Abstract

Understanding the factors influencing adolescent physical activity in Malaysia is critical, given the high prevalence of physical inactivity in this country. Malaysia is tenth in the world and highest among the Southeast Asian nations, scoring 61.4 percent on the inactive index. The goal of this research was to examine the psychosocial and environmental factors that influence adolescent physical activity behaviour. Conducted in Kuching, Sarawak, this research found about nine percent of adolescents met the step count recommendations (15,000 steps/day for boys and 12,000 steps/day for girls). The median step count was significantly higher in boys (median=6,556; IQR=3,923) than in girls (median=6,147; IQR=2,518) ($p<0.05$). A mixed methods approach was carried out to discover the underlying factors for physical inactivity. The Phase I qualitative study involved *photovoice* technique, focus group discussions, and in-depth interviews. Twenty adolescents and eight parents were recruited in the qualitative study. Data analysis employed constant comparison methods of the grounded theory which suggested, "feeling unsafe" when being outdoors as a central theme. The Phase I study proposed 12 factors affecting adolescent physical activity: fear of crime, traffic safety, recreation facility, accessibility, aesthetics, parental restriction, parental support, cultural barriers, peer support, perceived barriers, self-efficacy and screen time. The findings in Phase I were tested in Phase II by utilising a quantitative survey. Four hundred and forty three adolescents were recruited from four secondary schools. The mean age was 13.5 (± 0.52 years). Participants provided seven-day pedometer data and completed a self-administered questionnaire in May to July 2011. The structural equation model supported five significant predictors of physical activity ($p<0.05$): fear of crime ($\beta=0.194$), traffic safety ($\beta=0.178$), parental restriction ($\beta=-0.128$), peer support ($\beta=0.196$), and perceived barriers ($\beta=-0.121$). Fear of crime was interrelated with traffic safety ($\beta=-0.254$). Perceived barriers mediated the effect of fear of crime on physical activity. This suggests that fear of “street crime” is the major factor militating against adolescents being physically active outdoors. Parental restriction and peer support are stand-alone predictors of adolescent physical activity. The total variance explained in adolescent physical activity was 11 percent. Findings emerging from the current research suggest certain predictors of physical activity among Malaysian adolescents were different from the existing literature. First, there was a positive effect of fear of crime on physical activity. Second, this research found self-efficacy has no impact on physical activity. These findings suggest the unique needs of Malaysian adolescents should be considered while planning interventions. In conclusion, this research highlighted a recurrent finding: that psychosocial and physical environment factors were significant, and these factors were interrelated and mediated in influencing adolescent physical activity. The quantitative results provide a strong confirmation of the qualitative findings through triangulation and elaboration of the constructs and their interrelationships in the emergent theory.

Abstrak

Pemahaman mengenai faktor-faktor yang mempengaruhi aktiviti fizikal remaja di Malaysia adalah perlu memandangkan kadar prevalen tidak aktif yang tinggi di kalangan remaja. Malaysia berada di tangga ke sepuluh tertinggi di dunia dan teratas di kalangan negara-negara Asia Tenggara, dengan kadar indeks tidak aktif 61.4 peratus. Matlamat kajian ini adalah untuk mengkaji faktor-faktor psikososial dan persekitaran yang mempengaruhi tingkah laku aktiviti fizikal remaja. Kajian yang dijalankan di Kuching, Sarawak ini mendapati kira-kira sembilan peratus daripada remaja mematuhi kiraan langkah harian (15,000 langkah / hari untuk remaja lelaki dan 12,000 langkah / hari untuk remaja perempuan). Purata langkah harian lebih tinggi di kalangan remaja lelaki (median = 6.556; IQR = 3.923) berbanding perempuan (median = 6.147; IQR = 2.518) (p<0.05). Kajian *mixed methods* telah digunakan untuk mengetahui faktor-faktor ketidakaktifan fizikal di kalangan remaja. Fasa I kajian kualitatif melibatkan teknik *photovoice*, perbincangan kumpulan, dan temu bual. Dua puluh dua remaja dan lapan ibu bapa telah mengambil bahagian dalam kajian Fasa I ini. Analisis *grounded theory* menggunakan *constant comparative methods* mencadangkan "perasaan tidak selamat" apabila berada di luar rumah sebagai tema utama. Kajian Fasa I mencadangkan 12 faktor yang boleh mempengaruhi aktiviti fizikal remaja, iaitu: kebimbangan terhadap jenayah, keselamatan lalu lintas, kemudahan rekreasi, aksesibiliti, estetika, sekatan ibu bapa, sokongan ibu bapa, halangan budaya, sokongan rakan sebaya, *perceived barriers*, keyakinan diri melakukan sesuatu (*self-efficacy*) dan masa penggunaan teknologi berskrin. Hasil kajian Fasa I seterusnya diuji dalam Fasa II Kuantitatif dengan menggunakan survei. Seramai empat ratus empat puluh tiga orang remaja dari empat buah sekolah menengah telah menyertai survey ini. Purata umur adalah 13.5 (± 0.52 tahun). Peserta memakai pedometer selama tujuh hari dan melengkapkan borang soalselidik antara bulan Mei hingga Julai 2011. *Structural equation model* menyokong

lima faktor tingkahlaku aktiviti fizikal ($p<0.05$), iaitu: kebimbangan terhadap jenayah ($\beta=0.194$), keselamatan lalu lintas ($\beta=0.178$), sekatan ibu bapa ($\beta=-0.128$), sokongan rakan sebaya ($\beta=0.196$), dan persepi halangan ($\beta=-0.121$). Kebimbangan terhadap jenayah adalah saling berkaitan dengan keselamatan lalu lintas ($\beta=-0,254$). Kesan kebimbangan terhadap jenayah ke atas aktiviti fizikal juga diperantara oleh persepsi halangan. Ini menunjukkan bahawa kebimbangan terhadap jenayah jalanan adalah faktor utama menghalang remaja untuk aktif di luar rumah. Sekatan ibu bapa dan sokongan rakan sebaya masing-masing berpengaruh ke atas aktiviti fizikal remaja. Jumlah varians yang diterangkan dalam aktiviti fizikal remaja adalah 11 peratus. Hasil kajian ini mencadangkan faktor-faktor yang mempengaruhi aktiviti fizikal di kalangan remaja Malaysia adalah berbeza dari hasil kajian sedia ada. Pertama, terdapat kesan positif di antara kebimbangan terhadap jenayah dan aktiviti fizikal. Kedua, kajian ini mendapati keyakinan diri tidak mempunyai kesan ke atas aktiviti fizikal. Penemuan ini menunjukkan keperluan unik remaja Malaysia yang perlu dipertimbangkan dalam strategi promosi kesihatan. Kesimpulannya, kajian ini mengulangi hasil kajian sedia ada: bahawa faktor persekitaran fizikal memainkan peranan penting dalam mempengaruhi faktor psikososial, yang seterusnya mempengaruhi tingkahlaku aktiviti fizikal remaja. Hasil kajian kuantitatif memberi pengesahan yang kuat kepada hasil kajian kualitatif melalui *triangulation* dan perincian konstruk yang disarankan oleh *emergent theory*.

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Physical Activity among Adolescents in Sarawak: A Mixed Methods Approach

Field of Study: Health Promotion

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Publications

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Conference proceeding:

1. 6th Mix Methods International Conference, Baltimore, Maryland, USA, July 7-10, 2010 (Oral presentation) - http://www.healthcareconferences.leeds.ac.uk/community/presentations.php
2. Design and Health: 8th World Congress & Exhibition, Kuala Lumpur, July 27 – 1 2012 (Poster presentation) – http://events.designandhealth.com/events/wcdh/posters
3. 1st Asia Pacific Clinical Epidemiology and Evidence Based Medicine Conference (APCEEBM), Kuala Lumpur, July 6- 8, 2012 (Oral presentation) - http://apceebm.um.edu.my/index_participant.php

Journal:

1. Saimon, R., Choo, W. Y., & Bulgiba, A. (2013). "Feeling Unsafe": A Photovoice Analysis of Factors Influencing Physical Activity Behaviour Among Malaysian Adolescents. Asia Pac J Public Health. doi: 10.1177/1010539513480229

2. Patterns and factors influencing physical activity among adolescents in Kuching, Sarawak, Malaysia: Submitted to Preventive Medicine Journal (Sept 21, 2012) Status: Under revision

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Abbreviations

PA	-	Physical activity
PAL	-	Physical activity level
MET	-	Metabolic Equivalent of Task
MVPA	-	Moderate-vigorous physical activity
PE	-	Physical education
QUAL	-	Qualitative
QUAN	-	Quantitative
IPAQ	-	International Physical Activity Questionnaire
PAQ-A	-	Physical Activity Questionnaire – Adolescent
NEWS – Y	-	Neighbourhood Environment Walkability Scale – Youth
EFA	-	Exploratory factor analysis
CFA	-	Confirmatory factor analysis
SEM	-	Structural equation modelling
WHO	-	World Health Organisation
SCT	-	Social cognitive theory
NHMS	-	National Health and Morbidity Survey

CHAPTER 1: INTRODUCTION

Adolescents, defined as young people between the ages of 10 and 19 years, are often thought of as a healthy group. Nevertheless, many adolescents suffer from chronic illnesses (Prochaska & DiClemente, 1983; World Health Organisation, 2008). For example, tobacco use, sexually transmitted infections, poor eating and physical inactivity habits, all of which can lead to illness or premature death later in life. Many serious chronic diseases have their roots in adolescence and can be tracked into adulthood (Kimiecik & Horn, 2012). The focus of this thesis is on physical activity among adolescents. This chapter contains the introduction to the issues in which the research is concerned. At the end of this section, the purpose statement, research questions, and contribution of the study will be described.

1.1 Research Issues

Physical inactivity has been noted to be one of the most striking problems in the journey of human evolution from active *homo sapiens* (hunter-gatherer way of life) to *homosedens* (seated man) (Bouchard, Blair, & Haskell, 2012). Falling occupational and transportation physical activity and increased leisure time reinforced physical inactivity (Hallal et al., 2012). This is not surprising because the development of new technologies has cut out the need for physical labour to survive (Bouchard et al., 2012).

Today, many countries, including low- and middle-income countries, are facing physical inactivity as a public health issue (Hallal et al., 2012). Malaysia for example emerged tenth in the world and highest among the South-east Asian Nations, scoring 61.4 percent on the physical inactivity index (Hallal et al., 2012). Physical inactivity is a major non-communicable disease risk factor and the fourth leading cause of death worldwide (Das & Horton, 2012). Hallal et al. (2012) defined physical inactivity as not meeting any of the following criteria: 1) thirty minutes of moderate-intensity physical activity at least five days a week; 2) twenty minutes of vigorous-intensity physical activity at least three days a week; or 3) an equivalent combination of 600 metabolic equivalent (MET)-min per week.

Among adult population, the worldwide prevalence of physical inactivity increased from 17.4 percent (95% CI 15.1 –19.7) in 2009 (Dumith, Hallal, Reis, & Kohl, 2011) to 31.1 percent (95% CI 30·9 – 31·2) in 2012 (Hallal et al., 2012). In young people, about 80.3 percent of the worldwide adolescent population are physically inactive. Physical inactivity is pandemic with far-reaching health, economic, environmental and social consequences (Kohl et al., 2012).

The estimated total number of deaths because of physical inactivity was 3.2 million (Hallal et al., 2012). About 6 to 10 percent of all deaths because of coronary heart diseases, Type 2 diabetes, and breast and colon cancers, while another nine percent were due to premature mortality (Hallal et al., 2012). Without effective interventions, physical inactivity further increases adult morbidity and premature mortality as much as tobacco globally (Wen & Wu, 2012).

The current prevalence of non-communicable diseases among Malaysians is 66 percent and 74.4 percent, for males and females respectively (Mathers et al., 2004). The top two leading causes of death for both sexes are ischaemic heart disease and cerebrovascular disease. The total number of lives lost in terms of years in 2001 was 1.7 million with almost two-thirds of this burden of premature deaths resulting from chronic diseases (Yusoff, Kaur, Omar, & Mustafa, 2005).

Although adolescents cover only 19.6 percent of the Malaysian population (Department of Statistics Malaysia, 2010), they are a visible group because they highlight some of the ways in which society is changing. Among the Malaysian adolescents, about 45 percent (boys) and 88 percent (girls) did not achieve the recommended pedometer guideline. The pedometer cut-off points are set at 12,000 steps a day for boys and 10,000 steps a day for girls (Wilson, 2008).

In addition, the trend to immerse oneself in sluggish electronic entertainment such as gaming and online social networking is also increasing. Malaysian adolescents spent an average of 4.69 hours on weekdays and 5.69 hours on weekends on screen-based media (Cheah et al., 2011). Their sedentary time on media exceeded the sedentary guideline of no more than two hours a day (Tremblay et al., 2011).

Physical activity promotion is one of the priorities in the public health agenda in Malaysia. The Ministry of Health launched a Healthy Lifestyle Campaign in 1991 and the Ministry of Youth and Sports introduced Rakan Muda (Young Partners) in 1994. Despite these efforts, the prevalence of physical inactivity and non-communicable diseases in Malaysia has continued to rise at an alarming rate. These programmes, which mainly focused on intrapersonal factors, met with limited success. This is particularly true for disadvantaged populations who face greater environmental constraints and a lack of resources (Beaulac, Bouchard, & Kristjansson, 2009).

This is unfortunate, because the benefits of physical activity are many among the young. These include: preserving healthy bones; regulation of one's weight, building lean muscle; preventing high blood pressure; among others (National Center for Chronic Disease Prevention and Health Promotion, 2012). From the well-being aspect, positive outcomes include a sense of purpose and value, a better quality of life, improved sleep, reduced stress as well as stronger relationships and social connectedness (Das & Horton, 2012). Overall, the benefits of physical activity are far-reaching and extend beyond good health alone, regardless of one's age.

This suggests the need for new evidence based on community interventions, rather than targeting individuals. Understanding the broader factors influencing physical activity behaviour in a specific population is therefore a precondition to designing an effective intervention programme (Baranowski, Anderson, & Carmack, 1998). Interventions should be based on regional and cultural needs of the community (Hallal et al., 2012).

Nevertheless, the habits of physical inactivity are difficult to change, especially in an environment that does not support change (Sallis et al., 2006). Factors influencing physical activity behaviour are known to be complex (Haug, Torsheim, & Samdal, 2008). Various studies have been conducted to explain physical activity behaviour among adolescents. But these studies focus heavily on behavioural theories and models (Bauman et al., 2012). Among theories related to physical activity are the Stages of Change Theory (Godin, Lambert, Owen, Nolin, & Prud'homme, 2004), Social Cognitive Theory (Ramirez, Kulinna, & Cothran, 2012), and the Health Belief Model (Kimiecik & Horn, 2012).

In particular, Bandura's social cognitive theory and the concepts of self-efficacy and learning through modelling have been influential in understanding physical activity behaviour (Stephens, 2008). The use of self-efficacy in explaining physical activity observed in many studies. However, these studies can only explain about 20 percent to 40 percent of the variance in physical activity behaviour (Baranowski et al., 1998; Plotnikoff, Costigan, Karunamuni, & Lubans, 2013).

This suggests that people often do not behave in accordance with their intentions. Their intentions need to be supplemented by other more proximal factors that would best facilitate intentions and self-efficacy into action. That said, it supports the rationalisation that psychosocial models alone cannot inform the development of intervention strategies and should target changes beyond the individual level (Elder et al., 2007), such as social and physical environment levels. The physical environment presents cues and opportunities for physical activity behaviour to take place (McLeroy, Bibeau, Steckler, & Glanz, 1988).

Thus, in less than a decade, evidence on environmental correlates and physical activity has been blossoming (Das & Horton, 2012). Children and adolescents rely heavily on the neighbourhood built environment for opportunities to be formally or informally physically active (Baker, 2007). A neighbourhood that is more accessible to children is a key setting for the adolescent's outdoor play apart from school (Carver, Timperio, Hesketh, & Crawford, 2010). Distance to school, traffic safety, accessibility to land use, neighbourhood safety and friendliness, availability of resources (e.g. parks) have a significant influence on adolescent physical activity (Lee, 2010; Nelson & Woods, 2010; Shores, Moore, & Yin, 2010).

In summary, evidence of psycho-social and physical environment with respect to their link to physical activity is voluminous. Recently Bauman et al. (2012) suggested the current trend of physical activity studies on correlates has shifted from psychosocial factors to environmental factors. However, according to Kohl et al. (2012) the shift from psychosocial factors to environmental factors may inadvertently shift the strategy from behavioural to environmental, ignoring the holistic intervention strategies. Based on the social ecological framework, the researchers should consider the individual, social and physical environment factors (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Giles-Corti B. & R.J., 2002; Uijtdewilligen L et al., 2011). These factors collectively work together to influence physical activity behaviour (Rosenkranz, Welk, & Dzewaltowski, 2011).

Limited research has taken advantage of the social ecological framework to evaluate the structural factors of individual, social and environmental factors (Lee, Loprinzi, & Trost, 2010; Shores et al., 2010). Similarly, there is a critical shortage of studies assessing the social ecological factors in Malaysia. To date, only three studies have assessed the influence of the physical environment on physical activity and body mass index. Walking facilities (Cheah et al., 2011; Sreeramareddy, Majeed Kutty, Jabbar, & Boo, 2012) and facilities being easy to use (Abd-Latif, Mohd Nor, Omar-Fauzee, Ahmad, & Karim, 2012) were consistently associated with physical activity. However, the effect of the environment (e.g. busy roads, stray dogs, and crime) on physical activity is inconclusive (Abd-Latif et al., 2012; Cheah et al., 2011).

Possibly the social ecological model is underutilised because this model does not give guidance on which variables within each domain might be most important for the topic at hand. The use of the social ecological framework needs to integrate other models and theories to provide specificity for selected domains (Elder et al., 2007). Particularly, indirect effects in mediation analysis are generally overlooked in these studies. If indirect effects are not tested, the relationship between two variables of interest may not be fully considered (Holbert & Stephenson, 2003). Knowing the interdependence levels of the social-ecological model is important to provide health promoters with new points of intervention. This warrants the current research.

1.2 Purpose Statement

Although the use of the social ecological model is getting more common in guiding physical activity research (Bauman et al., 2012), identifying specific variables in specific populations is problematic. The main purpose of this research was **to identify factors influencing physical activity participation among adolescents in Kuching, Sarawak.**

This mixed methods research was conducted in two phases. The Phase I of the qualitative study applied a grounded theory strategy to explain adolescents' engagement in physical activity in their neighbourhood. The findings of this qualitative phase were used to develop age and culturally apt survey measures assessing correlates of physical activity among adolescents. In the Phase II quantitative study, the newly developed instrument was used to test the model on a large sample. The aim was to determine how the identified factors were related and to what extent the quantitative correlational results generalised the qualitative grounded theory model.

Collecting qualitative data first enabled the researcher to identify specific correlates of adolescent physical activity to be tested empirically. This procedure is expected to measure the local regional phenomenon more accurately than if it was based on information available in the literature alone.

1.3 Research Questions

In line with the nature of empirical inquiry of this research, research questions were articulated using the guidelines for exploratory research design (Creswell & Plano-Clark, 2011). The researcher combines at least one mixed method question with separate quantitative and qualitative questions (Tashakorri and Tedlie, 2010). Specifically, the overall purpose of the mixed methods research is stated in its most general form, followed by a list of more specific questions.

1.3.1 Phase 1 - Qualitative Study

What influences adolescents to become physically active in the neighbourhood?

Specific Research Questions

1. What are the meanings and types of physical activities engaged in by adolescents in their neighbourhood?
2. Where are adolescents physically active in their neighbourhood?
3. What factors or events/people influence adolescents to become physically active in their neighbourhood?

1.3.2 Phase II - Quantitative Study

How do factors/events/people identified in the qualitative phase interrelate in influencing adolescents' participation in physical activity?

Specific research questions

1. Are there any structural relationships among the correlates influencing adolescent physical activity levels?
2. Are there any mediation effects among the correlates influencing adolescent physical activity levels?

1.4 Contribution of the research

Interventions against non-communicable diseases in Malaysia have been undertaken since the 1990s, but they were concerted efforts in bringing about behavioural changes through educational activities. Despite these interventions, the prevalence of non-communicable diseases and their risk factors in Malaysia continues to rise at an alarming rate. In moving forward, the government recently recognized the importance of creating a living environment that promotes and facilitates healthy choices for all Malaysians in the newly formulated National Strategic Plan of Non-communicable Disease (Ministry of Health Malaysia, 2010). Aligned with the National Strategic Plan, this research may provide some evidence-based data to assist future interventions in physical activity, especially those that target adolescents.

Through a mixed methods research design, this research established a theoretical framework to better understand adolescents' participation in physical activity within the context of their neighbourhood. The theoretical model went through a rigorous and systematic analysis procedure of grounded theory and structural equation modelling to understand the complexity of physical activity behaviour.

The findings of this research may be informative for research methodologists in general, and the mixed methods community in particular, who are interested to translate grounded theory into a quantitative instrument and structural model procedures. Also of interest would be the *photovoice* data collection technique that provides a sensible description and a rich portrayal of adolescent physical activity within the context of their neighbourhood. *Photovoice* encourages active research participation among adolescents, and is useful in engaging multi-ethnic adolescents who would not have been as comfortable in voicing their views freely or through other media such as questionnaires (Badland, Schofield, Witten, & Schluter, 2009). The use of the *photovoice* technique helps the researcher to see the world as it is seen through the eyes of the subjects. This is essential because too often what experts think is important may not match what people at the grassroots think is important (Wang & Burris, 1997). The *photovoice* technique also adds research rigour in qualitative research to our body of knowledge, which is often dominated by quantitative research design.

1.5 Structure of the Thesis

Chapter 1 outlines the research premise through a general introduction to the problem area and a brief overview of the mixed methods to be used in this research. The general and specific research questions of each phase of the study are also introduced.

Following the Introduction, Chapter 2 provides a broad discussion and theoretical perspective by reviewing the relevant literature about key constructs involved in this research. The chapter provides a literature background for each construct of the theoretical model and offers a footing for the rest of the thesis.

Next, Chapter 3 presents a philosophical discussion, reasons for choosing mixed methods research design and stages of an exploratory sequential mixed methods design.

Later, Chapter 4 presents findings from the Phase I grounded theory qualitative study on factors influencing adolescents' participation in physical activity; and findings from the Phase II quantitative questionnaire validation and empirical results from the large-scale survey. Findings pertaining to structural characteristics and mediation effects are presented towards the end of the chapter. Summary of findings from the three phases concludes the results in Chapter 4.

Following this, Chapter 5 includes a discussion on the findings, limitation(s) of the study and implications for research and practice. Finally, Chapter 6 concludes with a summary, suggestions for future research and implications of the research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

With current physical inactivity pandemic and the high prevalence of physical inactivity in Malaysia, policy makers need data on physical activity levels, trends and factors influencing physical activity. Understanding the patterns and factors of physical activity is fundamental in the design of interventions. This chapter surveys the previous literature and studies relevant to this field of research.

For these reasons, the overall purpose of this chapter is to:

1. Operationally define key terms
2. Review the current prevalence of physical activity levels, mortality rate, the impact on adolescence health, the recommended levels of physical activity, the measurement of physical activity and physical inactivity in Malaysia.
3. Review theories and models related to adolescent physical activity behaviour.
4. Identify the correlates affecting adolescent physical activity behaviour from behavioural aspects to environmental aspects
5. Identify gaps in the literature
6. Address gaps in the literature

2.2 Operational Definitions of Key Terms

This research adopts the following operational definitions:

Adolescent defined as a subset of the young population aged between 13 and 15 years old, within the age group of 10 to 19 years old as defined by the World Health Organisation (2008).

Physical activity defined as outdoor activities such as sports / games, walking, cycling, badminton, basketball, gymnastics and domestic chores.

Physical activity level defined as measurement of a person's daily activity. In this research, physical activity level was measured using a pedometer through daily step counts.

Physical inactivity defined as not meeting the daily step counts' cutoff points of 12,000 for girls and 15,000 for boys.

Mixed methods research defined as a research procedure to collect and analyse both quantitative and qualitative data in the context of a single study.

Photovoice is a qualitative method that employed photo-elicitation and digital storytelling that allow research participants to create visuals that capture their individual perspectives as part of the research process.

The built environment defined as aspects of the environment that are man-made or modified by humans, such as homes, workplaces, street patterns, open spaces, playgrounds and parks (Handy, Boarnet, Ewing, & Killingsworth, 2002).

Recreation facilities defined as public or private facilities used for recreation purposes.

Aesthetic environment defined as any pleasing environment appearance such as beautiful buildings, beautiful landscaping, among others.

Poor neighbourhood aesthetics defined as incivilities including litter, graffiti, and stray dogs.

Fear of crime defined as a person's emotional reaction towards crime, such as kidnap, murder, rape, snatch-thieves, drug-addiction, drunkards, and bullying.

Street crime defined as criminal activity that happens in a public place, usually in a town or city, for example, snatch-thieving, pickpocketing, drugs trade, graffiti and vandalism of public property, and assaults.

Traffic safety defined as neighbourhood streets that installed with some safety measures, such as speed humps, crosswalk, sidewalk, traffic lights, traffic flow, and speed sign.

Parental support defined as a set of beliefs to strengthen and empower children so they can foster the optimal development of the child.

Peer support defined as having friend(s) to do things together, involve giving and receiving help.

Parental restriction defined as a parent limitation on certain adolescent behaviour, such as playing electronic games or being outdoors with friends for some reasons.
Perceived barriers defined as anything perceived as an obstacle to a specified behaviour or their desired goal status.

Self-efficacy defined as a person's belief in his or her ability to succeed in a particular task or behaviour.

Screen-time defined as a sedentary activity characterised by little physical movement, such as watching television, playing video games, using the computer or any other devices with screens, such as mobile phones and handheld electronic games during one's leisure/free time.

Salutogenic approach of health defined as an approach focusing on factors that support human health and well-being, rather than on factors that cause disease.

2.3 Physical Inactivity and Non-communicable Diseases

The development of new technology has eliminated the need for physical work to carry out many daily life tasks (Bouchard et al., 2012). The effects of some of these technologies on physical activity are observable (e.g., electric engines; trains; and cars), while others are more complicated (e.g., televisions, computers, electronic entertainment, and wireless communication devices) (Hallal et al., 2012).

The use of many of these technologies has been driven by the goal of increased individual worker productivity and reduced physical hardships and disabilities caused by jobs entailing continuous heavy labour. The human body has evolved in such a way that most of its systems (e.g., skeletal, metabolic, and cardiovascular) do not develop and function in an optimal way unless stimulated by frequent physical activity (Hallal et al., 2012). However, these technologies have come at a major cost in terms of the contribution of physical inactivity to the worldwide pandemic of non-communicable diseases (Hallal et al., 2012).

Physical inactivity causes six to 10 percent of the major non-communicable diseases of coronary heart disease, Type 2 diabetes, and breast and colon cancers (Lee et al., 2012). According to Chang (2004), two of every three deaths (34.5 million) worldwide in 2010 were deaths from non-communicable diseases. Physical inactivity alone has been estimated to cause more than 3 million preventable deaths per year (Hallal et al., 2012; Pratt et al., 2012).

The total number of deaths caused by physical inactivity equates even more to the deaths caused by tobacco (Hallal et al., 2012; Wen & Wu, 2012). Most of these deaths, as well as the huge burden of morbidity, take place in low and middle income countries (Pratt et al., 2012). Positively, Lee et al. (2012) estimated the life expectancy of the world's population may increase by 0·68 years with the elimination of physical inactivity. Physical inactivity directly affects many risk factors for morbidity and mortality, including adiposity, raised blood glucose concentrations, high blood pressure, and a poor lipid profile. People benefit from even modest activity. Compared with inactive individuals, those who were active but at levels less than recommended (about 1.5 hours per week), lived three years longer (Wen, Wai, Tsai, & et al, 2011).

Physical activity was recently considered as a cornerstone for combating non-communicable diseases by the United Nations (Das & Horton, 2012). However, making physical activity a public health priority is not easy to undertake, nor should it be taken lightly.

2.4 Global Prevalence of Physical Inactivity

Lack of physical activity is a serious health concern for all people. Hallal et al. (2012) defined physical inactivity as not meeting any of the following criteria: 1) thirty minutes of moderate-intensity physical activity at least five days a week; 2) twenty minutes of vigorous-intensity physical activity at least three days a week; or 3) an equivalent combination of 600 metabolic equivalent (MET)-min per week.

However, global prevalence and comparisons of patterns of participation in physical activity between countries and regions were only possible after a standardised instrument - the International Physical Activity Questionnaire (IPAQ) was developed in the late 1990s (Hallal et al., 2012). Approximately 31.1 percent (95% CI 30.9 – 31.2) of adults aged 15 and above are estimated to be physically inactive worldwide (Hallal et al., 2012).

The data in Figure 2.1 shows the frequency of inactivity among adults from 122 countries representing 88.9 percent of the world's population. These data show 43.3 percent (95% CI 43.0 – 43.6) are inactive in the Americas; 43.2 percent (95% CI 42.8 - 43.6) are inactive in the eastern Mediterranean region; 34.8 percent (95% CI 34.5 - 35.1) are inactive in Europe; 33.7 percent (95% CI 33.5 – 33.9) are inactive in the

Western Pacific; 27.5 percent (95% CI 27.3 - 27.7) are inactive in Africa; and 17.0 percent (95% CI 16.8 - 17.2) are inactive in Southeast Asia.

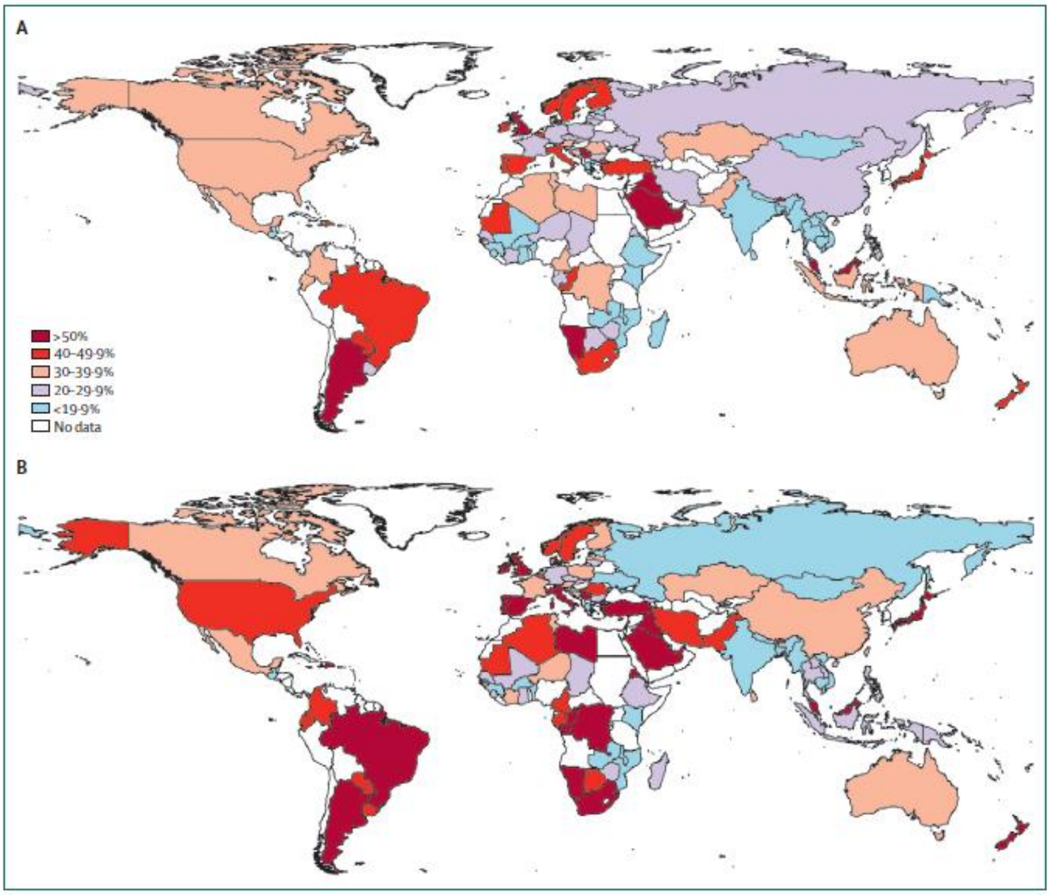


Figure 2.1   Physical inactivity in adults (15 years or older) worldwide in men (A) and women (B)
Source: Hallal et al. (2012)

Large differences exist in the level of physical inactivity between countries. For example, the proportion of inactive individuals of both sexes combined ranged from 4.7 percent (95% CI 4.3 – 5.1) in Bangladesh to 71.9 percent (95% CI 31.0 – 87.2) in Malta. Women reported to be less active (33.9 percent) than men (27.9 percent) (Hallal, Andersen, et al., 2012).

The Global School-Based Student Health Survey (GSHS) and the Health Behaviour in School-Aged Children (HBSC) survey, revealed about 80.3 percent (95% CI 80.1-80.5) adolescents aged 13 to 15-year-old were physical inactive globally. The researchers reported that physical inactivity is more prevalent in high-income countries, but it has also increased greatly in low- income countries (Hallal et al., 2012). The spread of physical inactivity among adolescent boys and girls of aged 13 to 15 from 105 low-, middle- and high-income countries is shown in Figure 2.2.

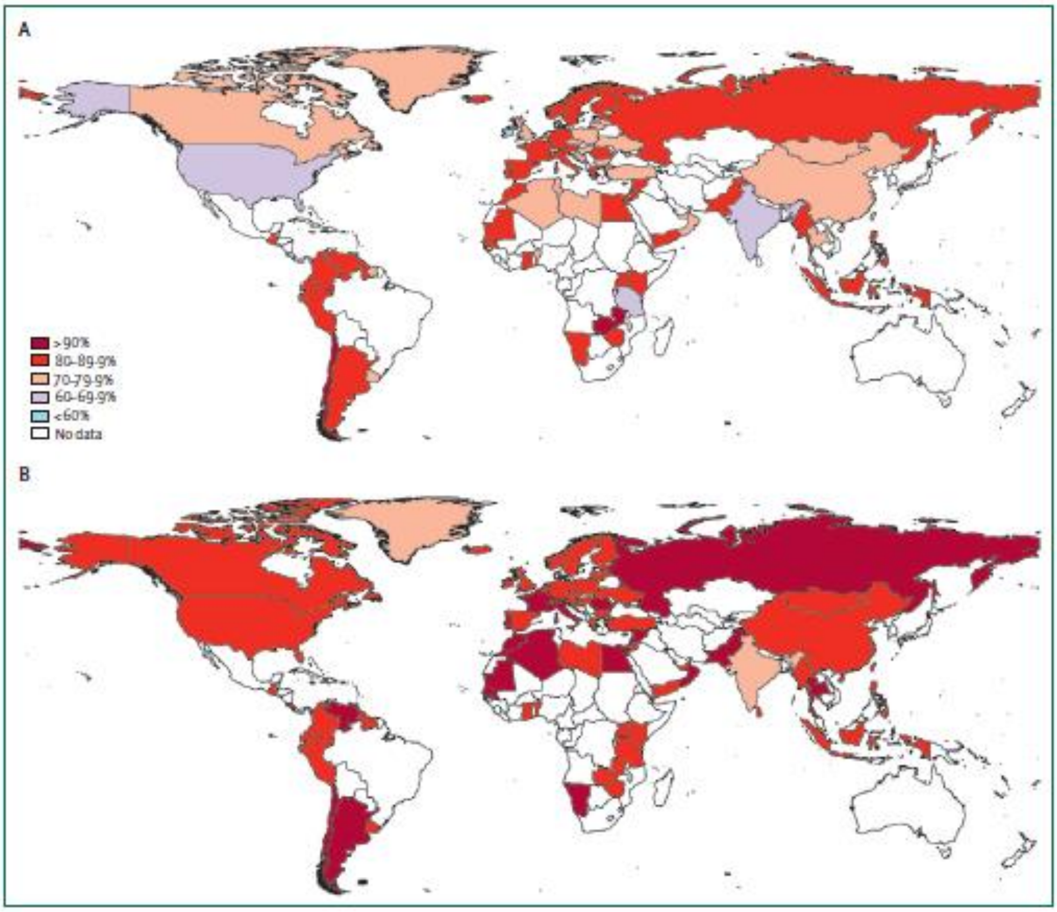


Figure 2.2 Proportion of 13–15-year-old boys (A) and girls (B) not achieving 60 min per day of moderate to vigorous physical activity
Source: Hallal et al. (2012)

Neighbouring countries of Malaysia, such as Indonesia and the Philippines recorded above 80 percent of physical inactivity index (Hallal et al., 2012), reflecting the seriousness of physical inactivity in the Asia-Pacific region. In general, the physical inactivity index in adolescents is much higher than that reported in adults. Adolescents do not achieve 60 minutes of moderate to vigorous physical activity per day and girls are less active than are boys (Hallal et al., 2012). Inactivity is putting these inactive individuals at greatest risk for a variety of chronic diseases, functional impairment and all-cause mortality (Haskell, Blair, & Hill, 2009).

Without effective intervention programmes to promote physical activity, the current global physical inactivity index in adults is expected to rise steeply in the next ten years. This is because physical activity decreases significantly as children move into the adolescent years and continues to decrease as adolescents progress into young adulthood (Kimiecik & Horn, 2012). Describing the characteristics of the groups that are most in need of interventions is important and timely.

2.5 Physical Activity and Adolescent Health

Physical activity has wide-ranging health benefits. Even modest amounts of physical activity can have health benefits and outweigh the drawbacks in high-risk youngsters (World Health Organization, 2010). This section reviews the effects of physical activity on six major health domains that are important to adolescents. These domains include: obesity, cardiovascular diseases, Type 2 diabetes mellitus, bone health, psychological well-being, and academic performance.

Obesity

Overweight children are at increased risk of many health problems, including hypertension, hyperlipidemia, Type 2 diabetes mellitus, hormone deregulation, respiratory problems and orthopaedic problems. Besides, obese children often agonise low self-esteem and lack of socialisation, leading to bullying, social exclusion, self-harm and even suicide (Blackwell, 2007; Kelly et al., 2011).

However, the effects of physical activity on body fat were not obvious. The European Youth Heart Study (Hardman & Stensel, 2009) and a study in Guangzhou, China (He et al., 2011) showed a strong negative association between physically active children with BMI and weight gain. A decrease in physical activity may result in increased adiposity over time among adolescent girls (Kettaneh et al., 2005).

Cardiovascular Diseases

Historically, most populations of South Asia have low levels of cardiovascular risk factors, particularly blood lipid levels, diabetes, and hypertension. However, in recent decades, the prevalence of these risk factors has increased, especially in urban areas (Fediuk & Kuhnlein, 2013). Although cardiovascular diseases manifest themselves in adulthood, there is evidence that risk factors appear much earlier in life or begin in childhood (Blackwell 2007). This prompts interest in whether physical activity in childhood helps to prevent cardiovascular diseases in adulthood.

Research has shown that physical activity is significantly associated with multiple measures of arterial stiffness in adolescents and young adults (Edwards, Daniels et al.

2012). The European Youth Heart Study assessed systolic blood pressure, triglyceride, total cholesterol, insulin resistance, skin folds and aerobic fitness on nine-year-old and 15-year-old adolescents from Denmark, Estonia and Portugal. The findings revealed that samples in the lowest three quartiles of physical activity seemed to have an elevated risk factor profile. The study therefore suggests that children and adolescents should perform more than one hour per day moderate-intensity physical activity to avoid clustering of cardiovascular diseases risk factors (Andersen, Harro et al. 2006).

Type 2 Diabetes Mellitus

Type 2 diabetes mellitus, which was previously found only in adults, has developed in children and adolescents (Chaolin, Liya, & Cook, 2012). Diabetes emerged as the leading childhood and adolescence chronic disease (Macniven et al., 2012). A concern arises as Pinhas-Hamiel and Zeitler (2005) reported a close relation between rates of Type 2 diabetes mellitus in adults and the eventual appearance of the disorder in adolescents. About 80 percent of people with Type 2 diabetes mellitus live in developing countries (Morikawa, 1989). In the Asia-Pacific region, the incidence of Type 2 diabetes mellitus in adults continues to grow at an alarming rate. By 2025, China is expected to show an increase of up to 68 percent, followed closely by India with 59 percent, and the other Asian countries and the Pacific Islands (41 percent) (Chaolin et al., 2012).

