometimes
- A lot

83. How much are strangers a safety problem for youth in your neighbourhood? 

- Very little
- Sometimes
- A lot

84. How much does your Church/Temple/Mosque support healthy eating? 

- Not at all
- A little
- Very much
- Not applicable

85. How do you rate the leaders at your Church/Temple/Mosque as role models for eating healthy foods? 

- Excellent
- Good
- OK
- Not very good
- Poor

86. How much does your Church/Temple/Mosque support physical activity? 

- Not at all
- A little
- Very much
- Not applicable

87. How do you rate the leaders at your Church/Temple/Mosque as role models for physical activity? 

- Excellent
- Good
- OK
- Not very good
- Poor

Do you agree or disagree with the following statements?

88. Skipping breakfast or lunch is a good way to lose weight? 

- Yes
- No
- Don’t know

89. Fruit drinks and cordials have as much sugar as soft drinks like Coke and Sprite. 

- Yes
- No
- Don’t know

90. Watching a lot of TV affects my weight. 

- Yes
- No
- Don’t know
91. Eating a lot of fruit and vegetables is bad for your weight.

Yes
No
Don’t know

92. Being bigger than average can be bad for your health.

Yes
No
Don’t know
A.2 Studies 1 and 2 Data Dictionary

**DATA DICTIONARY:**
Physical activity and Screen-based behavior variables

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<th>Data Type</th>
<th>Variable name</th>
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<td>Categorical</td>
<td>ethnicf1</td>
<td>1-Fijians 2-Indo Fijians 3-Others</td>
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<td>2 Gender of participant</td>
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<td>1-Males 2-Females</td>
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<td>...in last 5 school days</td>
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<td>4 How many times walk/bike to/from school</td>
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<td>1-0 2-1 3-2 . . 11-10 12-more than 10</td>
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<td>7 Activity at recess</td>
<td>Categorical</td>
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<td>1-Mostly just sat down 2-Mostly stood and walked around 3-Mostly played active game</td>
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<td>8 Activity at lunchtime</td>
<td>Categorical</td>
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<td>1-Mostly just sat down 2-Mostly stood and walked around 3-Mostly played active game</td>
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<td>9 Activity after school</td>
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<td>1-0 days 2-1 day 3-2 days 4-3 days 5-4 days 6-5 days</td>
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<td>Total Screen time per day (out of 7 days)</td>
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A.3 Study 3 Questionnaire: TWSQ

Introduction
Hello. Before we get started, I’d like to tell you a little bit about the survey you will take part in today. The questions in this survey will ask you some background information, the time you spend in front of TV, playing computer games, thoughts about yourself, your school, your attachment with parents, and your feelings and emotions in the last 30 days. It will take about 30-45 minutes. Please read and answer all of the questions on this survey as truthfully and completely as possible, although if you do not want to answer a question, leave it blank. There are no right or wrong answers. However, everything you tell us will be kept private. Your answers will not be shared with your parents or guardians, or your teachers. When we put the information that you give us together, your name will not be used.

Thank you for your help.

Date: _____/_____/

Participant ID: __________ (This has been emailed to you)
Name of Internet Cafe: __________ (This is where you have been recruited from)
Background Information

Please tick ☐ your responses below:

1. Are you a member of this Internet café?
   □ Yes □ No

2. How old are you?
   □ 13 years □ 14 years □ 15 years □ 16 years □ 17 years □ 18 years

3. What’s your gender?
   □ Male □ Female

4. What’s your ethnicity?
   □ Indigenous Fijian □ Indo-Fijian □ Other (please state) ______________

5. What form are you in at school?
   □ Form 3 □ Form 4 □ Form 5 □ Form 6 □ Form 7 □ Not going to school

6. Are you a resident of Fiji?
   □ Yes □ No

7. On average, how much time do you spend playing computer/video games?
   □ Zero mins /day □ <30 mins /day □ <1hr /day □ ≤2hrs /day □ > 2hrs /day

8. What were your marks in your last final exam or National exam?
   ≥401 marks □ 351–400 marks □ 301–350 marks □ 251–300 marks □ 201–250 marks □ ≤200 marks

SECTION A: Average time spent on TV, video, computer games, etc.

This section is about your AVERAGE time spent using screen-based media (e.g. TV, video, DVDs, computer/video games, Internet, etc.) per day.
Now, think about a normal school week and write down how long you spend doing the following activities before or after school each day and during the weekends. You can write fractions like \( \frac{1}{2} \) hour, \( \frac{3}{4} \) hour or 1 hour, 2 hours, 3 hours etc. or 0 if you did not spend any time on a particular activity on a particular day.