The above data appear to have implications among youngsters for and public obesity prevention programs. According to Hardman and Stensel (2009) obesity is noted to be the most modifiable risk factor for Type 2 diabetes mellitus. In support, Macniven et al. (2012) stated one of the key components of diabetes management and obesity is physical activity. Physical activity has the potential to assist the prevention of Type 2 diabetes mellitus by virtue of its effect on body composition.

Bone Health

Physical activity is critical for preventing osteoporosis in mature adults as it increases bone mineral density. Casazza, Hanks, Hidalgo, Hu, and Affuso (2012) found physical activity improved bone quality via antagonistic effects on femoral bone marrow adipose tissue and possible long term agonistic effects on bone mineralization. The skeleton appears to be more responsive to the effects of activity during the periods of the lifespan in which growth is taking place (Blackwell 2007). However, the optimal exercise programme for enhancing bone mineral accrual in children remains to be determined (Hind & Burrows, 2007; Osborne et al., 2012).

Mental health

Mental health problems affect 10 to 20 percent of children and adolescents worldwide (Kieling et al., 2011). Some of the problems faced by young people include concerns about appearance, difficulty in forming relationships, loneliness and isolation, low self-esteem, victimization, academic difficulties, family dysfunction, and bullying (Kieling et al., 2011) . Such problems may manifest in the form of eating disorders, social withdrawal, self-harm and suicide. Self-harm is very common in adolescents, being reported by around 10% of 15 and 16 year olds (Hawton & O'Connor, 2012).

In Malaysia, suicide is becoming an urgent concern as the suicide rates among teenagers are increasing in recent years. Approximately seven percent of adolescents experienced suicide ideation and more than half of them turned their thoughts into action (Kok & Goh, 2011). The National Suicide Registry Malaysia reported that there were 1.28 suicides per 100,000 in a population estimated at 27.73 million for 2008. It was averaging 60 cases per month and two cases each day (Hayati & Kamarul, 2008).

Extensive literature exists that broadly suggests the strong link between physical activity and mental well-being (Biddle, Fox, & Boucher, 2000). Physical activity improves the ability of young people to cope with mental health problems. Active adolescents tend to feel less lonely, shy and hopeless than their inactive peers (Gleave & Cole-Hamilton, 2012).

However, patterns of association between physical activity and mental health for primary and secondary boys and girls were generally mixed and inconsistent, mainly because of the reliance on self-reported physical activity. Self-reported physical activity was significantly related to self-reported symptoms of depression, anxiety, and burnout. Light to moderate physical activity that is performed regularly seems to be associated with more favourable mental health patterns compared with physical inactivity (Lindwall, Ljung, Hadžibajramović, & Jonsdottir, 2012).

Another study observed discretionary physical activity was inversely associated with depressed mood in secondary boys while non-discretionary physical activity (school physical education) was inversely associated with depressed mood in primary girls (McKercher, Schmidt, Sanderson, Dwyer, & Venn, 2012). However, when physical activity was objectively assessed using Actigraph accelrometers, a Health Survey in England found no association between objectively measured physical activity and fitness with psychological health (Hamer & Stamatakis, 2010).

Academic performance

Traditional beliefs are that too much “playing” results in poor academic performance. Some schools have downsized physical education under the assumption that more classroom instructional time will improve academic performance. To date, five controlled experimental studies in the United States, Canada and Australia have evaluated the effects on academic performance of allocating additional instructional time for physical education. All five studies clearly demonstrated that physical activity does not need to be sacrificed for academic excellence (Active Living Research, 2007).

A cluster-randomised controlled trial (RCT) study conducted in 24 elementary schools in northeast Kansas, United States revealed that after three years, the 117 children who received the intervention (“Physical Activity across Curriculum”) had higher academic scores than the 86 control school children, based on composite reading, mathematics, and spelling test scales. The differences were all clear-cut and statistically significant (Donnelly et al., 2009). The results of a systematic review of the evidence suggest adding physical education to the school day as it does not detract students from performing well academically (Rasberry et al., 2011).

The above review indicates the availability of well-established evidence on the benefits of physical activity on adolescent health. Such evidence should warrant the promotion of physical activity as a well-established agenda for public health agencies and all types of healthcare delivery systems worldwide (Heath et al., 2012).

2.6 Physical Activity Patterns and the Sedentary Lifestyle of Youth

There is strong evidence to support the decline of physical activity during the adolescent stage of development. Since 1990, both subjective (e.g. self-reported questionnaires) and objective data (e.g. pedometers and accelerometers) have consistently indicated a steep physical activity decline in young people between the age of nine or ten and the age of 18 or 19 (Nader, Bradley, Houts, McRichie, & O'Brien, 2008; Rowland, 1990; Trost et al., 2002; Vincent & Pangrazi, 2002) (See Figure 2.3 to Figure 2.6).

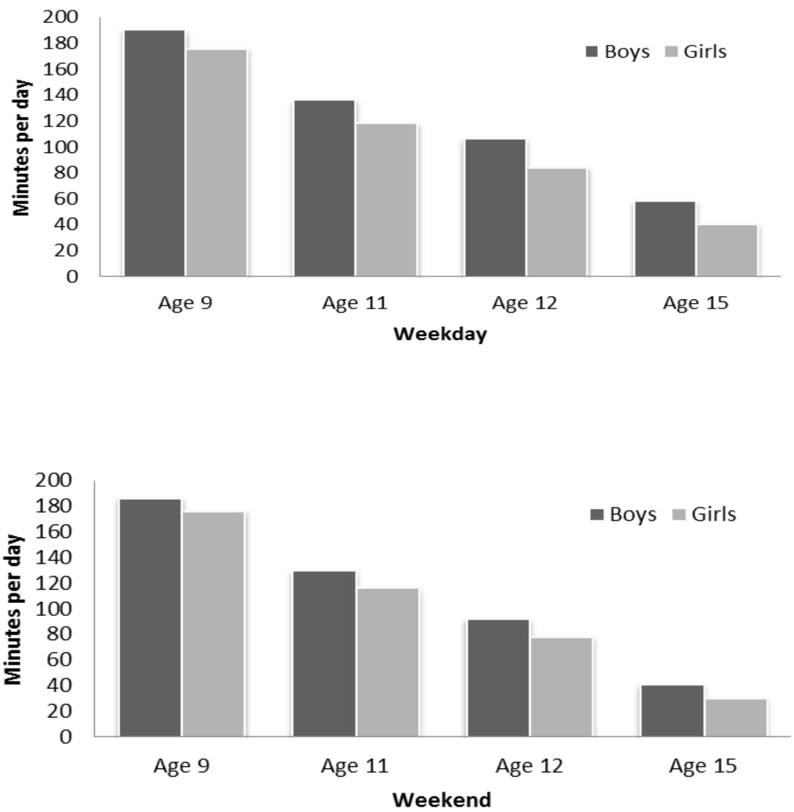


Figure 2.3 Mean minutes of moderate-to-vigorous physical activity per day in boys and girls from ages 9-15 years
Source: Nader et al. (2008)

Rowland (1990) illustrated the decline in physical activity as adolescents grow older (See Figure 2.4). This graph estimated the patterns of adolescent physical activity based on the daily energy expenditure derived from heart rate data.

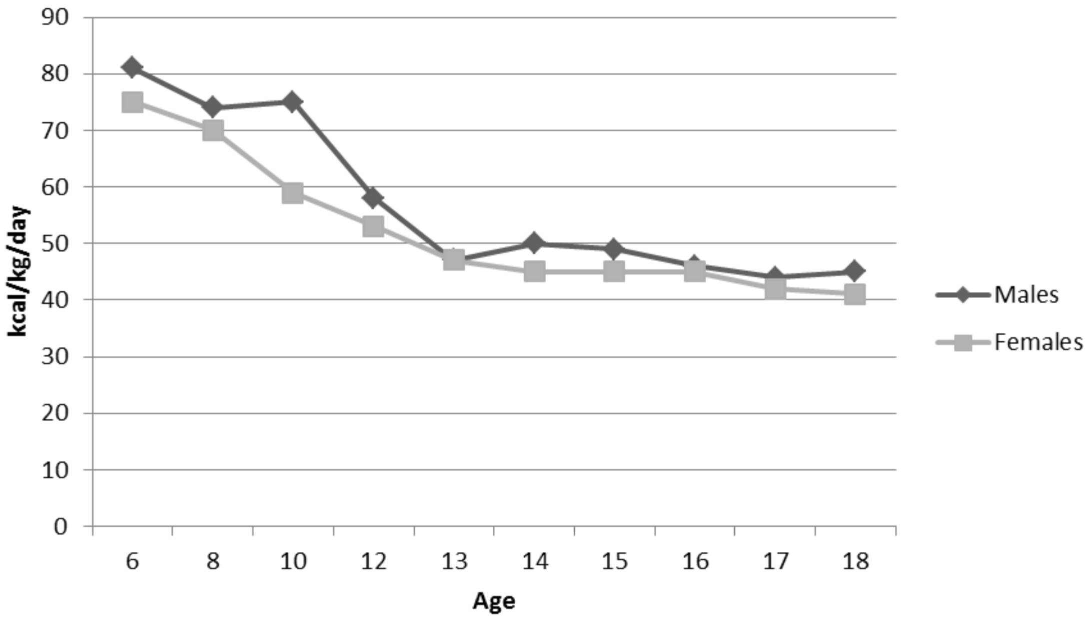


Figure 2.4 Total Daily Energy Expenditure for children and adolescents
Source: Rowland (1990)

Corbin, Pangrazi, and Masurier (2004) synthesized three data sets collected from children and adolescents in elementary (Vincent & Pangrazi, 2002) middle and high schools (Le Masurier, 2004a; Wilde, Corbin, & Le Masurier, 2004). The common trend towards decline in physical activity involvement was noted among the higher graders as shown in Figure 2.5.

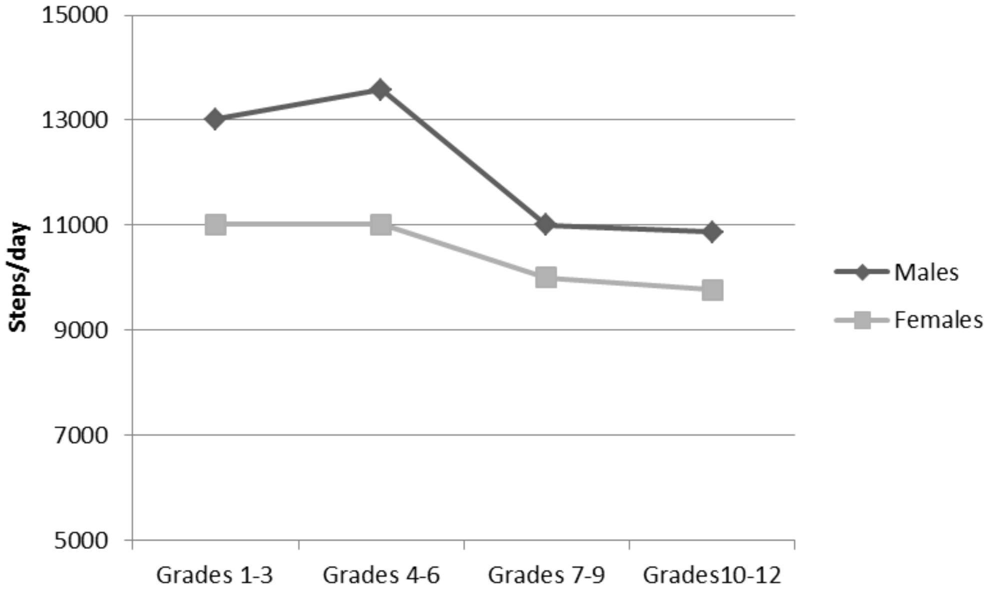


Figure 2.5 Mean steps/day for children and adolescents
Source: Vincent and Pangrazi (2002), Le Masurier (2004a), Wilde et al. (2004)

Males are more physically active than females at all ages. Steps accumulated by elementary school children do not differ by age / grade (Vincent & Pangrazi, 2002). Also there were no differences in steps taken between seventh and eighth grade middle school students (Le Masurier, 2004a). However, Wilde et al. (2004) found variation in activity from grade 10 to grade 12.

In another dataset using the CSA accelerometer, the researchers monitored physical activities among 400 school-aged children (grades 1 and 12) for seven consecutive days (Trost et al., 2002). The accelerometer estimates activity intensity counted by minutes of involvement in a combination of moderate to vigorous physical activity (MVPA). As demonstrated, MVPA decreased as grade level increased. At every grade level, males accumulated more activity than females. This was particularly true of vigorous activity (Trost et al., 2002).

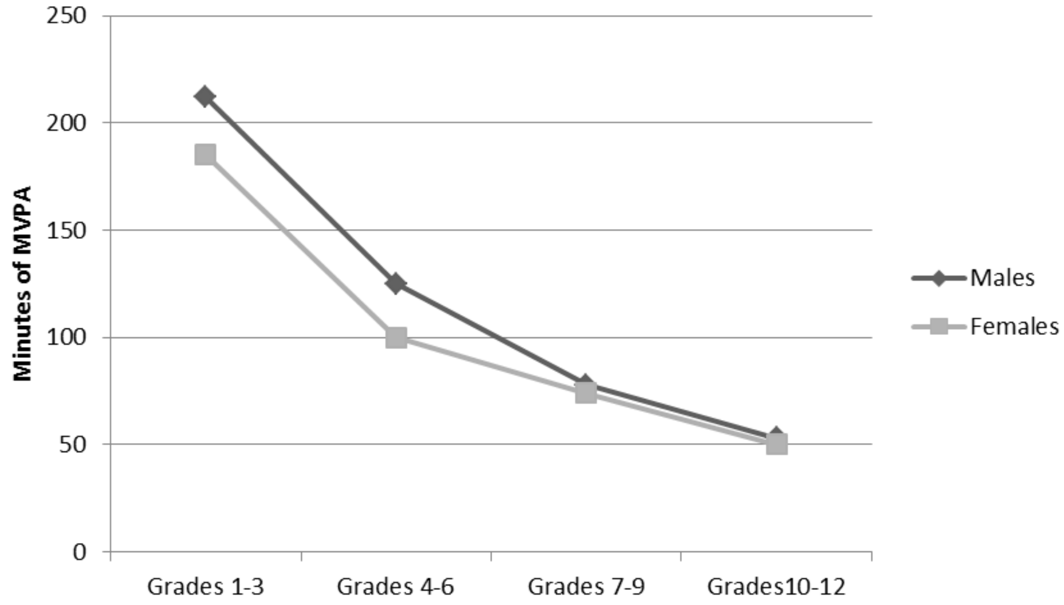


Figure 2.6 Mean minutes of moderate-to-vigorous physical activity (MVPA) of children and adolescents
Source: Trost et al. (2002)

Clearly, the figures show the drop in the level of physical activity during the adolescent stage. This may be seen as a normal biological process without many parents, caretakers or relevant authorities considering it as a major health problem. In addition, the trend of screen-based media entertainment (e.g. television, electronic games and online social networking) has increased in the last decade and that seems to be linked to physical inactivity (Costigan, Barnett, Plotnikoff, & Lubans, 2012; Melkevik, Torsheim, Iannotti, & Wold, 2010).

In the United States, about 88 percent adolescents have a video game console in the home with boys spending significantly more time playing games than girls (Ballard, Gray, Reilly, & Noggle, 2009). Consequently, about 40 percent of adolescents aged nine to 12 years were watching more than three hours of television on a school day (Nelson and Woods 2009). In Malaysia, adolescents spent an average of 4.69 hours/day on weekdays and 5.69 hours/day on weekends on screen-based media entertainment

(Cheah et al., 2011). Currently, the sedentary guideline for recreational screen time is less than two hours per day (Tremblay et al., 2011).

The current patterns of youth physical and sedentary activity provide the rationale for this research being targeted at adolescents, where the decline in the rate of physical activity is steep and the use of screen-based media entertainment is high.

2.7 Physical Activity Guidelines for Adolescents

Previously, adult standards were often used to determine if youth activity levels were adequate (Corbin et al., 2004). Held on June 1993, San Diego, CA, USA, an International Consensus of Physical Activity for Adolescents Conference produced the first physical activity guidelines for adolescents (Sallis, Patrick, & Long, 1994). The consensus panel recommended adolescents should be physically active daily, or nearly every day, for at least 30 minutes as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities. Adolescents should also engage in three or more sessions per week of activities that last 20 minutes or more and that require moderate to vigorous levels of exertion (Sallis et al., 1994).

The 60-minute standard is a minimum for adolescents to improve cardio-respiratory and muscular fitness, bone health, and cardiovascular and metabolic health biomarkers (World Health Organization, 2010). Most of the daily physical activity should be aerobic, including: play, games, sports, transportation, chores, recreation, physical education or planned exercise, in the context of family, school and community activities. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least three times a week.

Besides the above recommendations, the President's Council on Physical Fitness and Sports recommended an objective measure of physical activity. An initial pedometer guideline of 13,000 steps/day for boys and 11,000 steps for girls were established using the mean steps/day data observed among elementary-aged boys and girls (Vincent & Pangrazi, 2002). However, these recommendations were based on limited data and require revising.

In 2004, Tudor-Locke et al. (2004) used an empirical approach to establish steps/day guidelines for elementary school children related to body mass index (BMI). This was done by assessing secondary pedometer data involving 1,954 children ages 6 -12 years from America, Australia, and Sweden. This pedometer-BMI-referenced standard suggested that the step targets should be as high as 12,000 for girls and 15,000 for boys, which is higher than previous normative standards.

The 12,000 and 15,000 steps a day is necessary if the objective is for maintenance of a healthy BMI. Children who failed to meet these recommended standards were more likely to be classified as having a high BMI compared with those below these recommended standards (Tudor-Locke et al., 2004). Since no specific step count recommendations are currently available for adolescents, this research adopts a conservative approach developed by Tudor-Locke et al. (2004). The recommendations target 15,000 steps for boys and 12,000 steps for girls.

2.8 Measurement in Physical Activity

An accurate and reliable measure of physical activity helps to understand: 1) the association between these behaviours and health outcomes; 2) how to elicit favourable health outcomes, (3) determinants of physical activity, and (4) the impact of physical activity on the prevalence of overweight and obesity in children (Loprinzi & Bradley, 2011). Besides, it helps to monitor population health, and design effective interventions (Labarthe, 2011).

The goal of any assessment tool is to measure one or more dimensions of physical activity (i.e. type, frequency, duration, or intensity). Despite the fact that a wide variety of physical activity measures are available, there is no existing physical activity measures perfectly meeting all of the above criteria (Hillsdon, 2009). This subsection discussed the strengths and limitations of the each physical activity measures in order to assist in the decision of physical activity measurement to be used in the research.

2.8.1 Subjective Measures of Physical Activity

Typically self-report questionnaires, diaries, logs, and interviews offer a practical approach to measure and describe the type, frequency, duration and intensity of physical activity (Tudor-Locke, 2002). The most established and commonly cited measures in previous studies are the International Physical Activity Questionnaire (IPAQ) (IPAQ, 2005) and the Physical Activity Questionnaire for Adolescents (PAQ-A) (Kowalski, Crocker, & Faulkner, 1997).

The IPAQ defines walking to include any form of walking from place to place which equals 3.3 metabolic equivalents (METs). Moderate physical activity is defined as that which needs moderate physical effort and causes some shortness of breath. This equals four METs. An advantage of IPAQ long form is that it includes questions on sitting activities, such as reading, television viewing and sitting at a desk. Completion time was estimated at 15 minutes (IPAQ, 2005).

Although IPAQ has previously been shown to have acceptable reliability and criterion validity (Bauman et al., 2011), caution is warranted before using IPAQ data to support public policy decisions related to physical activity. The IPAQ long form appears to overestimate levels of physical activity for both males and females, suggesting that the instrument has problems in measuring levels of physical activity, as found in Brazilian adults (Sebastião et al., 2012). Similarly, the IPAQ and PAQA were found to have limited validity in Vietnamese adolescents, particularly in rural areas (Lachat et al., 2008). However, the reasons for the low validity and differences between rural and urban areas remain unclear. Additional efforts are required to develop specific instruments to assess physical activity in adolescents in rural areas.

Stanford 7-Day Recall (7-DR) is an interview administered questionnaire and takes approximately 15 minutes to complete. The 7-DR estimates all levels of physical activity from light to very hard, specific to the seven days prior to questionnaire administration. For each day of the past week, participants report the approximate number of hours they slept and spent in moderate, hard, and very hard activity. The 7-DR was reasonably accurate in assessing usual levels total and very hard intensity activity (more than 7 METs), but not moderate physical activity (Richardson, Ainsworth, Jacobs Jr, & Leon, 2001).

A 3-day Bouchard activity diary involves the self-report of physical activity intensity and provides information on frequency as well as the context of energy expenditure. It is not dependent upon memory and interpretation. However, the 3-day diary might likely be affected by socially desirable responses, and if not filled out properly, may lead to decreased precision. This diary provided a reasonably valid alternative for assessing activity energy expenditure (Machado-Rodrigues AM et al., 2012).

A 7-day physical activity diary is a self-completion diary that requires participants to ‘tick’ 15 minute blocks of activity as they occur over the course of each day, for seven consecutive days. It includes occupational, leisure time and sports activity. It requires no verbal instruction for completion. Although no estimate of completion time is given it is reasonable to assume that the daily completion time is minimal. The main challenge for participants is likely to be remembering to do it for seven days. The reliability and validity is adequate to be used in research on physical activity in adolescents (Bratteby, Sandhagen, Fan, & Samuelson, 1997).

Self-report questionnaires, diaries and logs can be administered to a large sample at a relatively low cost and are commonly used in large epidemiological studies and national surveys. However, the limitation includes recall bias, differential interpretations of terms (e.g. light, moderate, vigorous), floor effects (the lowest score available is too high for some respondents), and lack of sensitivity to ambulatory activity or walking (Tudor-Locke, 2002). It was also noted that self-report measures typically overestimate lower intensity physical activities and underestimate higher intensity physical activities (Hussey, Bell, & Gormley, 2007).

2.8.2 Objective Measures of Physical Activity

The use of self-report approaches to measure physical activity is still considered imperative in understanding the context and patterns of physical activity. However, there has been a rapid increase in both the number and type of objective physical activity assessment instruments using electronic motion sensors available to researchers. Pedometers offer researchers a convenient and inexpensive tool for objective measurement of physical activity. Pedometers have been used in Japan to assess physical activity and increase walking behaviours for over 30 years under the name of the "manpo" (in Japanese this means 10,000 steps) (Tudor-Locke, 2002). Pedometers record and display movement as 'steps taken' as a simple measure of ambulatory activity (McClain & Tudor-Locke, 2009).

Pedometers display good agreement with accelerometers (r=0.80-0.90) (Tudor-Locke, 2002) and the reliability of pedometer data in youth samples has generally been considered to be acceptable (Strycker, Duncan, Chaumeton, Duncan, & Toobert, 2007). A recent review conducted on pedometer methods identified 30 of the 34 articles reported using the Yamax pedometer (Yamax Corporation, Tokyo, Japan) to determine free-living physical activity in youths (McClain & Tudor-Locke, 2009). But research also has shown that the Yamax pedometer underestimates (by approximately 25%) steps taken at slow walking speeds of less than 60 meters/minute (Bassett et al., 1996; Hendelman, Miller, Baggett, Debold, & Freedson, 2000). This indicates that the use of pedometers may be limited among the elderly.

Most pedometers record and display movement as steps taken (a simple, raw or pure measure of ambulatory activity) (Tudor-Locke, 2002). Some also have features to estimate energy expended (kcals) and/or distance travelled (miles or kilometres). However, studies have shown that pedometers are most accurate at measuring steps taken (Bassett et al., 1996; Hendelman et al., 2000), less accurate at estimating distance travelled (Bassett et al., 1996; Hendelman et al., 2000), and even less accurate at estimating energy expenditure (Bassett et al., 2000). For these reasons, researchers have recommended that steps taken, or steps/day be universally adopted as a standard unit of measurement for collecting, reporting, and interpreting pedometer data (Rowlands, Eston, & Ingledew, 1997; Tudor-Locke & Myers, 2001b), which was discussed earlier.

Concern has also been raised about error related to increased obesity. In particular, abdominally distributed adiposity may interfere with accurate detection of steps taken due to inappropriate placement (e.g., rotation of the pedometer horizontally (Tudor-Locke, 2002). Pedometers are generally not designed to detect time in specific intensity categories (e.g., time in moderate-to-vigorous physical activity) or to record non-ambulatory activities, such as swinging on bars, skateboarding, cycling or water-based activities (Wilson, 2008). Another challenge in using pedometers was that pedometers are sensitive to shaking.

The pedometer is mounted at the waist, is mostly unobtrusive, and causes relatively minimal participant burden or discomfort. But some pedometers require the use of an additional elastic belt to properly fit the instrument to the wearer, which may be considered as an additional burden to some children (i.e. due to comfort, inconvenience, or fashion) (McClain & Tudor-Locke, 2009). Pedometers prices ranged from USD17 – USD30 (without memory) and USD48 - USD70 (7-day memory) per unit.

The intensity and duration of physical activity are of particular interest within surveillance research due to their relationship to current physical activity public health guidelines. Accelerometers are available which allow objective assessment of physical activity intensity and duration among children. Accelerometers are relatively small (the size of a wristwatch), lightweight, and worn around the waist with an adjustable belt. Accelerometers record the frequency and magnitude of the body's acceleration during movement. As acceleration occurs, the acceleration signal from the accelerometer is digitized and generates an "activity count" (Loprinzi & Bradley, 2011).

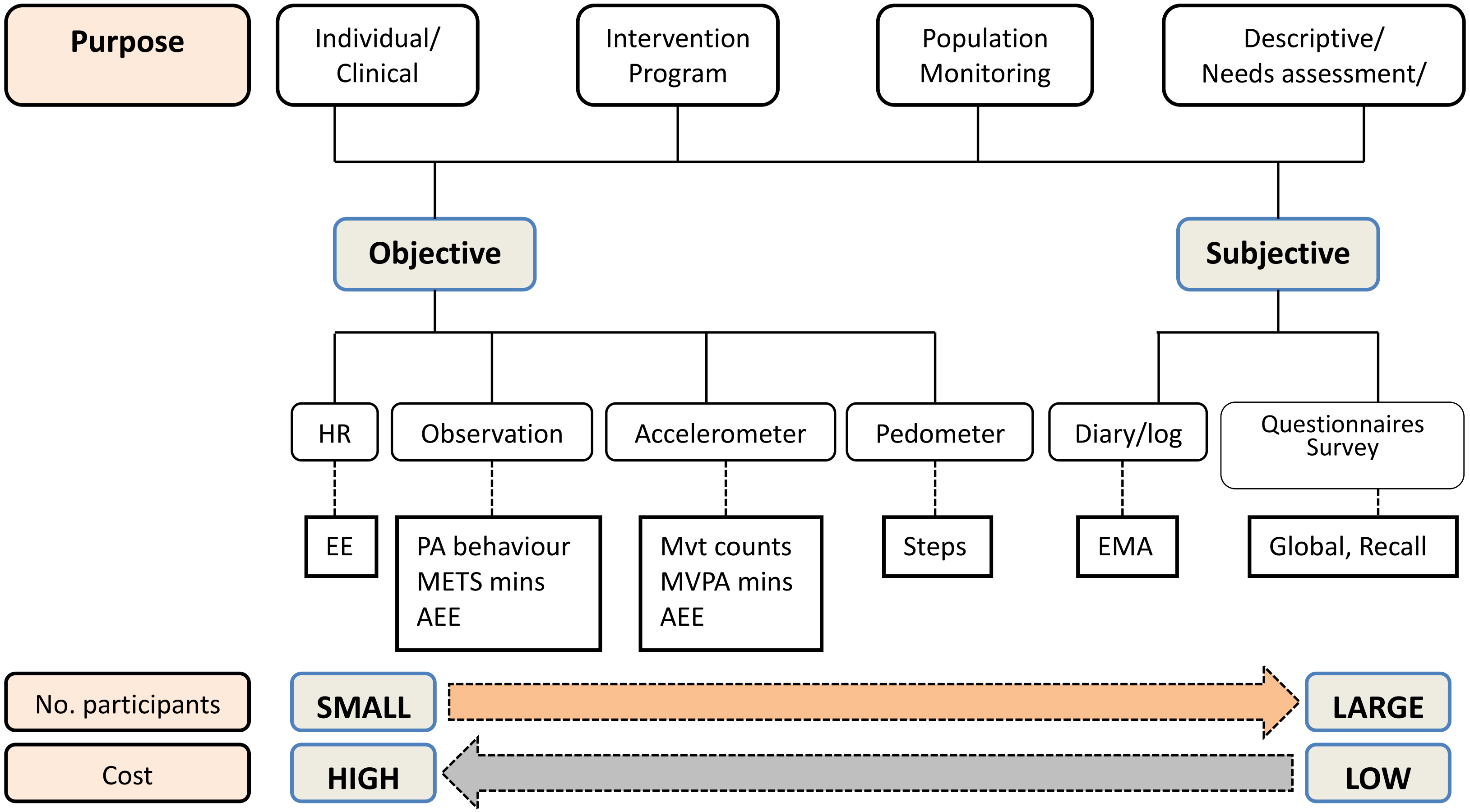
Measurement intervals can range from five seconds to one minute depending on the device used. Combining the output of some accelerometers with data on gender, height, weight and age can yield energy expenditure data, such as metabolic equivalent units (METs). The number of steps accumulated per unit of time is used to estimate intensity level and can be classified as light-, moderate- and vigorous-intensity activity using reported cut off points. Cut off points may be affected by anthropometric measurements so they may need to be population specific. The results are then either displayed as an accumulated total or, most often, downloaded for computer analysis (Chen & Bassett, 2005).

Heart rate monitoring is an attractive approach based on the physiological response to movement for assessing physical activity. Heart rate monitoring has been widely used among children and adolescents to provide an indication of intensity, duration, and frequency of physical activity (Loprinzi & Bradley, 2011). However, various factors (i.e. age, gender, stress, training status and environmental conditions) can influence the relationship between heart rate and oxygen consumption, enabling energy expenditure to be estimated. The slope between heart rate and energy expenditure varies between individuals; therefore individual calibration equations have been utilized. The lengthy and complex procedure in calibrating may make this method impractical in large sample sizes (Livingstone et al., 1992). In addition, heart rate can increase if a person is anxious or excited without any movement.

The doubly labelled water technique is a non-invasive means to accurately measure total daily energy expenditure in free-living humans. The technique was first introduced in the 1950s as an isotopic technique for measuring carbon dioxide production rate in small animals. The current recommended levels of caloric intakes and activity levels prepared by the U.S. Institute of Medicine and the World Health Organization are based on doubly labelled water data (Stifelman, 2007).

For researchers, the doubly labelled water method and indirect calorimetry serve as criterion measures for self-report tools and activity monitors. The doubly labelled water method administers two forms of stable isotopically labelled water: 1) deuterium-labelled (^2H_2O) and 2) 18oxygen-labelled ($H_2{}^{18}O$). The disappearance of the hydrogen-labelled ^2H_2O represents the total water flux while the disappearance of the oxygen-labelled $H_2{}^{18}O$ represents the sum of water flux and CO_2 generated from respiration. The difference in disappearance rates between the two isotopes represents the energy expended over a period of 1–3 half-lives of the labelled water. The resulting duration of observation is typically 1–3 weeks, depending on the size and activity level of the subject (Stifelman, 2007).

In conclusion, no single physical activity instrument is appropriate for all situations, populations, and research questions. For the purpose of this research, the pedometer was chosen to measure physical activity levels among adolescents based on the decision flowchart developed by Dollman et al. (2009) (See Figure 2.7). This decision flow chart is useful in selecting physical activity measures depending on the research purpose, number of participants and costing. From this flowchart, the pedometer is one of the few valid and reliable objective measures of youth physical activity that allow direct comparisons across studies of young people in numerous countries (Strycker et al., 2007).



HR: Heart rate; **EE**: Energy expenditure; **AEE:** Activity Energy Expenditure; **Mvt:** Movement; **MVPA**: Moderate-to-vigorous- physical activity; **EMA:** Ecological momentary assessment

Figure 2.7 Decision flow chart to select physical activity measurement approaches for use with young people
Source: Dollman et al. (2009)

2.9 Physical Inactivity in Malaysia

Malaysia, a fast developing nation in Southeast Asia, is experiencing the double burden of communicable and non-communicable diseases (Mathers et al., 2004). The estimated mortality rate due to non-communicable diseases was 67 percent. Among risk factors, physical inactivity recorded the highest prevalence (60.5 percent) followed by obesity (44.2 percent), and raised blood pressure (34.7 percent) (World Health Organisation, 2013).

The top two leading causes of death among Malaysians are ischaemic heart disease and cerebrovascular disease (Mathers et al., 2004). The total deaths in Malaysia in 2001 estimated to be 1.7 million with almost two-thirds resulting from chronic diseases (Yusoff et al., 2005). The five important risk factors for non-communicable diseases and their prevalence were: physical inactivity (43.7 percent), being overweight (29.1 percent), smoking (21.5 percent), hypercholesterolemia (20.6 percent) and obesity (14 percent) (Yusoff et al., 2005).

Data from global surveillance indicated Malaysia as one of the countries with more than half of its adult population reported to be physically inactive. *The Lancet* reported Malaysia to rank number 10 in the world for physical inactivity, scoring 61.4 percent (Hallal, Bauman et al. 2012). Also, in the Southeast Asian and Western Pacific Region, Malaysia was ranked the highest (in male) and second highest (in female) in terms of physical inactivity (Guthold, Ono et al. 2008) (Figure 2.8 and Figure 2.9).

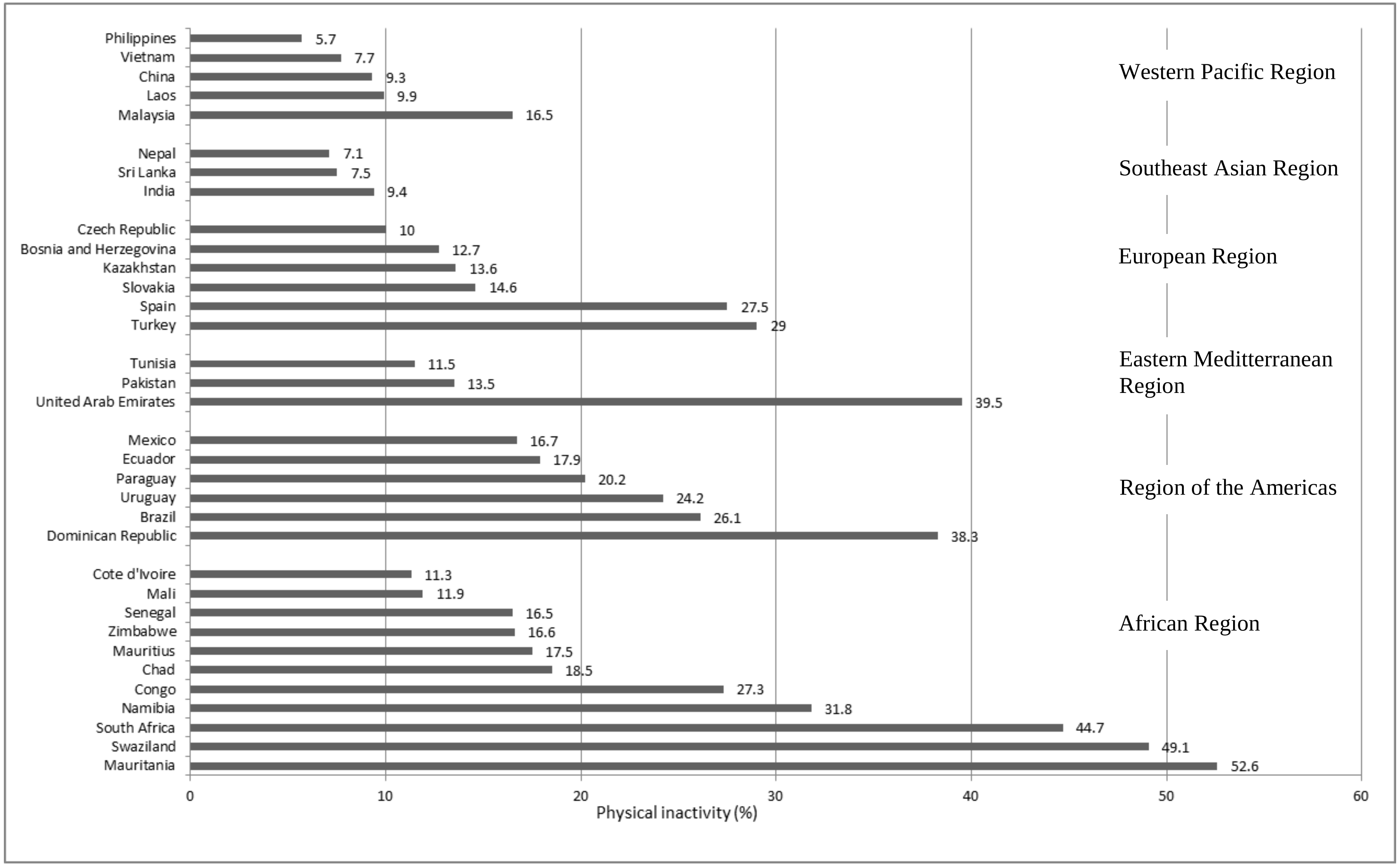


Figure 2.8 Prevalence of physical inactivity for men in 51 countries, grouped by WHO region, World Health Survey, 2002–2003
Source: Guthold, Ono, Strong, Chatterji, and Morabia (2008)

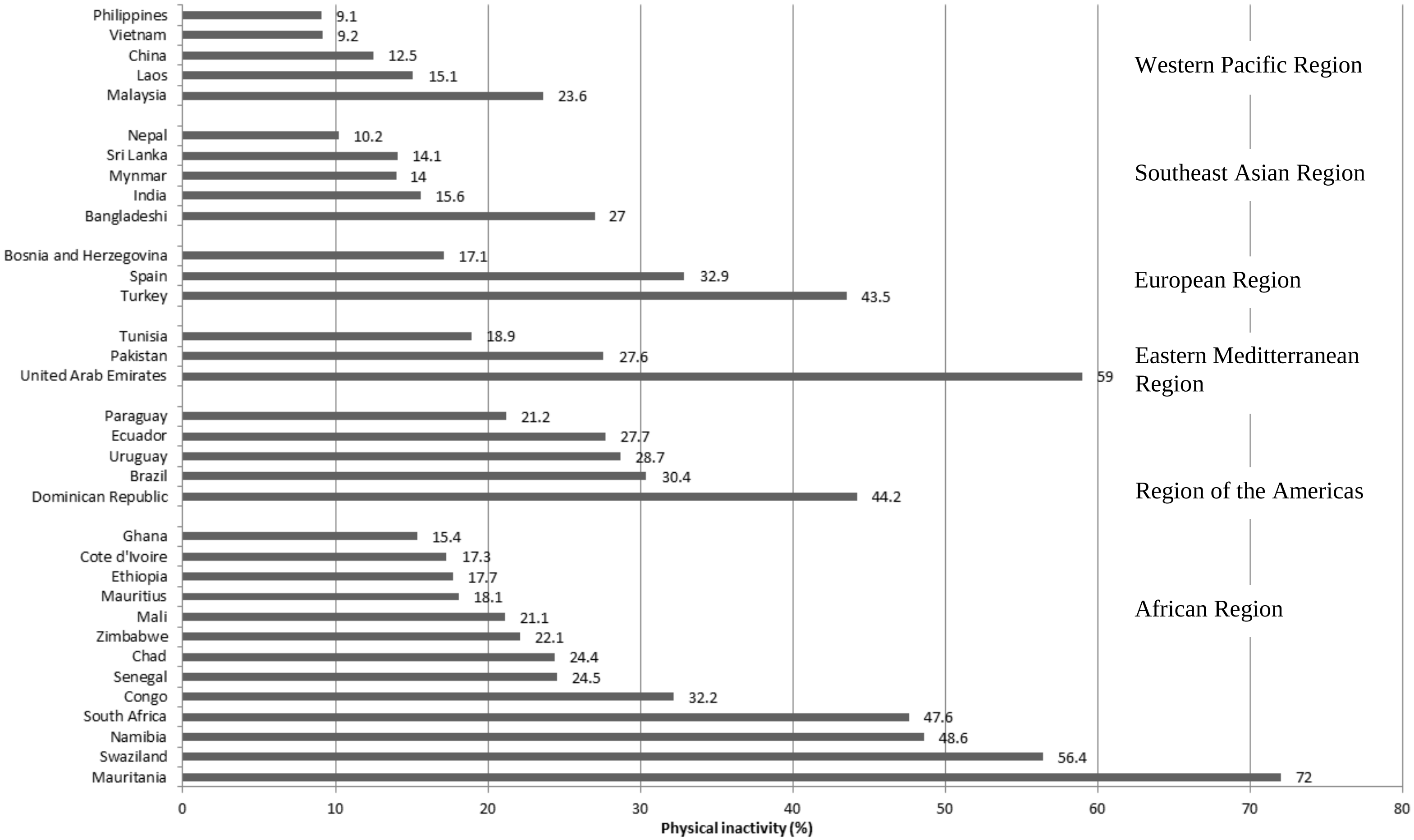


Figure 2.9 Prevalence of physical inactivity for women in 51 countries, grouped by WHO region, World Health Survey, 2002–2003
Source: Guthold et al. (2008)

Based on the Malaysian National Health and Morbidity Survey III (NHMS III) in 2006, 43.7 percent of 5.5 million Malaysian adults were physically inactive. Of these, 85.7 percent Malaysian adults were inactive during leisure time, 72.6 percent inactive during working and 72.1 percent during travelling (Omar, Samad, Daud, Hasan Nudin, & Yusoff, 2006).