An example of how to fill this in is as follows:

<table>
<thead>
<tr>
<th>Average Time (in minutes or hours) Spent on Using Screen-Based Media per Day</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching TV/video/DVDs at home/someone else’s home</td>
<td>0</td>
<td>1/2</td>
<td>0</td>
<td>1</td>
<td>1/2</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Playing computer/video/electronic games at home/someone else’s home/Internet cafes</td>
<td>0</td>
<td>1</td>
<td>1/2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>On social networks like Facebook, Twitter, emails, etc. at home/someone else’s home/Internet cafe</td>
<td>1/2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Now please can you tell us how much time on average you spend on activities below in a typical school week or weekend?

<table>
<thead>
<tr>
<th>Average Time (in minutes or hours) Spent on Using Screen-Based Media per Day</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching TV/video/DVDs at home/someone else’s home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing computer/video/electronic games at home/someone else’s home/Internet cafes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On social networks like Facebook, Twitter, emails, etc. at home/someone else’s home/Internet cafe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECTION B: Thoughts About Yourself**

This section is looking at how you feel about yourself. Please indicate to what extent you agree or disagree with the statements below by circling:
How much do you agree or disagree with these statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In general you are satisfied with yourself.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2. At times you think you are no good at all.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3. You feel that you have a number of good qualities.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4. You can do things as well as most other people.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5. You feel that you do not have much to be proud of.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6. You feel useless at times.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7. You feel that you are at least as good as other people.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8. You wish you could have more respect for yourself.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9. Sometimes you think of yourself as a bad person.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**SECTION C: School Work**

This section asks about your views about the value of school work. Please tell us about your agreement about the importance of school work by circling:

4 if you STRONGLY AGREE

3 if you AGREE

2 if you DISAGREE

1 if you STRONGLY DISAGREE

How much do you agree or disagree with these statements?
1. You like school a lot. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

2. School is boring. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

3. You do poorly at school. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

4. You don’t really belong at school. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

5. Homework is a waste of time. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

6. You try hard at school. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

7. You usually finish your homework. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

8. Getting good grades is very important to you. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

9. Sometimes you do extra work to improve your grades. | Strongly Agree | Agree | Disagree | Strongly Disagree |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

10. If you could choose on your own between studying to get a good grade on a test or going out with your friends, would you:

- Definitely go out with friends | Definitively study |
- Probably go out with friends | Probably study |
- Sometimes you do extra work to improve your grades | Sometimes you do extra work to improve your grades |
- No! - if it’s very false | No! - if it’s very false |
- Yes! - if it’s very true | Yes! - if it’s very true |
- No - if it’s somewhat false | No - if it’s somewhat false |
- Yes - if it’s somewhat true | Yes - if it’s somewhat true |

SECTION D: View of Closeness with Parents

This section asks about how close you are with your parents. Please tell us how much you agree or disagree with the statements below by circling:

1 **NO!** - if it’s very false

2 **no** - if it’s somewhat false

3 **yes** - if it’s somewhat true

4 **YES!** - if it’s very true

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

1. Do you feel very close to your mother? | Very False | Somewhat False | Somewhat True | Very True |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO!</strong></td>
<td>no</td>
<td>yes</td>
<td><strong>YES!</strong></td>
<td></td>
</tr>
</tbody>
</table>

2. Do your share your thoughts and feelings with your mother? | Very False | Somewhat False | Somewhat True | Very True |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO!</strong></td>
<td>no</td>
<td>yes</td>
<td><strong>YES!</strong></td>
<td></td>
</tr>
</tbody>
</table>

3. Do you feel very close to your father? | Very False | Somewhat False | Somewhat True | Very True |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO!</strong></td>
<td>no</td>
<td>yes</td>
<td><strong>YES!</strong></td>
<td></td>
</tr>
</tbody>
</table>

4. Do your share your thoughts and feelings with your father? | Very False | Somewhat False | Somewhat True | Very True |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO!</strong></td>
<td>no</td>
<td>yes</td>
<td><strong>YES!</strong></td>
<td></td>
</tr>
</tbody>
</table>
SECTION E: Feelings in the Last 30 Days

This section is about how you have been feeling in the last 30 days. Please indicate how you have been feeling in the past 30 days by circling:

1 if the statements NEVER relate to you
2 if the statements SELDOM relate to you
3 if the statements SOMETIMES relate to you
4 if the statements OFTEN relate to you
5 if the statements ALWAYS relate to you

In the last 30 days, how often...

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Were you very sad?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Were you grouchy or irritable, or in a bad mood?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Did you feel hopeless about the future?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Did you feel like not eating or eating more than usual?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Did you sleep a lot more or lot less than usual?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Did you have difficulty concentrating on your school work?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

SECTION F: Statements about things that might be a problem to you

This section contains a list of things that might be a problem for you. Please tell us how much of a problem each one has been for you in the LAST MONTH by circling:

0 if it is never a problem
1 if it is **almost never** a problem
2 if it is **sometimes** a problem
3 if it is **often** a problem
4 if it is **almost always** a problem

In the **LAST MONTH**, how much of a **problem** has this been for you ....

<table>
<thead>
<tr>
<th>About My Health and Activities (problems with...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is difficult for me to walk more than 100 metres.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. It is difficult for me to run.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. It is difficult for me to play sport or do exercise.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. It is difficult for me to lift something heavy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. It is difficult for me to have a bath or shower by myself.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. It is difficult for me to help around the house.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I get aches and pains.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I have low energy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>About My Feelings (problems with...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel afraid or scared.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I feel sad.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I feel angry.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I have trouble sleeping.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I worry about what will happen to me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How I Get Along with Others (problems with...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I have trouble getting along with other teenagers.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Other teenagers do not want to be my friend.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Other teenagers tease me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I cannot do things that other people my age can do.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. It is hard to keep up with other teenagers.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>About School (problems with...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is hard to pay attention in class.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I forget things.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
3. I have trouble keeping up with my school work.  
   | 0 | 1 | 2 | 3 | 4 |
4. I am away from school because I feel sick.  
   | 0 | 1 | 2 | 3 | 4 |
5. I am away from school to go to the doctor or hospital.  
   | 0 | 1 | 2 | 3 | 4 |

SECTION G: Your Thoughts About Aggression

Please tell us about your thoughts about aggression by circling:

1 if you STRONGLY AGREE
2 if you AGREE SOMEWHAT
3 if you DISAGREE SOMEWHAT
4 if you STRONGLY DISAGREE

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree Somewhat</th>
<th>Disagree Somewhat</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If I’m mad at someone I just ignore them.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Even if other kids should think I’m weird, I would try to stop a fight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. It’s OK for me to hit someone to get them to do what I want.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Sometimes a person doesn’t have any choice but to fight.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. When my friends fight, I try to get them to stop.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. If I back down from a fight, everyone will think I’m a coward.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. There are better ways to solve problems than fighting.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I try to work out a problem than fighting.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I feel big and tough when I push someone around.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. If people do something to make me really mad, they deserve to be beaten up.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Sometimes I have only two choices: get punched or punch the other person first.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. If I get crazy with anger, it’s OK to hit someone.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
The end!

Thank you for your time to complete this questionnaire. The information you have just provided is very valuable to us in making informed decisions about screen time and social problems related to adolescents.

Should you have any further questions or concerns regarding this survey or any of its questions, please contact Ramneek Goundar via mobile: 9252568 or via email: ramneek.goundar@fnu.ac.fj from the College of Medicine, Nursing and Health Sciences, Fiji National University.
**A.3 PedsQL Inventory**

Date: _____ / _____ / ______

**PedsQL™ Inventory**

*Version 4.0 – Australian English*

Teenager Report (Ages 13-18)

**DIRECTIONS**

On the following pages is a list of things that might be a problem for you. Please tell us how much of a problem each one has been for you in the **LAST MONTH** by circling:

- 0 if it is **never** a problem
- 1 if it is **almost never** a problem
- 2 if it is **sometimes** a problem
- 3 if it is **often** a problem
- 4 if it is **almost always** a problem

There are no right or wrong answers. If you do not understand a question, please ask for help.

In the **LAST MONTH**, how much of a problem has this been for you ...