This sedentary lifestyle was observed among adolescents. Local studies reported the prevalence of physical inactivity ranging between 17.6 percent and 35.5 percent (Dan & Mohd Nasir, 2008; I Aniza & M R Fairuz, 2009; Thea & Mohd Nasir, 2008). Another local study that employed pedometer-assessed physical activity reported a higher percentage of physical inactivity, 45 percent of adolescent boys and 88 percent in adolescent girls (Wilson, 2008).

Malaysia has high prevalence of physical inactivity (Hallal, Bauman et al. 2012) for both men and women (higher among women) and higher among those living in urban areas (Guthold et al., 2008). The NHMS III reported that Chinese (47.1 percent) were the highest ethnic grouping in terms of inactivity, followed by Indians (44.5 percent), Bumis (44.1 percent) and Malays (42.4 percent). The prevalence of physical inactivity was higher among respondents with no formal education (57.4 percent) and those who were unemployed (60.8 percent) (Omar et al., 2006).

Comparing the states in Malaysia, Selangor recorded the highest percentage of physically inactive people (52.1 percent), followed by Kuala Lumpur (51.8 percent), Labuan (49.2 percent), Perlis (49.1 percent) and Sarawak (48 percent). Pahang and Terengganu have the lowest prevalence in terms of physical inactivity (Omar et al., 2006) as shown in Figure 2.10.

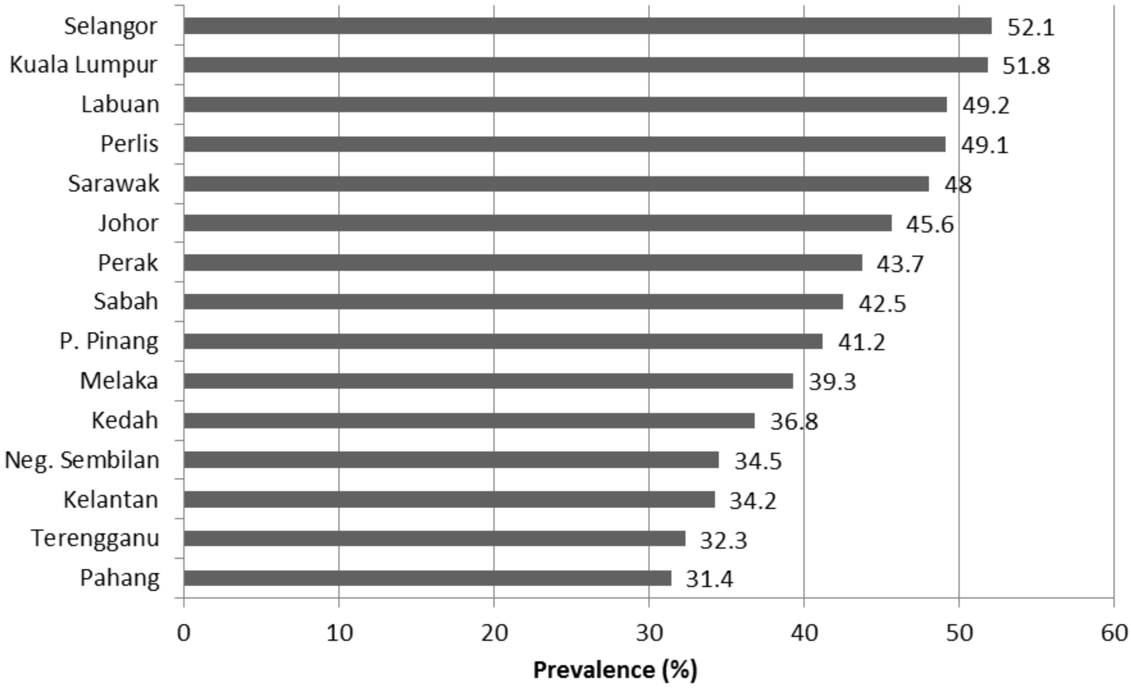


Figure 2.10 Prevalence of physical inactivity by state in Malaysia
Source: Omar et al. (2006)

Overall, locally and globally, population levels of physical activity participation are low and improved understanding of why some people are active and others are not is needed. Girls are reported to be less active than are boys. The worldwide decline in physical activity appears to follow the speed of economic growth, suggesting that the prevalence of inactivity may rise with increasing economic and technological advances that eventually reduce occupational and transportation physical activity (Heath et al., 2012).

2.10 Theories and Models Related to Physical Activity Behaviour

As early adolescence has been found to be a key point in the acquisition of health behaviours, intervention to promote physical activity behaviour was a cornerstone in this age group. Furthermore, recent evidence suggests that early adolescence is also a time where inactive adolescents can become predisposed to adverse health outcomes later in life. This includes being overweight, increased levels of obesity, Type 2 diabetes mellitus and risk factors for cardiovascular disease (Lee et al., 2012).

Theories and models of human behaviour are necessary to guide the development and refinement of intervention efforts. Theory guides the search for reasons why adolescents do or do not engage in certain health behaviours. Thus, in this section, elements of behavioural and social science theories and models to guide much of the research on physical activity are discussed (See Table 2.1).

Table 2.1 Summary of theories and models used in physical activity research

Theory / model	Level	Key concepts
Social cognitive theory	Interpersonal	Reciprocal determinism Behavioural capability Self-efficacy Outcome expectations Observational learning Reinforcement
Health belief model	Individual	Perceived susceptibility Perceived severity Perceived benefits Perceived barriers Cues to action Self-efficacy

Theory of planned behaviour	Interpersonal	Attitude toward the behaviour
		  Outcome expectations
		  Value of outcome expectations
		Subjective norm
		  Beliefs of others
		  Motive to comply with others
		Perceived behavioural control

Relapse prevention	Individual	Skills training Cognitive reframing Lifestyle rebalancing
Transtheoretical model	Individual	Precontemplation Contemplation Preparation Action Maintenance

Ecological perspective	Environmental	Multiple levels of influence
		  Intrapersonal
		  Interpersonal
		  Institutional
		  Community
		  Public policy

Source: Glanz and Rimer (1995)

2.10.1 Cognitive-Behavioural Theories

At the individual and interpersonal levels, contemporary theories of health behaviour can be broadly categorized as “Cognitive-Behavioural” (Glanz & Rimer, 1995). The theories include; the Social Cognitive Theory (SCT), the Health Belief Model (HBM), the Stages of Change (Transtheoretical) Model, the Theory of Planned Behaviour (TPB), and the Relapse Prevention Model. In these theories, there are three key concepts. First, behaviour is mediated by cognitions; that is, what people know and think affects how they act. Second, knowledge is necessary for, but not sufficient to produce, most behaviour changes. Third, perceptions, motivations, skills, and the social environment are key influences on behaviour.

Social Cognitive Theory

The social environment includes family members, colleagues, friends, health professionals, and others. Because it affects behaviour, the social environment also impacts health. The Social Cognitive Theory (SCT) is one of the most frequently used and robust health behaviour theories (Glanz & Rimer, 1995). It explores the reciprocal interactions of people and their environments, and the psychosocial determinants of health behaviour. As a person adopts new behaviours, this causes changes in both the environment and in the person.

According to SCT, three main factors affect the likelihood that a person will change health behaviour: (1) self-efficacy, (2) goals, and (3) outcome expectancies. If individuals have a sense of self-efficacy, they can change behaviours even when faced with obstacles. If they do not feel that they can exercise control over their health behaviour, they are not motivated to act, or to persist through challenges (Glanz & Rimer, 1995). Among these three factors, the concept of self-efficacy has been influential in understanding physical activity behaviour and developing health promotion intervention (Stephens, 2008). It has been used successfully as the underlying theory for physical activity, dietary and pain control (Glanz & Rimer, 1995; Ramirez et al., 2012; Salvy, de la Haye, Bowker, & Hermans, 2012).

Self-efficacy is defined as the extent of one's ability to perform a task that is most influenced by past experiences and social support (Bandura, 1997). A key part of self-efficacy theory is that the stronger the individual's belief in his or her ability to perform a set of actions, the more likely they will be to initiate and persist in the given activity and vice versa. On the same note, Williams and Williams (2010) stated individuals with high levels of self-efficacy, approach difficult tasks as challenges to master rather than as threats to be avoided. There are four sources of self-efficacy; namely mastery experiences, social models, social persuasion and positive mood (Bandura, 1994).

The interactions among self-efficacy, social and physical environment variables affecting adolescent physical activity was elaborated clearly by Bandura (1997). Bandura explained there are two levels of self-efficacy (low and high) interact with two types of environment (responsive and unresponsive) to produce the following four predictive variables:

1. Success. A person with a high-level of self-efficacy in a responsive environment will be successful. Their positive attitude toward their abilities coupled with environmental change promotes success and improves long-term motivation.

2. Depression. A person with a low self-efficacy in a responsive environment may fall into a depressed state. They know the environment will change but their lack of belief in their own abilities stops them from trying and succeeding.
3. Apathy and helplessness. A person with low self-efficacy and an unresponsive environment will feel helpless and decide that all efforts are pointless thus causing them to be inactive.
4. Effort intensification or change of course. A person with high self-efficacy in an unresponsive environment will either increase their efforts to change or decide they need to change their goals.

In summary, some similarities can be noted among the cognitive-behavioural theories to understand and enhance health behaviours such as physical activity. Many of the theoretical approaches highlight the role of the perceived outcomes of behaviour, although different terms are used for this construct, including perceived benefits and barriers (health belief model) and outcome expectations (social cognitive theory and theory of planned behaviour). The social cognitive theory features the role of social influences, as in the concepts of observational learning, perceived norms (theory of reasoned action and theory of planned behaviour), social support, and interpersonal influences (ecological perspective).

Health Belief Model

The Health Belief Model (HBM) was one of the first theories of health behaviour, and remains one of the most widely recognized in the field (Glanz & Rimer, 1995). It was first developed in the 1950s by social psychologists Godfrey Hochbaum, Irwin Rosenstock, and Stephen Kegels.

The model was developed in response to the failure of a free tuberculosis (TB) health-screening program. The HBM stipulates that a person's health-related behaviour depends on the person's perception of four critical areas: perceived susceptibility, perceived severity, perceived benefits, perceived barriers and cues to action (Rosenstock, 1974; Stephens, 2008).

The central focus of HBM is about health motivation, thus a good fit for addressing problem behaviours that evoke health (e.g. high-risk sexual behaviour and the possibility of contracting HIV). However, the construct of self-efficacy, or a person's confidence in his ability to successfully perform an action has been added to the model, allowing it to better account for habitual behaviour such as physical activity (Rosenstock, 1990). However, the HBM is more descriptive than explanatory, and does not suggest a strategy for changing health-related actions. For the most effective use of the model, it should be integrated with other models that account for the environmental context and suggest strategies for change.

Theory of Planned Behaviour

The theory of planned behaviour (TPB) (Ajzen, 1991) was developed from the theory of reasoned action (TRA) , which was proposed by Martin Fishbein together with Icek Ajzen in 1975. Both the TPB and the TRA assume *the behavioural intention* is the most important determinant of behaviour (Glanz & Rimer, 1995). According to these models, behavioural intention is influenced by a person's *attitude* toward performing behaviour, and by beliefs about whether individuals who are important to the person approve or disapprove of the behaviour (*subjective norm*). The TPB and TRA assume all other factors (e.g., culture and the environment) operates through the models' constructs, and do not independently explain the likelihood that a person will behave in a certain way (Glanz & Rimer, 1995).

The Theory of Planned Behaviour is a major social-cognitive theory that has been applied to explain physical activity behaviour in numerous populations (Plotnikoff et al., 2011), targeting psychological factors such as attitudes and cognitive factors like decision processes (Stephens, 2008). The TPB differs from the TRA in that it includes one additional construct, *perceived behavioural control*; this construct has to do with people's beliefs that they can control their behaviour.

Relapse Prevention Model

Some researchers have used the concepts of relapse prevention (Marlatt & Gordon, 1985) to help new exercisers anticipate problems with adherence. Factors that contribute to relapse include negative emotional or physiologic states, limited coping skills, social pressure, interpersonal conflict, limited social support, low motivation, high-risk situations, and stress (Brownell, Marlatt, Lichtenstein, & Wilson, 1986; Marlatt & Gordon, 1985). Principles of relapse prevention include identifying high-risk situations for relapse (e.g., change in season for outdoor physical activity) and developing appropriate solutions (e.g., finding a place to walk inside during the winter).

Stages of Change (Transtheoretical) Model

Developed by Prochaska and DiClemente (1983) the Stages of Change Model evolved out of studies comparing the experiences of smokers who quit on their own with those of smokers receiving professional treatment. In this model, behaviour change has been conceptualized as a five-stage process related to a person's readiness to change: *precontemplation*, *contemplation*, *preparation*, *action*, and *maintenance* (Glanz & Rimer, 1995). People at different points along this continuum have different informational needs, and benefit from interventions designed for their stage. The basic premise is that behaviour change is a process, that individuals pass through qualitatively different stages as they move from Inaction to Action (Callaghan, Khalil, & Morres, 2010).

The Stages of Change Model has previously been applied to a wide variety of problem behaviours. These include smoking cessation, exercise, low fat diets, radon testing, alcohol abuse, weight control, condom use for HIV protection, organizational change, use of sunscreens to prevent skin cancer, drug abuse, medical compliance, mammography screening, and stress management (Geller, Nigg, Motl, Horwath, & Dishman, 2012; Nigg et al., 2011; Velicer, Prochaska, Fava, Norman, & Redding, 1998).

Self-Determination Theory

Physical activity engagement involves a complex interaction between biological, environmental, social and psychological influences. However, many behavioural theories fail to account for how that behaviour is energized. One theoretical approach to human motivation that is receiving increasing attention in the exercise domain is Self-Determination Theory (SDT) (Deci & Ryan, 1985). In particular, motivation is a critical factor in supporting sustained physical activity, which in turn is associated with important health outcomes (Teixeira, Carraca, Markland, Silva, & Ryan, 2012).

Accordingly, research on physical activity motivation from the perspective of self-determination theory (SDT) has grown considerably in recent years. SDT defines motivation as psychological energy directed at a particular goal (Deci & Ryan, 1985). The SDT emphasized the importance of motivational *quality* in addition to its *quantity*. It has also offered a particularly comprehensive approach to studying health behaviour via its conceptualization and measurement of autonomy, perceived competence, relatedness to others, and its emphasis on the role of the social context in supporting optimal motivation.

Although, there has been a surge of activity in applying SDT to many of life's domains, including well-being and health, sport and exercise, close relationships, parenting, education, and work (Deci & Ryan, 2008), there remain some inconsistencies and mixed evidence with regard to the relations between specific SDT constructs and exercise.

Overall, cognitive-behavioural theories are useful to explain the variance in physical activity behaviour. Recent meta-analyses reviewed conducted by Plotnikoff et al. (2013), revealed 33 percent and 48 percent of the variance respectively for physical activity and intention. This means more than half of the variance in physical activity behaviour is unexplained. This suggests the psychosocial models need to be expanded by including a broader context of the environment.

2.10.2 The Ecological Perspective

One way of conceptualising the interdependence among people, their behaviour and their environment is through social ecological models, which are now becoming common (Bauman, Reis et al. 2012). “Ecology” is a term that describes the interrelations between organisms and their environments. Its origin in biology shifted to other disciplines, such as psychology, sociology and public health, for understanding people’s relations with their physical and social environment (Stephens 2008). It highlights people’s interactions with their physical and social-cultural environments because behaviour must be enacted in specific physical settings (Sallis, 1998).

Two key concepts from the ecological perspective help to identify interventions for promoting health: first, behaviour is affected by *multiple levels of influence*; and second, individual behaviour both shapes, and is shaped by the social environment (*reciprocal causation*) (Glanz & Rimer, 1995). McLeroy et al. (1988) identified five levels of influence for health-related behaviours and conditions. These levels include: (1) intrapersonal or individual factors; (2) interpersonal factors; (3) institutional or organizational factors; (4) community factors; and (5) public policy factors (See Table 2.2).

Table 2.2 Ecological Perspective: Levels of Influence

Concept	Definition
Intrapersonal Level	Individual characteristics that influence behaviour, such as knowledge, attitudes, beliefs, and personality traits
Interpersonal Level	Interpersonal processes and primary groups, including family, friends, and peers that provide social identity, support, and role definition
Community Level:	
Institutional Factors	Rules, regulations, policies, and informal structures, which may constrain or promote recommended behaviours
Community Factors	Social networks and norms, or standards, which exist as formal or informal among individuals, groups, and organizations
Public Policy	Local, state, and federal policies and laws that regulate or support healthy actions and practices for disease prevention, early detection, control, and management

Source: Glanz and Rimer (1995)

Each level of influence can affect health behaviour. For example, an adolescent who supposedly can walk or cycle to her or his school but instead decided to use motorised transport. At the individual level, adolescent action may be due to traffic safety and fear of crime. At the interpersonal level, parents may have similar concerns about safety. He or she may also need friends to walk together to school. At the policy level, there may no sidewalks, bike paths and incentives encouraging walking and bicycling to school. Thus, the outcome, not cycling or walking to school, may result from multiple factors.

The advantage of an ecological perspective is that multilevel interventions may combine behavioural and environmental components. This ecological model was developed through the work of a number of prominent researchers. Kurt Lewin (1979) was one of the first psychologists to theorise that perceptions of the environment external to the individual had a bearing on behaviour (Brug, Van Lenthe, & Kremers, 2006).

Urie Brofenbrenner subsequently proposed a multilevel model that emphasised interactive systems that influence behaviour and were used as a basis for understanding health promotion issues. These systems were called microsystems (immediate environments such as family or classroom); mesosystems (connection between immediate environments such as home and school); exosystems (external environments which indirectly affect development such as parents' workplace); and macrosystems (the larger socio-cultural context). Each system contained roles, norms and rules that can powerfully affect individual behaviour (Brofenbrenner, 1989). Although, the social ecological model is favourable to explain physical activity behaviour, this model does not give specific guidance on which variables within each domain might be most important for specific target population.

2.11 The Correlates of Adolescent Physical Activity

A literature review was conducted to assess the individual, social and environmental correlates of physical activity. Literature searches were undertaken to identify studies examining correlates of physical activity among adolescents aged 13 to 17. Articles published after January 1, 2009 up to July 2012 was conducted in the databases ScienceDirect, CINAHL, PsyINFO and ProQuest. The following search terms were used: "adolescent", "teenage", "physical activity", "exercise", "factors", "correlates", and "determinants". The review was restricted to studies in the English language. A PRISMA flowchart was used to show the flow of search result (Moher , Liberati, Tetzlaff, & Altman, 2009) (Figure 2.11).

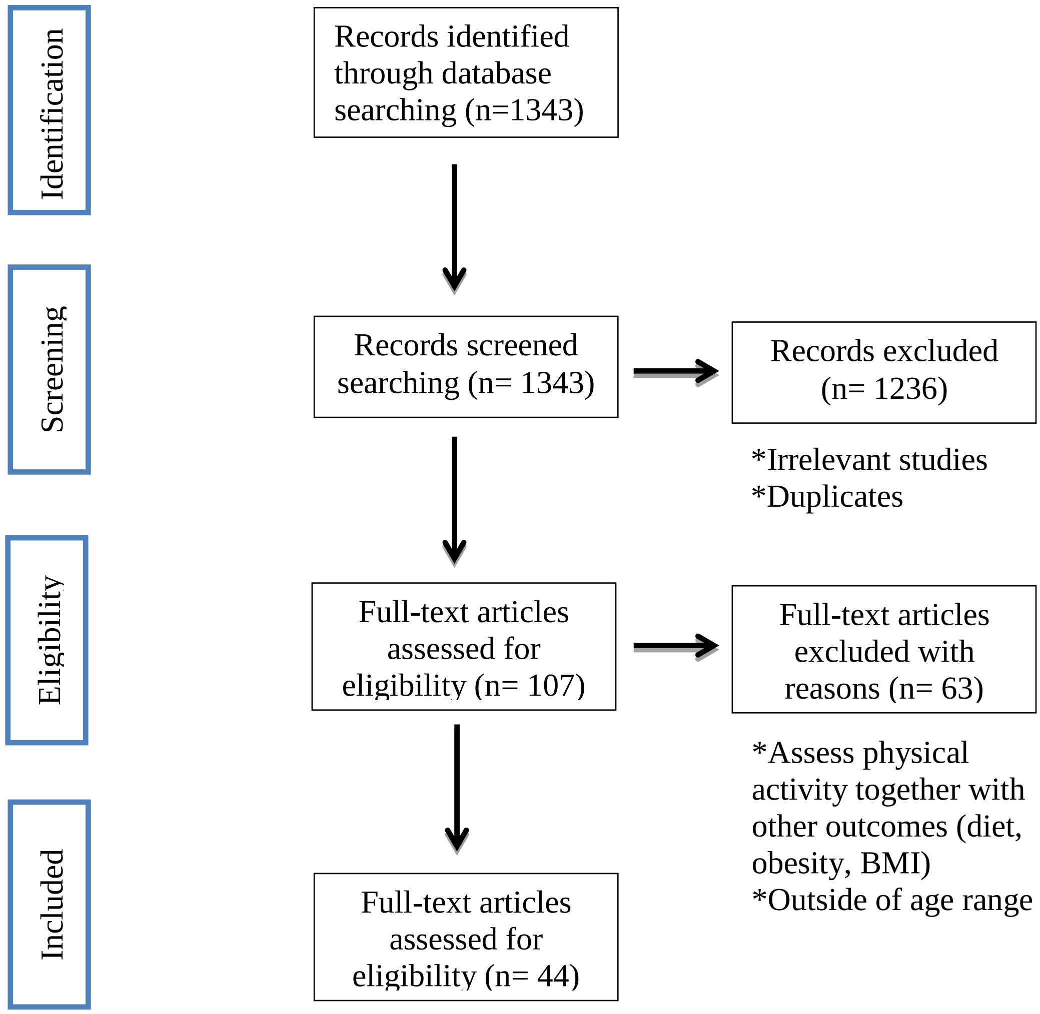


Figure 2.11 PRISMA 2009 Flow Diagram (Moher et al., 2009)

The searches produced a substantial amount of literature (n=1343 studies). Of these, 107 reports met the inclusion criteria. However, 63 studies were further excluded. Out of this 63 studies, 45 had assessed the correlates of physical activity combined with other outcomes, such as healthy eating, overweight, or body mass index. This review was only interested in the correlates of physical activity independent of other outcomes. Another 18 studies were conducted among adolescents outside of the age range specified for this review. Forty-four studies were included in the final review. The correlates were grouped into five domains: demographic and biological; psychological;

behavioural; social and environmental (Bauman et al., 2012; Park & Kim, 2008; Uijtdewilligen L et al., 2011).

In accordance to the Cochrane and the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) approaches, the quality of these studies were also assessed using the risk of bias tool (Hoy et al., 2012). The judgement of the overall risk of study bias is based on assessment of 10 individual items (Hoy et al., 2012). Items 1 to 4 assess the external validity of the study (domains are selection and nonresponse bias), and items 5 to 10 assess the internal validity. Item 10 assesses bias related to the analysis (See Table 2.3).

Table 2.3 Ten-item tool to assess risk of study bias

External validity	
1	Was the study's target population a close representation of the national population in relation to relevant variables?
2	Was the sampling frame a true or close representation of the target population?
3	Was some form of random selection used to select the sample, OR was a census undertaken?
4	Was the likelihood of nonresponse bias minimal?
Internal validity	
5	Were data collected directly from the subjects (as opposed to a proxy)?
6	Was an acceptable case definition used in the study?
7	Was the study instrument that measured the parameter of interest shown to have validity and reliability?
8	Was the same mode of data collection used for all subjects?
9	Was the length of the shortest prevalence period for the parameter of interest appropriate?
10	Were the numerator(s) and denominator(s) for the parameter of interest appropriate?

Source: Hoy, D. et al. (2012)

Table 2.4 and Table 2.5 present the summary of the review and the findings of the risk of bias assessment for the included studies, respectively.

Table 2.4 Summary of studies investigating the correlates of adolescent physical activity behaviour

Authors	Study Design	Location/ Participants	Investigated PA Correlates	Measurement method	Statistics Analysis	Findings
Babey, Hastert, Huang, and Brown (2009)	Cross sectional	N=3,451 US adolescents aged 12-17 years	Socio-demographic, family, and environmental characteristics associated with active commuting	California Health Interview Survey	Logistic regression	Males, Latinos, from lower-income families, attending public school, living in urban areas, and living closer to school more likely to actively commute. Perceptions of neighbourhood safety were not associated with adolescent active commuting.
Mota, Almeida, Santos, and Ribeiro (2009)	Cross sectional	N=1,123 adolescents Actives (n = 589) Non-active (n = 534)	Perceived neighbourhood environment and environmental variables	Physical activity was assessed by questionnaire	Logistic regression	Accessibility of shops, the social environment, neighbours with recreational facilities, and aesthetics. Aesthetic (OR=1.302; $p<0.05$) and recreational facilities (OR=1.297; $p<0.05$) domains were related to being physically active.
Lubans and Morgan (2009)	Cross sectional	Australia, N=119, 14–15 year old students from three secondary schools	Social, psychological and behavioural correlates of physical activity	Pedometers for 4 consecutive school days and completed questionnaires assessing demographic, social, psychological and behavioural correlates of physical activity	Hierarchical regression	Approximately one-third of boys (32%) and girls (33%) satisfied existing step recommendations (girls 11,000 steps/day and boys 13,000 steps/day). Gender, peer support, self-management strategies and perceived barriers accounted for 16% of the variance in mean steps/day.

Bélanger, Gray-Donald, O'Loughlin, Paradis, and Hanley (2009)	Cross sectional	Canada, N=1,293 students, initially aged 12 to 13 years over 5 years	Seasonal variation in physical activity	7-day physical activity diary. Participants recall checklist every 3 months.	Poisson regressions	Physical activity was lower during winter and increased during warmer months. However, the warm-month increases did not compensate for winter decreases so that activity decreased by 7% yearly.
Maddison et al. (2009)	Cross sectional	New Zealand, N=110, aged 12 to 17 years (M = 14.6 ± 1.55)	Perceived and built environmental and individual factors	Geographical Information Systems (GIS) software was used to measure the physical environment (walkability, access to physical activity facilities). ActiGraph accelerometer, PAQ-A	Structural equation modelling	Intention and Perceived Behavioural Control (PBC) explained 43% of the variance of PAQ-A. The model explained 13% of time spent in moderate and vigorous physical activity (Actigraph). Unique and individual contributions were made by intention. Social cognitive variables were better predictors of both subjective and objective PA compared to perceived environmental and built environment factors.
Cradock, Kawachi, Colditz, Gortmaker, and Buka (2009)	Cross sectional	N=680 young people (ages 11-15 years at baseline)	Neighbourhood-levels of social cohesion, range of youth services and educational attainment	Self-reported general physical activity were assessed at follow-up 2-3 years later and Community Survey	Hierarchical regression analyses	Neighbourhood social cohesion influences participation in physical activity.
Ries et al. (2009)	Cross sectional	US, N=329 adolescents	Park use, neighbourhood crime, and park	A Web-based survey assessed Geographical Information Systems	Logistic regression	Perceptions of greater park availability, quality, and use by friends were associated with a

			availability, quality, and use by friends and family.	data were used to develop objective measures of park availability and crime Accelerometers		significantly greater likelihood of an adolescents' park use. Objective measures of park availability and objective and subjective measures of crime were not associated with either park use or physical activity.
Van Dyck, Cardon, Deforche, and De Bourdeaudhuij (2009)	Cross sectional	Belgium, N=120, aged 12–18 years	High-walkability environment	Neighbourhood Environmental Walkability Scale (NEWS), the Neighbourhood Physical Activity Questionnaire (NPAQ) Pedometer for 7 days activity log.	T-test	Lower walkability and larger distance to school was associated with more physical activity in Belgian adolescents.
Lee et al., (2010)	Cross sectional	Singapore N=1,814, (919 boys, 895 girls, mean age 14.4±1.1 years).	Psychosocial and environmental factors	3-Day Physical Activity Recall and a questionnaire	Hierarchical regression	Self-efficacy, enjoyment of physical activity, parental support, and participation in sport teams are associated with physical activity. Total variance explained was 10% of boys and 8% in girls.
Spence et al., (2010)	Cross sectional	American students N=4,779 (Boys = 2,222, girls – 2,557) (Mean age = 13.6 yrs.).	Gender moderated the relationship between self-efficacy and physical activity	PAQ-C, Self-efficacy scale	Multilevel analyses	Self-efficacy is an important correlate of PA among adolescent girls but that boys are more physically active because they have more self-efficacy for PA.

Seabra et al., (2011)	Cross sectional	Portuguese, N=3,352 males and females Attending basic and secondary schools, their parents	Demographic (age, sex, SES) and socio-cultural (father, mother, sibling, peers and PE teacher influences)	PA was assessed with a psychometrically validated questionnaire.	Multinomial logistic regression	Demographic and socio-cultural correlates – in particular age, sex, SES, mother and sibling PA, and peer influence have an influence on physical activity
Cumming et al. (2011)	Cross sectional	England, N=407 female (Mean age 13.2 ±1. 0 years)	Biological maturity status, physical self-concept	PAQ-A, The Children and Youths' Physical Self-Perception Profile (CY-PSPP) as used to assess the participants' physical self-concept.	SEM-maximum likelihood estimation and bootstrapping	Indirect relation was observed between maturity status and physical activity, through physical self-concept. Those with a positive physical self-concept remain active during adolescence and those with a negative physical self-concept become less active.
Duncan et al., (2012)	Cross sectional	British, N=197, aged 13–14 year olds	Attitude, subjective norm, Perceived Behavioural Control and intention	PAQ-A, measures of the TPB variables	Hierarchical regression analyses	Perceived Behavioural Control emerged as the only significant predictor of physical activity behaviour and explained 3.7% of the variance.
Slater and Tiggemann (2011)	Cross sectional	US, N=714 adolescents (332 girls, 382 boys) aged between 12 and 16 years	Teasing, self-objectification, body image, Gender differences	Questionnaire about participation in sport and other physical activities; Teasing and self-Objectification Questionnaire; Objectified Body Consciousness Scale	Fisher z tests	Adolescent girls participated in organised sport at a lower rate than boys, but experienced higher levels of teasing. Both girls and boys reported being teased by same-sex peers. Girls reported being teased by opposite-sex peers (i.e. Boys); Teasing and body image concerns may

				(McKinley & Hyde, 1996); Eating Disorder Inventory		contribute to adolescent girls' reduced rates of participation in sports and other physical activities
Santos, Page, Cooper, Ribeiro, and Mota (2009)	Cross sectional	Portugal, N=1,124 adolescents (592 girls and 532 boys) 12- to 18-years-old	Perceptions of the built environment	Self-report questionnaires	Logistic regression	More girls (*p*<0.01) were classified as low-active (61.5%) compared to boys (22.9%). Among girls, availability of free- or low-cost recreational facilities in the neighbourhood (OR=1. 44; 95% CI 0.99-2.11) was associated with physical activity. Among boys, the presence of people being active in the neighbourhood was associated with higher levels of physical activity (OR=1.59; 95% CI 1.05-2.40).
Tucker et al. (2009)	Cross sectional	UK, N=811 adolescents, aged 11-13	Presence of neighbourhood recreational opportunities	Previous Day Physical Activity Recall Geographic information system	Complex Samples Procedure& Logistic regression	On average, students engaged in 159.9 min/day of physical activity. Both subjective and objective measures of recreational opportunities were associated positively with physical activity (*p*<0.05).
Fang et al. (2011)	Cross Sectional	Baltimore, N=350 adolescents, Mean age of 15.7 years old.	Socio-demographic and urban neighbourhood	Physical activity was measured by Actigraph GIS	Multivariate mixed model	Increased age, being female was associated with decreases in the MVPA. Both individual and neighbourhood characteristics are significant predictors of physical activity in the sample

Soojin, Lounsbery, Bungum, and Gast (2010)	Cross sectional	US, N=175 Adolescents aged 13 to 17 years old.	Gender and ethnicity	Youth Risk Behaviour Surveillance System	MANOVA	No significant differences were found between gender groups in PA. Caucasian students were more likely to be active and to perceive that PA makes their health better. Hispanics were more likely to perceive that PA requires more time than Caucasians.
Butt, Weinberg, Breckon, and Claytor (2011)	Cross sectional	US, N = 1,163 adolescents aged between 13 and 16 years	Perceived barriers and benefits across age, gender, and race	25-item Children's Attraction to Physical Activity (CAPA) scale assessed interest in physical activity; 26-item Expected Outcomes and Barriers for Physical Activity Scale.	Multivariate analyses of variance	PA participation decreased in older females. Fun of physical exertion was a primary attraction to PA for males more than females. Body image as an expected outcome of PA contributed most to gender differences.
Evenson, Murray, Birnbaum, and Cohen (2010)	Cohort, 2-year change	US, Adolescent girls, 6th grade at baseline	Perceived neighbourhood characteristics and transport	Actigraph (model #AM7164); -self reported measures of neighbourhood environment	Longitudinal analysis with mixed-model repeated-measures	None of the Neighbourhood or transportation measures were associated with changes in non-school sedentary behaviour
Devís-Devís, Peiró-Velert, Beltrán-Carrillo, and Tomás (2012)	Cross sectional	Spain, N=323 (mean age 13.59 years)	Socio-demographic factors, screen media time usage	Spanish adapted version of Cale's interviewer-administered recall questionnaire	SEM	Male and younger adolescents spent more time on vigorous activities at the weekend. Females and older adolescents showed a greater involvement in light activities both on weekdays and

						weekends. TV viewing negatively linked to vigorous activities during weekdays and to light and moderate activities on weekends
Sheu-jen, Wen-chi, Patricia, and Jackson (2010)	Cross sectional	Taiwan, N=523 grades five and six	Perceived neighbourhood environment	Modified International Physical Activity short form; a Chinese translation of the Neighbourhood Environment Walkability Scale	Analysis of variance and multiple regression models.	No significant difference in walkability between the urban and rural areas. The urban children reported more physical activity after school, on holidays and weekends, and also in the total amount of physical activity compared with the rural children. Accessibility to facilities had a significant impact on the children's physical activity.
Perry, Saelens, and Thompson (2011)	Cross sectional	N=773 Latino youth	Barriers and motivators to physical Activity, risk behaviours, and park use	Youth Risk Behaviour Surveillance (YRBS)	Logistic regression models	None of the behavioural domain variables were related to meeting PA recommendations. Attending 5 days of PE and participating in an organized after school activity were consistent and strong correlates of meeting recommended levels of PA.
Fitzgerald, Fitzgerald, and Aherne (2012)	Systematic review	US, 10 and 18 years	Peer influence	13 used self-report; 3 used validated questionnaires,; 6 used objective; 2 used both objective and self-report	-	Peers and friends influence physical activity behaviour of adolescents. Six processes were identified through which peers and/or friends may have an influence on physical activity including: peer and/or friend

						support, presence of peers and friends, peer norms, friendship quality and acceptance, peer crowds, and peer victimization
Carver, Timperio, Hesketh, and Crawford (2010)	Cross-sectional	Australia, N=270, aged 10-11 years	Parental restriction of children's active transport	Accelerometer Actigraph, Model 7164; Ferraro's indices of constrained behaviour with regard to crime victimization (Ferraro, 1995).	Independent sample t-tests and linear regression analyses	Constrained behaviour was negatively associated with active transport among younger boys and among girls in both age-groups.
Kim and Cardinal (2010)	Cross sectional	US, N=1,347 students enrolled in the 7th to 12th grades (males, 943; females, 404).	Psychological and social variables	Social Support for Exercise Questionnaire, developed by Sallis et al. (1987); Decision Balance Scale for Exercise, developed by Plotnikoff et al. (2001); Exercise Self-efficacy Scale was (Shin et al. 2001); Leisure-Time Exercise Questionnaire by Godin and Shephard (1985)	Correlation analysis and structural equation modelling	The psychosocial variables accounted for 40.6%of the variance in the adolescent physical activity behaviour, and the proposed model had an excellent fit for exploring relationships among psychological variables, social support, and physical activity behaviour.