<table>
<thead>
<tr>
<th>About My Health and Activities (PROBLEMS WITH...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is difficult for me to walk more than 100 metres.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. It is difficult for me to run.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. It is difficult for me to play sport or do exercise.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. It is difficult for me to lift something heavy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. It is difficult for me to have a bath or shower by myself.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. It is difficult for me to help around the house</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I get aches and pains.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I have low energy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>About My Feelings (PROBLEMS WITH...)</td>
<td>Never</td>
<td>Almost Never</td>
<td>Sometimes</td>
<td>Often</td>
<td>Almost Always</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------</td>
<td>--------------</td>
<td>-----------</td>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>1. I feel afraid or scared.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I feel sad.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I feel angry.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I have trouble sleeping.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I worry about what will happen to me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How I Get Along with Others (PROBLEMS WITH...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I have trouble getting along with other teenagers.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Other teenagers do not want to be my friend.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Other teenagers tease me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I cannot do things that other people my age can do.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. It is hard to keep up with other teenagers.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>About School (PROBLEMS WITH...)</th>
<th>Never</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is hard to pay attention in class.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I forget things.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I have trouble keeping up with my school work.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I am away from school because I feel sick.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I am away from school to go to the doctor or hospital.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Appendix B: Research and Ethics Documentation (Study 3)

B.1 Letter for Internet Café Owners

25 July 2012

Teens with Screens Survey!

Dear Sir/Madam,

My name is Ramneek Goundar. I am a PhD student based at Fiji School of Medicine, within the College of Medicine Nursing and Health Sciences at Fiji National University but enrolled at Deakin University (supervised by Professor Boyd Swinburn), Australia. I am involved in a research study of teenagers looking at computers and video game use, school work, and several measures of quality of life. I would like to seek your approval to conduct this important study whereby teenagers themselves write their names and contacts details on a sheet of paper placed on the front counter in your Internet cafe.

I am interested in exploring a link between teenagers’ behavioural activities (like watching TV, playing video and computer games and other similar activities) and social factors (like school work, and several measures of quality of life). Information
about the type and level of activities with relation to social factors is of real interest to me. The findings of this study will be important in helping understand screen-based media use influencing teenagers’ social behaviours. This research will be relevant across the Pacific region as video games and game parlours rapidly increase in Pacific countries.

For this reason, we have identified your famous Internet cafe as one our potential study sites. As an acknowledgement and ‘Thank You’ participants and your manager (or whoever will be a focal point of contact at your Internet cafe) will be given a free $6.00 and $11.00 cell phone recharge cards (upon completing an online survey) respectively.

There will be minimal disturbance to your business as participants will be only writing their names and contacts on one form to be contacted later by the investigator to fill an online questionnaire.

Looking forward to a favourable response in this regards.

With thanks,

Signature Redacted by Library

Ramneek Goundar

PhD Candidate, Deakin University

Based at Department of Public Health & Primary Care,
Fiji School of Medicine,
College of Medicine, Nursing and Health Sciences,
Fiji National University,
Tamavua Campus, Suva.

Phone: (+679) 3311700 ext. 3255
Fax: (+679) 3233243
Mobile: (+679) 9252568
Direct line: (+679) 3233255
Email: ramneek.goundar@fnu.ac.fj
Website: http://www.fnu.ac.fj
B.2 F1.0 Recruitment Form for Potential Participants

Once you have ticked ☑ your choice of answers below, please fold this slip and drop it in the box provided and you will be contacted on email soon!!

First Name: ___________________ Last Name: ___________________
Cell phone/home tel: ___________________ Date: ___/_____/_____
Email: _______________________________________________________
(please write your email address clearly as we will contact you via this contact)

If you are interested in a

RESEARCH STUDY

about watching TV, playing computer or videogames, please complete the form below

Are you...

In high school?   Between 13-18 years old?   Living in Fiji?
☐ Yes ☐ No       ☐ Yes ☐ No       ☐ Yes ☐ No

Playing computer/ video games?
☐ Zero mins /day  ☐ <30 mins /day   ☐ <1hr /day   ☐ ≤2hrs /day   ☐ >2hrs /day

Please note:

Those who are included in the study and who complete the an online questionnaire will receive a small token of appreciation for their time (a $6.00 cell phone recharge card)

Thank you for showing your interest!
FOLD THIS
&
PLACE THIS IN THE DROP BOX PROVIDED

(Back of the F1.0 form)
B.3 F2.0 Template To List Eligible Participants

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Age (13-18 years)</th>
<th>Email</th>
<th>Mobile/Home</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Dear Participant,

My name is Ramneek Goundar. I am a PhD student based at Fiji School of Medicine, within the College of Medicine Nursing and Health Sciences at Fiji National University but enrolled at Deakin University (supervised by Professor Boyd Swinburn), Australia. I am involved in a research study of teenagers looking at computers and video game use, school work, and several measures of quality of life.