Juan, Bengoechea, Montes, and Bush (2010)	Cross sectional	US, N=1,084 students aged 12 to 17 years	Individual and School Factor	Self-report survey during school hours	Multinomial logistic Regression	The physical self-perceptions variable was the most consistent individual correlate of PA across participation patterns.
Shores et al. (2010)	Cross sectional	US, N=147 youth, ages 9-18 years old	Self-efficacy, social support, and access to physical activity areas	Researcher-administered questionnaire	Ordinary least squares regression	Low self-efficacy, low social support, and no access to PA areas were related to lower levels of PA participation among rural youth.
Prins et al. (2011)	Cross sectional with follow-up	Australia, N=209, mean age: 14.5 (SD: 0.6) years)	Availability of parks and sport facilities	Actigraph GT1M for one week (four or more weekdays including at least one weekend day;GIS	Multilevel linear regression analyses and mediation analyses	No direct association was found between the objectively measured availability of the facilities and objective assessments of MVPA and no evidence for mediation by cognitions was found in any of the buffer sizes
Rodríguez et al. (2012)	Cross sectional	Minneapolis and San Diego, N=293 adolescent females aged 15 to 18 years old	Built environment	Accelerometer, ActiGraph model 7164; GPS units, ArcGIS 9.2	Generalized linear latent and mixed models (GLLAMM) extension	The odds of higher physical activity intensity (3-level outcome: sedentary, light, MVPA) were higher in places with parks, schools, and high population density, during weekdays, and lower in places with more roads and food outlets.
Rangul et al. (2011)	4-year prospective study	Norway, N= 2,348 adolescents , (13–19-year olds) and their	Factors that may explain changes in levels of PA during adolescence	PA was assessed using WHO Health Behaviour in School-Aged Children surveys;	Logistic regression analysis	Being overweight, dissatisfied with life, and not actively participating in sports at baseline were significant PA predictors among boys at follow-up. For

		parents		Self-reported questionnaire on body image and weight-related factors, subjective pain and well-being, leisure time activity and lifestyle factors		girls, smoking, drinking, low maternal education, and physical inactivity predicted relapsers and inactive maintainers. Higher levels of education and more physically active parents at baseline seemed to protect against decreased PA during follow-up for both genders.
Dowda, Pfeiffer, Lobelo, Porter, and Pate (2012)	Cross sectional	US African American adolescent girls (n=786) mean age 17.6 SD=0.6 years)	Proximity to commercial physical activity facilities	Submaximal fitness test; GIS; 3-Day Physical Activity Recall.	Mixed model regressions	The presence of a commercial PA facility within a .75-mile street-network buffer of a girl's home was associated with higher cardiorespiratory fitness.
Pabayo, Belsky, Gauvin, and Curtis (2011)	Cohort at age 10, 11, and 15 years	US , N=889, from ages 10 through 15 years, equal proportions of boys (50.1%) and girls (49.9%).	Neighbourhood socioeconomic conditions and cohesion	Economic deprivation summary score; Social fragmentation/ deprivation indicators; Neighbourhood social cohesion	Growth curve models , a generalization of the general linear model	Greater area deprivation at age 10 years was associated with lower weekday MVPA for boys at 10 years and these differences persisted to age 11 and 15 years. Neighbourhood social cohesion was positively associated with boys weekday MVPA minutes across time.
Slater et al. (2010)	Repeated cross-sections from 2001 in 2003	American adolescents, 8th and 10th graders	Friendliness of the built environment-safety, outdoor and commercial PA settings, and urban	Self-reported PA; Physical disorder scale; Monitoring the Future (MTF)	Multilevel models	Increased levels of physical disorder were associated with decreased PA and higher weight.

			sprawl	survey		
Trilk et al. (2011)	Cross-sectional	US, N=1,394 girls from 22 schools	Physical activity facilities within walking distance of school	Self-report of PA after 3pm; Geographic Information System	Linear mixed-model analysis of variance	Girls who attended schools with > 5 facilities within the buffer reported more physical activity per day. The number of physical activity facilities surrounding the school should be considered to encourage physical activity in 12th grade girls.
Davidson, Simen-Kapeu, and Veugelers (2010)	Cross sectional	Canada, N=3,421 grade 5 Canadian students	The presence and pathways of the influence of neighbourhood characteristics on self-efficacy	Physical Activity Questionnaire for Children (PAQ-C) Neighbourhood factors and self-efficacy surveys	Multilevel logistic regression methods and structural equation modelling	Neighbourhood satisfaction and services as well as neighbourhood sidewalks and parks as determinants of self-efficacy. Over and above various independent associations of neighbourhood characteristics with self-efficacy, PA and body weight, self-efficacy exhibited a positive effect on PA and a negative effect on body weight.
Almanza, Jerrett, Dunton, Seto, and Ann Pentz (2012)	Cross-sectional	US, N=208, children aged 8 – 14 year old	Community design, greenness	Actigraph GT2M accelerometer (Actigraph LLC, FL, USA); GPS; Vegetation Index (NDVI)	Generalized linear mixed model	Greenness exposure was positively associated with the contemporaneous moderate-to-vigorous physical activity (MVPA). For smart growth residents, 39% increase in odds of MVPA for a10th to 90th percentile increase in exposure to greenness OR=1. 39, 95% CI 1.36–1.44

Lachowycz, Jones, Page, Wheeler, and Cooper (2012)	Cross sectional study	UK, N=902 English children aged 11–12.	Urban greenspace	Accelerometers Actigraph GT1M) for seven consecutive days; GPS (Garmin Fortrex 201) on four school days Between the end of school and bedtime (3 pm–10 pm) and on at least one weekend day between 8 am–10 pm	GPS points on the landuse maps	Around half of outdoor moderate-vigorous activity took place in green space at the weekend and use was consistent across seasons. The findings suggest the importance of certain types of green space to children's physical activity.
Sigmundová, El Ansari, Sigmund, and Frömel (2011)	Two cross-sectional cohorts of adolescents ten years apart.	Czech Republic, N=902 adolescents (410 boys; 492 girls) aged 14-18	Levels, types and secular trends of PA and sedentary behaviour	Yamax SW-701 or Omron HJ-105 pedometer continuously for 7 days (at least 10 hours per day)	Multivariate ANOVA (MANOVA	About 55%-75% of Czech adolescents met the recommended steps per day; the findings show a secular decrease in PA amongst adolescents. The significant interaction effects (cohort × age; and cohort × gender) that this study found suggested that secular trends in PA differ by age and gender.
Maslow and Colabianchi (2011)	Cohort, from May 2006 to March 2008.	US, N=145 adolescents aged 14-17 living in 14 public housing	Physical activity resources	Accelerometer and a travel diary; interview that lasted for 60 minutes	Multiple Regression	Race and gender were other positive significant contributors to daily moderate-vigorous physical activity. The overall regression model accounted for 20% of the variance.

Nichol, Janssen, and Pickett (2010)	Cross sectional	Canada, N=9,114 adolescents grade 6 to 10	The safety of neighbourhoods and availability of parks and facilities	2006 Health Behaviour in School-Aged Children Survey	Multivariate multilevel analyses	Moderate gradients in physical activity were observed according to individual and group perceptions of safety. Boys and girls with the highest perceptions of safety were 1.31 (95% CI: 1.17–1.45) and 1.45 (1.26–1.65) times more likely to be physically active, respectively, than those with the lowest perceptions.
Kirby et al. (2011)	5-year longitudinal study	US, N = 641 adolescents	Peer support, peer socializing, parental support, and independent play	PAQ-C	Logistic regression	Boys reported higher physical activity, peer support, paternal support, and independent play than girls. Among both genders, peer, paternal, and maternal support decreased with age, whereas independent play increased. Parental support was less important than peer influences; only same-sex parental support remained significant in multivariable models.
Millstein et al. (2011)	Cross sectional	US, N =137 adolescents (ages 12–18)	Home, school, and neighbourhood factors	Physical activity index Neighbourhood Environment Walkability Scale-Youth (NEWS-Y)	Hierarchical regression models	For adolescents, pieces of equipment at home, family recreation membership, equipment at school, and neighbourhood aesthetics explained 15.8% of variance in PA.

Nelson and Woods (2010)	Cross sectional	US, N=1,143 males and 1016 females (mean age 16.04 ± 0.66)	Perceptions of the physical environment	Self-reported active (walk or cycle) or inactive (car, bus, or train) mode of travel to school	Bivariate logistic regression, multivariate models	Land-use-mix diversity, and the perceived presence of public parks remained significant among males, whereas excess traffic speed, shops within walking distance, and paths separate from the road remained significant among females.

Table 2.5 Summary of studies (n=44) assessed for risk of bias

Authors	**Item 1**	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**Item 8**	**Item 9**	**Item 10**	***Overall***
Babey et al. (2009)	Low	Low	Low	Low	Low	Low	High	Low	Low	Low	*Low*
Mota et al. (2009)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Lubans and Morgan (2009)	High	High	High	High	Low	High	Low	Low	High	Low	*High*
Bélanger et al. (2009)	Low	Low	Low	Low	Low	Low	Unclear	Low	Low	Unclear	*Low*
Maddison et al. (2009)	High	High	High	High	Low	Low	Low	Low	Low	Unclear	*Low*
Cradock et al. (2009)	Low	Low	Low	Low	Low	Low	Unclear	Low	Low	Unclear	*Low*
Ries et al. (2009)	High	High	High	High	Low	Low	Low	Low	Low	Low	*Low*
Van Dyck et al. (2009)	High	High	Low	High	Low	Low	Low	Low	Low	High	*Low*
Lee et al.,(2010)	Low	Low	Low	Low	Low	Low	High	Low	Low	Low	*Low*
Spence et al., (2010)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Seabra et al.,(2011)	Low	Low	Low	Low	Low	Low	High	Low	High	Low	*Low*
Cumming et al. (2011)	High	High	Low	High	Low	Low	Low	Low	Low	High	*Low*
Duncan et al., (2012)	High	High	High	High	Low	Low	High	Low	Low	High	*High*
Slater and Tiggemann (2011)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Santos et al. (2009)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Tucker et al. (2009)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Fang et al. (2011)	High	High	High	High	Low	Low	Low	Low	Low	Unclear	*Low*
Soojin et al. (2010)	High	High	High	High	Low	Low	Low	Low	Low	High	*High*
Butt et al. (2011)	Low	Low	Low	Unclear	Low	Low	Low	Low	Low	High	*Low*
Evenson et al. (2010)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	*Low*
Devís-Devís et al. (2012)	High	High	High	High	Low	Low	High	Low	Low	Unclear	*High*
Sheu-jen et al. (2010)	Low	Low	Low	Low	Low	Low	High	Low	High	Unclear	*Low*
Perry et al. (2011)	Low	Low	Low	High	Low	Low	Low	Low	Low	Unclear	*Low*
Carver et al. (2010)	High	High	High	High	Low	Low	Low	Low	Low	Low	*Low*
Kim and Cardinal (2010)	Low	Low	Low	Low	Low	High	High	Low	Low	Low	*Low*
Juan et al. (2010)	Low	Low	Low	Low	Low	High	High	Low	Unclear	Low	*Low*
Shores et al. (2010)	High	High	High	High	Low	Low	High	Low	High	Unclear	*High*

Prins et al. (2011)	High	High	High	High	Low	Low	Low	Low	Low	High	*High*
Rodríguez et al. (2012)	High	High	High	High	Low	Low	Low	Low	Low	Unclear	*Low*
Rangul et al. (2011)	High	High	High	High	High	Low	Low	Low	High	Low	*High*
Dowda et al. (2012)	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	*Low*
Pabayo et al. (2011)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Slater et al. (2010)	Low	Low	Low	Low	Low	High	Low	Low	High	Low	*Low*
Trilk et al. (2011)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*
Davidson et al. (2010)	Low	Low	Low	Low	Low	High	Low	Low	Unclear	Low	*Low*
Almanza et al. (2012)	High	High	High	High	Low	Low	High	Low	Low	Unclear	*High*
Lachowycz et al. (2012)	Low	Low	Low	Low	Low	Low	Low	Low	High	Low	*Low*
Sigmundová et al. (2011)	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	*Low*
Maslow and Colabianchi (2011)	High	High	High	High	Low	Low	Low	Low	Low	Unclear	*Low*
Nichol et al. (2010)	Low	Low	Low	Low	Low	Low	Low	Low	Unclear	Low	*Low*
Kirby et al. (2011)	Low	Low	Low	Low	Low	High	Low	Low	High	Low	*Low*
Millstein et al. (2011)	High	High	High	High	Low	Low	High	Low	Low	Unclear	*High*
Nelson and Woods (2010)	Low	Low	Low	Low	Low	High	High	Low	High	Low	*Low*

Demographic, Psychological and Behavioural Correlates

Studies attempting to explain physical activity behaviours among adolescents have focused heavily on behavioural theories and models (Bauman et al., 2012) such as self-efficacy; perceived barriers; perceived benefits; attitude; body image; behavioural control; intention; and enjoyment. Of psychosocial correlates, self-efficacy (confidence in the ability to be physically active in specific situations) continuously appeared to be a positive significant predictor of adolescent physical activity (Kim & Cardinal, 2010; Lee, 2010; Plotnikoff et al., 2013; Seabra, Mendonça, Thomis, Malina, & Maia, 2011; Shores et al., 2010; Spence et al., 2010).

Kim and Cardinal (2010) proposed that self-efficacy had the strongest correlation with and direct effect on physical activity (r = 0.45). In their study, self-efficacy provided the largest total effect and when combined with *pros* and *cons* variables, the overall psychosocial variables accounted for 40.6 percent of the variance in explaining adolescents' physical activity participation. The *pros* and *cons* derive from the conflict model of decision-making and focus on the importance of perceived benefits (pros) and barriers (cons) of a behaviour change. In decision-making theory, it was hypothesized that an individual will not change her/his behaviour unless she/he perceives the benefits of change to outweigh the barriers. In addition, both friend and family support had a significant direct effect, as well as an indirect effect, on physical activity through self-efficacy and *pros* (Kim & Cardinal, 2010).

Another common correlate being studied was perceived barriers and benefits in relation to physical activity behaviour (Butt et al., 2011; Duncan et al., 2012; Perry et al., 2011). Perceived barriers appeared to explain less physical activity behaviour (variance of 3.7

percent) (Duncan et al., 2012) compared to intention and self-efficacy (30 percent). In addition, the mediating role of physical self-concept of the relations between biological maturity status and self-reported physical activity in adolescent girls has been studied (Cumming et al., 2011). The indirect effect of maturity status and physical self-worth was close to being fully mediated (a 95 percent portion of the total effect) by variance in perceived attractiveness and sport competence, and that the indirect effect between maturity status and physical activity was at least partially mediated (a 68 percent portion of the total effect) by variance in physical self-concept. This study concluded that advanced maturation in adolescent girls is associated with less involvement in physical activity. Perceived behavioural control (general perceptions of ability to be physically active) is a determinant in adolescents (Bauman et al., 2012; Duncan et al., 2012). Individuals who have more perceived exercise benefits and fewer barriers are typically more active.

Social Factors

In adolescents, social support from peers and friends is a consistent correlate to physical activity behaviour (Kirby, Levin, & Inchley, 2011; Lubans & Morgan, 2009). Peers may have an influence on physical activity through six processes outlined by Fitzgerald et al. (2012). These include peer support; presence of peers; peer norms; friendship quality and acceptance; peer crowds; and peer victimization such as peer teasing. Girls were found to have low participation in organised sport because they experienced a higher level of teasing. Girls reported being teased by opposite-sex peers (the boys) (Slater et al., 2010).

Although parents and family are important, parental support has been found to be less important (Edwardson & Gorely, 2010; Kirby et al., 2011), particularly in low-income and middle-income countries (Bauman et al., 2012; Duncan et al., 2012). Adolescents are increasingly influenced by their peers as they get older. Support from friends has been associated with more physical activity among youth (Kirby et al., 2011). The influence of physical education teachers and adolescent physical activity behaviour have been reported to be not significant (Seabra et al., 2011)

Environmental Factors

Several studies reported some association between perceived or objective environment variables and adolescent physical activity (Evenson et al., 2010; Nelson & Woods, 2010; Sheu-jen et al., 2010). Perceived access to recreation facilities is the most consistent environmental correlate; a positive association with leisure-time, transport, and total physical activity level. Perceived safety from crime and traffic has been reported to be not associated with physical activity (Bauman et al., 2012). According to Nelson and Woods (2009), environmental characteristics, such as street lightings, land use-mix diversity, access to shops/public transport, the presence of public parks/bike lanes, and accessible well-maintained paths, have been found to be significantly associated with physical activity behaviour.

However, a 2-year cohort study conducted by Evenson et al. (2010) found none of the neighbourhood or transportation measures were associated with changes in non-school physical inactivity. This finding was shared by another repeated cross-sectional study, with no direct association between the objectively measured availability of the facilities and objective assessments of MVPA (Prins et al., 2011).

According to Bauman et al. (2012) findings on the influence of environmental variables on physical activity behaviour were generally inconsistent across studies because of measurement of the environmental variables. Most reports show associations with perceptions of the environment, rather than with objective measures. This is also unsurprising because evidence suggests that cognitive models provide an incomplete account of health behaviour (Armitage & Conner, 2000).

Although the combination and interaction of social ecological factors are expected to influence physical activity (Bauman et al., 2012), the potential of ecological approaches in correlational research involving adolescent or adult population has not been fully utilised. For example, the present review found only two studies that used the ecological approach by integrating individual, social and environmental factors (Lee et al., 2010; Shores et al., 2010).

Lee et al. (2010) reported self-efficacy, enjoyment of physical activity, parental support, and participation in sports teams were significant correlates of physical activity. These variables only explain a small variance in physical activity behaviour, 10 percent for boys and eight percent in girls (Lee et al., 2010). Meanwhile, Shores et al. (2010) found three consistent correlates of physical activity; the individual and interaction effects of self-efficacy, social support, and access to physical activity areas to predict rural youth physical activity participation. Shores and colleagues concluded low self-efficacy, low social support, and no access to physical activity areas were related to lower levels of physical activity. These variables exerted a stronger impact when factors were allowed to interact than when their isolated effects were summed (Shores et al., 2010).

2.12 Summary of studies investigating correlates of physical activity

The summary of literature review includes risk of bias, study design, location of the study undertaken, measurement of physical activity levels, statistical analysis and significant correlates influencing adolescent physical activity.

Risk of bias

The risks of bias analysis identified nine studies had high risk of bias and 35 studies had low risk of bias. These nine studies suffered from methodological issues, such as inadequate sample size and non-random sampling. Measurement of the outcomes (physical activity level) for these studies use self-developed tools without adequate reliability and validity of the instrument. The effects reported were inconsistent in these studies, making comparison across studies difficult. Some of the well-designed studies showed no improvement in measures of physical activity.

Study design

About 82 percent of the research in this review applied cross-sectional designs. The remaining studies applied cohort and cross-sectional with follow-up designs, which mainly conducted in developed countries. Cohort and cross-sectional with follow-up designs are crucial in understanding the aetiology and physiology of physical activity. There may be unpredictable interactions between individual, social and environmental factors unique to certain country or its population.

The absence of qualitative study was obvious. Indeed, the complexity of physical activity behaviour required complex research methods, such as qualitative or mixed methods approach. These methods are capable to explore a topic in depth in an unstructured way to generate richer understanding of the full range of opinions and experiences on physical activity.

Location of the studies

Most research evidence stems from the United States, Australia, Canada, United Kingdom and other European countries. Studies coming from low-income and middle-income countries were limited (6.8 percent) and these studies mainly investigated demographic correlates of physical activity behaviour. Risk factors may differ due to unparalleled geographic, social, and cultural diversity. The conduct of similar studies may generate locally relevant results to stimulate political will for health promoting policy.

Measurement of physical activity

The studies included in this review commonly measured physical activity levels through a localised self-report questionnaire (41 percent) despite the availability of the well accepted Physical Activity Questionnaire – Adolescent (PAQ-A). Only about 18 percent of the studies used PAQ-A. The use of objective measures such as the accelerometer is increasing, with 11 studies that used accelerometer and four studies used a pedometer out of 44 studies. Self-report measures were noted to be problematic in assessing physical activity accurately due to problems of recall bias and missing data limiting the validity of the results (Lubans & Morgan, 2009; Morgan et al., 2003). Other remaining studies used activity diary techniques, such as 7-day activity diary and 3-day physical activity recall.

Statistical analysis

The majority of studies (70 percent) in this review analysed their data with regression procedures. These include logistic regression, linear regression, hierarchical regression, generalized linear mixed models, and Poisson regression. Four studies used t-test, ANOVA and MANCOVA and another four studies employed structural equation modelling. One study used a Global Positioning System (GPS) points on the land use maps and analysed their data. This indicates the lack of structural and mediation analyses usage in assessing multifactorial physical activity behaviour.

Correlates of adolescent physical activity behaviour

The current review identified more than 27 factors represented by five main domains being associated with adolescent physical activity. The five main domains were: demographic/biological factors; individual factors; behavioural factors; social factors; and environment factors. Figure 2.11 shows the significant correlates of adolescent physical activity behaviour from 44 reports.

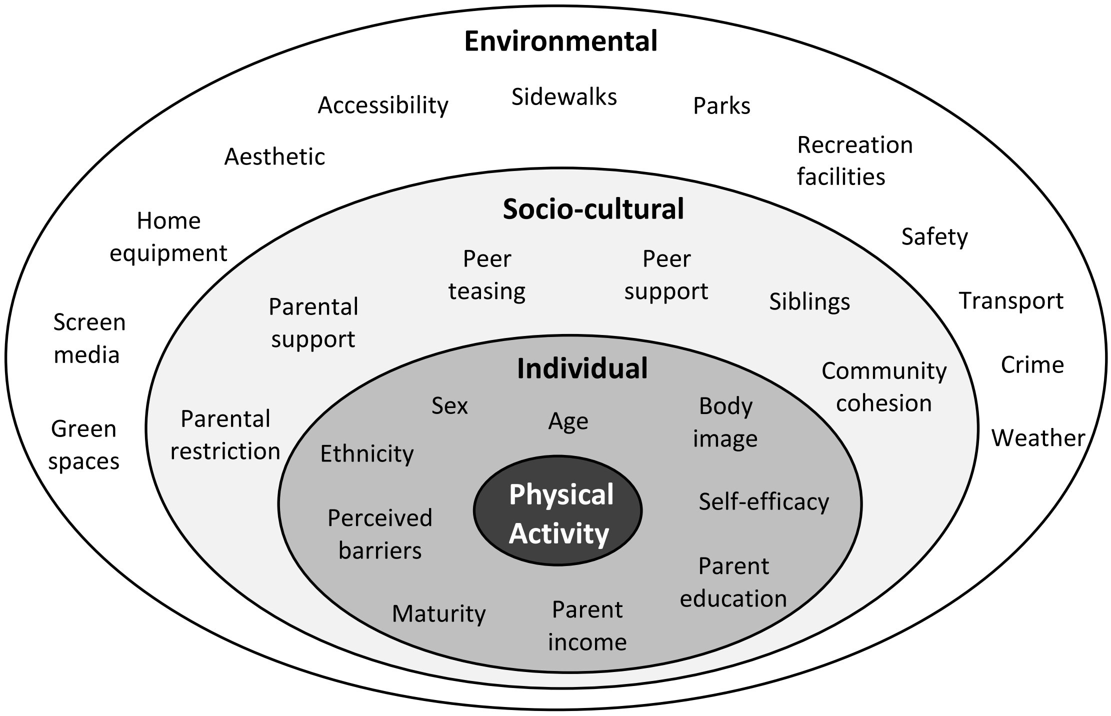


Figure 2.12 Summary of significant influences on adolescent physical activity

2.13 Gaps in the literature

There are critical conceptual and methodological issues confronting public health researchers interested in determining factors influencing physical activity. Cross-sectional studies commonly reported. Furthermore, there was less information on correlates of physical activity in low-income and middle-income countries. This gap is critical because ideally public health interventions are dependent on the context where they are implemented. An intervention that has been shown to be effective in one setting (e.g developed countries) may turn out to be ineffective in another setting (e.g. low- or middle-income countries), even supposing it can be implemented there.

Furthermore, little is known about the ecological correlates in Malaysia. Evidence that examined these influential factors simultaneously in an integrated social ecological framework is scarce (Deforche, Van Dyck, Verloigne, & De Bourdeaudhuij, 2010; Holt et al., 2009; Shores et al., 2010).

Although, multilevel studies and the use of hierarchical analyses were useful (Panter & Jones, 2008), these statistical approaches do not allow researchers to simultaneously examine multiple patterns of relationships within and across levels of analysis. In addition, the analyses used could not provide conclusive evidence for moderators and mediators of physical activity.

2.14 Gaps this research will address

Recognizing the limitation of conceptual and methodological issues confronting public health researchers in determining factors influencing physical activity, this research attempts to add new knowledge by applying mixed methods to; (1) develop a theoretical framework suits the local community by using a grounded theory approach; (2) assess and test the structural effects of correlates simultaneously by using structural equation model; and (3) use pedometer to measure physical activity level (PAL).

The primary goal of conducting qualitative research was to carefully select relevant social ecological variables to be included in the research. The quantitative study was expected to provide a basis to create rigorous scales that reliably and validly represent the best possible questions that would not over or under represent the ecological framework.

The complexity of physical activity behaviour requires complex model testing. A structural equation modelling technique can be used to provide unbiased simultaneous parameter estimates while testing complex models, which allows the assessment of latent constructs with more reliability (Hair, Black, Babin, & Anderson, 2010). Factor analysis and structural equation modelling techniques helped the researcher to reduce the number of observed variables into a smaller number of latent variables by examining the covariation among the observed variables (Schreiber, Nora, Stage, Barlow, & King, 2006).

Overall, a Malaysian research in physical activity is urgently needed to support the development of interventions to reverse the rapidly changing determinants of inactivity occurring through sedentary work, passive entertainment, and motorised transport. A wide range of research methods can be applied to tease out multifactorial factors of physical activity behaviour.

CHAPTER 3: RESEARCH METHODOLOGY

In this chapter, the researcher describes and explains the mixed methods research methodology used in the thesis. The sub-topics in this chapter describe the study location, rationale for applying a mixed methods research design and the research paradigm. The subsequent topics describe the research design and research procedures according to individual phases of the study; Phase I is a Qualitative study; and Phase II is a Quantitative study. It does also where appropriate, indicate sampling methods, research instruments and statistical methods employed. The purpose of this is to inform the reader on the methods used to collect data and generate the findings reported.

3.1 Study Location and Population

The largest state in Malaysia, Sarawak, was ranked fifth in the country in terms of physical inactivity at 48 percent, after Selangor (52.1 percent), Kuala Lumpur (51.8 percent), Labuan (49.2 percent), and Perlis (49.1 percent) (Omar et al., 2006). Sarawak, located in East Malaysia, has a total population of 2.51 million (Department of Statistics Malaysia, 2010). Kuching, the capital of Sarawak, is the fourth largest urban city in Malaysia. Kuching is one of the most diversely populated cities in Malaysia with a total population of 720, 400. The population is made up of Ibans (30 percent), Chinese (24 percent), Malays (23 percent), Bidayuh (8 percent), Melanau (6 percent), Orang Ulu (5 percent) and other minor ethnic groups (5 percent) (Department of Statistics Malaysia, 2010). The map of Sarawak is shown in Figure 3.1.

Figure 3.1 Map of Kuching, Sarawak (Insert – Malaysia map)

3.2 Mixed Methods Design

Mixed methods is based on an evolving philosophical assumption of the research process (Creswell & Plano-Clark, 2011), in which a researcher combines elements of qualitative and quantitative research approaches for the purpose of breadth of understanding or corroboration (Johnson, Onwuegbuzie, & Turner, 2007). This approach is particularly useful to understand complex relationships between multilevel factors and adolescent participation in physical activity.

Incorporating both, qualitative and quantitative approaches were intended to provide various types of data, thus giving the research rigour, and also quantitative breadth and qualitative depth. Such a combined approach increases the confidence in and the value of the data (Creswell & Plano Clark, 2007), and provides a richer contextual basis for interpreting and validating results (Kaplan & Duchon, 1988). There are three key concepts of a mixed methods study design to be observed in the present study: priority, implementation and integration (Ivankova, Creswell, & Stick, 2006).

Priority

Priority refers to which approach, quantitative or qualitative (or both), a researcher gives more weight or attention to throughout the data collection and analysis process (Ivankova et al., 2006). Although an instrument development design places more emphasis on the quantitative phase of the study (Creswell & Plano Clark, 2007), this study used a rigorous grounded theory approach in its qualitative phase, thus elevating the role of the qualitative phase to be equal with the quantitative phase. As such, the design of this research can be represented by "QUAL → QUAN" which indicated the sequential ordering of the two equally important methods (Morse, 2003).

Implementation

Implementation refers to whether the quantitative and qualitative data collection and analysis come in sequence, one following another, or concurrently (Ivankova et al., 2006). The particular mixed methods design for this research is a sequential exploratory design, characterised by an initial qualitative phase that explores the central phenomenon which then informs a second quantitative phase (Creswell & Plano Clark, 2007). Figure 3.2 illustrates the sequential progression of the research.

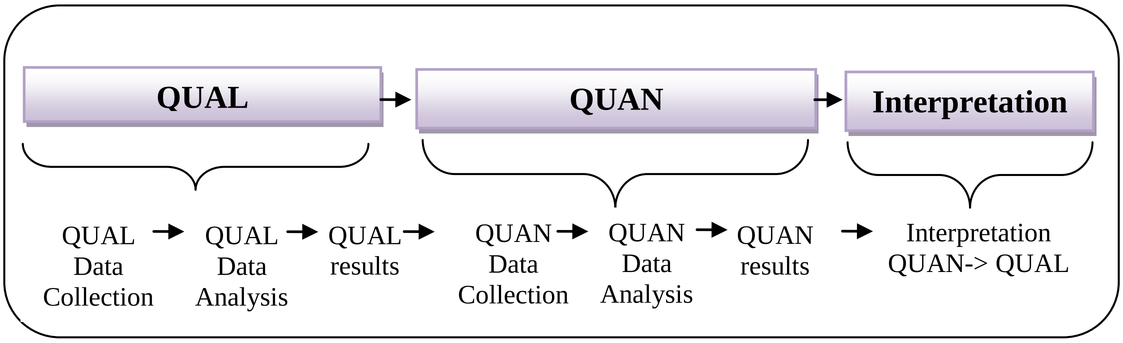


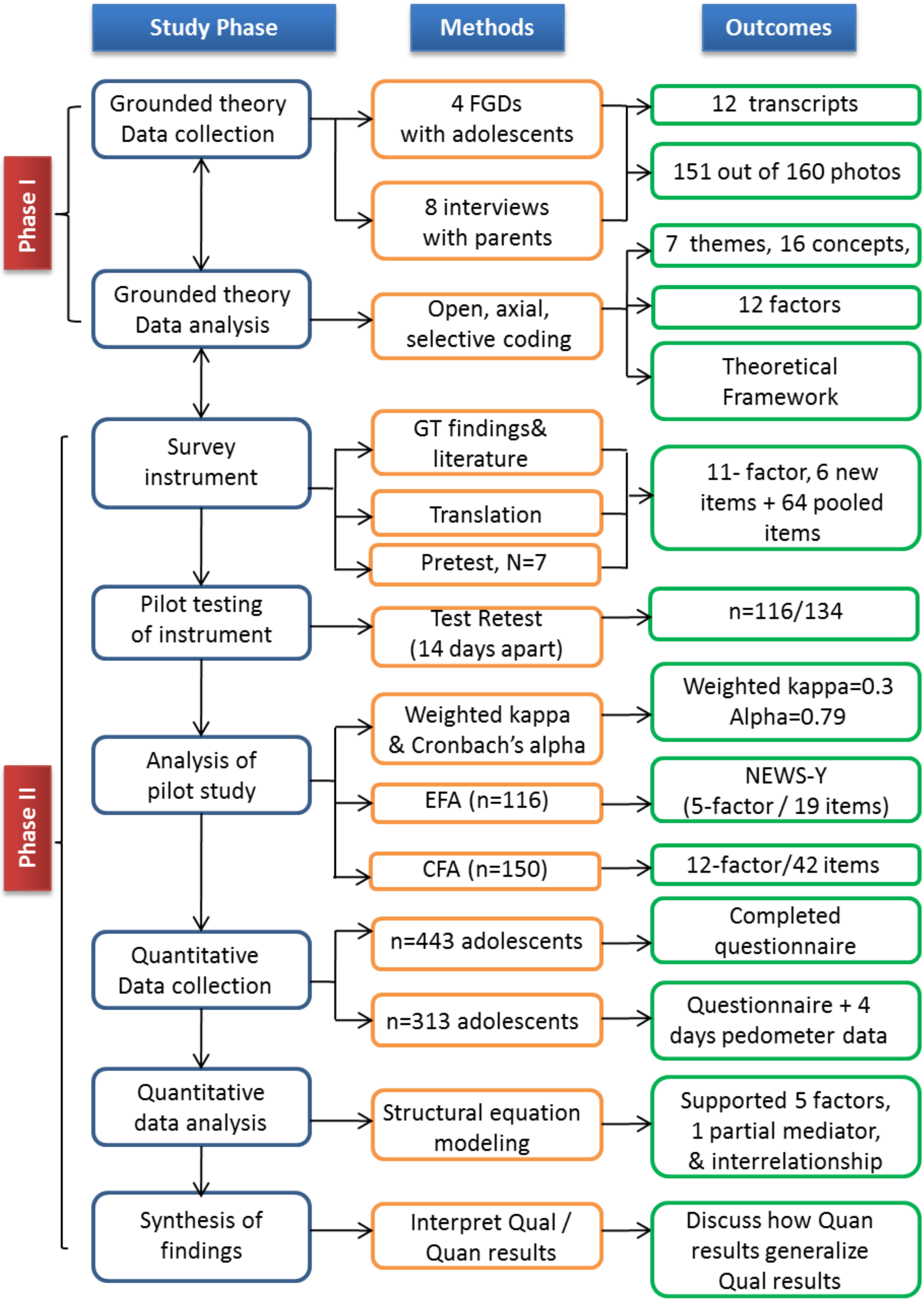
Figure 3.2 Schematic of Sequential Exploratory Mixed-Methods Research Design

Within this design, the sequence of qualitative and quantitative data collection was determined by the study's purpose and research questions. In the qualitative study (Phase I), the researcher first collected and analysed the qualitative data, which rely on the grounded theory research strategy (Glaser & Strauss, 1967). This was to allow the researcher to gain a deeper understanding of the phenomenon of interest, formulate relevant questions and test whether the problems are truly the concerns of the population. As noted by Padgett (1998), the validity of the concepts and inquiries on quantitative research can be enhanced by first being grounded in real life situations and observations through having conversations or interviews from an open perspective.

These were particularly worthwhile when little is known about patterns of physical activity among Malaysian adolescents living in Kuching, Sarawak. The grounded theory generated a theoretical model depicting conceptual relationships among the key points in adolescent physical activity. The next quantitative study (Phase II) then involved the researcher in developing measurement scales to extract questionnaire items from the qualitative phase and existing literature. The instrument development connects the initial qualitative phase to the subsequent quantitative strand of the study. A pre-test, pilot test and a large sample of data were collected to empirically test the theoretical model of this study. The data were analysed using structural equation modelling (SEM).

Finally, the researcher interprets in what ways and to what extent the quantitative results generalize or expand on the initial qualitative findings. This type of methodological pluralism was regarded as imperative not only to attempt a triangulation of methods but also to flesh out and test theoretical frameworks (Greene, Caracelli, & Graham, 1989), which is currently lacking in this field of research. The strength of exploratory design is that this design is straightforward to describe, implement and report (Creswell & Plano-Clark, 2011).

Figure 3.3 provides a visual model of the exploratory sequential investigative procedures for this research. This shows the two phases with the respective procedures of data collection, data analysis, and outcomes. This visual model also elucidates the nature of data produced for each phase.



Note: **FGD** = Focus group discussion **GT** = Grounded theory
EFA = Exploratory factor analysis **CFA** = Confirmatory factor analysis
NEWS-Y = Neighbourhood Environment Walkability Scale - Youth

Figure 3.3 Visual model of an exploratory sequential mixed methods research

Integration

Integration of data occurred in the final stages of interpretation and explanation of results. At this point, the findings from both the quantitative and qualitative stages were integrated to ascertain whether commonalities or differences exist to further enhance the understanding of the topic. This integration into a coherent discussion on the final stages of the research was intended to provide stronger evidence for a conclusion through convergence (Johnson & Onwuegbuzie, 2004).

In general, a number of health-related studies have applied mixed-methods designs such as in cardiology (Curry, Nembhard, & Bradley, 2009), family medicine (Stange, Crabtree, & Miller, 2006), nursing (Wilkins & Woodgate, 2008), public health nutrition (Klassen, Smith, Black, & Caulfield, 2009), and mental health services (Creswell & Zhang, 2009; Palinkas, Horwitz, Chamberlain, Hurlburt, & Landsverk, 2011). Recently, the federally funded mixed methods investigations spanned 23 different National Institute of Health, with many supported by the National Institute of Mental Health, the National Institute of Nursing Research, and the National Cancer Institute (National Institutes of Health & Office of Behavioral and Social Sciences Research, 2001). This indicated a growing interest in mixed methods research in medical and health sciences.

3.3 Rationale for the Mixed Methods Approach

Considering the novelty of the research topic among the adolescent population in Kuching, Sarawak, the researcher was uncertain about the relevant constructs to be included in this research. Although the literature has identified some key factors, specific factors pertaining to the lifestyle and culture of a multi-ethnic Malaysian population, particularly in Sarawak, need to be explored. This can be catered to by a qualitative inquest, known to be capable of providing preparation for quantitative studies including identifying and selecting variables needing to be measured, theories to guide the study and to devising a questionnaire (Rowan & Wulff, 2007).

Methodological expansion is another rationale mentioned in mixed methods instrument development studies. The qualitative interviews provide additional evidence how these items were generated, thereby strengthening the content validity (Knafl et al., 2007). Furthermore, by revealing the processes on how the scale items are first located and then refined, these items become more grounded in an inclusive context and become more credible (Denzin & Lincoln, 2000).

There was also an argument that children and adolescents, especially of the indigenous groups are often vulnerable and marginalised in society due to the absence of their authentic “voices” in public discourses such as research (Aldridge, 2012). Through a mixed methods design, adolescents are given the right to be properly researched (Beazley, Bessell, Ennew, & Waterson, 2009). Using an appropriate method, adolescents as participants can participate meaningfully; express their opinions, views and experiences. Participants are viewed as “credible experts” who can increase the understanding of the researcher and improve the quality of the research and scale validity by directly incorporating the participants’ ideas and vocabulary (Nassar-McMillan, Wyer, Oliver-Hoyo, & Ryder-Burge, 2010).

Since most studies assessing the correlates of adolescent physical activity have been quantitative studies, this research engaged adolescents in both methods for the purpose of triangulation and elaboration (Greene et al., 1989). The major aim of triangulation was to provide confirmation and completeness of data by overcoming the biases inherent in single-method or single-theory approaches (Halcomb, 2005). The quantitative phase aims to provide convergent validity for the findings from the qualitative phase. For example, exploratory factor analysis methods were used in the quantitative analysis phase to corroborate the dimensionality of various theoretical constructs that were formulated as part of the qualitative findings, and the structural equation modelling technique was utilised to substantiate the emergent relational propositions from qualitative data.

3.4 Post-Positivist Constructivist Research Paradigm

Due to the lack of a theoretical framework in explaining adolescent physical activity in the neighbourhood context, the researcher worked from a constructivist research paradigm during the qualitative phase of the study to value multiple perspectives and deeper understanding of the phenomenon. The constructivist worldview adopted in this research explained that knowledge is constructed to make sense of experience and is continually modified and tested in the light of new experiences. Constructivism is discussed in terms of ontology, epistemology and methodology (Guba & Lincoln, 1994) as follows:

- ➔ Ontology: Reality is constructed by individuals or groups in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature.
- ➔ Epistemology: The researcher and research participants interact so that the ‘findings’ are literally created as the investigation proceeds.

➔ Methodology: The researcher focused on the specific ways, the methods, to try to understand the world.

In this process of discovering the "reality", there was a need for a sense of reciprocity between the researcher and participants which facilitates the co-construction of meaning, leading to the use of participants' stories framed within the written theory (Graham & Thomas, 2008). Strauss and Corbin (1998) reinforce these considerations citing the importance of the interplay between the researcher and the participants and the incorporation of multiple perspectives in writing the emerging theory.

When the researcher moves to quantitative phases, the underlying assumptions shifted to those of post positivism to guide the need for identifying and measuring variables. In other words, multiple worldviews were used in this research, and the worldviews shift from one phase to the other. In this research, the world view of the post-positivist constructivist research paradigm (also known as critical realism) attempts to capture the unheard voices within society, map these voices into a model to explain adolescent physical activity behaviour and finally empirically test the models in a larger sample.

3.5 PHASE 1 - QUALITATIVE RESEARCH METHODOLOGY

Following the research procedures discussed earlier, the first phase of empirical investigation comprised a qualitative collection and analysis. This phase focused on developing a theoretical framework to explain the process of adolescent participation in physical activity. Various procedures from the grounded theory approach were followed to systematically collect and analyse data. This chapter begins with a brief overview of grounded theory methodology, followed by a systematic data collection and analysis procedures. Last, the procedures applied in ensuring the quality and rigour of qualitative research procedures and the credibility of the emergent theory were presented.

3.5.1 Grounded Theory Methods

Historically, grounded theory emerged in the 1960s as a result of Glaser and Strauss's sociological research program on the dying in hospitals with the goal to discover a theory that would fit the data, and would work in the real world (Glaser & Strauss, 1967). Grounded theory methodology is a qualitative inquiry approach that is used to build a theory through a "systematic, inductive, and comparative process" (Bryant & Charmaz, 2007). According to Strauss and Corbin (1998), generating theories about phenomena, rather than just generating a set of findings, is important to the development of a field of knowledge. A theory enables users to explain and predict events, thereby providing guides to action. Charmaz (2006) stated the purpose of grounded theory is to serve as a way to learn about the worlds we study and a method for developing a theory to understand them.

This particular approach is appropriate for this research, since limited literature illuminate the process of Malaysian adolescents' participation in physical activity in the neighbourhood setting. Hence, the use of grounded theory in the present research used to gather data, and then systematically develop the theory, and then systematically seek out evidence to verify it (Walker & Myrick, 2006) (See Figure 3.4)

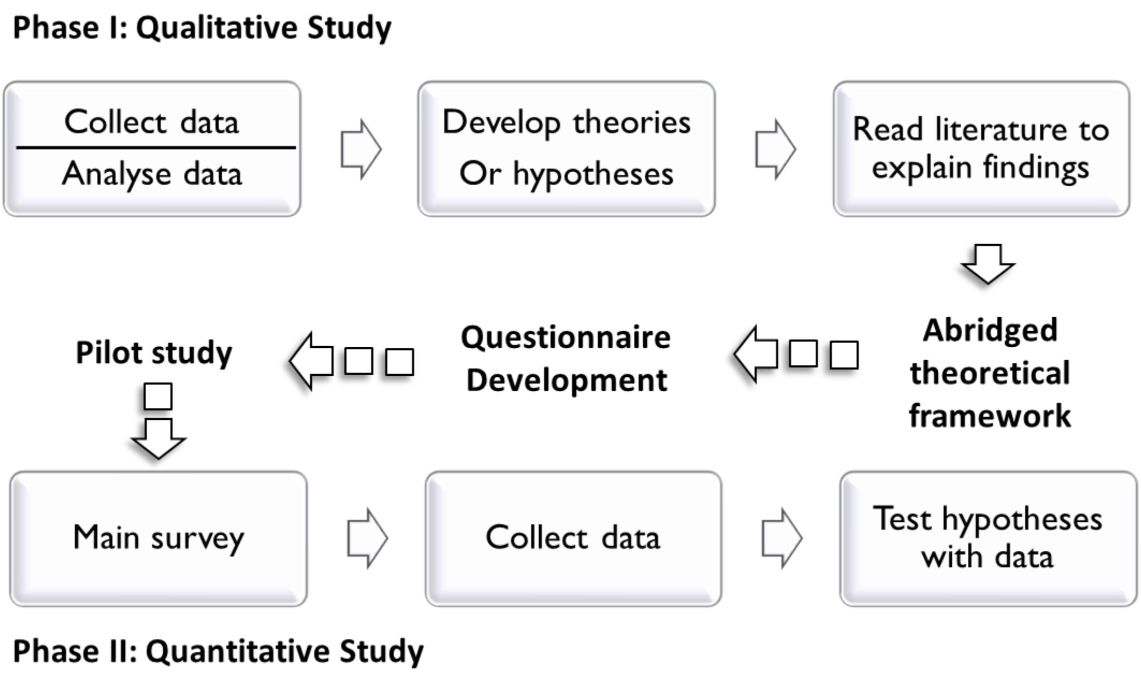


Figure 3.4 Grounded theory in exploratory sequential mixed methods design

In adopting grounded theory, there are two key beliefs to follow; (a) the researcher has to set aside theoretical ideas; and, (b) the concepts are to be developed through constant comparison. The first orthodox view of grounded theory advocates that researchers enter the field of inquiry with as few predetermined thoughts as possible (Glaser, 1978). While it is impossible to begin research with no preconceived ideas, Eisenhardt (1989) highlighted the importance of being as close as possible to having no theory under consideration or hypotheses to test in order to reduce bias.

In recent years, many grounded theory researchers accept that some prior reading is required to identify initial ideas and concepts, with extant literature being incorporated into the emerging theory as the research progresses (Denscombe, 2003). McCallin (2006) conducted an initial literature review as a base for comparison with emerging concepts. The identification of similarities between the grounded theory and the literature can help to improve the transferability, validity, and generalisability of the theory (Eisenhardt, 1989). On the other hand, conflicting literature can force the researcher to be more creative and encourage a frame-breaking mode of thinking that they might otherwise not achieve (Eisenhardt, 1989). Apart from literature, Goulding (2005) cites the researcher's life experiences, research, and scholarship as knowledge, cannot be erased prior to conducting their research.

Regardless of any particular approach, without the concept of constant comparison, grounded theory cannot be developed. Since its first publication in 1965, the constant comparative method has been a key concept in the development and understanding of grounded theory (Glaser, 2001). The constant comparative method and theoretical sampling ensures that the researcher engages in data collection and data analysis in a joint and iterative fashion. Theoretical sampling is the process of data collection whereby the researcher collects, codes, and analyses data and decides what data to collect next and from which sources. This enables the dynamic and continuous development of theory in an emergent manner (Glaser & Strauss, 1967).

For a novice researcher in adopting this approach, Mansourian (2006) recommended adherence to the key principles of constant comparison, theoretical sampling and emergence. Along these lines, the researcher used the constant comparative method that involves a cyclical progression through four stages (1) generating categories and their properties; (2) integrating categories and their properties; (3) delimiting the theory; and (4) explaining the theory. The constant comparative method requires that the researcher generates concepts (categories and properties) by comparing incidents in the data and looking for patterns. As concepts emerged, they were compared with other incidents for verification, as well as with previously identified concepts for establishing the best fit with the data. A direct consequence of following this approach is that with the progression of analysis, concepts tend to become increasingly integrated, and the researcher starts making sense of their interrelationships. Subsequently, this emerging proposition that begins to be taken for a theoretical model serves as a guide for further data collection analysis, and hence leading to further theoretical sampling (Glaser & Strauss, 1967; Strauss & Corbin, 1998).

3.5.2 Data Collection and Data Analysis

The present qualitative study adopted the version of grounded theory developed by Strauss and Corbin (1998), in which the researcher has the freedom to enter the field and discover the main concerns of participants and analyse ways they resolve these problems. The key features of grounded theory are the detailed open, axial and selective coding procedures. Data collection, coding and analysis occur immediately, concurrently, and throughout. Nonetheless, explaining a method that happens sequentially, subsequently, simultaneously, serendipitously and in a scheduled manner (Glaser, 1998) is challenging. In this qualitative study, the researcher followed the procedures outlined by Lehmann (2001) in a spiral process that starts by collecting 'slices of data' in a substantive area of enquiry (See Figure 3.5).

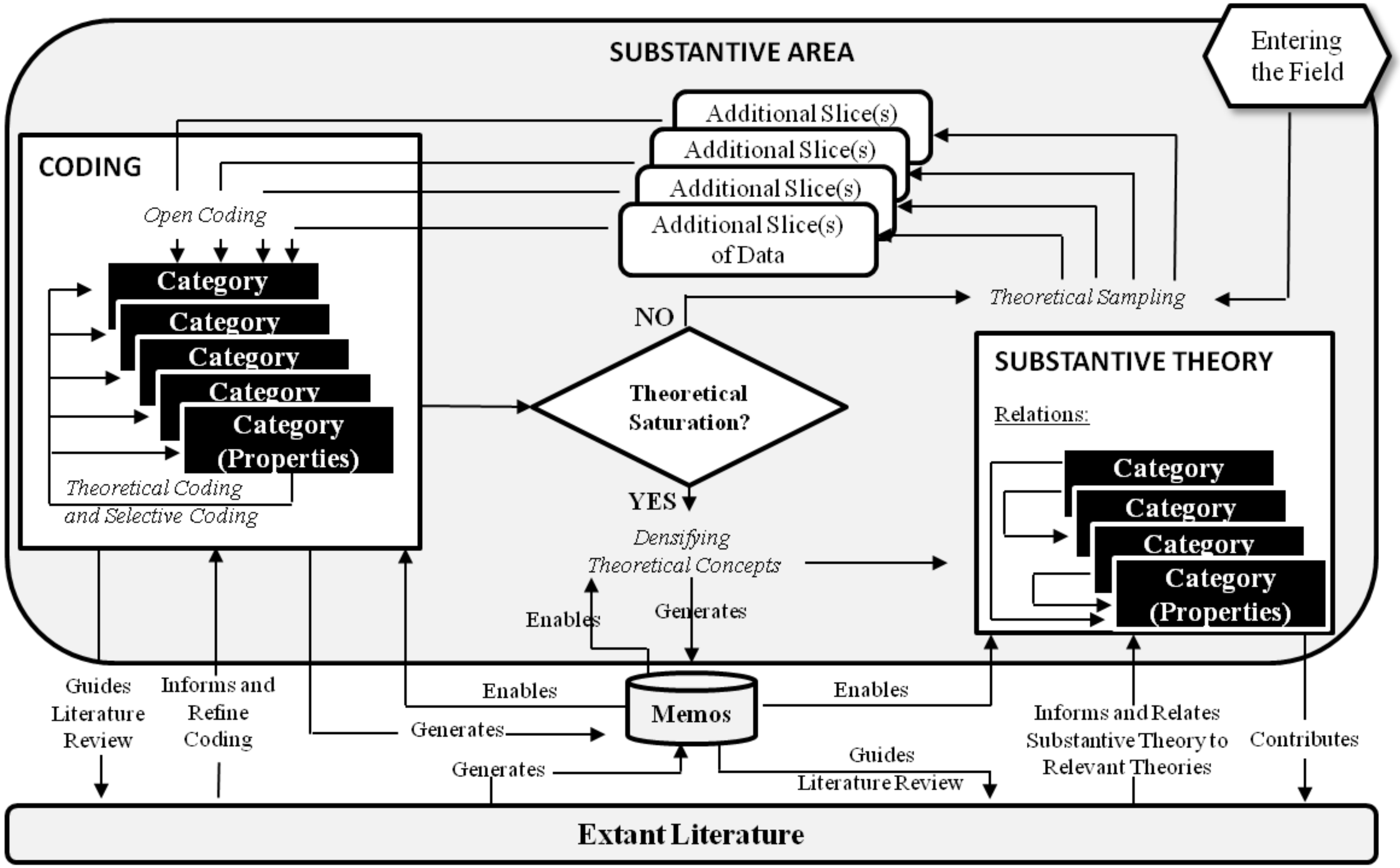


Figure 3.5 Grounded theory's building process
Source: Lehmann (2001a); Fernández (2002)

The process was started by collecting ‘slices of data’ in a substantive area of enquiry. Subsequently, the data were codified and categorised in a continuous process that moves toward saturation and results in the theoretical densification of concepts represented by a substantive theory (Lehmann, 2001). This procedure was further improved by Fernández (2002) by including the significant role of extant literature external to the substantive area in the formulation of the substantive theory, and the role of memos.

Entering the field

Entering the field was the first process in the grounded theory procedures. It included preparatory work such as selecting an appropriate site, negotiating and obtaining access to the case, contacting participants and gaining their consent. Following the grounded theory tradition, the study assumed that ‘the problem’ was to be discovered from accounts of people in the substantive area of enquiry. This contrasts with the need of other methods for precise research questions emerging from the literature review. The initial research question was as broad as possible (e.g., what influences your participation in physical activity?). As the researcher had a pre-research assumption regarding physical activity as a main theme, this assumption was handled according to the method; that is, the researcher produced a ‘slice of data’ to be compared with others.

Theoretical Sampling

Theoretical sampling means the researcher chooses participants who have experienced the phenomena (Strauss & Corbin, 1998) for illuminating and extending relationships and logic among constructs. Some readers have made the faulty assumption that the cases should be representative of any population, as are data in large-scale hypothesis testing research. Just as laboratory experiments are not randomly sampled from a population of experiments, but rather, chosen for the likelihood that they offered theoretical insight (Eisenhardt & Graebner, 2007).

The population of interest for this study was adolescents between 13 to 15 years of age and parents/guardians. The researcher recruited participants using a snowball sampling strategy, where the first few participants were identified via the researcher's personal networks, which included friends. It would have been difficult to locate the relevant resources otherwise. Subsequently, these participants invited other friend(s) and/or neighbour(s) to join the research. Kuching district was chosen to represent the "voices" of adolescents from different ethnic backgrounds.

Study Area

Two residential areas in Kuching were purposively selected as a *substantive area* for the research to take place. The first residential was located at the foot of *Gunung*[1] Siburan, 40 kilometres away from Kuching to correspond to the Indigenous groups. The other residential area was selected to represent other ethnic groups, namely the Malays and Chinese.

Theoretical Saturation

It is essential to get an appropriate sample size that would generate enough data (Auberbach, 2003). In grounded theory, the sample size was decided explicitly by

[1] *Gunung* is a Malay word for mountain

theoretical concerns (Clarke, 2005), which mean the sample generates enough in-depth data that can illuminate patterns, concepts, categories, properties, and dimensions of the given phenomena (Strauss & Corbin, 1998). The key ground of appropriate sample size can be determined by *theoretical saturation*. Theoretical saturation is defined as the point at which no additional data can be found to add to the empirical content of various categories in the theory. In a way, the researcher continues expanding the sample size until data collection (e.g. interviews) reveals no new data (Morse, 2000). As demonstrated by literature reviews, the researcher must allow the data to dictate the sample size. Normally saturation occurs between 10 and 30 interviews (Strauss & Corbin, 1998).

In this study, it took about four months of cyclical interplay between data collection and analysis, and interviewing, before a theoretical sample of 22 adolescents and eight parents were emerged as the core category and central theme. The core category fulfilled the role of an underlying latent structure that explained the relationships among most other categories.

The judgment of sample size also depends upon the scope of the research question. A broader research scope requires far more data and thus requires more data collection, which translates to more interviews and it might require alternative data sources (Morse, 2000). The ability, experience or knowledge of the researcher also affects the sample size (Morse, 2000). Researchers with more experience and strong interviewing skills will require fewer participants as they can guide and encourage the participants to reveal the data (Morse, 2000; Strauss & Corbin, 1998).

Data Collection Technique

Once adolescents and parents were drawn from two diverse neighbourhoods in the Kuching district, the researcher used *photovoice* (Wang, 2004), focus groups (Kitzinger, 1995), and in-depth interviews (Ritchie & Lewis, 2003) to understand the correlates of adolescent physical activity in the neighbourhood context. In particular was the understanding of: (1) how the neighbourhood is structured and perceived, and (2) how this affects the manner in which adolescents engage in physical activity in this neighbourhood.

Based on the premise that what experts think is important may not match what people at the grassroots think is important, *photovoice* was developed by Dr. Caroline Wang in 1992. *Photovoice* project was initially taken to empower women living in the remote countryside of Yunnan Province in China to use photographs and narrative stories about their photographs to influence policies that affect their lives (Wang & Burris, 1997).

Photovoice enables community residents of all ages and languages, including those who may be marginalised, to conceptualise their life experiences and their environment and share information through pictures (Wang & Burris, 1997). *Photovoice*, in this sense, was able to penetrate the vulnerable and marginalised participants, such as adolescents, to provide insight into unseen or hard-to-reach locations and hidden experiences and help to bridge gaps between researcher and the researched (Aldridge, 2012).

As a qualitative method, *photovoice* has also been noted to work well with young people (Cook & Hess, 2007) and to engage people in active listening and dialogue (Wang, 1999). *Photovoice* is also increasingly gaining much popularity in public health research. A few studies have applied this data collection technique in physical activity research among adolescents (Badland et al., 2009; Hennessy et al., 2010).

For the purpose of this study, participants were provided with a digital camera for them to take about 10 to 15 photographs of items, places, people or events in the neighbourhood which they perceive as factors affecting their engagement in physical activity. “Physical activity” was defined as any physical movement or mobility carried out for the purpose of leisure (e.g., walk in the park, workout at the gym) or transportation (e.g., walking / cycling to a destination). ‘Neighbourhood’ is defined as a social organisation of a population residing in a geographically proximate locale (within 800 meters – radius from residence) (Galster, 2009), which in this study is referred to as ‘village’ or ‘housing area’.

A hands-on training session on using a digital camera was conducted in order to teach them the relevant procedures. Participants were also briefed on the risk of taking photographs of places or individuals from or in public places. The photographs were used as discussion materials in focus groups (with adolescents) and in-depth interviews (with parents). Digital cameras with built-in memory cards were loaned to participants (22 adolescents and eight parents). They had seven days to complete the photo-taking task. This activity was conducted between January and April 2010.

Once the photographs were taken, the *photovoice* should use the three-stage process of: (1) selecting – participants choose the photographs to be discussed; (2) contextualising and storytelling – occurs during interview/group sessions; and (3) codifying issues, themes and theories that may generate many different meanings for a single image (Wang & Burris, 1997).

Before focus group discussions were held at the participants' premises and at the mosque (*surau*) in the housing estates on weekends, the participants chose the best eight noteworthy photographs in relation to physical activity factors. Based on a previous *photovoice* study (Mahmood et al., 2012), the eight photographs were found sufficient to discover salient factors in physical activity behaviour. The photographs were then transferred and projected directly to a television or liquid crystal display (LCD) screen. This procedure was a modification of the previous *photovoice* technique where participants needed to write captions on a printed photograph (Badland et al., 2009).

After initial introductions, topics were posed to the group in sequence. These included the meaning of physical activity, preferred physical activity, benefits of physical activity and factors that influence adolescent engagement in physical activity. During the discussion of the last topic (influential factors in the adolescents' physical activity), participants told their stories about a self-selected photographs, guided by a set of questions listed in Table 3.1.

Table 3.1 Interview Checklist

Themes	Questions
Definition of PA	What does physical activity mean to you? (Probe: What kind of activities do you consider as physical activity?)
Importance of PA	Do you think physical activity is worthwhile? Why is it so?
Types of PA engaged	What type(s) of physical activity do you do before and after school? What do you do during leisure time?
Duration of PA	Do you think you have enough physical activity? How often you do engage in physical activity? How many times in a week and how many hours in a day? How often do you think adolescents like you should engage in physical activity?
What factors/events/people influence adolescent PA in the neighbourhood context?	You have taken photos around your neighbourhood. Tell us more about the photos. 1. Describe your photograph. 2. What is happening in your photograph? 3. Why did you take this photograph? 4. What does this photograph tell us about your engagement in physical activity? Do you want to add or raise some questions before we move on to the second part of the discussion? Where do you go to be active? Do you have places to engage in physical activity in your neighbourhood? Where are they? Can you name them? What do you like about these places? Do you engage in this activity alone or with family members or friends? How do you get to these places? Have you encountered problems when trying to do physical activity (other than what you have shown in the photos)? [Probe: Parental influence? Friend's influence?] What are the improvements to be made in the neighbourhood to help you become more active?

Although the sequence of questions was posed according to the interview checklist, the topics of discussion were shifted around by asking adolescents to present their photographs first. This was done to stimulate the adolescents' interest in the discussion and served as an ice-breaking session. During the discussion, other participants were encouraged to give their views on the photographs being presented. Probes were used to stimulate discussion whenever there were extended pauses in conversation, and those who appeared to be too shy to respond were encouraged to talk. The facilitators helped the participants to engage in the analysis of photographs, and helped the group achieve a consensus to reflect the collective views (Hennessy et al., 2010). The interviews were conducted mainly in the Malay language for about 90 to 180 minutes.

Data Analysis / Coding

With the participants' permission, all the interviews were audio recorded and transcribed. Initially, the Nvivo software application was used to facilitate open coding and other coding activities. However, *photovoice* needed coding to be done side-by-side with the participants' photographs, and that was difficult to handle with Nvivo. Furthermore, as stated by Glaser (1998), the 'technological traps' of data analysis tools such as NVivo or ATLAS.ti create unnecessary restrictions, inhibit the researcher's development of skills and impose time-consuming learning curves.

Data analysis of photovoice was guided by grounded theory approach. The researcher started analysing the data as soon as it was collected and moved on to compare the analysis of one set of data with another (Strauss & Corbin, 1998). In this study, *photovoice* analysis was conducted as illustrated in Figure 3.6.

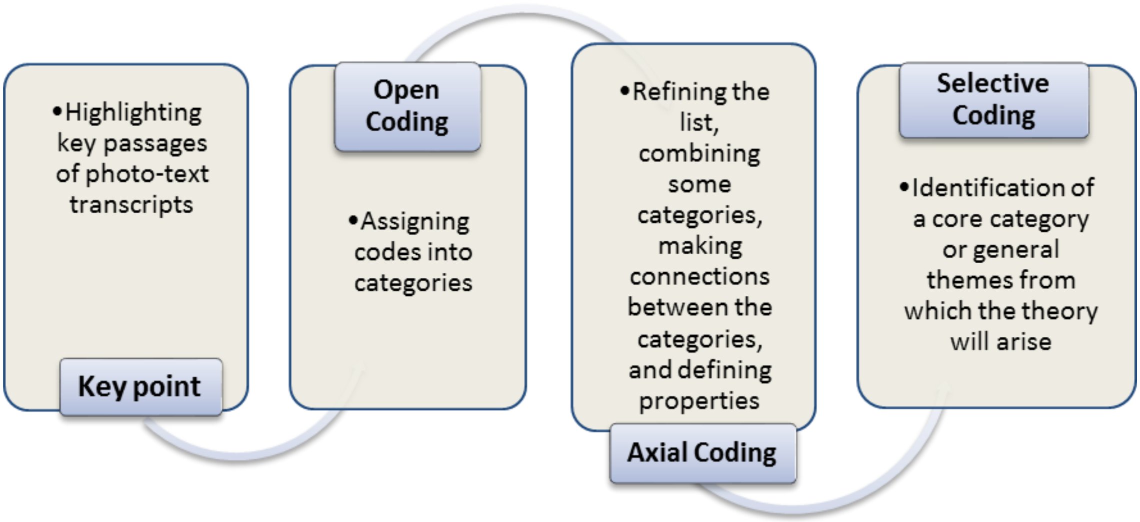


Figure 3.6 Data analysis using grounded theory

As shown in Table 3.2, the coding was then done manually, line by line using Microsoft Word instead. Other tools include notepads, whiteboard and Microsoft PowerPoint to draw box diagrams representing the interrelation of emerging concepts and to organise ideas and themes.

Table 3.2 Example of open, axial and selective coding procedures from focus group discussion with adolescent boys

	Open Coding	Axial Coding	Selective Coding / Core Category
	This is my **ball** and its pump. It **encourages** us to **play** with it whenever we see it. If we do not have a ball we **cannot play**. It feels like something missing. **Football** is **fun**. Whenever we **see people** playing football, we **feel** like **going out** and playing too.	"ball" "encourages" "play" "cannot play" "football" "fun" "see people" "feel' "going out"	Ball, fun of playing football and seeing other people playing football motivate others to play outside. ○ Availability of sports equipment ○ Enjoyable sport / fun ○ Seeing others playing **Concept → Motivation**
	These **dogs** like to **chase** and disturb people. They **limit** our **outdoor activities**. An owner used to walk his dog around and it used to defecate everywhere. This is extremely **dirty**. I feel like to **vomit** being **licked** by dogs. I was chased by dogs once. I **kicked** at it, **ran** away, **picked up stones** along the way and **threw them** [at the dogs].. the Padawan **Council** should **catch** these dogs. [Focus group #3, Boys, Urban]	"dogs" "chase" "limit" "outdoor activities" "defecate" "dirty" "vomit" "licked by dogs" "kicked" "ran" "picked up stones" "threw" "Council" "catch"	Presence of stray dogs limits outdoor activities. Dogs may harm people's safety; unclean to Muslims; and unclean to the environment. Local council should take charge. ○ Animal threats ○ Poor aesthetics (unclean environment) **Concept → Safety and aesthetics**

The purpose of this coding was to build a theoretical framework while providing a means for handling a massive amount of raw data and help the researcher to transition from analysing low-level discrete concepts in formulating high-level structures of relationships that constitute the central phenomenon in the emergent theory. The *photovoice* analysis starts with a **key point** stage. The researcher only highlighted key points in the photo-text transcripts and excluded things like digressions, repetitions and other irrelevant materials.

Open Coding

Open coding assigned codes to categories by “running the data open”, that is, analysing the data to extract a set of categories and their properties. This was done by coding for as many categories as possible without a preconceived set of codes (Glaser, 1978). During open coding, the researcher labelled the text of each interview and detected new lines of enquiry, which guided subsequent data acquisition activity.

The process of open coding commenced as soon as the data began coming in (Clarke, 2005). Many categories were identified from the first transcript and then progressively fewer new categories from each successive transcript, as the proportion of new information decreases. Open coding in the present study generated 342 codes from adolescents and 647 codes from parents. The end point of this open coding process was the production of an initial list of categories. To ensure mutual consistency and credibility, the process of assigning codes to categories for one transcript was scrutinised by another researcher (supervisor) to check reproducibility.

Axial Coding

Axial coding followed directly and iteratively from open coding, and involved taking the concepts that emerged during open coding and reassembling them with relational propositions to link various concepts. Axial coding refined the list by deleting or combining some categories, followed by making connections between categories and defining properties, i.e. context and preconditions.

Selective Coding

Selective coding is the process of selecting the core category and systematically relating the core category to other major categories identified in the research (Glaser and Strauss 1967). In selecting the core category, the researcher needs to identify a central theme and ascertain that it offers a coherent story line in such a way that its relationships to other categories become the descriptive narrative for the emergent theory. There were several steps involved in selective coding; (1) selecting the core category; (2) relating it to other categories; (3) validating the relationships against the data; and (4) refining categories that may need further development (Strauss & Corbin, 1998).

In this study, multiple dimensions of physical activity correlates were integrated through a core category that explained adolescents' participation in physical activity. As the theory developed and crystallised around the core category, data collection and analysis increasingly focused towards the refinement of theoretical output. During this process, the researcher made sure the audience could easily understand the theoretical output. The template of a reflective coding matrix was used to relate the categories and patterns from preceding open and axial coding in a structured fashion around the central phenomenon. In the final iterations of axial and selective coding, there was an increased emphasis on ensuring that a conceptually rich substantive theory had indeed emerged, and there were no significant issues remaining to be analysed (Strauss & Corbin, 1998).

Memo Writing

The writing of theoretical memos was considered to be an integral activity in grounded theory (Glaser & Strauss, 1967; Jones & Noble, 2006) and starts almost in parallel with open coding. Memos can be characterised as the researcher's record of analysis, thoughts, interpretations, questions and directions for further data collection (Strauss & Corbin, 1998). For example, these were some of the researcher's memos:

1. Early in the project, participants were supposed to be identified by adult key informants (e.g. the village head or the resident representative) but this was not efficient. Subsequently, snowball sampling was applied by asking the participants' friends to participate in the research.

2. Based on interim analysis results, requirements for additional data were identified and information was solicited from parents.

3. The researcher opted to modify the sequence of interview topics. The photographs taken by participants were discussed first to encourage active participation and enhance the quality of the emergent theory. By incorporating these steps in the research process, the researcher attempted to alleviate concerns surrounding the negative effects of insufficient pattern variability in the data which can consequently lead to theories lacking in conceptual richness and density (Jones &

Noble, 2006). The *photovoice* session served as an ice-breaking in focus group discussions to make the session enjoyable and educational.

Because memos are the theorising write-up of ideas about codes and their relationships as they strike the analyst while coding (Glaser, 1998), memos were produced constantly in grounded theory, from the beginning of the analysis process until reaching closure, capturing the thoughts of analysts while they progress through the work. Memos raised the theoretical level via a continuous process of comparison and conceptualisation. They also provided freedom, flexibility, and enhance creativity (Glaser, 1998). Overall, the integrated use of coding and memoing in the analysis process facilitated the process of theorizing by collapsing many fuzzy categories into fewer clearer conceptual structures that explain adolescent participation in physical activity.

Theory Matching and Integration

As codes and memos accumulated, the researcher started to perceive relationships between them. This process, called theoretical coding, conceptualized the interrelation of substantive codes by generating hypotheses for integration into a theory. Therefore, theoretical codes emerged from open coding and theoretical memos, weaving a new story from the fragmentation of open coding (Charmaz, 2006). The grounded integration of concepts was a flexible activity that provides broad pictures and new perspectives. However flexible, theoretical codes must remain grounded in data, they cannot be empty abstractions (Glaser, 1998). The concept of flexibility implies theoretical sensitivity to a number of possible coding paradigms, or coding families, consciously avoiding over-focusing on one possible explanation.

The emergence of a pattern marks the beginning of selective coding. This process refers to delimiting the theory to one or two core variable(s) which act as a guide for further data collection and analysis (Glaser, 1978). By doing so, the research focused on one of the several basic social processes or conditions that are present in the data. The delimitation of the analysis to those significant variables affecting the core variable contributes to parsimonious theory (Glaser & Strauss, 1967).

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At this stage in the process, the role of the extant literature becomes very important because researchers need to acquire sensitivity and knowledge of grounded concepts. The literature was therefore read as a source of more data to be compared with existing grounded data. For example, in this study, readings about health behavioural theories, ecological theories, broken-window theory, and physical environment psychology raised the theoretical level and improved construct definitions (Eisenhardt, 1989).

The researcher achieves theoretical saturation when the main concern of the research can be accounted for, and further sampling fails to add significant value to the study through adding new categories or properties. At this stage, when the theory becomes dense with concepts and enriched by relevant extant literature, the researcher has ‘discovered’ a substantive theory. Substantive theories are applicable to the particular area of empirical enquiry from which they emerged. They can be classified as ‘middle-range’ theories; that is, between ‘minor working hypotheses’ and ‘grand theories’ and they are relevant to the people concerned as well as being readily modifiable (Glaser & Strauss, 1967).

3.5.3 Qualitative Research Accuracy

The general agreement seems to have been reached that quality concepts developed for quantitative research such as validity, reliability, and replicability cannot and ought not be applied to qualitative research (Auberbach, 2003). Qualitative research is based on subjective, interpretive and contextual data, where quantitative research attempts to control and/or exclude those elements. To solve the dilemma of the measurement of validity, qualitative researchers have developed measurement concepts in line with the qualitative paradigm (Seale, 2003). Maxwell (1992) developed five categories to judge the validity of qualitative research: descriptive validity, interpretive validity, theoretical validity, generalisability and evaluative validity.

'Descriptive validity' refers to the accuracy of the data in which the data must accurately reflect what the participant has said or done. The reporting of the data must also reflect the same accuracy, which means that the transcription is an accurate account of what was said or the transcription of the videotapes portrays the unfolding of events in an accurate manner. The 'interpretive validity' captures how well the researcher reports the participants' meaning of events, objects and/or behaviours (Maxwell, 1992). The point here is that the interpretations were not based on the researcher's perspective but that of the participant.

What 'theoretical validity' seeks to evaluate is the validity of the researcher's concepts and the theorised relationships among the concepts in context with the phenomena. 'Generalisability' refers to the ability to apply the theory resulting from the study universally (Auberbach, 2003; Maxwell, 1992), under the heading of 'transferability'. For qualitative research, generalisability is problematic. 'Evaluative validity' moves away from the data itself and tries to assess the evaluations drawn by the researchers (Maxwell, 1992).

Corbin and Strauss (2008) applied a validation scheme by sending their early analysis to three interviewees for comments. Maxwell (1992) on the other hand suggested the validity of qualitative methods to be based on validity norm and category of ‘transparency’. In this validation, Maxwell (1992) informed the reader about how they arrived at their interpretation. The reader must understand the processes involved in the interpretation; the method of sample selection, the research design, the interview protocol, the coding procedures and the researchers’ own epistemological viewpoints.

The present study adopted Corbin and Strauss (2008) scheme validation by going back to participants and asking for their agreement on the analysis outcome. Debriefing sessions with participants were organised to confirm the preliminary findings (Charmaz, 2006) and these were largely participant-driven (Hennessy et al., 2010). A few sub-category items (house-breaking, face-saving, animal faeces, drunken people and the presence of rivers) were added. There were 17 adolescents and five parents attended the debriefing sessions (two parents and five adolescents were unable to due to other commitments). Peer debriefing discussions of the emergent themes were conducted among the research team members to increase the credibility of the findings (Maley, Warren, & Devine, 2010). The researcher also adopted the validity norm by informing the process involved from departure to arrival of a theoretical framework (Maxwell, 1992).

3.6 PHASE II – QUANTITATIVE STUDY METHODOLOGY

3.6.1 Item development

Using an instrument developed in western countries raises questions about the applicability of the instrument to measure local neighbourhood environments with regards to the physical activity behaviour of the adolescents. Moreover, the validity and reliability of the integrated individual, social and environmental instruments have not been examined. This justified the need for devising and testing the reliability and validity of the survey instrument used for this study. In a mixed methods framework, this phase represents the 'mixing' of the qualitative and quantitative phases, or the explicit relation of the qualitative and quantitative data (Creswell & Plano Clark, 2007).

In this section, the process of how the Individual, Social and Environment Scale (ISES) were developed and tested for reliability and validity to achieve the stated research questions is explained (as shown in Figure 3.7).

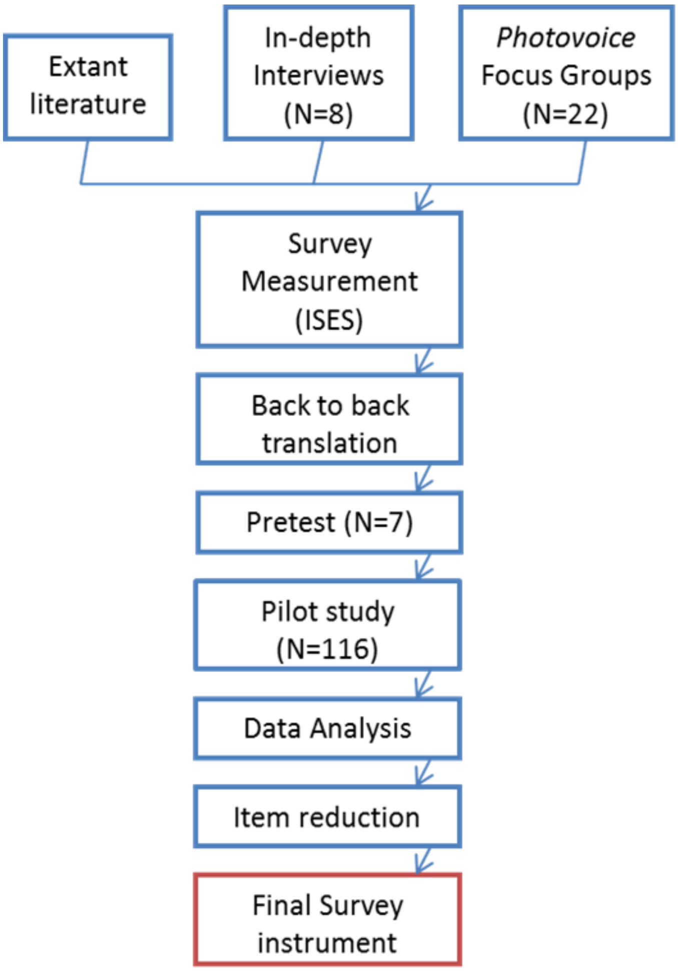

Figure 3.7 Production of the survey instrument

The survey items were developed and generated from qualitative findings (*photovoice* focus groups and in depth interviews), and from the existing literatures. Published literature, reference lists and websites were searched to identify potential measures to match with the qualitative constructs. The criteria for selecting survey measures include domains measured, validity and reliability, and protocols to use. Overall, five existing self-reported measures were selected from the existing literature to measure constructs identified in the qualitative study (See Table 3.3).

Table 3.3 Summary of selected instruments and their psychometric properties

Concept	Measure	Psychometric properties	Number of items
Recreation facilities Accessibility to facilities Traffic hazard* Aesthetics* Fear of crime*	Neighbourhood Environment Walkability Scale (NEWS-Y) (Rosenberg et al., 2009)	Test-retest Reliability = 0.75	35
Parental support	Social Support Scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987)	Alpha = 0.85 Test-retest = 0.83	7
Peer support		Alpha = 0.88 Test-retest = 0.89	7
Parental restriction	Ferraro's Indices of Constrained Behaviour (Carver et al., 2010)	Alpha = 0.79 Test-retest Reliability = 0.44	6
Self-efficacy	8-item Self-Efficacy Scale (Saunders et al., 1997)	Alpha = .78 and .79 (Baseline & follow up)	8
Perceived barriers	Perceived barriers to exercise scale (Cheng et al., 2003)		7

(*New items were added in the existing constructs)

Neighbourhood Environment Walkability Scale (NEWS-Y)

The immediate environment in which the individuals live, play and work was noted to influence the person's ability to be physically active. In recent years, geographical information systems (GIS) and geographical positioning systems (GPS) are commonly used to assess the neighbourhood environment characteristics objectively (Almanza et al., 2012; Dowda et al., 2012; Lachowycz et al., 2012; Rodríguez et al., 2012; Trilk et al., 2011). The cost of these gadgets was between USD300 and USD400 per unit, but it was a limitation of the current study that a similar measure could not be used.

Thus, the widely validated measure, the self-report of Neighbourhood Environment and Walkability Scale - Youth (NEWS-Y) (Rosenberg et al., 2009) was instead used. The Neighbourhood Environment Walkability Scale (NEWS-Y) (Rosenberg et al., 2009), consists of nine constructs and 67 items meant to assess the neighbourhood walkability index (Cerin, Saelens, Sallis, & Frank, 2006). In NEWS-Y, respondents were asked to report on a number of characteristics relating to their neighbourhood including: access to amenities and services within walking distance; street connectivity; places for walking and cycling; neighbourhood aesthetics; safety from traffic; and safety from crime (Saelens, 2003).

With the exception of residential density and land use, all items were scaled from 1 (strongly disagree) to 4 (strongly agree) with higher scores indicating a more favourable value of environmental characteristics on physical activity participation. Land use was assessed by the duration it takes by walking from home to various places, with responses ranging from 1 – 5 minutes reverse coded as 5, and to more than 30 minutes walking reverse coded as 1. Higher scores indicate the higher walkability of the neighbourhood. With the exception of residential density scale, all subscale scores were calculated as the mean across the subscale items. Test-retest reliability of the NEWS has been reported to be high, with an intraclass correlation greater than 0.75 for all subscales (Saelens, 2003).

For the purpose of this study, the researcher only selected constructs that have emerged from the qualitative phase. Six new items were generated from the present qualitative study, suggested to be added to the NEWS-Y existing constructs (See Table 3.4).

Table 3.4 New items of neighbourhood environment factors

Constructs	Items
Aesthetics	My neighbourhood open spaces are free from garbage and construction debris My neighbourhood is free from stray dogs.
Traffic hazards	There is no speed limit sign in my neighbourhood streets. There is no traffic calming (e.g speed humps) in my neighbourhood streets.
Crime safety	I am worried about being outside because other kids like to bully me. I am worried about being outside because of bad groups (e.g drunks, drug addicts, and gangsters).

Self-Efficacy

Perceived self-efficacy is one of the most widely researched concepts in health promotion, defined as "beliefs in one's capabilities to organize and execute the courses of action required for producing given attainments (Bandura, 1997). The self-efficacy item for this study was adapted from Saunders et al. (1997) to assess support seeking and positive alternatives.

Support seeking and positive alternatives were assessed by 17 items. However, after the validation done by Motl et al. (2000) and Bartholomew, Loukas, Jowers, and Allua (2006) the 8-item (1 factor) version was used instead of the 17-item (3-factor version). The scale instructs respondents to indicate on a 4-point rating scale (1 = not at all true, 2 = rarely true, 3 = moderately true, 4 = always true) how confident they are with regard to carrying out regular physical activities and exercise. Higher scores indicate high self-efficacy to perform physical activity or exercise.

Perceived barriers

The perceived barriers items were adapted from previous studies among young adults (Allison, Dwyer, & Makin, 1999; Cheng et al., 2003) and consisted of 7 items (internal barriers) rated on a 5-point Likert-type scale from never (1) to very often (5).

Parental and Peer Support

Social support was a consistent correlate of youth physical activity. The social support scale included seven items rated twice, measuring *family* and *friends* support. The scale was originally adapted from Sallis (1986). Each item was scored on a five-point Likert scale from none (1) to very often (5), assessing what family members or friends might do or say to someone who is trying to do physical activity regularly. Higher scores denote good social support for physical activity behaviour.

Parental Restriction

Besides family and peer support, parental restriction emerged from the qualitative study, suggesting the construct should be included. Ferraro's indices of constrained behaviour with regard to crime victimization were adopted from the work of Carver et al. (2010). The six items asked adolescents to indicate their level of agreement with five response options; (1) strongly disagree to (5) strongly agree, with higher scores denoting a strong parental restriction to play at outdoors (Table 3.5).

Overall, Table 3.5 presents 10 constructs to measure multilevel correlates of physical activity. Two constructs; self-efficacy and perceived barriers, are used to measure the individual factors. Three constructs assessed the social factors: family support, parental restriction and friend support. Another five constructs: recreation facilities, access to physical activity resources, traffic hazards, and aesthetics and crime safety were used to assess the neighbourhood environment factors.