I am interested in exploring a link between teenagers’ behavioural activities (like watching TV, playing video and computer games and other similar activities) and social factors (like school work, and several measures of quality of life). Information about the type and level of activities with relation to social factors is of real interest to me. The findings of this study will be important in helping understand screen-based media use influencing teenagers’ social behaviours. This research will be relevant across the Pacific region as video games and game parlours rapidly increase in Pacific countries.

For this reason, I would like to invite you to fill in an online questionnaire on this topic. Before completing an online questionnaire (that will be coded, with no names), you would need a written consent as approval from your parents and provide a brief background information about yourself such as name, age, contact details, gender,
ethnicity, form, and whether you have any membership at any Internet cafes. In the questionnaire, some examples of the types of questions you may be asked are: “On average, how many hours do you watch TV at home?” and “Do you have trouble keeping up with your school work?” It would also ask about your views on your closeness with parents alongside your views on school work. This questionnaire will take around 20-30 minutes to complete. Following the completion of the study you will be sent a summary of the results at your request and a free $6.00 cell phone recharge card as a token of acknowledgement for your participation in this study.

Please be assured that total confidentiality will be maintained at all times. Your name and address written on consent forms will be kept in a locked cabinet, separate from the data obtained via the questionnaire. All online questionnaires will have coded participant identification, which is, labelled as numbers. This is an important research study; however you are under no obligation to participate. If you agree to participate, you are free to withdraw at any time during the data collection phase and your information will not be used.

If you have any concerns about the conduct of this research project please contact the Secretary, Deakin University Ethics Committee, Research Services, Deakin University, 221 Burwood Highway, Burwood VIC 3125, phone (03) 9251 7123 or the Secretary, Fiji National Research Ethics Review Committee, Ministry of Health, Dinem House, Amy Street, Suva, Fiji

I am grateful for your assistance with this study. If you have any questions about this study, please do not hesitate to contact me on 9252568 or my supervisor on boyd.swinburn@deakin.edu.au
Thank You.

Kind regards,

[Signature Redacted by Library]

Ramneek Goundar

PhD Student, Deakin University, Australia

Based at Department of Public Health & Primary Care,

Fiji School of Medicine,

College of Medicine, Nursing and Health Sciences,

Fiji National University,

Tamavua Campus, Suva.

Phone: (+679) 3311700 ext. 3255
Fax: (+679) 3233243
Mobile: (+679) 9252568
Direct line: (+679) 3233255
Email: ramneek.goundar@fnu.ac.fj
Website: http://www.fnu.ac.fj
Dear Parents,

My name is Ramneek Goundar. I am a PhD student based at Fiji School of Medicine, within the College of Medicine Nursing and Health Sciences at Fiji National University but enrolled at Deakin University (supervised by Professor Boyd Swinburn), Australia. I am involved in a research study of teenagers looking at computers and video game use, school work, and several measures of quality of life. I would like to invite your child to take part in this important study. It would be grateful if you would complete the enclosed consent form for your child to fill in an online questionnaire, which should take about 20-30 minutes and return them by 30th November, 2012.

I am interested in exploring a link between teenagers’ behavioural activities (like watching TV, playing video and computer games and other similar activities) and social factors (like school work, and several measures of quality of life). Information about the type and level of activities with relation to social factors is of real interest to me. The findings of this study will be important in helping understand screen-based media use influencing teenagers’ social behaviours. This research will be
relevant across the Pacific region as video games and game parlours rapidly increase in Pacific countries.

For this reason, I would like to invite you to fill in an online questionnaire on this topic. Before completing an online questionnaire (that will be coded, with no names), you would need a written consent as approval from your parents and provide a brief background information about yourself such as name, age, contact details, gender, ethnicity, form, and whether you have any membership at any Internet cafes. In the questionnaire, some examples of the types of questions you may be asked are: “On average, how many hours do you watch TV at home?” and “Do you have trouble keeping up with your school work?” It would also ask about your views on your closeness with parents alongside your views on school work. Following the completion of the study your child will be sent a summary of the results at their request and a free $6.00 cell phone recharge card as a token of acknowledgement for their participation in this study.

Please be assured that total confidentiality of your child will be maintained at all times. Their name and address on the consent forms will be kept in a locked cabinet, separate from the data obtained via the questionnaire. All online questionnaires will have coded participant identification, which is, labelled as numbers. This is an important research study; however they are under no obligation to participate. If they agree to participate, they are free to withdraw at any time during the data collection phase and their information will not be used.