Table 3.5 Proposed constructs to measure individual, social and neighbourhood environment factors

Construct	Operationalization	Source	Responses
Intrapersonal Factors			
Self-efficacy	I think I can: 1. Ask my best friend to be physically active with me. 2. Be physically active most days after school. 3. Be physically active after school even if I could watch TV or play video games. 4. Be physically active even if I have a lot of homework. 5. Be physically active even if my parent wants me to do something else. 6. Ask my parents to take me to a physical activity or sport practice. 7. Be physically active even if it is raining or hot. 8. Be physically active even if I have to stay at home.	(Bartholomew et al., 2006)	1= Not at all true 2= Rarely true 3 = Moderately true 4 = Always true
Perceived barriers	1. I don’t have enough time for physical activity. 2. I am too tired for physical activity. 3. There are no proper facilities to perform physical activity near my home. 4. I don’t have the energy to do physical activity. 5. I don’t like physical activity or sports. 6. Physical activity or sports are a waste of time. 7. I feel lazy to do physical activity because of hot weather.	(Cheng et al., 2003)	1=Never 2=Seldom 3=Sometimes 4=Often 5=Very often

Social Factors

Family Support	During the past three months, my family 1. Are active with me. 2. Offered to exercise with me. 3. Gave me helpful reminders to be active. 4. Gave me encouragement to be active. 5. Change their schedule so we could exercise together. 6. Planned for physical activity or recreational outings. 7. Talked about how much they like to exercise	(Sallis, 1986)	1=Never 2=Seldom 3=Sometimes 4=Often 5=Very often
Friend Support	During the past three months, my friend 1. Have been active with me. 2. Have offered to exercise with me. 3. Gave me helpful reminders to be active. 4. Gave me encouragement to be active. 5. Changed their schedule so we could exercise together. 6. Planned for physical activity or recreational outings. 7. Talked about how much they like to exercise	(Sallis, 1986)	1=Never 2=Seldom 3=Sometimes 4=Often 5=Very often
Parental Restriction	1. My parents prevent me from playing alone outdoors in our neighbourhood. 2. My parents prevent me from playing with friends outdoors in our neighbourhood. 3. My parents prevent me to spend time outside after dark. 4. My parents prevent me to walk/cycle on the street after dark. 5. My parents prevent from playing alone on local streets in our neighbourhood. 6. My parents prevent from playing with friends on local streets in our neighbourhood.	(Carver et al., 2010)	1=SD 2=D 3=Not sure 4=A 5=SA

Neighbourhood Environmental Factors

Recreation facilities	1. Indoor recreation facility 2. Beach, lake, river or creek 3. Bike/hiking/walking trails, paths 4. Basketball court 5. Other playing fields 6. Swimming pool 7. School with recreation facilities open to public 8. Walking/running track 9. Small public park 10. Large public park 11. A public playground with equipment 12. Public open space	(Rosenberg et al., 2009)	1= <5-min 2=6-10-min 3=11-20-min 4=21- 30-min 5= >31-min 5= Don't know
Land use -access to facilities	1. Stores are within easy walking distance of my home. 2. There are many places to go (alone or with someone) within easy walking distance of my home. 3. From my home, it is easy to walk to a bus stop (bus/train), alone or with someone. 4. The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in (alone or with someone). 5. There are major barriers to walking in our local area that make it hard to get from place to place.	(Rosenberg et al., 2009)	1=SD 2=D 3=A 4=SA

Traffic safety	1. There is so much traffic along nearby streets that makes it difficult or unpleasant to walk in my neighbourhood. 2. Most drivers go faster than the posted speed limits in my neighbourhood. 3. There is no speed limit sign in my neighbourhood streets. 4. There is no traffic calming (e.g. speed humps) in my neighbourhood streets. 5. There are a lot of exhaust fumes when walking in my neighbourhood 6. There are no crosswalks and traffic signals to help walkers cross busy streets in my neighbourhood. 7. There are no street lights in my neighbourhood.	(Rosenberg et al., 2009)	1=SD 2=D 3=A 4=SA
Aesthetics	1. There are trees along the streets in my neighbourhood. 2. There are many interesting things to look at while walking in my neighbourhood. 3. There are many buildings/homes in my neighbourhood that are nice to look at. 4. My neighbourhood open spaces are free from garbage and construction. 5. My neighbourhood is free from stray dogs. 6. The grass on the open space area is trimmed regularly.	(Rosenberg et al., 2009)	1=SD 2=D 3=A 4=SA
Crime safety	1. There is a high crime rate in my neighbourhood. 2. The crime rate in my neighbourhood makes it unsafe to go on walks alone or with someone at night. 3. I am worried about being outside alone around my home because I am afraid of being taken or hurt by a stranger. 4. I am worried about playing or walking alone or with friends in our local streets. 5. I am worried about being outside because other kids like to bully me. 6. I am worried about being or walking alone in my neighbourhood because I am afraid of the bad groups (e.g gangsters).	(Rosenberg et al., 2009)	1=SD 2=D 3=A 4=SA

Translation and Pre-test of the Questionnaire

Once the initial items were identified for measuring the correlates of adolescent physical activity, the instrument was subjected to a translation. The instruments were first translated into Bahasa Malaysia and then back translated into English for cross-cultural harmony. The purpose of this activity was to determine the relevancy and local understanding of the items. Any discrepancies were rectified. The Bahasa Malaysia version questionnaire was then pretested on a sample of seven adolescents aged 13 to 15 years (male: 3, female: 4), who did not participate in the pilot study.

The participants identified a few problems with understanding recreation facilities listed in Section B. "Small public park" and "Large public park" to these groups gave the same meaning. Thus, the two items were combined and paraphrased as "public park". The "indoor recreation facility" gave many interpretations such as "closed stadium", indoor playing courts such as badminton and squash. To avoid confusion, this item was eliminated. Another facility item dropped was the "School with recreation facilities open to public", which is not applicable in Malaysian schools.

3.6.2 Pilot Study

A pilot study was conducted to evaluate the psychometric properties of the instruments. The purpose was to further refine and improve the newly developed Individual, Social and Environment Scale (ISES). ISES was designed to assess multidimensional factors (personal, social, environmental) affecting adolescent physical activity in a neighbourhood context. This section reports on the test-retest reliability, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Participants and Setting

The pilot study was conducted in the middle of January 2011 at the beginning of school term. The school was conveniently selected in the urban Kuching area. An introductory letter explaining the nature of the research and a consent form for the children's participation in the research was sent to each parent in a self-addressed envelope. A visit to the school was made to distribute these letters to parents/guardians via students. A total of 140 adolescents (aged between 13 and 14 years) from a lower form (Form 1 and Form 2 students) were invited to participate in the pilot study with 134 adolescents having given consent to participate in this survey. The response rate was 95% (134/140). The final sample only included 116 adolescents. Eight participants were absent during Test 1 and 10 participants were absent from Test 2 (14 days apart).

Measures

The newly developed 70-item ISES questionnaire was divided into three sections; Section A: Socio-demographic and anthropometric measures (height and weight); Section B: Correlates of physical activity; and Section C: Screen time. Next was the outcome measure of the pilot study. The main outcome measure of adolescent physical activity was obtained using the pedometers that record and display movement as 'steps taken' as a simple measure of ambulatory activity (Baranowski, 1988). Pedometers were found to offer an easy-to-use and cost-effective objective measure of physical activity in both youths and older adults (Kilanowski, 1999). The Yamax Digi-Walker electronic pedometer CW-700 with a one week memory was used to collect the objective data of the adolescents' one weekly physical activity. The international guideline of pedometer steps / day for children was set at 15,000 steps for boys and 12,000 steps for girls (Tudor-Locke, Ham, Macera, & al, 2004).

Adolescent sedentary behaviour was measured by time per typical week spent on electronic entertainment (watching TV, using a computer and surfing the internet, playing electronic games, sitting and listening to music, sitting and talking on the phone), adapted from the Youth Risk Behaviour Survey (CDC, 2011). The questions were asked for a usual weekday and weekend day separately. The sedentary composite hours per week, was the sum of weekday and weekend sedentary time.

Standing heights were measured using a portable Seca 214. Body weights were measured on the Seca 841 digital scale. Body Mass Index (BMI), a reliable indicator of body fatness for most children and adolescents was then calculated and compared with BMI classification based on the age- and gender-percentiles (Centers for Disease Control and Prevention, 2012). BMI-for-age weight status categories and the corresponding percentiles are shown in Table 3.6.

Table 3.6 BMI-for-age weight status categories and the corresponding percentiles

Weight status category	Percentile range
Underweight	Less than the 5^{th} percentile
Healthy weight	5^{th} percentile to less than the 85^{th} percentile
Overweight	85^{th} to less than the 95^{th} percentile
Obese	Equal to or greater than the 95^{th} percentile

Source: Centers for Disease Control and Prevention (2012)

Procedures

Participants completed surveys on two occasions, separated by two weeks to evaluate the test-retest reliability. A questionnaire was administered in the school hall with the help of two research assistants. The first activity required adolescents to answer the questionnaire (for about 40 minutes). Subsequently the participants' height and body weight were measured. Completed questionnaires with height and weight data were collected on the same day. Pedometer was distributed on the same day. A hands-on demonstration was conducted to demonstrate the use and the care of a pedometer.

Each participant was assigned with a pedometer, elastic belt, a 7-day pedometer diary, and pedometer instructions. The pedometer diary intended to provide information about participation in non-ambulatory activities such as swimming, cycling and weight training. All the items were kept in a zip-on plastic file with participant's name written on it. After receiving detailed instructions, students were instructed to attach the pedometer to an adjustable elastic belt. The pedometer was worn over the right hip. They were instructed to wear a pedometer during their waking hours for seven consecutive days. A reminder in a form of short text messages (SMS) was sent to participants or their guardian's mobile phone at least once.

On the eighth day, participants were expected to return their pedometer, a 7-day pedometer diary and elastic belt kept in its zip-on plastic file. The recording of participants' step counts into a data sheet was done immediately within the same day of the pedometers being returned. This is to avoid the data of the first day being automatically erased if it is recorded on the 9th day. This pedometer only retained 7-days of readings at a time.

Test-retest Reliability Analysis

Test-retest reliability, which measures stability over time, was designed to re-administer the questionnaire after 14 days to the same subjects. This interval was selected so that reliability estimates are not inflated due to memory effects (Garson, 2012). Reliability refers to the reproducibility of the measurement when it is randomly repeated for the same study subject (Bartko, 1991).

The previous reliability studies used intraclass correlation coefficient (ICC) to assess agreement. The NEWS-Y subscales reported to have an acceptable test–retest reliability (ICC range .56–.87) (Rosenberg et al., 2009). The social support scale reported ICC range 0.83 to 0.89 (Sallis, Pinski, Grossman, Patterson, & Nader, 1988). The parent restriction scale reported ICC of 0.44 (Carver, Timperio, Hesketh, & Crawford, 2010); and self–efficacy (0.78 to 0.79) (Saunders et al., 1997). The ICC averages the correlations among all possible ordering of the pairs. The ICC also extends to more than two observations in contrast with the correlation coefficient (r) (Teixeira et al., 2012). However, the use of ICC in assessing agreement has also been criticized by Bland and Altman for the reason the ICC ignores orders and treats both methods as a random sample from a population of methods (Bland & Altman, 1990).

This argument brings about the use of Cohen's kappa (*k*) in the reliability analysis of the present study. Kappa is a common technique for estimating paired interrater agreement for nominal and ordinal-level data (Fleiss, 1981). With ordinal variables (i.e. Likert scale) one must select weights arbitrarily to calculate weighted kappa. A weighted kappa measures the agreement between two raters, where the disagreements involving distance values are weighted more heavily than disagreements involving more similar values (Maclure & Willett, 1987). For example the self-efficacy of 4-point rating scale (1 = not at all true, 2 = rarely true, 3 = moderately true, 4 = always true) to denote how confident they are with regard to carrying out regular physical activities and exercise. In weighted kappa, a rating of 1 and 4 on a 4-point Likert scale would be weighted heavily, whereas ratings of 3 and 4 on the same variable (a minor disagreement) would have a low weighting. Hence, weighted kappa is appropriate for ordinal scales (Lantz, 1997). STATA 11.2 (Stata Corp, USA) generated the weighted kappa in the present study.

Following are the criteria for test-retest reliability according to Landis and Koch (1977):

- Poor agreement — Less than 0
- Slight agreement — 0.01 to 0.20
- Fair agreement — 0.21 to 0.40
- Moderate agreement — 0.41 to 0.60
- Substantial agreement — 0.61 to 0.80
- Almost perfect agreement — 0.81 to 1.00

Internal Consistency

The internal consistency of items in a scale was estimated with Cronbach's alpha, also known as the reliability coefficient, It measures the extent to which item responses obtained at the same time correlate highly with each other. Cronbach's alpha was calculated for each factor domain. The widely-accepted social science cut-off is that alpha should be 0.70 or higher for a set of items to be considered a scale, but some use 0.75 or 0.80 while others are as lenient as 0.60 for large sample size (Garson 2012). In brief, the construct reliability must be established before construct validity (Hair et al., 2010).

Factor Analysis

Factor analysis can be used to confirm and verify the number of dimensions or psychological constructs in a model (Churchill, 1979). The general purpose is to define the underlying structure among the variables in the analysis (Hair et al., 2010) or classify data on several variables to a smaller number of supposed underlying dimensions or factors (Gray & Kinnear, 2012).

There are two basic requirements for factor analysis: sample size and the strength of the relationship of the measures. The sample size of 100 or larger is preferred although the researcher should always try to obtain the highest cases-per-variable ratio (e.g. 10:1 ratio) to minimize the chances of over fitting the data (Hair et al., 2010). The sample size of 116 for the current pilot study was sufficient. A matrix that is factorable should include correlations in excess of .30.

Conducting **exploratory factor analysis** is important in order to ascertain if the data did in fact create factors to measure what it is intended to measure. Churchill (1979) stressed the necessity of constructing a sound conceptual specification while developing a new measurement scale. In this study, the EFA conducted on NEWS-Y constructs. This was because new items generated from grounded theory had been added in NEWS-Y. The exploratory factor analysis provided key information, such as the underlying factor structure of the data, necessary to test the replication of the factor structure with a confirmatory factor analysis (Worthington & Whittaker, 2006).

Since the interest of the present study is to explain the correlations in a data set as a result of a few underlying factors, the method to follow was to use Principal Axis Factoring using SPSS version 18. This preferred technique is commonly reported on social and behavioural science research and in accordance with the measurement models of the structural equation model (Blunch, 2010).

The conduct of exploratory factor analysis involves four stages: (1) a correlation matrix is generated for all possible pairings of the variables; (2) from the correlation matrix, factors are extracted with the principal axis factoring methods, (3) the factors are rotated, and (4) interpretation of the results of the factor analysis (Gray & Kinnear, 2012). Rotation is defined as a procedure in which the eigenvectors (factors) are rotated in an attempt to achieve simple structure (Bryant & Yarnold, 1995). For the purpose of this study, Promax rotation was applied to generate the factor correlation matrix of values over ± 0.32, using the criterion explained in Tabachnick and Fidell (2007). The factorability of the correlation matrix was evaluated using the Kaiser-Meyer-Olkin (KMO) procedure (Worthington & Whittaker, 2006). This procedure indicates the extent to which a correlation matrix actually contains factors or simply chance correlations between a small subset of variables. A satisfactory value for KMO is > 0.6 (Gray & Kinnear, 2012).

Varieties of approaches were used to determine factor retention. The Eigenvalues determine which factors remain in the analysis. Eigenvalues of < 1 were considered for deletion, as that value may indicate a potentially unstable factor (Gray & Kinnear, 2012). The relative values of Eigenvalues as shown in the scree plot test were also considered. Factors with Eigenvalues that occurred after the break in the plot were considered for deletion (Cattell, 1966).

In general, factors retained in the model need to have a minimum of three items as suggested by Tabachnick and Fidell (2001). Item loading and cross loading on factors were a consideration in item retention. Items loading below 0.32 and those that cross-loaded above 0.32 on more than one factor were considered for deletion (Tabachnick & Fidell, 2001). Costello and Osborne (2005) suggest that item communalities between 0.40 and 0.70 are adequate for most social science research, so items with communalities below 0.40 were closely scrutinized for possible deletion.

Once the factor structure was identified by the exploratory factor analysis, a series of **confirmatory factor analyses** (CFA) was performed to confirm the factor structure in order to support the validity of the scale (Worthington & Whittaker, 2006). The CFA was performed using the maximum likelihood estimation (MLE) in AMOS 18 on 150 samples, extracted from the main study (N=443). Confirmatory factor analysis is a tool to either "confirm" or "reject" a preconceived theory (Hair et al., 2010). The MLE is a procedure that iteratively improves parameter estimates to minimize a specified fit function and provides valid and stable results when the assumption of multivariate normality is met with the sample size between 100 and 200 (Hair et al., 2010). Another requirement of confirmatory factor analysis is that one hypothesizes beforehand the number of factors in the model and then tests this hypothesized structure statistically to determine the adequacy of its goodness of fit to the sample data (Byrne, 2010).

Eleven constructs were subjected for CFA. The construct of "Recreation facilities" was not factor analysed because of different rating formats. Thus, ten underlying constructs (access to land use, traffic safety, traffic hazard, aesthetics, fear of crime, family support, peer support, parental restriction, self-efficacy and perceived barriers),with a total of 60 items (a *priori*) were assessed. Confirmatory factor analysis was conducted in a two-step procedure. First, a one-factor congeneric measurement model was conducted on each construct. The congeneric measurement model is a measurement model that hypothesizes no covariance between or within constructs error variances, meaning they are all fixed at zero (Hair et al., 2010). The process begins by listing the constructs that comprise the measurement model. Second, the confirmatory factor models were investigated for one-factor congeneric models to assess the measurement model overall fit. It was also recommended to have a minimum of three items or more per factor (Hair et al., 2010). In this step, all of the individual constructs come together to form an overall measurement model.

One of the most fundamental assessments of construct validity involves the measurement relationships between items and constructs known as path estimates. The indicator of path estimates is based on factor loadings, which should be at least 0.5 and ideally 0.7 or higher. If loading is 0.5, the factor is explaining half of the variation in the item with the other half being error variance. Factor loadings greater than 0.60 were considered to be significant and do not load high if the coefficient is below 0.40 (Hair et al., 2010). Loadings of this size or larger confirm that the indicators are strongly related to their associated constructs and are one indication of construct validity (Hair et al., 2010).

Goodness-of-fit indices were used to determine the overall fit of each factor model. Models with good fit are deemed to adequately present the data and to enable confident generalisation to the whole population. AMOS prints 25 different goodness-of-fit measures. It was suggested that at least one measure from each classification from the fit indices should be employed (Hair et al., 2010). This study chose seven fit statistics tests from three classification indices to assess the overall fit of the models. First, the non-significant chi-square (χ^2). However, the chi square test may provide inaccurate model fit if the sample size is too large or is a violation of multivariate normality (Jöreskog & Sörbom, 1993). The normed chi square test (χ^2/df) therefore used to supplement the result of the chi-square test. The normed chi-square index should be below three (Bentler, 1990).

Two measures on the Absolute Fit classification were used. A goodness-of-fit index (GFI) greater than 0.90 represents a good model fit (Joreskog & Sorbom, 1984). The Root Mean Square Error of Approximation (RMSEA) is a popular measure of fit, partly because it does not require comparison with the null model. It assesses the lack of fit of the model to the population covariance matrix. RMSEA index values up to 0.80 indicate a reasonable fit and less than ≤ 0.10 as an acceptable model fit (Browne & Cudeck, 1993).

The comparative fit index (CFI) and normed fit index (NFI) were used in the confirmatory factor analysis, given their suitability as indicators of global model fit with a small sample size (Byrne, 2010). Index values greater than 0.90 indicated a satisfactory fit (Bentler, 1990). The Akaike Information Criterion (AIC) was used for model comparison, a model that fits with the smallest value of the AIC being the most parsimonious fitting model (Byrne, 2010).

The aim of confirmatory factor analysis is to identify models that can provide statistically acceptable fit and theoretically meaningful interpretations of the data. If the results indicate a lack of fit based on empirical or substantive evidence, the models can be respecified. The confirmatory factor analysis provides additional diagnostic information that may suggest modifications to improve the model's test of measurement theory (Hair et al., 2010). This is done by removing from the model all straight arrows connecting latent variables, adding curved arrows representing the covariance between every pair of latent variables and leaving in the straight arrows from each latent variable in its indicator variables as well as leaving the straight arrows from error and disturbance terms to their respective variables. Model respecification was based on the analysis of standardized factor loadings and the values of the Consistent Akaike's Information Criterion (CAIC) for comparing different models (Patrick & Williams, 2012). However, in developing a theory and modifying models, the contents of the theory are equally important when making decisions whether to retain or include a statement (item) (Patrick & Williams, 2012).

In the confirmatory factor analysis procedure, missing data was expected to be minimal for most variables and if occurred to be imputed with a series of means. The assumption of univariate normality was assessed through variable skewness and Kurtosis. All the skewness values should be less than 1 magnitude to assume symmetry of individual values. The Mardia statistic for multivariate normality is calculated and the CR value should be less than 5 in magnitude for multivariate normality to be assumed.

3.6.3 Major Survey

3.6.3.1 Research Design

This study applied a cross sectional design to answer the quantitative phase research questions. The researcher was interested to examine the structural and mediation effects of correlates on adolescent physical activity.

3.6.3.2 Sample size and power

Proposed guidelines regarding sample sizes vary with analysis procedures and model characteristics. As the sample size becomes large (>400), the method becomes more sensitive and almost any slight differences are detected as significant, making goodness-of-fit measures suggest poor fit. As such, the sample sizes in the range of 100 to 400 are suggested (Hair et al., 2010). This was further supported by Fritz and MacKinnon (2007) who conducted a review on 166 articles. From 166 articles, 26 studies assessed SEM overall model fit. These studies reported a median sample size of 340 (upper and lower quartiles: 189, 778). Another 22 studies assessing indirect effects reported a median sample size of 142 (upper and lower quartiles: 115, 285). With 443 cases available for analysis, the sample size assumption for overall model fit and test of mediation was met. Secondly, the number of observed scales per latent construct must be at least three. This assumption was also met given that there were at least three observed variables for each latent construct.

3.6.3.3 Participants

School going adolescents, aged between 13 to 15 years old from four out of eight eligible mixed gender secondary schools across the Kuching area were recruited. Each school randomly selected 120 Form 1 and Form 2 students[2]. School counsellors helped in recruiting participants by distributing research information to adolescents and their respective parents. Data was collected from May to July 2011 to avoid major school events (e.g sports day or major school exams).

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[2] Form 1 and 2 are equivalent to Grade 7 and 8 respectively

This study excluded participants from religious-, technical-, and vocational-based schools for the reason these schools have longer academic hours than the normal schools. Also excluded were schools with boarders because the research objective was to examine correlates of neighbourhood physical activity. Classrooms comprising students with severe cognitive (reading and writing) disabilities and students with health problems (using a walking aid device, on medication for serious illnesses such as asthma, leukaemia or heart conditions) were discouraged to participate in the study.

The Medical Ethics Committee, University Malaya Medical Centre, granted ethical approval (Ref. Number: 756.9). Permission to conduct the study was obtained from the Ministry of Education, Malaysia as well as the State Education Department of Sarawak. Written informed parental consent was obtained prior to participation.

3.6.3.4 Procedures

The survey and anthropometric assessment were carried out with the help of trained research assistants. Participants were gathered in the school hall. Pedometers were distributed to participants on the same day (on Monday). A briefing was provided on the nature of their participation in the study. Adolescents were given a demonstration on how to attach, re-attach, and record the pedometer data. Participants were asked to wear the pedometer during all waking hours except showering, swimming or taking part in a rigorous body contact activity (i.e. rugby, taekwando, karate, *Silat*, judo, etc.).

The adolescents were provided with elastic belts and given a 7-day recording diary to record the starting and ending time of wearing the pedometer, pedometer readings at

12.00 noon and at 6.00pm and the types of physical activity being performed on each day. The purpose of the diary record is to differentiate school and non-school pedometer physical activity. As such, no attempt made to seal the pedometer.

3.6.3.5 Instruments

The Individual, Social, and Environment Scale (ISES)

The validated version of the newly developed Individual, Social, and Environment Scale (ISES) that included 11-factor /42 items was administered to adolescents (N=443) (See Table 3.7). The internal consistency, Cronbach's alpha was 0.703, suggesting good internal reliability. The test-retest reliability (weighted kappa) was 0.30, a fair agreement based on the kappa interpretation provided (Landis & Koch, 1977). The questionnaire had three sections; Section 1: Socio-demographic, body weight and height; Section 2: Correlates of physical activity and Section 3: Time spent on screen entertainment (e.g. TV, video game, computer, etc.).

Table 3.7 Individual, Social and Environmental Scale Survey Instrument

Constructs and items
I. Individual Factors
Self-Efficacy
1) Physically active after school even if I could watch TV or play video games.
2) Physically active even if I have a lot of homework.
3) Physically active even if my parents want me to do something else.
4) I ask my parents to take me to a physical activity or sport practice.
5) Physically active even if it is raining or hot.
6) Physically active even if I have to stay at home.
Perceived Barriers
1) I am too tired for physical activity.
2) There is no proper place that is safe to perform physical activity near my home.
3) I don't have the energy to do physical activity.
4) Physical activity or sports are a waste of time.
5) I feel lazy to do physical activity because of weather conditions.
II. Social Factors
Family Support
1) Active with me.
2) Offered to exercise with me.
3) Gave me helpful reminders to be active.
4) Gave me encouragement to be active.
5) Change their schedule so we could exercise together.
6) Planned for physical activity or recreational outings
7) Talked about how much they like to exercise
Peer Support
1) Active with me.
2) Offered to exercise with me.
3) Gave me helpful reminders to be active.
4) Gave me encouragement to be active.
5) Change their schedule so we could exercise together.
6) Planned for physical activity or recreational outings
7) Talked about how much they like to exercise.
Parental Restriction
1) My parents restrict me from playing alone outdoors in our neighbourhood.
2) My parents prevent me from playing with friends outdoors in our neighbourhood.
3) My parents prevent me from spending time outside after dark.
4) My parents prevent me from walking/cycling in the street after dark.
5) My parents prevent me from playing alone or with friends in local streets in our neighbourhood.
6) My parents prevent me from walking/cycling with friends in our neighbourhood.

III. Neighbourhood environment factors

Recreation facilities
1) Basketball / futsal / badminton court
2) Other playing fields / courts
3) Swimming pool
4) Walking/running track
5) Public park

Access to land-use
1) Shops are within easy walking distance of my home
2) There are many places to go (alone or with someone) within easy walking distance of my home.
3) From my home, it is easy to walk to a bus stop (bus/train), alone or with someone.
4) There are major barriers to walking from one place to another place in our neighbourhood (e. stray dogs)

Traffic safety
1) There is a speed limit sign in my neighbourhood streets.
2) There is a crosswalk and traffic signal to help walkers cross busy streets in my neighbourhood.
3) The speed of traffic on nearby streets is usually slow (< 30 mph)

Traffic Hazards
1) There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in my neighbourhood.
2) Most drivers go faster than the posted speed limits in my neighbourhood
3) There are a lot of exhaust fumes when walking in my neighbourhood

Aesthetics
1) There are many interesting things to look at while walking in my neighbourhood.
2) There are many buildings/homes in my neighbourhood that are nice to look at.
3) My neighbourhood open spaces are free from garbage and construction debris.
4) My neighbourhood is free from stray dogs.

Crime safety
1) There is a high crime rate in my neighbourhood.
2) The crime rate in my neighbourhood makes it unsafe to go on walks alone or with someone at night.
3) I am worried about being outside alone around my home because I am afraid of being taken or hurt by a stranger.
4) I am worried about playing or walking alone or with friends in our local streets.

Screen- based media entertainment

Adolescent screen-based media behaviour was measured in terms of time per typical week spent on electronic entertainment (watching TV, using a computer and surfing the internet, playing electronic games, sitting and listening to music, sitting and talking on the phone), as adapted from the Youth Risk Behaviour Survey (CDC, 2011). Test-retest reliability ranged from r = 0.13 (measured 2 weeks apart) to r = 0.98 (measured one hour apart). The Canadian sedentary guideline for adolescents was used as a cut-off point, indicating recreational screen time as no more than two hours per day (Tremblay et al., 2011).

Pedometer-measured physical activity

Physical activity, as the outcome variable, was measured using the Yamax Digiwalker CW 700 (with 7-day memory) that was worn over seven days. Accuracy of pedometers was randomly verified by a walking test, which involved a researcher wearing two pedometers, each on the left and right hip for 50 steps. No pedometer recorded an error exceeding 4% (± 2 steps out of 50 steps) (Vincent, 2003). Pedometers were also checked for functionality and labelled before being individually assigned to each participant.

The first day's data and the final day's data were ignored because these were shorter recording days. Daily records were excluded from the calculation of mean daily data if the pedometer recorded less than 1,000 steps/day (Wilson, 2008) (n = 118 daily records), or more than 60,000 steps/day (Cleland, Schmidt, Salmon, Dwyer, & Venn, 2011) (no record) as these values may be erroneous. Average daily steps were calculated for participants with at least four daily readings (two weekdays and two weekend days), consistent with other studies (Cleland et al., 2011) (n=37 participants did not meet this criterion). The conservative U.S guidelines (15,000 steps/day for boys and 12,000 steps/day for girls) were used as cut-off points (Tudor-Locke et al., 2004).

Anthropometric

Height and weight were measured using a Stadiometer and digital weighing scales (SECA Instruments, Germany, Ltd). The body mass index (BMI, kg/m^2) was calculated, which was then plotted onto a BMI-for-age percentiles chart for different gender. Based on the WHO's 2007 reference, underweight is indicated when the BMI is below the 50th percentile; a healthy weight is between 50th to <85th percentile; overweight is between 85th to 95th percentile; and, obese is above the 95th percentile.

3.6.3.6 Data Analysis

Descriptive statistics

The data collected were entered into statistical package, PASW Statistics 18. The significance level was set at 0.05. Descriptive statistics reported the mean and standard deviation (SD) unless otherwise stated. T-test, one-way ANOVA and Kruskal-Wallis H statistics tests (due to violation of normality assumption and unequal variances) were used to detect differences between anthropometric data and pedometer-assessed physical activity across socio-demographic data. For analysis involving ANOVA, Bonferonni adjustment was used for the significance level set at 0.05. For analysis involving the Kruskal-Wallis test, significant results would be subjected to further investigation using Mann-Whitney U test for pairwise comparisons (Field, 2009).

Structural equation modelling

The goal of structural equation modelling in the current study is to examine multiple and interrelated dependence relationships and to take into account the measurement error of the independent variables (Chan, 2005). The initial step of the structural equation model is to specify a full model or a *priori* and to test the model based on the sample and variables included in the measurement. The model should be theoretically based and is supported by findings in the literature or knowledge in the field (Schreiber, Nora, Stage, Barlow, & King, 2006). In this study, *a priori* is developed from grounded theory procedures and specified in a graphical form. Models are easily conceptualized and communicated in this form (See Figure 3.8).

In the event that the original model is not appropriate, the model needs to be modified. Two basic approaches for model modification in structural equation modelling involve reducing or increasing constraints on the model being tested (Chou & Bentler, 1990). A structural equation model using AMOS 18 was used to test the fit of hypothesized physical activity models as proposed by grounded theory. The next step in structural equation modelling is to test the measurement model using confirmatory factor analysis. The results of the confirmatory factor analysis must be associated with the construct validity. After the constructs have met the required measurement standards, the relationships between the constructs can be estimated (Hair et al., 2010).

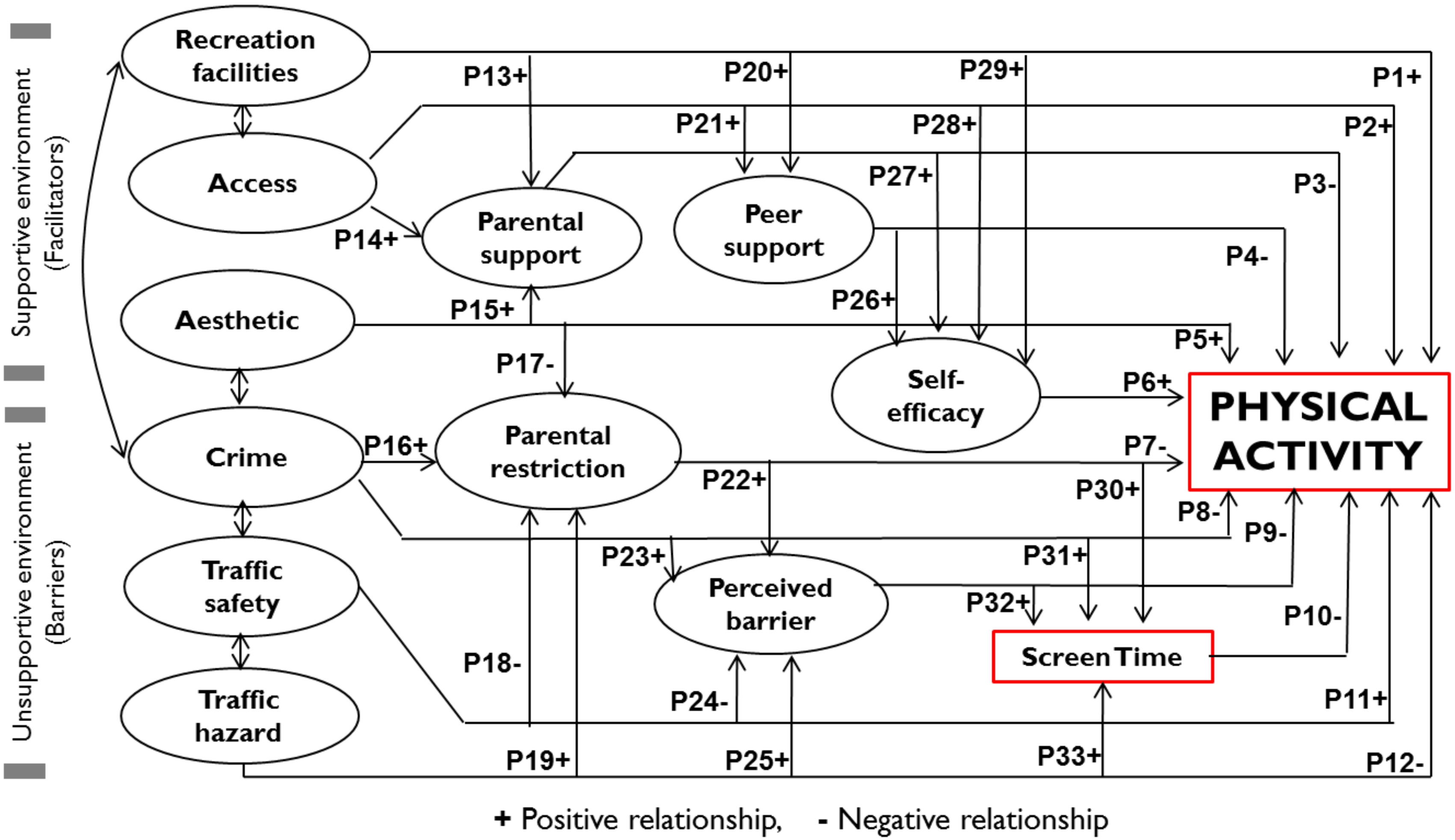


Figure 3.8 Abridged Theoretical Model for Quantitative Investigation

The abridged theoretical model shown in Figure 3.8 served as a *priori*. This model hypothesized supportive environment (e.g. provision of recreation facilities, aesthetic, parental support, and peer support) may increase adolescents' self-efficacy to be physically active at outdoors. On the other hand, unsupportive environment (e.g. crime, traffic safety, and poor aesthetic) may cause parental restriction, screen time, and perceived barriers to outdoor physical activities. Although the model derived from qualitative data, the model is based on the foundation of social cognitive theory, health belief model, and ecological model. Personal and environmental factors influencing adolescent physical activity include individual variables (e.g. self-efficacy, perceived barriers), social and physical environmental variables (parental support, neighbourhood safety, recreation facilities), and behavioural variable (e.g. physical activity) (Duncan, Duncan, Strycker, & Chaumeton, 2004). These factors are hypothesized to have direct and indirect effects on adolescents' engagement in physical activity.

Table 3.8 shows the relational propositions among factors and how these factors lead to adolescent participation in physical activity behaviour. The specification of the abridged theoretical model started with the direct relationships, followed by the indirect relationships to physical activity. Altogether, 33 relational propositions pertaining to 12 theoretical constructs were formulated to characterize the associations and linkages among the constructs. The 12 theoretical constructs were; recreation facilities, accessibility, aesthetics, fear of crime, traffic safety, traffic hazard, parent support, parent restriction, peer support, perceived barriers, self-efficacy and screen time.

Table 3.8 Relational propositions in the abridged theoretical model

Proposition	Model Path	Relationship
P1	Recreation facility → Physical Activity	+
P2	Accessibility →Physical Activity	+
P3	Parental support → Physical Activity	+
P4	Peer support → Physical Activity	+
P5	Aesthetics → Physical Activity	+
P6	Self-efficacy → Physical Activity	+
P7	Parental restriction → Physical Activity	-
P8	Crime → Physical Activity	-
P9	Perceived barriers → Physical Activity	-
P10	Screen time → Physical Activity	-
P11	Traffic safety → Physical Activity	+
P12	Traffic hazard → Physical Activity	-
P13	Recreation facility → Parental support	+
P14	Accessibility → Parental support	+
P15	Aesthetics → Parental support	+
P16	Crime → Parental restriction	+
P17	Aesthetics → Parental restriction	-
P18	Traffic safety → Parental restriction	-
P19	Traffic hazard → Parental restriction	+
P20	Recreation facility → Peer support	+
P21	Accessibility → Peer support	+
P22	Parental restriction → Perceived barriers	+
P23	Crime → Perceived barriers	+
P24	Traffic safety → Perceived barriers	-
P25	Traffic hazard → Perceived barriers	+
P26	Peer Support → Self-efficacy	+
P27	Parental support → Self-efficacy	+
P28	Accessibility → Self-efficacy	+
P29	Recreation facility → Self-efficacy	+
P30	Parental restriction → Screen time	+
P31	Crime → Screen time	+
P32	Perceived barriers → Screen time	+
P33	Traffic hazard → Screen time	+

In preparation for structural equation modelling, various assumptions need to be satisfied. These relate to missing data, outliers, non-normality, sample size, and uncorrelated error terms.

i. Missing data analysis

The missing value analysis procedure in PASW Statistics 18 was used to identify the percentage of missing data for demographic information and all items on each scale in the model. In this study, the missing values for social-demographic and predictor items were less than two percent, except for parent's income (four percent). The non-response was replaced with mean series offered in PASW Statistics 18. Following the criteria of previous pedometer procedures (Cleland et al., 2011; Wilson, 2008), 130 out of 443 adolescents were eliminated from the data set. These participants recorded fewer than 1,000 steps and had less than four days of pedometer data (minimum two weekends and two weekdays). Independent sample t-tests showed that the non-responders (n=130) did not differ greatly from the responders in age, height, weight, and BMI as shown in Table 3.9.

Table 3.9 No group differences in age, height, weight and BMI

	Non responders, n=130	Responders, n=313	*p* value (95% CI of mean difference)
Age (year)	13.48 (± 0.517)	13.52 (± 0.519)	0.477 (-0.145 - 0.068)
Height (cm)	154.58 (± 8.61)	155.33 (± 9.18)	0.429 (-2.596 - 1.104)
Weight (Kg)	48.93 (± 12.95)	49.96 (± 12.70)	0.440 (-3.650 - 1.591)
BMI (kg/m^2)	20.32 (± 4.10)	20.50 (± 4.27)	0.679 (-1 048 - 0.684)

ii. Outliers

Outlier analyses were undertaken prior to all major analyses. If outliers are found, they are checked for coding errors and the analysis conducted both with and without outliers.

iii. Non-normality

Multivariate normality was evaluated using Mardia's tests for multivariate normality. In addition, univariate indices of skewness and kurtosis were examined to determine if the absolute value of any of these indices was greater than 2.0. If non-normality appears to be problematic, then bootstrapping was pursued as a remedy. *P*-values and the confidence interval were estimated using bias-corrected methods. The number of bootstraps usually replicates 500 or 1000 (Cheung & Lau, 2008).

iv. Bootstrapping

Bootstrapping is a statistical technique of resampling. In this study, bootstrapping procedure was performed as an aid to non-normal data. Hayes and Preacher (2010) stated bootstrapping is an attractive alternative for inference when the assumptions of commonly-used statistical methods are not met, the shape of the sampling distribution of the statistic is unknown, or standard error of a statistical index is difficult or impossible to derive analytically. The resampling method has more accurate Type I error rates and power than a single sample method that assumes a normal distribution (Hu, 2010). In this study, pedometer-assessed physical activity data were positively skewed, thus bootstrapping that replicated 1,000 samples was applied to obtain normal distributions. All other assumptions for testing statistical multivariate within a cross-sectional design were met, with variance inflation factors less than 2.0 and tolerance more than 0.50, indicating no issues with multicolinearity.

Analysis of Mediation Effects

A mediation model provides the researcher with a story about the sequence of effects that leads to something or to explain why a relationship between two constructs exists (Hair et al., 2010). Mediation is defined as the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest (MacKinnon, 2008). Mediating variables are often called intervening or intermediate variables to clearly indicate their role as coming between an independent and a dependent variable (Baron & Kenny, 1986). The basic mediation model is a causal sequence in which the independent variable (X) causes the mediator (M) which in turn causes the dependent variable (Y), therefore explaining how X had its' effect on Y. In a mediation relationship, there is a *direct effect* between an independent variable and a dependent variable. There are also *indirect effects* between an independent variable and a mediator variable, and between a mediator variable and a dependent variable (See Figure 3.9).