If you or your child has any concerns about the conduct of this research project please contact the Secretary, Deakin University Ethics Committee, Research
Services, Deakin University, 221 Burwood Highway, Burwood VIC 3125, phone (03) 9251 7123 or the Secretary, Fiji National Research Ethics Review Committee, Ministry of Health, Dinem House, Amy Street, Suva, Fiji.

I am grateful for your assistance and your child’s consent to participate in this study. If you or your child has any questions about this study, please do not hesitate to contact me on 9252568 or my supervisor on boyd.swinburn@deakin.edu.au

Thank You.

[Signature Redacted by Library]

Ramneek Goundar
PhD Student | Deakin University, Australia &
Based at Department of Public Health & Primary Care,
Fiji School of Medicine,
College of Medicine, Nursing and Health Sciences,
Fiji National University,
Tamavua Campus| Suva.

Phone: (+679) 3311700 ext. 3255
Fax: (+679) 3233243
Mobile: (+679) 9252568
Direct line: (+679) 3233255
Email: ramneek.goundar@fnu.ac.fj
Website: http://www.fnu.ac.fj
B.6 F5.0 Assent Form

I, _______________________________________________(First name, Last name) of _______________________________________________(residential address)

Hereby do consent to be a subject of a human research study to be undertaken by Ramneek Goundar based at Fiji School of Medicine, College of Medicine Nursing and Health Sciences School of Health and enrolled at School of Health and Social Development at Deakin University, Melbourne, Australia and supervised by Professor Boyd Swinburn, Dr. Peter Kremer, Dr. Wendy Snowdon of Deakin University and Professor Ian Rouse of Fiji National University, Fiji and I understand that the purpose of the research is to explore the relationship between screen-based behaviour and Physical activity and social problems among a sample of adolescents (13-18 years) in Suva City, Fiji.

I acknowledge that:

1. Upon receipt of the online link, my online questionnaire will be coded and my name and address kept separately from it; my parent will also give his consent for me to participate.

2. Any information that I provide will not be made public in any form that could reveal my identity to an outside party, that is, I will remain fully anonymous.

3. Aggregated results will be used for research purposes and may be reported in scientific and academic journals.
4. Individual results **will not** be released to any persons except at my request and on my authorisation.

5. That I am free to withdraw my consent at any time during the study data collection phase in which event my participation in the research will immediately cease and any information obtained from me will not be used.

Signature: _____________________________ Date: _______________________

------------------------------------------------------------------------

---------------------------------

Withdrawal from study

I, _________________________________________________((First name, Last
name) of

_______________________________________________________________(residential
address)

**Hereby wish to withdraw** my participation from this research study for reasons personal to me. I understand any information obtained from me will not be used in this study.

Signature: _____________________________ Date: _______________________

------------------------------------------------------------------------
B.7 F6.0 Consent Form

I, ____________________________________________________ (First name, Last name)
parent of ____________________________________________ (Child’s First name, Last name)
of __________________________________________________ (residential address)

Hereby do consent my child to be a subject of a human research study to be undertaken by Ramneek Goundar based at Fiji School of Medicine, College of Medicine Nursing and Health Sciences School of Health and enrolled at School of Health and Social Development at Deakin University, Melbourne, Australia and supervised by Professor Boyd Swinburne, Dr. Peter Kremer and Dr. Wendy Snowdon of Deakin University and Professor Ian Rouse of Fiji National University, Fiji and I understand that the purpose of the research is to explore the relationship between screen-based behaviour and physical activity and social problems among a sample of adolescents (13-18 years) in Suva City, Fiji.

I acknowledge that:

1. Upon receipt of the online link, my child’s online questionnaire will be coded and his name and address kept separately from it; my child will also give his consent for participation.

2. Any information that my child provide will not be made public in any form that could reveal his identity to an outside party, that is, he will remain fully anonymous.
3. Aggregated results will be used for research purposes and may be reported in scientific and academic journals.

4. Individual results **will not** be released to any persons except at my child’s request and on my authorisation.

5. That my child is free to withdraw his consent at any time during the study data collection phase in which event my participation in the research will immediately cease and any information obtained from him will not be used.

Signature: _____________________________ Date: _______________________

---

**Withdrawal from study**

I, ________________________________ *(First name, Last name)* of ________________________________ *(residential address)*

**Hereby wish to withdraw** my participation from this research study for reasons personal to me. I understand any information obtained from me will not be used in this study.

Signature: _____________________________ Date: _______________________

---

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## B.8 Human Ethics Exemption Form

**DEAKIN UNIVERSITY**

**APPLICATION FOR HUMAN ETHICS EXEMPTION**

### Researcher Information

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of applicant:</td>
<td>Dr. Peter Kremer</td>
</tr>
<tr>
<td>Phone numbers:</td>
<td>03 5227 8434</td>
</tr>
<tr>
<td>Email address:</td>
<td><a href="mailto:peter.kremer@deakin.edu.au">peter.kremer@deakin.edu.au</a></td>
</tr>
<tr>
<td>Name of principal investigator:</td>
<td>Dr. Peter Kremer</td>
</tr>
<tr>
<td>Qualifications/experience:</td>
<td>BA, BSc (Hons), Grad Dip (Mntl Hlth Sc), PhD</td>
</tr>
<tr>
<td>School:</td>
<td>School of Psychology</td>
</tr>
<tr>
<td>Faculty:</td>
<td>Faculty of Health, Medicine, Nursing and Behavioural Sciences</td>
</tr>
<tr>
<td>Campus:</td>
<td>Geelong Waterfront Campus</td>
</tr>
<tr>
<td>Phone numbers:</td>
<td>03 5227 8434</td>
</tr>
<tr>
<td>Email address:</td>
<td><a href="mailto:peter.kremer@deakin.edu.au">peter.kremer@deakin.edu.au</a></td>
</tr>
<tr>
<td>Is this a student application?</td>
<td>Yes</td>
</tr>
<tr>
<td>Name of Student:</td>
<td>Ramneek Nadan Goundar</td>
</tr>
<tr>
<td>Qualification sought:</td>
<td>Doctor of Philosophy</td>
</tr>
<tr>
<td>Name of supervisor:</td>
<td>Dr. Peter Kremer</td>
</tr>
<tr>
<td>Name of co-investigator(s):</td>
<td>N/A</td>
</tr>
<tr>
<td>Email address:</td>
<td><a href="mailto:peter.kremer@deakin.edu.au">peter.kremer@deakin.edu.au</a></td>
</tr>
</tbody>
</table>

### Project Information*

- The Obesity Prevention in Communities (OPIC) study comprised the following: the Australia-based “It’s Your Move!” project, the Fiji-based “Healthy Youth Healthy Communities” project and the Tonga-based “Ma’alahi Youth Project”. There was also a New Zealand arm to the study which is not included in this application. The OPIC study consisted of country-specific interventions that focused on obesity prevention in communities and was targeted at adolescents. The school and community-based interventions were multi-focused with objectives around increasing the intake of healthy foods, decreasing the consumption of sugar-sweetened drinks and increasing the level of physical exercise.

The proposed research study intends to utilize data components of baseline and intervention databases from OPIC Project to evaluate the impact of interventions using multi-level modeling methods.

### Research Proposal:

**Background to project:**

Obesity is a major problem around the world, particularly amongst adolescents in the Pacific Region. In 2004, the proportion of overweight children under the age of 18 years in Fiji was less than twenty percent.

A number of strategies and approaches have been proposed to address obesity amongst children. One approach is multi-faceted Community-Based Interventions (CBI) that focuses on the application of multiple strategies across multiple settings. This research study proposes to use Longitudinal and Cross-sectional data analysis within the Obesity Prevention in the Community (OPIC) Project database. The
Analysis of such a complex databases is difficult and the best approach is unclear. Often data from CBI include information from multiple levels and samples derived from one or more sampling strategies, meaning that clustering effects such as school and/or community need to be considered. This study intends to propose an optimal approach.

**Project Aim and Rationale:**

OPIC data includes three waves from 2005 to 2007 across multiple levels of the community such as time, individuals, households, schools, and churches.

The objectives of this research study are: 1. Assess different statistical approaches in various research studies; 2. Analyse across time spans within and between population groups. Analysis will include multivariate methods, multilevel modelling and; 3. Adjust for sampling cluster effects across these multiple levels; 4. Apply the different statistical methods across multiple levels; 5. Propose an optimal approach to analyze complex data for Community Based Intervention projects.

**Source of Data or Records:**
The data are sourced from the WHO Collaborating Centre for Obesity Prevention, Deakin University through Professor Boyd Swinburn.

**Format Data/Records will be obtained in:**
Electronic format, as a de-identified Stata datafile.

**Nature of consent originally obtained from participants:**
Written consent was obtained from the parent/guardian of each child and implied consent to participate was obtained from the child.

**Reason for request to waive consent requirements:**
The project involves ONLY a pre-existing data set containing non-identifiable data. Individual data are coded using a numeric identifier but re-identification of any individual is not possible since this information was not recorded.