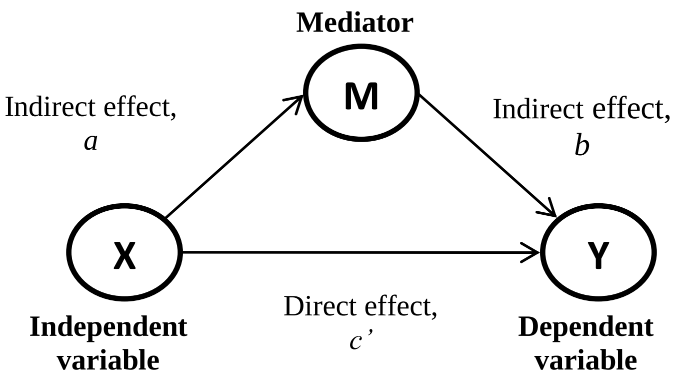


Figure 3.9 The indirect effect (X → M → Y) represents the mediating effect of the construct M on the relationship between X and Y

Various methods for testing mediation hypotheses were available, but the most commonly used is the causal steps strategy using OLS regression or structural equation modelling (Preacher & Hayes, 2008). Full mediation would occur if inclusion of the mediation variable (M) drops the relationship between the independent variable (X) and dependent variable (Y) to zero. For example, this study hypothesized parental restriction for adolescents to be active outdoors (M) will drop the relationship between adolescent's fear of crime (X) and participation in outdoor physical activity (Y) to zero. In this situation parental restriction is a full mediator of adolescent physical activity. However, according to MacKinnon (2008) this rarely occurs. The most likely event is that *c'* becomes a weaker, yet still significant path with the inclusion of the mediation effect. This situation is referred to as partial mediation. There is not only a significant relationship between the mediator and the dependent variable, but also some direct relationship between the independent and dependent variable. If direct and indirect effect is < 0.05 and total effect is < 0.05, then partial mediation is significant.

This method is found to be fundamental in many substantive areas, especially psychology and the social and medical sciences (MacKinnon, 2008). This study proposed six potential mediators in eight sets of relationships to be investigated (See Figure 3.10 – Figure 3.17. In Figure 3.10, the availability of recreation facilities (independent variable) is hypothesized to increase parental support, peer support and self-efficacy (mediators), which in turn increase adolescent physical activity levels (dependent variable).

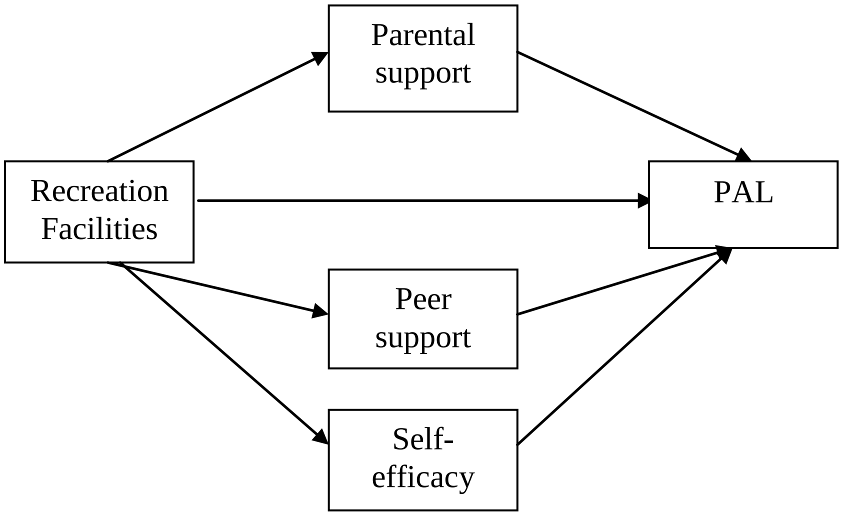


Figure 3.10 The relationship between recreation facilities and physical activity level (PAL) mediated by parental support, peer support and self-efficacy

In Figure 3.11, neighbourhood aesthetic (independent variable) is hypothesized to increase parental support (mediators), which in turn increases adolescent physical activity levels (dependent variable). In contrary, poor aesthetic is hypothesized to aggravate parental restriction (mediator) and reduces adolescent physical activity levels.

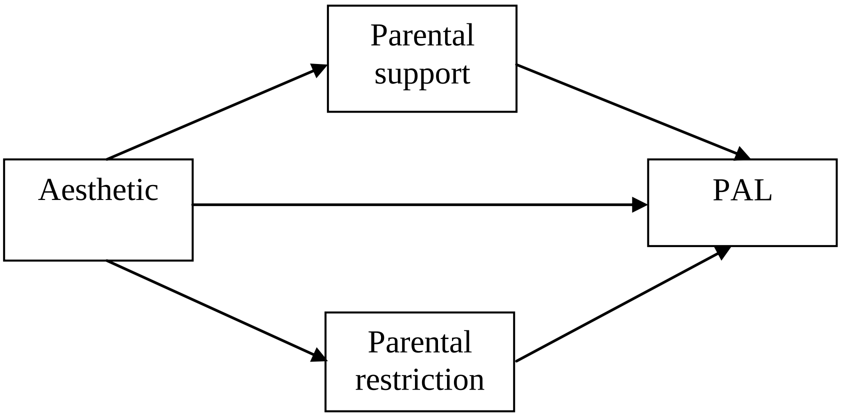


Figure 3.11 The relationship between aesthetics and physical activity level (PAL) mediated by parental support and parental restriction

Figure 3.12 hypothesizes the direct and indirect effects of fear of crime (independent variable) on parental restriction; adolescent's perceived barriers, and screen-time and physical activity.

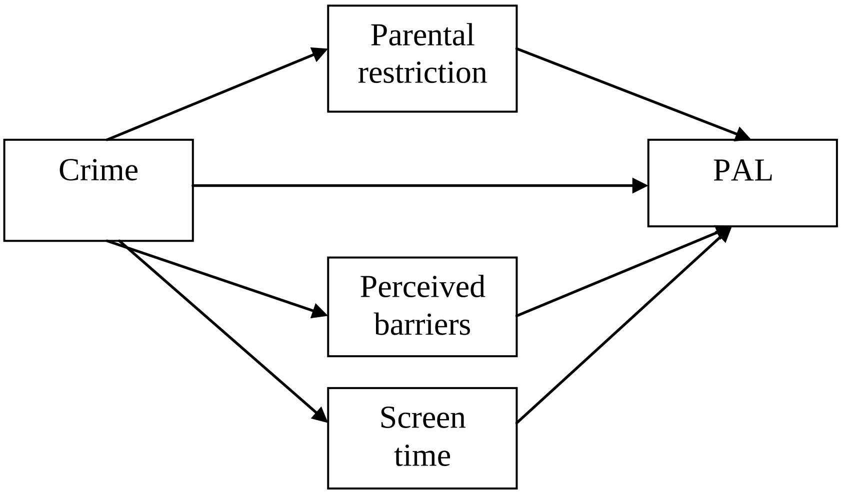


Figure 3.12 The relationship between crime and physical activity level (PAL) mediated by parental restriction, perceived barriers and screen time

Figure 3.13 posited the effect of traffic safety (independent variable) on adolescents' self-efficacy, parental restriction, perceived barriers and screen-time (mediators), which in turn affect adolescent physical activity levels (dependent variable).

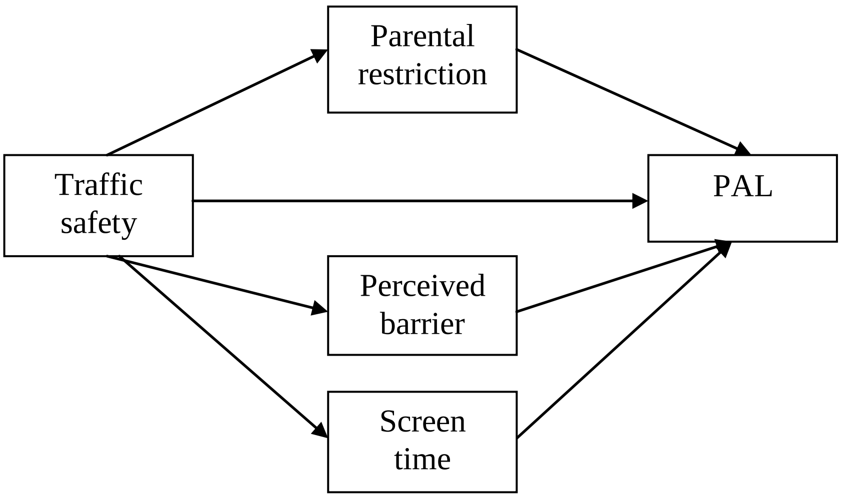


Figure 3.13 The relationship between traffic safety and physical activity level (PAL) mediated by parental restriction, perceived barriers and screen time

In Figure 3.14, parental support is hypothesized to affect adolescents' self-efficacy (mediator), which in turn, increases adolescent physical activity levels.

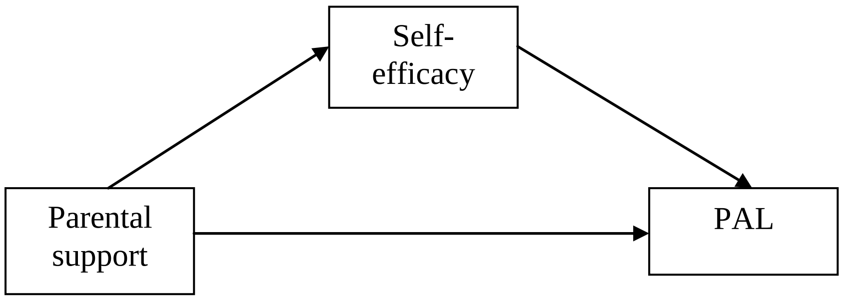


Figure 3.14 The relationship between parental support and physical activity level (PAL) mediated by self-efficacy

In Figure 3.15, parental restriction is hypothesized as an independent variable to influence perceived barriers and screen time (mediators), which in turn affect adolescent physical activity level (dependent variable).

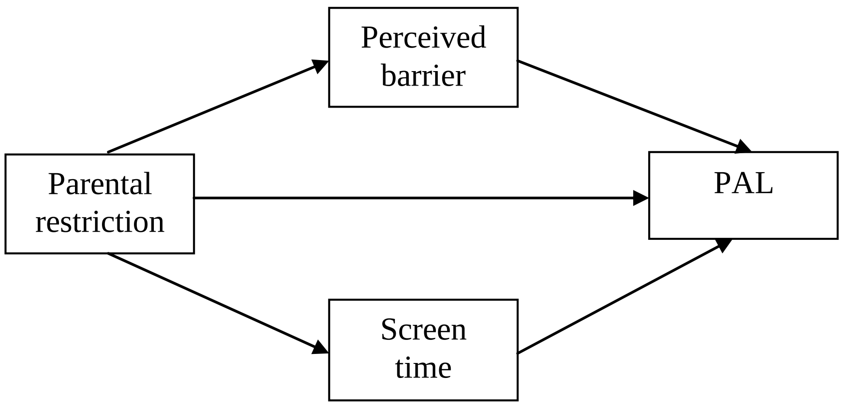


Figure 3.15 The relationship between parent restriction and physical activity level (PAL) mediated by perceived barrier and screen time

In Figure 3.16, peer support (independent variable) may be the main source of adolescent self-efficacy (mediator) to be physically active.

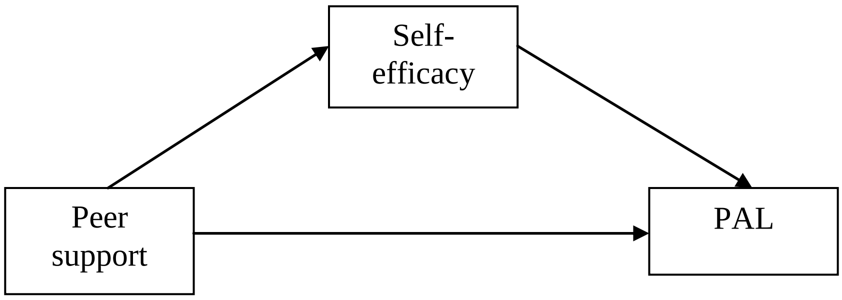


Figure 3.16 The relationship between peer support and physical activity level (PAL) mediated by self-efficacy

Lastly, in Figure 3.17, perceived barriers may influence adolescents' self-efficacy and screen time (mediators), which in turn affects physical activity levels.

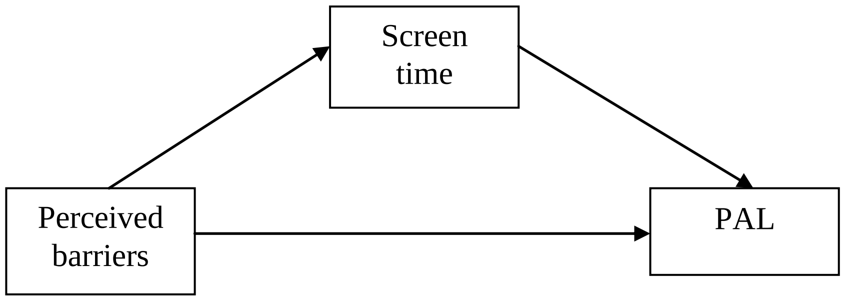


Figure 3.17 The relationship between perceived barriers and physical activity level (PAL) mediated by screen time

The model fits

A model is considered a good fit if the value of the chi-square test is not significant, and at least one incremental fit index (e.g. CFI, GFI, AGFI, TLI, etc.) has an index > 0.9 and one badness of fit index (e.g. RMSEA, SRMR, RMR, etc.) has an index <0.08. The squared multiple correlation (R^2) associated with the latent variable of physical activity was used to evaluate the effectiveness of the model in explaining the variance observed in the participants' physical activity behaviour.

The statistical goal of structural equation modelling is to test a set of relationships representing multiple equations. Therefore, measures of fit or predictive accuracy for other techniques (i.e R^2 for multiple regressions) are not well suited for structural equation modelling. The researcher must "accept or reject" the entire model, determining if the overall fit is acceptable (Hair et al., 2010). In cases where correlations are low, path coefficients may be so low as not to be significant, even when fit indices show "good fit". Likewise, one can have good fit in a misspecified model. One indicator of this occurring is if there are high modification *indices* in spite of good fit (Hair et al., 2010).

3.6.4 Conclusion

This chapter discussed the qualitative and quantitative methodology applied in this research. The phase I qualitative study applied the grounded theory methodology of data collection and data analysis. In phase II of the quantitative study, test-retest reliability and factor analysis were applied to validate the survey questionnaire. Finally, in the main quantitative survey, the questionnaire was administered to 443 adolescents. The main survey data was analysed and subjected to structural equation model analysis.

CHAPTER 4: RESULTS

This chapter details the findings derived from Phase I - Qualitative Study and Phase II - Quantitative Study were presented. The chapter begins with the qualitative study. The main result is the abridged theoretical model that served as a priori for the Quantitative study. Next, the results of a pilot study are elaborated. The final section reports the results of the major survey. Results are presented in the form of text, figures and tables, with data analysis. Following that, the findings were synthesized as mixed methods results.

4.1 PHASE I – QUALITATIVE STUDY

The main research question in Phase 1 was "What influences adolescents to become physically active in the neighbourhood?" followed by specific research questions as below:

1. What are the meanings and types of physical activity engaged in by adolescents in their neighbourhood?
2. Where are adolescents physically active in their neighbourhood?
3. What factors/events/people influence adolescents to become physically active in their neighbourhood?

A total of 151 out of 160 photographs were discussed by adolescents (n=22) and parents (n=8). Nine photographs were excluded because of duplication or being taken in a video format. Four adolescents and two parents from rural neighbourhoods were unable to provide photographs. Some participants also took fewer photographs because of the rainy season in January. However, these participants were still included in the study. Information about the participants' characteristics is presented in Table 4.1. The mean household income belongs to the lower middle income and poor groups.

Table 4.1 Participants' Characteristics

	Adolescents (n=22)	Parents/ Guardians (n=8)
Mean age (years)	14.27 ± 0.7	48 ± 6.8
Gender		
Male	12	1
Female	10	7
Ethnic groups		
Indigenous groups	10	6
Malay	10	1
Chinese	1	1
Indian	1	0
Mean income (monthly)		
Rural	MYR 833 (± 472) (USD 457)	
Urban	MYR 2671 (± 1456) (USD 839)	

4.1.1 What are the meanings and types of physical activity engaged in by adolescents in their neighbourhood?

The adolescents perceived "physical activity" mainly as sports activities or outdoor games that are beneficial for a healthy body and mind, to keep fit, to improve body image, to reduce stress and to occupy one's leisure time. The types of physical activity and sedentary leisure activities engaged in by both genders are shown in Table 4.2.

Table 4.2 Types of physical and sedentary activities engaged in by adolescents

Gender	Physical activities	Sedentary activities
Boys	Football	*Facebook*
	Gardening	Video games
	Cycling Skateboarding	Computer games
	Skimboarding	Handheld games
		Internet surfing
		Online games
		Lepak [3]
		Watching TV
		Riding motorcycles
		(Leisure and transportation)
Girls	Gym	*Facebook*
	Badminton	Text messaging (SMS)
	House work	Listening to the MP3/radio
		Computer games
		Handheld games
		Video games
		Internet surfing
		Online games
		Playing musical instruments
		Watching TV
		Lepak
		Riding motorcycles
		Reading magazines/comics
		Sewing
		Selling vegetables in the market
		Sleeping

In general, adolescents listed involvement in fewer types of physical activity compared to their long list of sedentary activities, which are mainly on screen-based media entertainment (e.g. Television, Facebook, computer games, etc.).

[3] Lepak is a Malay word for "hanging out"

"This is my computer. I love logging on to Facebook. I can see my friends and chat with them. I would spend two hours a day [on Facebook]. After that I play online games, "Counterstrike". My parents used to yell at me" [Focus Group #3, Boy, Urban]

"*Lepak"* was a popular leisure activity among adolescents. Among boys, "*lepak*" meant taking a breath of fresh air, chatting and looking at girls. For girls, "*lepak"* meant chatting and gossiping.

"Evening..We like to "lepak" here. Just a few steps from my house. We like to sit here..listen to songs [from our cell phones]...Trying a new hairstyle"[Focus group, #4 - Girls]

Another popular activity among adolescents across genders was motorcycling. Motorcycles are the main mode of transport among adolescents to get them to grocery stores, places of worship, meetings with friends and also to attend co-curricular activities in school. Motorcycling was reported to be a fun leisure activity and a quicker mode of transport to reach one's destination. It also afforded adolescents protection from stray dogs and snatch thieves. Furthermore, the boys felt motorcycling was "cool" as it attracted the opposite sex.

"After school training. My friends and I go for motorbike riding. Just to move around in the neighbourhood. To relax. To get fresh air. To relax our eyes.. What is that? To see girls around...[Focus Group #3, Boys]

Although some parents conveniently rely on their adolescents to ferry them to the market or to purchase items from grocery stores, some parents were annoyed by their adolescent's dependency on a motorcycle.

"His legs are going to break if he walks on foot. Nowadays, they want an easy life. They don't walk anymore even to the nearest place. If he can, he might ride the motorbike to the toilet" [Mother #3, 40 years old]

Football was the boys' most preferred type of sports activity whilst the girls preferred badminton. Both are commonly played on neighbourhood streets.

"This is my ball and its pump. It encourages us to play with it whenever we see it. If we do not have a ball we cannot play. It feels like something missing. Football is fun. Whenever we see people playing football, we feel like going out and playing too". [Focus Group #3 – Boys]

4.1.2 Where are adolescents physically active in their neighbourhood?

Neighbourhood streets were commonly used as a "playground" for activity such as badminton and football as described by the following *photovoice.*

That is Arthur and Boy.. They play skateboard.. bicycle in the evening. A lot of cars coming back from work. I always remind them.. If you play bicycle.. You better watch out.. don't play in the middle.. [Mother # 3, 45 years old, Urban].

"My children.. They like to play badminton. Here we don't have badminton court. They just play on the on the road [Mother #6, 46 years old]

“They play football on the road. Our village road not so busy. We have a football field, but far from here. At Sinjok. Quite far. About 10 to 15 minutes’ walk from here. Kids from other village also going there.” [Mother # 3, 39 years old]

“We are training here for school sports. This is at the back of my housing” [Focus group #3 – Boys].

People playing football. We love football. People play every day at this "padang"[4]*, except, if it is raining". [Focus group #3 –Boys]*

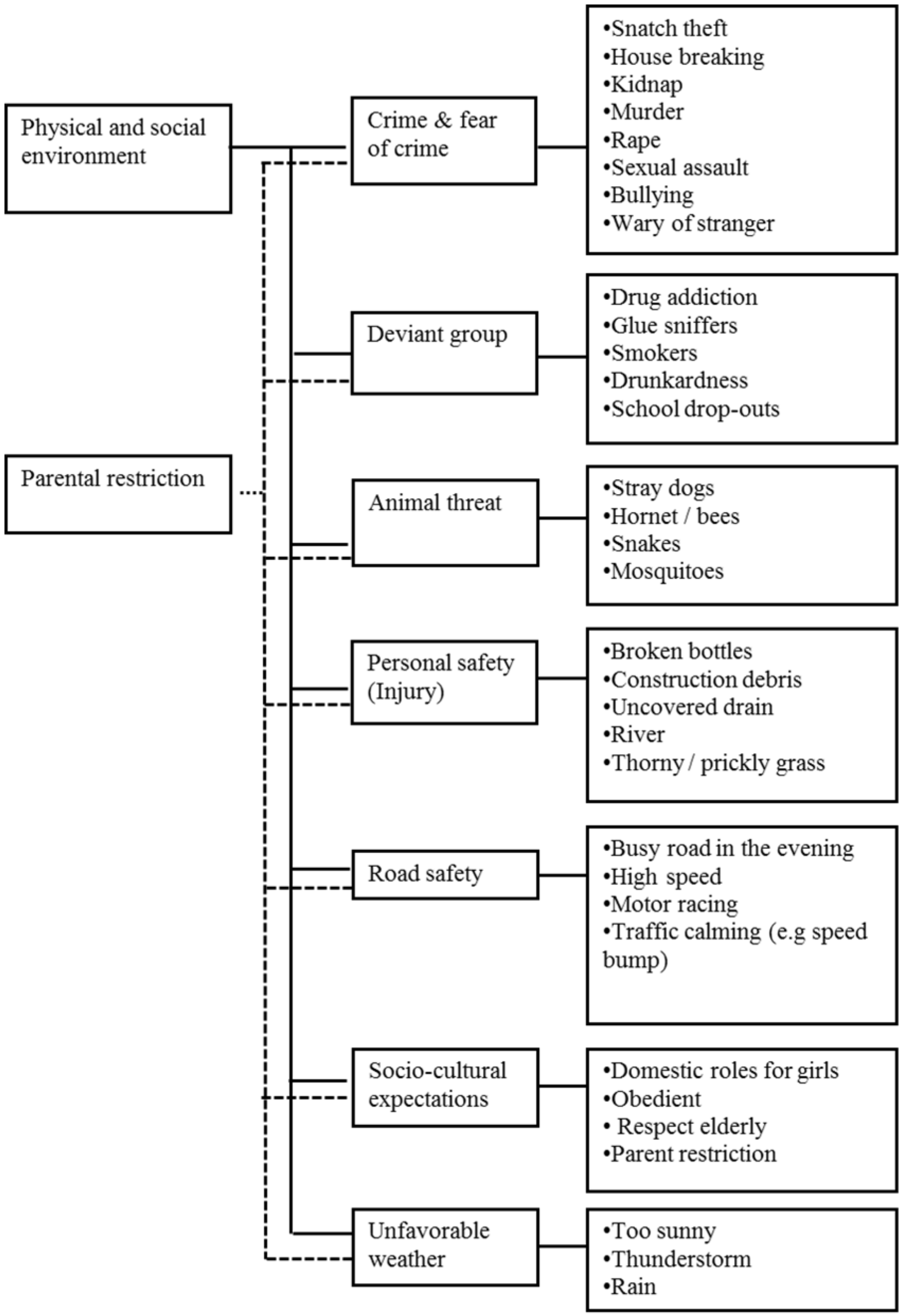
"Skimboarding at Santubong beach" [Focus Group #3 – Boys]

[4] *Padang* is a Malay word for playing field

4.1.3 What factors/events/people influence adolescents to become physically active in the neighbourhood?

The stories from 151 photographs produced seven major themes that influence adolescent participation in physical activity. These themes were; (1) physical and social environment (crime, road safety, availability of physical activity resources, accessibility to physical activity resources, aesthetics, unfavourable weather, etc.); (2) parent restriction; (3) parent support; (4) peer influence, (5) hobbies during leisure time; (6) transportation mode; and (7) ethnic segregation of play space in the neighbourhood.

The themes were centred upon the concepts of “safety”, “facilities”, “parental restriction”, “friends”, “cultural norms”, “media”, “community cohesiveness”, and “weather”. The central theme was focused on “feeling unsafe” when being outdoors. A Figure 4.1 illustrates and maps the themes, codes and meaning units around correlates of adolescent physical activity.


Physical and social environment
Parental restriction
Crime & fear of crime
•Snatch theft
•House breaking
•Kidnap
•Murder
•Rape
•Sexual assault
•Bullying
•Wary of stranger
Deviant group
•Drug addiction
•Glue sniffers
•Smokers
•Drunkardness
•School drop-outs
Animal threat
•Stray dogs
•Hornet / bees
•Snakes
•Mosquitoes
Personal safety (Injury)
•Broken bottles
•Construction debris
•Uncovered drain
•River
•Thorny / prickly grass
Road safety
•Busy road in the evening
•High speed
•Motor racing
•Traffic calming (e.g speed bump)
Socio-cultural expectations
•Domestic roles for girls
•Obedient
• Respect elderly
•Parent restriction
Unfavorable weather
•Too sunny
•Thunderstorm
•Rain

(Continued)

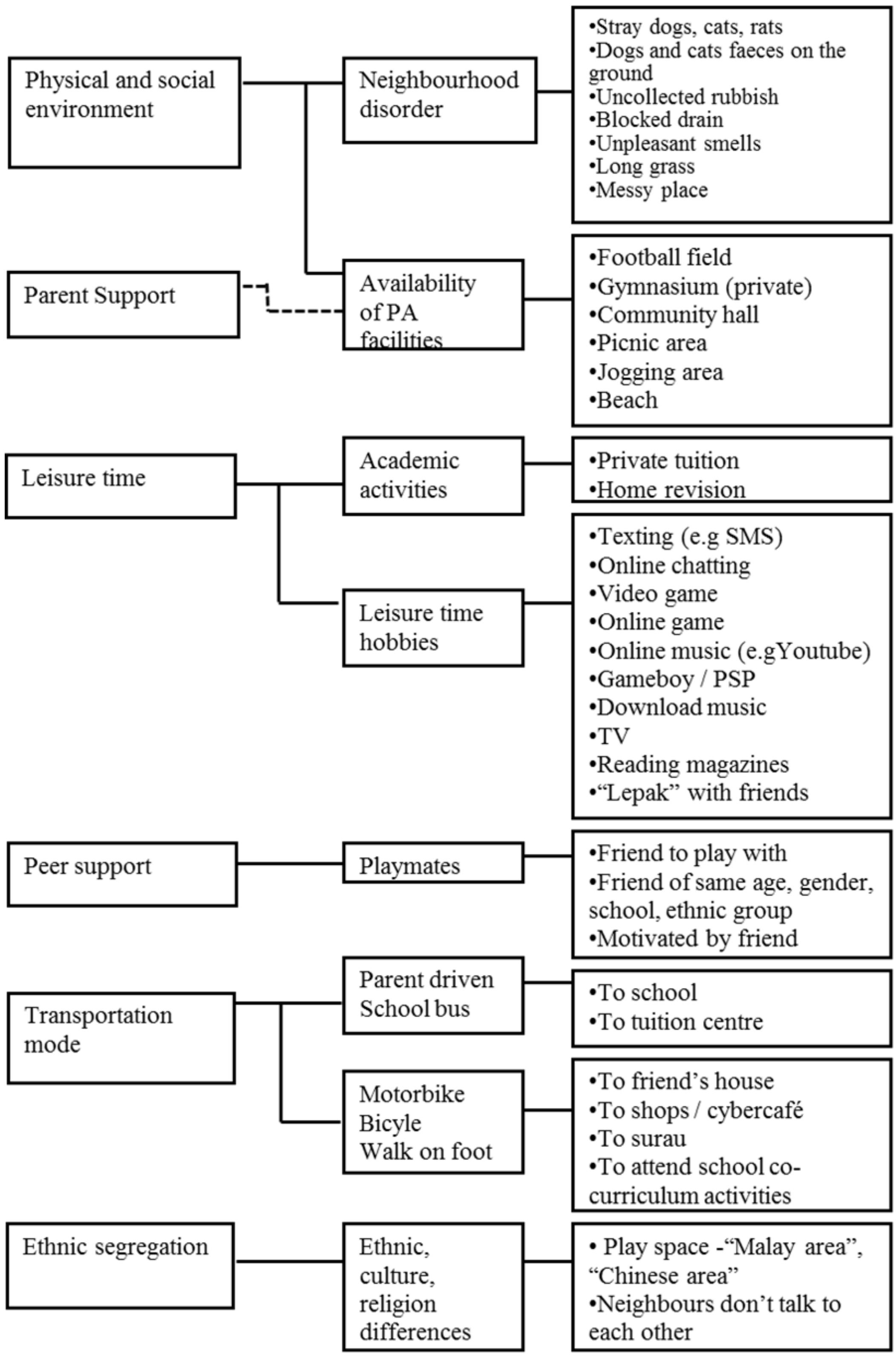


Figure 4.1 Flowchart representing the themes, codes and meaning units around correlates of adolescent physical activity

Based on the Analysis Grid for Environments Linked to Obesity framework (ANGELO) (Swinburn, Egger, & Raza, 1999), the themes have been categorised into: (1) physical environment (e.g. road safety, animal threats, injury, neighbourhood disorder, availability of physical activity facilities, mode of transportation, and weather); and (2) socio-cultural environment (e.g. fear of crime, deviant group, socio-cultural expectations, playmates, ethnic segregation of play space, and leisure time activities) (Table 4.3).

Table 4.3 Qualitative themes from the photovoice data

Themes	Quotations
I. SOCIO-CULTURAL ENVIRONMENT	
Crime	 This is near our house. My son was passing through this area alone. Suddenly, a motorcyclist stopped him and put a knife to his neck. Then, he grabbed my son's mobile phone. *[Mother #4, 48 years old]*
Wary of stranger	 This play space is near my house but we are scared to go here. We are afraid bad things may happen to us. We could be raped, kidnapped, murdered, snatched or bullied. [Name], you remember the guy on a motorbike? He stopped at the end of this play space and flashed his private part at us... An old man... We were so scared! My mother doesn't like me to go out. She gets worried. This housing area is not safe *[Focus Group 4, Girls]*

Drug pusher/
Drug addiction

… Pills that make them high – ecstasy or, as some people call it – ice. We are worried about this. They have it in schools too. Outsiders sell it to them. So after school they meet at certain places. We don’t know.*[Mother #8, 45 years old]*

Bullying

Sometimes I don’t ask him to go out because the big kids like to bully him. One time, someone called out to him, “Hey you! Come out and fight!” It was raining. I went out. The boy saw me and ran away. *[Mother #7, 53 years old]*

Screen-time

This is my computer. I love logging on to Facebook. I can see my friends and chat with them. I would spend two hours a day [on Facebook]. After that I play online games, “Counterstrike”. My parents used to yell at me. *[Focus Group #3, Boys]*

Parental restriction

This drain is dangerous for them.. The edging is breaking too. During the raining season, the water can be as deep as two metres. If they go out, I get worried. Worry they may fall into the drain. *[Mother #7]*

We are not allowed to swim or go fishing here. If you go swimming, the ghost will pull your legs.*[Focus Group #1, Girl]*

Playmates

These are my friends, teaching me how to ride a bicycle. But most of the time we just *lepak* (hang out) and gossip. When we talk, our hands are still busy “SMSing” (texting) other friends. *[Focus Group #4, Girls]*

He doesn’t go out anymore because he doesn’t have friends his age. He feels shy *[Grandmother #1, 61 years old]*
*No photo provided

Community cohesiveness	RELA only patrols the area at night. In this housing area, most parents are working. We don't see each other. We don't talk to our neighbours. *[Mother #8, 45 years old]* If we have a wedding or someone passes away, the girls help by washing plates, cutting onions… *[Grandmother #1, 61 years old]*
Ethnic segregation of play space	Many races live here. Iban, Bidayuh, Chinese, Orang Ulu. We can mix. But the Malays find it difficult to mix with the non-Malays. So they play on the other side. Because you know kids, when they eat, they don't know what is *halal* or *non-halal* *[Mother #5, 47 years old]*
Socio-cultural expectations	I have to do house chores. Cooking and cleaning. I am the only girl in the family. My parents are working and all my siblings are boys. *[Focus Group #4, Girls]*
Socio-cultural expectations	The girl must learn to do house chores. They are growing to be adults. *[Grandmother #1, 61 years old]*
Socio-cultural expectations	We should not mix freely with the boys. We are worried bad things may happen. Girls need to take care of themselves. *[Focus Group #4, Girls]*
Socio-cultural expectations	Jogging?! The people here are not used to jogging. The Chinese, they like to jog. In this village, if you jog, people will say you are crazy! *[Father #2, 51 years old]*

II. PHYSICAL ENVIRONMENT

Lack of physical activity facilities

We only have one football field on that side but we don’t have any proper place for those who want to exercise...cycling, playing badminton. The kids always use the road.
[Mother #6, 46 years old]

My kids.. They play football on the road. Here, our road is not so busy, but it is still dangerous. We have a football field at Sinjok but it is quite far from here.
[Mother #3, 39 years old]

Neighbourhood disorder

Trash on the ground... difficult to walk around. Awfully smelly and is an eyesore. The rubbish collector doesn't collect rubbish on the ground. *[Focus Group #4, Girl]*

It's difficult to ride my bicycle. My parents planted fruit trees around the house.
[Focus Group #1, Girl]

Road safety

A car almost knocked my nephew from the next house. He wanted to turn but didn't see the car coming towards him so fast. The road in front of our house has no speed hump. *[Mother #6, 46 years old]*

The road is narrow and a lot of big vehicles use the road back and forth. Dangerous for the kids. My dog died after being knocked down by a lorry. *[Focus Group #2, Boys]*

Personal safety (Injury)

We have open spaces to play football. But they are dangerous; there are a lot of broken bottles here. People drink “langkau” (local liquor) and then break the bottles. Maybe they were drunk.
[Focus Group #3, Boys]

Dangerous to swim. People throw rubbish and sharp objects in the river. *[Focus Group #2, Boys]*

Animals threats

This stray dog has bitten my leg. It made me want to poison a bun and feed it to the dog. I used to walk on foot to the market. I didn't realize the dog coming from the back and it bit me. My jeans were torn and my leg was bleeding. Nowadays I don't walk anymore. I use a car to go to the supermarket.
[Mother #5, 47 years old]

There is a snake in the puddles of water. Sometimes I follow my grandfather to the farm but my grandmother is always discouraging me from going because she is worried I may be bitten by the poisonous snake. *[Focus Group #2, Boys]*

Weather

"This is during a hot day. There is strong sunlight. Parents don't like us to go out if it is too hot. We may get sick".
(All participants)

Interrelationships between factors influencing adolescent PA

A supportive environment (e.g. provision of recreational facilities and accessibility) encourages parents and peer support, thereby enhancing adolescents' self-efficacy to be physically active. Conversely, unsupportive environment (e.g. neighbourhood crime, road safety, and poor aesthetics) aggravate the sense of one "feeling unsafe" which triggers parental restrictions and perceived barriers, thereby induces more screen-based media usage among adolescents. These psychosocial and environmental factors are believed to be interrelated and have direct and indirect effects on physical activity behaviour. The linkages between these factors are depicted in the form of a conceptual framework as an aid to the quantitative phase (See Figure 4.2).

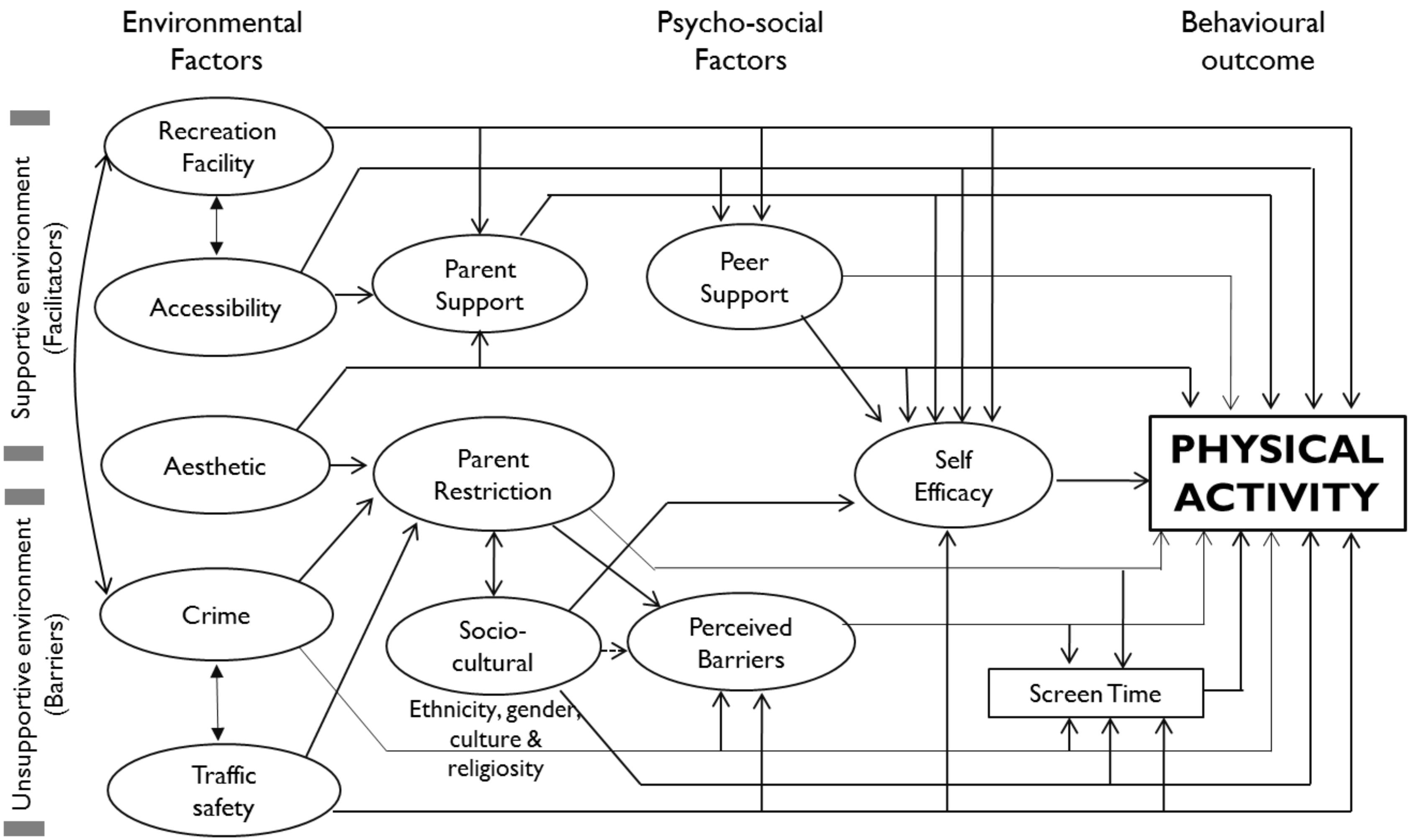


Figure 4.2 The pathways between the psychosocial and environmental variables, screen-time, and physical activity

Conclusion

This qualitative study is explorative in outlining the types of physical activity and factors influencing adolescent physical activity behaviour. The factors were centred on "safety" and the sources of insecurity include neighbourhood crime, unsafe facilities, getting into road accidents, drug addicts, being bitten by animals, being bullied and/or teased and inter-gender friendships. When individuals perceive their social and physical environment as unsafe, they are unlikely be physically active in their neighbourhood and consequently venture further into screen-based media entertainment. These qualitative findings would be confirmed by quantitative correlational analysis in Phase II – the Quantitative study.

4.2 PHASE II – QUANTITATIVE STUDY

4.2.1 Pilot Study

The pilot test included a sample of 116 adolescents. The demographic profiles of adolescents were measured in terms of age, gender, ethnicity, and parents' socioeconomic status (See Table 4.4).