**Statement of ethical issues and means by which they will be addressed:**
No ethical issues are anticipated for this study.

**I am aware that I am required to submit an Annual/Final Report to the Ethics Office for this project when requested and agree to do so in a timely manner.**

---

**DECLARATION**

We, the undersigned declare that the information supplied in this application is true and accurate to the best of my/our knowledge.

We the undersigned have read the *National Statement on Ethical Conduct in Research Involving Humans* and accept responsibility for the conduct of the research.
detailed in this application in accordance with the principles contained in the
Statement.

Signatures:

Principal Investigator: Date: 19-05-2010

Student (where applicable): Date: 19-05-2010

Signature Redacted by Library

ACKNOWLEDGMENT OF HEAD OF SCHOOL /DIRECTOR OF
RESEARCH

I the undersigned acknowledge that the Faculty has considered and approved the
academic worth of the project described in this application.

Name: Associate Professor Greg Tooley

Signature: Date:
B.9 Ethics Approval: Fiji School of Medicine

The Administrative Officer
Deans Office
Faculty of Health, Medicine, Nursing & Behavioural Sciences

Dear Sir/Madam,

As the Fiji School of Medicine -based custodian of the ‘Healthy Youth Healthy Communities’ which is part of the Obesity Prevention in Communities (OPIC) dataset, I have granted full access to Ramneek Goundar for the purpose of investigating relationships among a subset of the existing variables in analyses for his PhD D research project. The OPIC dataset that will be supplied will be fully de-identified. Furthermore, it is not possible to re-identify any individual who participated in the OPIC project. Access is granted to Ramneek, on the following conditions:

1.1 That data will be used solely for the above purpose
1.2 That permission for use of data and dissemination of any materials arising from the data is signed by the in-country Principal Investigator, Co-Investigator or his/her nominee
1.3 That study participants and teams who collected, entered and managed and/or analysed data be acknowledged in writing in all written documents, presentations and publications resulting from data use
1.4 That the Pacific OPIC Project at all of the relevant sites and, where applicable, the TROPIC project, is acknowledged whenever the data are used
1.5 That clearance from myself is given prior to submission of any papers containing results for Fiji
1.6 That Ministry of Health Fiji be provided with a copy of all publications (student projects and theses, published papers, conference presentations) arising from data use

The OPIC Project has been previously approved by Deakin University Human Research Ethics Committee (EC-22-2005), and Fiji ethics review committee. The overall aim of the OPIC project was to build the community’s capacity to create its own solutions to promoting healthy eating, physical activity and healthy weight in adolescents aged 12-18 years and their families.

Sincerely,

[Signature Redacted by Library]

Assoc. Professor Graham Roberts
College of Medicine, Nursing & Health Sciences
Fiji National University

Cc: Dr. Peter Kremer
Professor Boyd Swinburn
Professor Ian Rouse
Ramneek Goundar
B.10 Ethics Approval: Deakin University

Deakin Population Health Strategic Research Centre
Burwood Melbourne campus
Burwood VIC 3215 Australia
Telephone +61 3 9251 7145
Facsimile +61 3 9244 6624
Boyd.swinburn@deakin.edu.au

22 October 2015

Ms Josephine Wee
Administrative Officer
Centre: Research - Arts & Education

Dear Ms Josephine Wee,

As the Deakin-based custodian of the Obesity Prevention in Communities (OPIC) dataset which comprises the following datasets: the Australia-based “It’s Your Move!” project, the Fiji-based “Healthy Youth Healthy Communities” project and the Tonga-based “Ma’alahi Youth Project”, I have granted full access to Ramneek Goundar for the purpose of investigating relationships among a subset of the existing variables in analyses for his PhD research project.

The OPIC Project has been previously approved by Deakin University Human Research Ethics Committee (EC-22-2005). The overall aim of the OPIC project
was to build the community’s capacity to create its own solutions to promoting healthy eating, physical activity and healthy weight in adolescents aged 12-18 years and their families. The OPIC dataset that will be supplied will be fully de-identified. Furthermore, it is not possible to re-identify any individual who participated in the OPIC project.

Kind regards,

Signature Redacted by Library

Professor Boyd Swinburn
Alfred Deakin Professor, and
Director, WHO Collaborating Centre for Obesity Prevention

Cc: Dr. Peter Kremer
    Professor Ian Rouse
    Tilema Cama
    Jimaima Schultz
    Ramneek Goundar