Table 4.4 The characteristics of adolescent participants for the pilot study N=116

	Boy (n=54)	Girl (n=62)
Age	13.5 (± 0.52)	13.3 (± 0.51)
Weight (kg)	50.40 (±16.67)	49.54 (± 11.60)
Height (cm)	152.39 (±7.88)	151.8 (± 5.66)
BMI	21.36 (±5.61)	21.33 (± 4.48)
Overweight	38.9 %	35.2%
Meets PAL	27.8% (>15000 steps/day)	4.8% (>12000 steps/day)
Mean of PAL	10288 (± 3983)	7919 (± 2359)
Ethnicity group		
Malay	80 (69%)	
Bidayuh	18 (15.5%)	
Iban	9 (7.8%)	
Melanau	5 (4.3%)	
Chinese	3 (2.6%)	
Others	1 (0.9%)	
Mother's schooling		
Primary	1 (2.4%)	
Secondary	24 (57.1%)	
College / University	17 (40.5%)	
Father's schooling		
Primary	3 (4.7%)	
Secondary	35 (54.7%)	
College / University	26 (40.6%)	
Parent monthly income	MYR3,313 (±2,291) (USD 1070 ± 739)	

From 116 adolescents, 109 respondents provided a complete set of pedometer data (minimum of two weekends and two weekday's data). The mean for daily steps was 9,007 (SD=3,406; range=2,338 - 23,033). The boys were found to be significantly physically more active (M=10,288 ; SD=3,983) than the girls (M=7,919 ; SD=2,359, $p<0.05$). More boys (27.8 percent) met the recommendation of pedometer-assessed physical activity compared to girls (4.8 percent) (Recommendation: Boys >15,000 steps/day and girls >12,000 steps/day (Tudor-Locke et al., 2004). The percentage of overweight respondents was slightly higher among boys (38.9 percent) compared to girls (35.2 percent). The mean parent income was RM3,313.80 (SD=2,291.95), which is under the middle income bracket.

4.2.2 Test-Retest Reliability and Internal Consistency

Previous test-retest reliability studies commonly report on the intraclass correlation coefficient (ICC). For example, NEWS-Y subscales had acceptable test–retest reliability (ICC range 0.56 to 0.87) (Rosenberg et al., 2009). The social support scale was reported to have an ICC range from 0.83 to 0.89 (Sallis, Pinski, Grossman, Patterson, & Nader, 1988). The parental restriction scale was reported to have an ICC of 0.44 (Carver et al., 2010); and self–efficacy (0.78 to 0.79) (Saunders et al., 1997). In this study, weighted kappa coefficients were instead used to calculate each item in the questionnaires in order to investigate the test-retest reliability. Internal consistency was examined by calculating Cronbach's alpha coefficient.

Figure 4.3 provides the distribution of weighted kappa coefficient values and Cronbach's alpha for the total sample (n=116) for all tested instruments. All items from 10 subscales provide the overall weighted kappa mean value of 0.30. Except for the

"Recreation Facility" subscale, all subscales had weighted kappa values ranging from 0.20 to 0.41 (fair to moderate agreement). The neighbourhood aesthetics had the highest weighted kappa coefficient of 0.41. The recreation facility subscales (9 items) had a poor agreement with the lowest weighted kappa of 0.18. Otherwise, all instruments can be considered to have fair reliability based on conventional criteria for kappa values provided by (Altman, 1991).

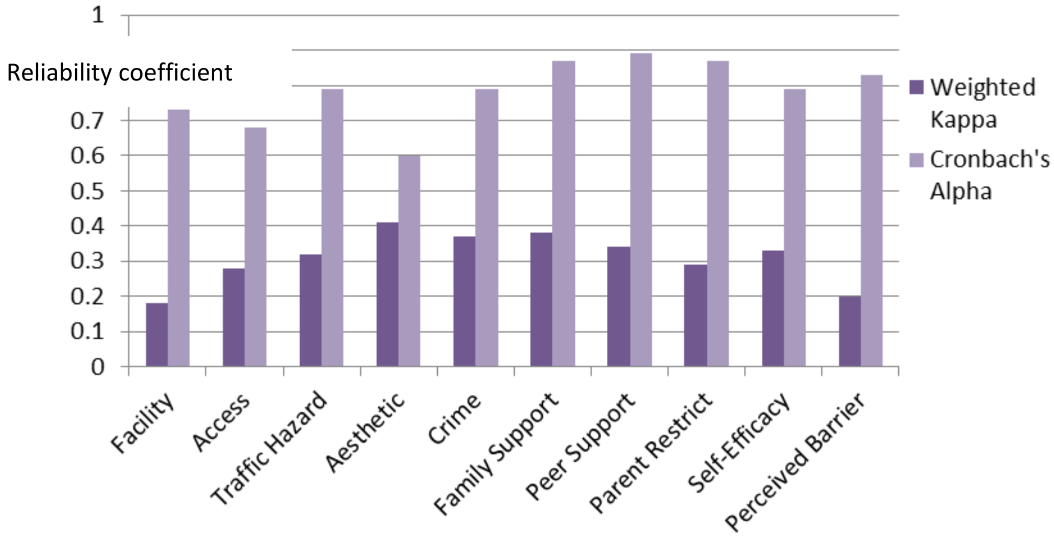


Figure 4.3 Average weighted kappa and Cronbach's Alpha value on the correlates of adolescent physical activity instrument

The overall Cronbach's alpha mean value was 0.79, above the cut off point for a set of items to be considered a scale. All subscales had alphas greater than 0.70 except for the subscale of aesthetics (0.60). Four subscales: peer support, family support, parental restriction and perceived barriers, had Cronbach's alpha values greater than 0.80.

Table 4.5 shows the distribution of weighted kappa and a 95% CI on individual items. The items with the highest weighted kappa values were: 1) traffic hazard - item number #6: "There are no street lights in my neighbourhood" (weighted kappa = 0.57, 95% CI

0.53– 0.62); and 2) aesthetics - item number # 5: “My neighbourhood is free from stray dogs “(weighted kappa = 0.58, 95% CI 0.49 – 0.60). This new item was included because dog is considered “unclean” to the Muslim community. Fair to moderate reliability was evident for the following subscales: accessibility, traffic hazard, aesthetics, crime safety, family support, peer support, parental restriction, self-efficacy, and perceived barriers.

Table 4.5 Distribution of weighted kappa and Cronbach's alpha of the Individual, Social, and Environmental Scale (ISES)

	Weighted Kappa	95% CI	Alpha, α
Recreation facilities			0.73
1. Beach, lake, river	0.26	017, 0.32	
2. Bike, hiking, walking trails, paths	0.23	0.10, 0.26	
3. Basketball / futsal / badminton court	0.18	0.11, 0.23	
4. Other playing fields / courts	0.30	0.27, 0.37	
5. Swimming pool	0.13	0.05, 0.18	
6. Walking/running track	0.01	-0.16, 0.07	
7. Public park	0.20	0.13, 0.29	
8. Playground with equipment	0.29	0.23, 0.31	
9. Public open space that is not a park	0.10	0.03, 0.13	
Access to services			0.68
1. My school is within walking distance	0.36	0.27, 0.45	
2. Shops are within easy walking distance of my home	0.28	0.19, 0.32	
3. There are many places to go (alone or with someone) within easy walking distance of my home.	0.22	0.16, 0.38	
4. From my home, it is easy to walk to a bus stop (bus/train), alone or with someone.	0.34	0.22, 0.43	
5. There are major barriers to walking from one place to another place in our neighbourhood (e. stray dogs)	0.28	0.19, 0.33	
6. The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in (alone or with someone).	0.20	0.10, 0.20	
Neighbourhood safety (Traffic hazard)			0.79
1. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in my neighbourhood.	0.29	0.22, 0.34	
2. The speed of traffic on nearby streets is usually slow (< 30 mph)	-0.17	-0.23, -0.09	
3. Most drivers go faster than the posted speed limits in my neighbourhood.	0.26	0.23, 0.31	
4. There is no speed limit sign in my neighbourhood streets.	0.47	0.38, 0.54	
5. There are no crosswalks and traffic signals to help walkers cross busy streets in my neighbourhood.	0.36	0.19, 0.55	
6. There are no street lights in my neighbourhood.	0.57	0.53, 0.62	
7. There are a lot of exhaust fumes when walking in my neighbourhood	0.09	0.08, 0.13	

Neighbourhood surroundings (Aesthetics)			0.60
1. There are trees along the roads in my neighbourhood.	0.39	0.32, 0.53	
2. There are many interesting things to look at while walking in my neighbourhood.	0.53	0.48, 0.56	
3. There are many buildings/homes in my neighbourhood that are nice to look at.	0.33	0.23, 0.37	
4. My neighbourhood open spaces are free from garbage and construction.	0.46	0.37, 0.49	
5. My neighbourhood is free from stray dogs.	0.58	0.49, 0.60	
6. The grass on the open spaces area is trimmed regularly	0.14	0.11, 0.15	
Crime safety			0.79
1. There is a high crime rate in my neighbourhood.	0.43	0.35, 0.55	
2. The crime rate in my neighbourhood makes it unsafe to go on walks alone or with someone at night.	0.43	0.36, 0.46	
3. I am worried about being outside alone around my home because I am afraid of being taken or hurt by a stranger.	0.34	0.28, 0.42	
4. I am worried about playing or walking alone or with friends in our local streets.	0.31	0.14, 0.39	
5. I am worried about being outside because I am afraid of being bullied.	0.39	0.33, 0.43	
6. I am worried about being or walking alone or with friends in my neighbourhood because I am afraid of the gangster groups.	0.33	0.19, 0.34	
Family Support			0.87
1. Active with me.	0.48	0.41, 0.55	
2. Offered to exercise with me.	0.36	0.22, 0.45	
3. Gave me helpful reminders to be active.	0.34	0.21, 0.43	
4. Gave me encouragement to be active.	0.33	0.25, 0.36	
5. Change their schedule so we could exercise together.	0.26	0.23, 0.28	
6. Planned for physical activity or recreational outings.	0.53	0.50 0.56	
7. Talked about how much they like to exercise	0.34	0.19, 0.35	
Peer Support			0.89
1. Active with me.	0.41	0.24, 0.57	
2. Offered to exercise with me.	0.39	0.23, 0.42	
3. Gave me helpful reminders to be active.	0.37	0.33, 0.49	
4. Gave me encouragement to be active.	0.33	0.20, 0.36	

5. Change their schedule so we could exercise together.	0.32	0.25, 0.36	
6. Planned for physical activity or recreational outings.	0.42	0.31, 0.48	
7. Talked about how much they like to exercise.	0.17	0.13,0.25	
Parental Restriction			0.87
1. My parent restricts me from playing alone outdoors in our neighbourhood.	0.34	0.26, 0.36	
2. My parents prevent me from playing with friends outdoors in our neighbourhood.	0.35	0.33, 0.36	
3. My parents prevent me from spending time outside after dark.	0.26	0.21, 0.31	
4. My parents prevent me from walking/cycling in the street after dark.	0.28	0.27, 0.38	
5. My parents prevent me from playing alone or with friends on local streets in our neighbourhood.	0.28	0.24, 0.31	
6. My parents prevent me from walking/cycling with friends in our neighbourhood.	0.22	0.15, 0.32	
Self-Efficacy			0.79
1. Ask my best friend to be physically active with me.	0.30	0.19, 0.40	
2. Physically active most days after school.	0.22	0.21, 0.27	
3. Physically active after school even if I could watch TV or play video games.	0.44	0.40, 0.50	
4. Physically active even if I have a lot of homework.	0.34	0.29, 0.38	
5. Physically active even if my parents want me to do something else.	0.27	0.16, 0.37	
6. Ask my parents to take me to a physical activity or sport practice.	0.39	0.35, 0.53	
7. Physically active even if it is raining or hot.	0.41	0.31, 0.47	
8. Physically active even if I have to stay at home.	0.25	0.15, 0.31	
Perceived Barriers			0.83
1. I don't have enough time for physical activity.	0.19	0.07, 0.25	
2. I am too tired for physical activity.	0.21	0.14, 0.30	
3. There is no proper place that is safe to perform physical activity near my home.	0.13	0.03, 0.25	
4. I don't have the energy to do physical activity.	0.17	0.10, 0.20	
5. I don't like physical activity or sports.	0.30	0.27, 0.36	
6. Physical activity or sports is a waste of time.	0.19	0.11, 0.25	

7.	I feel lazy to do physical activity because of weather conditions.	0.21	0.19, 0.30

Overall, the weighted kappa values reported in this study ranged from 0.18 to 0.41, which was lower compared to other reliability studies using ICC methods. The recreation facility subscales had a poor agreement with a weighted kappa of 0.18. The type of recreation facilities listed on the scale could be uncommon among local adolescents, particularly those in rural areas. Nonetheless, the results of adolescent test-retest reliability provide some support for the use of the selected items to examine multifactorial correlates of physical activity for larger adolescent samples.

4.2.3 Exploratory Factor Analysis

The exploratory factor analysis was conducted using a sample of 116 adolescents. The performance of the 25 items of neighbourhood environment domains was assessed. The subscales used 4-point rating scales. The recreation facilities subscale cannot be factor analysed due to their different formats (indicate time in minute taken to walking from home to recreation facilities) (Cerin et al., 2006). Table 4.6 shows the subclass of the neighbourhood environment prepared for factor analysis procedures

Table 4.6 Subscales of the neighbourhood environment prepared for factor analysis procedures (4-factor / 25 items)

Domain and Items
Access to service
1. My school is within walking distance
2. Shops are within easy walking distance of my home
3. There are many places to go (alone or with someone) within easy walking distance of my home.
4. From my home, it is easy to walk to a bus stop (bus/train), alone or with someone.
5. There are major barriers to walking from one place to another place in our neighbourhood (e. stray dogs)
6. The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in (alone or with someone).
Neighbourhood safety (Traffic hazard)
1. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in my neighbourhood.
2. The speed of traffic on nearby streets is usually slow (< 30 mph)
3. Most drivers go faster than the posted speed limits in my neighbourhood.
4. There is no speed limit sign in my neighbourhood streets.
5. There are no crosswalks and traffic signals to help walkers cross busy streets in my neighbourhood.
6. There are no street lights in my neighbourhood.
7. There are a lot of exhaust fumes when walking in my neighbourhood
Neighbourhood surroundings (Aesthetics)
1. There are trees along the roads in my neighbourhood.
2. There are many interesting things to look at while walking in my neighbourhood.
3. There are many buildings/homes in my neighbourhood that are nice to look at.
4. My neighbourhood open spaces are free from garbage and construction sites.
5. My neighbourhood is free from stray dogs.
6. The grass on the open spaces area are trimmed regularly
Crime safety
1. There is a high crime rate in my neighbourhood.
2. The crime rate in my neighbourhood makes it unsafe to go on walks alone or with someone at night.
3. I am worried about being outside alone around my home because I am afraid of being taken or hurt by a stranger.
4. I am worried about playing or walk alone or with friends in our local streets.
5. I am worried about being outside because I am afraid of being bullied.
6. I am worried about being or walking alone or with friends in my neighbourhood because I am afraid of the gangster groups.

The principal axis factoring used a Promax rotation. The Kaiser-Meyer Olkin (KMO) measure of sampling adequacy suggested the value should be at least 0.5 (Gray & Kinnear, 2012) for the sample to be factorable. The KMO was 0.709 and Bartlett's test of sphericity χ^2 (300) =902. 17, p <0.001, indicated that correlations between items were sufficiently large for factor analysis.

The next step was to determine the number of factors to retain for examination and possible rotation. Using the cut-off value of 1.0 for the Eigenvalue, the four hypothesized factors expanded to nine factors / 25 items (shown in Table 4.6). The scree analysis indicates nine factors to be extracted with a simple structure (factor loadings > 0.30). (see Figure 4.7). Cumulatively, all factors explain 69.27 percent of the total variance.

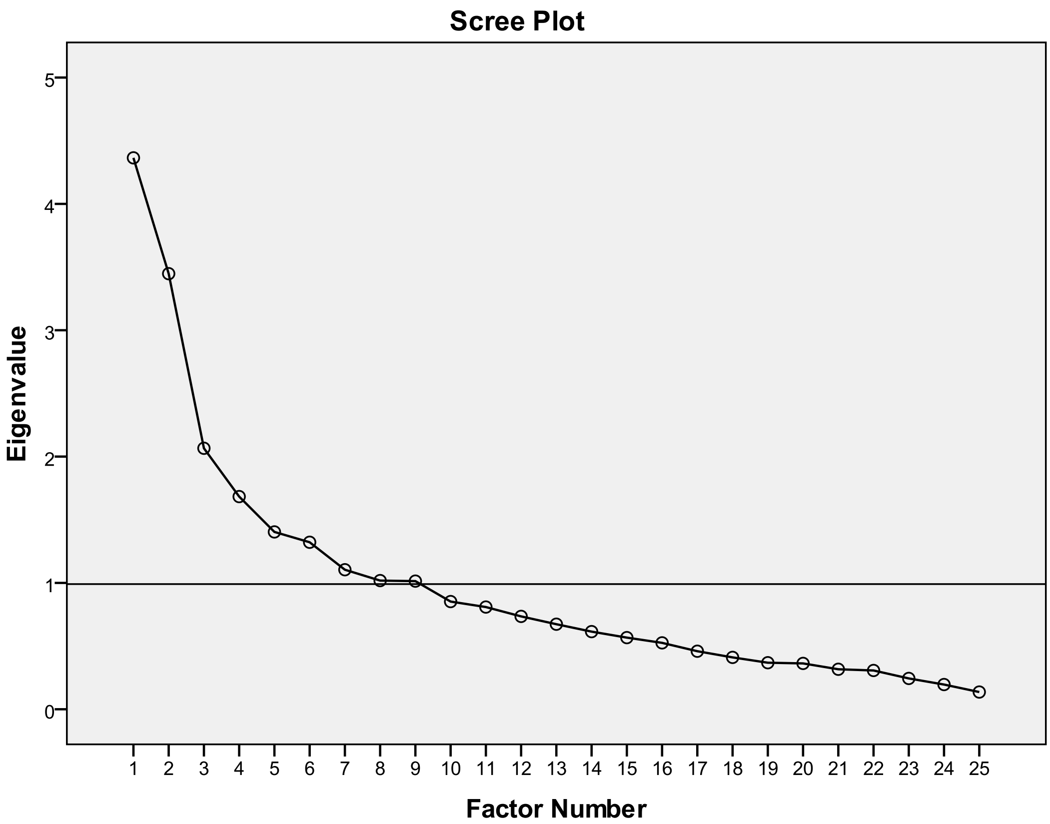


Figure 4.4 Scree Test for Common Factor Analysis

Table 4.7 Results for the Extraction of Common Factors: Extraction Method – Principal Axis Factoring

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.264	17.056	17.056	4.264	17.056	17.056
2	3.434	13.738	30.794	3.434	13.738	30.794
3	2.056	8.224	39.018	2.056	8.224	39.018
4	1.687	6.748	45.766	1.687	6.748	45.766
5	1.389	5.557	51.323	1.389	5.557	51.323
6	1.311	5.245	56.568	1.311	5.245	56.568
7	1.105	4.419	60.987	1.105	4.419	60.987
8	1.071	4.283	65.269	1.071	4.283	65.269
9	1.001	4.005	69.274	1.001	4.005	69.274

Extraction Method: Principal Axis Factoring.

Table 4.8 indicated five items loaded onto Factor 1. These five factors are related to neighbourhood surroundings (aesthetics) or pleasing environment. However, one of the items related to traffic hazard (“There are street lights in my neighbourhood”) was grouped in this factor. Theoretically, streetlights could contribute to pleasing environment. Four items loaded onto a second factor labelled as “crime safety”. The four items that loaded onto Factor 3 relate to “accessibility” to land use within easy walking distance.

Table 4.8 Rotated factor matrix (five-factor / 19 items)

	Item	1	2	3	4	5
Ae5	My neighbourhood is free from stray dogs	.814				
Ae2	There are many interesting things to look at while walking in my Neighbourhood.	.754				
Tr6	There are street lights in my neighbourhood	.688				
Ae6	The grass on the open spaces area is trimmed regularly	.679				
Ae3	There are many buildings/homes in my neighbourhood that are nice to look at.	.641				
Cr3	I am worried about being outside alone around my home because I am afraid of being taken or hurt by a stranger.		.849			
Cr5	I am worried about being outside because I am afraid of being bullied.		.830			
Cr4	I am worried about playing or walking alone or with friends in our local streets.		.776			
Cr2	The crime rate in my neighbourhood makes it unsafe to go on walks alone or with someone at night.		.707			
Ac3	There are many places to go (alone or with someone) within easy walking distance of my home.			.842		
Ac6	The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in (alone or with someone).			.562		
Ac1	My school is within walking distance			.540		
Ac4	From my home, it is easy to walk to a bus stop (bus/train), alone or with someone.			.493		
Tr3	The speed of traffic on nearby streets is usually slow (< 30 mph)				.738	
Tr7	There are no crosswalks and traffic signals to help walkers cross busy streets in my neighbourhood.				.573	
Tr4	There is no speed limit sign in my neighbourhood streets.				.561	

Tr1 There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in my neighbourhood.					.843
Tr3 Most drivers go faster than the posted speed limits in my neighbourhood.					.496
Tr5 There are a lot of exhaust fumes when walking in my neighbourhood					.496
Eigenvalues	4.26	3.43	2.05	1.68	1.38
Percent of variance	17.05	13.73	8.22	6.74	5.55
Alpha	0.831	0.821	0.608	0.550	0.570

Items that reflect traffic hazard divided into two factors (Factor 4 and Factor 5), each with three items. Factor 4 grouped three items ("*The speed of traffic on nearby streets is usually slow (< 30 mph)", "There are no crosswalks and traffic signals to help walkers cross busy streets in my neighbourhood",* and *"There is no speed limit sign in my neighbourhood streets").* The negative items ("*There is no crosswalk and traffic signal to help walkers cross busy streets in my neighbourhood",* and *"There is no speed limit sign in my neighbourhood streets")* were then rephrased into a positive statement to reflect "traffic safety".

Factor 5 grouped three items to measure "traffic hazard" of the nearby streets in one neighbourhood. Four other factors loaded with less than three items per factor. Two items loaded into Factor 6 (related to Crime), an item loaded to Factor 7 (Accessibility), two items loaded with Factor 8 (Accessibility) and an item loaded to Factor 9 (Aesthetic) (See Table 4.9).

Table 4.9 List of items with less than three items per factor

	Items	Factor
Cr1	There is a high crime rate in my neighbourhood.	6
Cr6	I am worried about being or walking alone or with friends in my neighbourhood because I am afraid of gangster groups	6
Ae1	My neighbourhood open spaces are free from garbage and construction	7
Ac2	Shops are within easy walking distance of my home	8
Ac5	There are major barriers to walking from one place to another place in our neighbourhood (e. stray dogs).	8
Ae1	There are trees along the roads in my neighbourhood.	9

Costello and Osborne (2005) suggested the researcher should drop the factor from the analysis if there were less than three items per factor or if there are several adequate to strong loaders (0.50 or better) on each factor. After checking for their relevancy these six items (in Table 4.9) were dropped. Tabachnick and Fidell (2001) also cited 0.32 as a good rule of thumb for the minimum loading of an item. A "cross loading" item is an item that loads at 0.32 or higher on two or more factors.

To establish the reliability of each factor retained by EFA, the Cronbach's alpha if items are deleted was reviewed on individual factors. The overall Cronbach's alpha for the measurement was 0.676, which is considered to be adequate in social science (Garson, 2012). However, the Cronbach's alpha value for traffic hazard subscales was only 0.55, below the cut-off 0.6. Since the traffic hazard was relevant to the theoretical structure and the main theme in qualitative data, all items were included as measurement based on review of the reliability of the scores. The final EFA for NEWS-Y contained five-factor / 19 items with the total variance of 51.323. This five-factor scale was subsequently subjected to confirmatory factor analysis.

4.2.4 Confirmatory Factor Analysis

Confirmatory factor analysis included 11-factors / 64 items to corroborate factor structures. Five constructs of the neighbourhood environment scale: accessibility, aesthetic, crime, traffic hazard, and traffic safety were preliminarily determined by exploratory factor analysis. The recreation facility factor was included in this stage. Other constructs that measure the psychosocial aspects included in this procedure were: self-efficacy, perceived barriers, peer support, parental support and parental restriction. These items were originally adopted from previous studies (Bartholomew et al., 2006;

Carver et al., 2010; Cheng et al., 2003; Sallis, 1986), thus, only subjected to confirmatory factor analysis.

The psychometric properties of the scale were evaluated through a confirmatory factor analysis, using a sample of 150 adolescents. The sample size was calculated based on the minimum requirement of 5 subject per 1 item ratio (Hair et al., 2010). Confirmatory factor analysis was performed using AMOS 18.

The demographic profiles of adolescents are presented in Table 4.10. The mean age was 13.51 (± 0.50). There were more girl participants (n=99) than boy participants (n=51). More than half of the sample were Chinese (59.3 percent) followed by Bidayuh / Iban (34 percent) and Malays (6.7 percent). Only six (4 percent) out of 150 participants in the adolescent sample met the requirement of physical activity level (>15,000 steps/day for boys and > 12,000 steps/ day for girls). Overweight and obese participants were more common among adolescent boys (41.2 percent) compared to adolescent girls (16.2 percent).

Table 4.10 Demographic profiles of adolescent participants, N = 150

	Boy (n=51)	**Girl (n=99)**
Age	13.5 (0.5)	13.4 (0.5)
Weight	55.9 (16.3)	46.3 (9.1)
Height	159.9 (8.6)	153.0 (5.3)
Overweight	13.7%	11.1%
Obese	27.5%	5.1%
Mean of Physical Activity Level	7024 (±2,479)	6,294 (±2160)
Meets PAL criteria	2%	5%
Boy: > 15,000 steps/day		
Girl: > 12,000 steps/day		
Ethnicity group		
Chinese	89 (59.3%)	
Bidayuh / Iban	51 (34%)	
Malay	10 (6.7%)	
Parent monthly income	RM2,356 (±2,268) (USD 761 ± 732)	

The confirmatory factor analysis was conducted by fitting one-congeneric measurement model to determine the construct reliability and validity. The confirmatory measurement model was evaluated on 11-factor / 64 items (See Table 4.11).

Table 4.11 Individual, social and environment constructs to assess adolescent correlates of physical activity

Constructs	**Number of items**
Self-efficacy	8
Perceived barrier	7
Family support	7
Peer support	7
Parental restriction	6
Recreation facilities	10
Accessibility to land-use	4
Traffic hazard	3
Traffic safety characteristics	3
Aesthetic	5
Crime	4
Total items	64

Subsequently, all individual constructs came together to form an overall measurement model and the issue of unidimensionality becomes critically important. Unidimensional measures mean that a set of measured variables can be explained by only one underlying construct. In such a situation, each measured variable is hypothesized to relate to only a single construct. All cross loadings are hypothesized to be zero when unidimensional constructs exist (Hair et al., 2010).

After each item was checked for their factor loading characteristics, the confirmatory factor analysis procedures deleted 22 items. The rationales for deletion are highlighted in Table 4.12, but were mainly due to low communality, low loading or cross loadings.

Table 4.12 Rationales for item deletion

Item	Statement	Rationale
SE2	Physically active most days after school	Cross load
SE1	Ask my best friend to be physically active with me	Cross load
Ba1	I don't have enough time for physical activity	Cross load
Bar5	I don't like physical activity or sports.	Low loading
Fs2	Gave me encouragement to be active.	Low loading
Fs3	Gave me helpful reminders to be active.	Low loading
Fs7	Talked about how much they like to exercise	Low loading
Ac1	My school is within walking distance	Cross load
Ac5	There are major barriers to walking in our local area that make it hard to get from place to place.	Low loading
Ae1	There are trees along the roads in my neighbourhood	Low loadings /Ambiguous question for rural settings
Ae2	There are many interesting things to look at while walking in my neighbourhood.	Low loading
Ae6	The open spaces are free from garbage.	
Cr1	There is a high crime rate in my neighbourhood	Low loading
Cr5	I am worried about being outside because other kids like to bully me	Low loading
Cr6	I am worried about being or walking alone in my neighbourhood because of the bad groups	Low loading
Pr6	My parents prevent me from walking/cycling with friends in our neighbourhood	Low loading
Ps1	Active with me.	Low loading
Ps4	Gave me encouragement to be active.	Low loading
Ps6	Planned for physical activity or recreational outings.	Low loading
Rc1	Beach, lake, river	Low loading
Rc2	Bike, hiking, walking trails, paths	Low loading

After the deletion of 22 items, the remaining 11-factor / 42 item scale provided a minimum model fit. Although the Chi-square values were significant, their sensitivity to sample size lessens the importance of this particular test of model fit in relation to other goodness-of-fit measures (Byrne, 2010). The remaining tests CFI and RMSEA demonstrated good fit. The model is shown in Table 4.13 and Figure 4.5. The confirmatory factor analysis indicated that the 11-factor and 42-item model adequately fits the data.

Table 4.13 Confirmatory factor analysis and model fit

Index	CFA Model
Chi-square	1017.620
Degree of freedom	763
p-value	<0.001
χ^2/df	1.334
CFI	0.940
RMSEA	0.033
AIC	1297.620

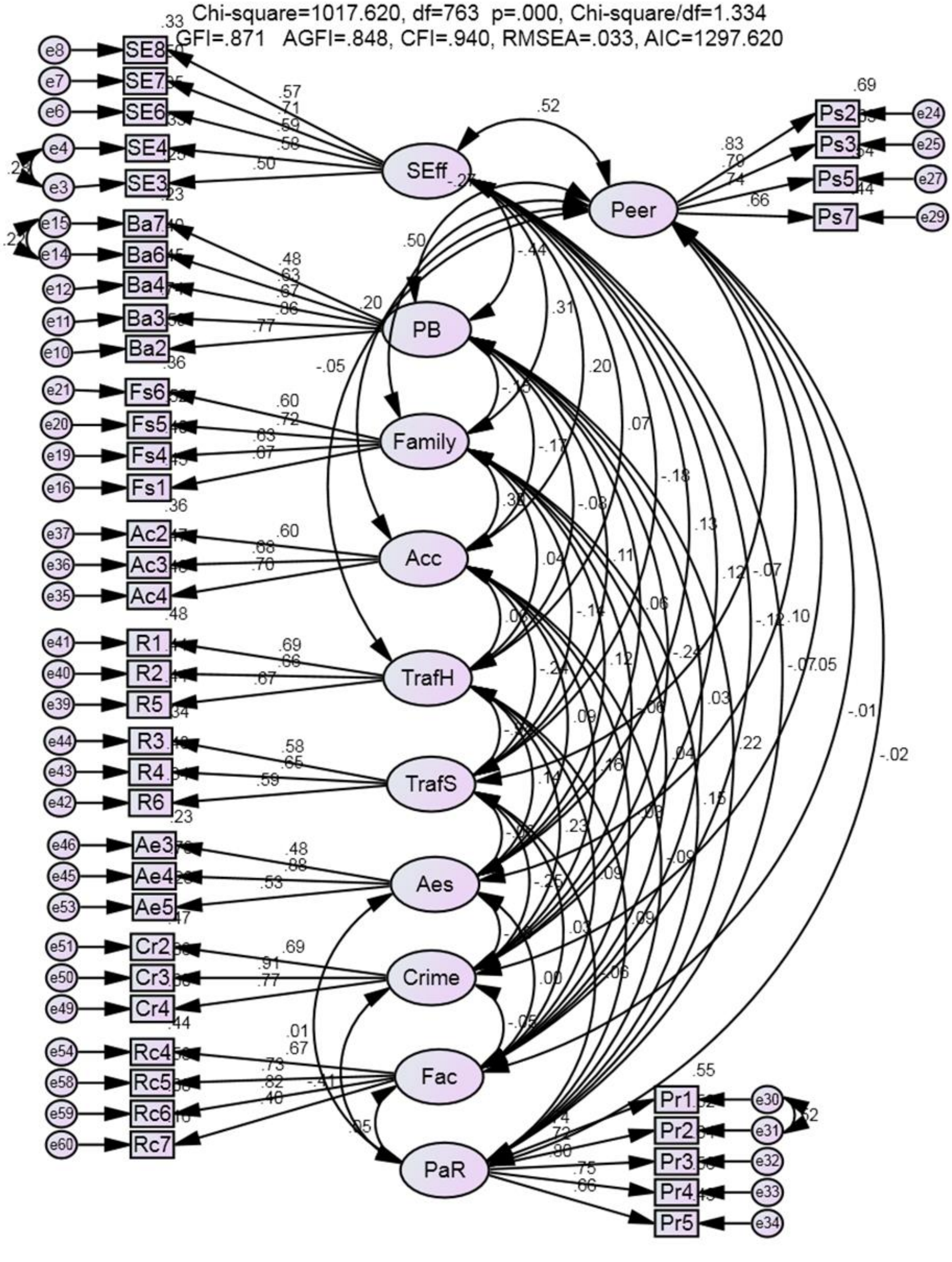


Figure 4.5 CFA on overall measurement model based on adolescent data (n=150)

4.2.5 Major Survey

4.2.5.1 Descriptive statistics

Table 4.14 shows 313 adolescents (103 boys and 210 girls), predominantly Chinese (55.9 percent), followed by Indigenous (33.2 percent) and Malays (10.6 percent). The respondents' mean age was 13.5 (SD=0.52). The parent's mean household income was RM 2,366 (SD=2,605), which falls in the range of a middle-income household. Using the cut-off of BMI-for-age >85th and 95th percentile for overweight and obese respectively, there was a total of 12.1 percent of overweight adolescents and 11.8 percent of obese adolescents. When analysed by gender; 14.6 percent of boys and 11 percent of girls were overweight, while 22.3 percent of the boys and 6.7 percent of the girls were obese. The boys' BMI was significantly greater than the girls (M=21.3; SD=5.12 versus M=19.9; SD=3.7, p=0.017). There was no significant difference in BMI across ethnicity and parent household income.

Table 4.14 also shows only 3.9 percent of boys and 5.2 percent of girls achieved the pedometer step count recommendation set at 15,000 steps/day and 12,000 steps/day, respectively. About 69.3 percent of the total sample exceeded the sedentary guidelines of no more than two hours a day. Adolescents in the present study spent an average of 3.22 (±1.86) hours a day on media entertainment.

Table 4.14 Demographic characteristics of the sample in the main survey (n=313)

Demographic	n	%
Age (years old)		
12	1	0.3
13	153	48.9
14	157	50.2
15	2	0.6
Mean (SD)	13.5 (±0.52)	
Gender		
Boys	103	32.9
Girls	210	67.1
Ethnicity		
Chinese	175	55.9
Indigenous	104	33.2
Malays	34	10.9
Body mass index		
Underweight	31	9.9
Normal weight	207	66.1
Overweight	38	12.1
Obese	37	11.8
Meets PAL recommendations		
Boys (>15,000 steps/day)	4	3.9
Girls (>12,000 steps/day)	11	5.2
Screen-time (media entertainment)		
Less than 120 minutes / day	96	30.7
Equivalent or > 120 minutes day	217	69.3
Mean (SD) (hours)	3.22 (±1.86)	

4.2.5.2 Patterns of pedometer-assessed physical activity levels

Table 4.15 shows the median daily steps as 6,225 (IQR=2,917). The boys recorded an average of 6,556 (IQR=3,923) steps a day, which is significantly more than the girls 6,147 (IQR=2,518) (p=0.040, 95% CI 31-1280). The mean steps/day was significantly higher on weekdays than weekends (p<0.001, 95% CI 1556 - 2316) and significantly higher during school-time than non-school time (p < 0.001, 95% CI 2119 - 3212).

Table 4.15 Physical activity levels by gender

	All (n=313)	Boys (n=100)	Girls (n=213)	Group difference (p value)
Average steps/day	6,225 (2,917)	6,556 (3923)	6,147 (2,518)	0.040
Weekdays steps/day[a]	7,400(3,790)	8,609 (5,387)	6,833 (3,212)	0.021
Weekends steps/day	5,079 (3,475)	5,305 (4,850)	4,839 (3,169)	0.443
School-time steps/day[b]	4,853 (3,608)	5,853(3,773)	4,743 (3,349)	0.007
Non-school-time steps/day	2,466 (1,677)	2,115 (1,349)	2,492(1,681)	0.069

Note: All step counts are reported as median (IQR)
[a] Weekdays steps are higher than the weekends steps, p <0.001, 95% CI 1556 - 2316
[b] School-time steps are higher than non-school time steps, p <0.001, 95% CI 2119- 3212

Table 4.16 shows the Indigenous adolescents have higher mean step counts compared to Chinese (p=0.014, 95% CI 132 - 1621). The Indigenous recorded more step counts on weekdays compared to Chinese (p=0.05, 95% CI 1291 - 2045) and Malays (p=0.036, 95% CI 52 -2111).

Table 4.16 Physical activity levels by ethnicity

	Chinese[a]	Indigenous[b]	Malays[c]	Group difference * (*p* value)
Average steps/day	6,100 (2,661)	6,826 (3,717)	6,333 (2,361)	b > a , p=0.015 95% CI 132 - 1621
Weekdays steps/day	6,601(3,458)	7,669 (4,216)	6,924 (2,215)	b > a, p=0.005 95% CI 1291 - 2045 b > c, p=0.036 95% CI 52 - 2111
Weekends steps/day	4,828 (3,150)	5,083 (4,131)	5,018 (3,209)	No difference
School-time steps/day	4,994 (3,768)	6,083 (3,574)	4,736 (3,032)	b > c, p=0.046 95% CI 22 - 3126
Non-school-time steps/day	2,448 (2,464)	2,683 (1,726)	3,180 (4,083)	No difference

Note: All step counts are reported as median (IQR)
* *Post-hoc* analyses conducted for comparing all possible group differences

Figure 4.6 shows physical activity levels between boys and girls. On weekdays, the boys had higher mean step counts than the girls. But on weekends, the mean step counts were almost similar between boys and girls. The physical activity level peaks on Thursday, but drops drastically on Friday and further decline on weekends. Monday data was not included because Monday was the distribution day for pedometers.

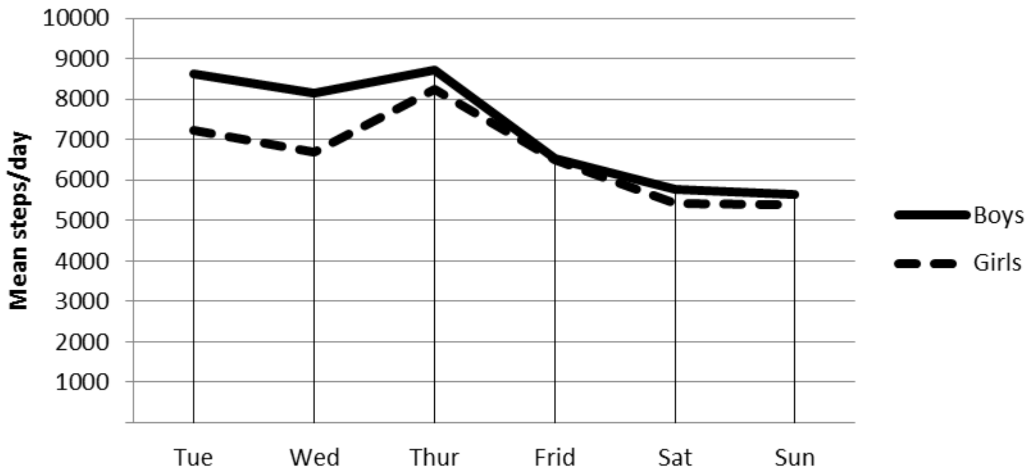


Figure 4.6 Patterns of pedometer-assessed physical activity level by gender

4.2.5.3 Structural Equation Model

Sample correlation matrix

The correlation matrix examines twelve constructs to determine if interrelationships between constructs existed before testing them in the structural equation model. Correlations were calculated to examine relationships among the twelve model variables (see Table 4.17). Based on Cohen's criteria of effect size in social science research, values of r were interpreted as small with $r = 0.1 - 0.23$, medium with $r = 0.24 - 0.36$ and large with $r > 0.37$ (Cohen, 1988). With these criteria, all constructs were intercorrelated with minimum correlation values >0.20, except for screen time and recreation facility.

Table 4.17 Sample correlation matrix among theorized latent factors influencing adolescent physical activity levels

	1	2	3	4	5	6	7	8	9	10	11	12
1. Screen time	1.000											
2. Traffic Safety	-.109	1.000										
3. Traffic hazard	.022	-.598	1.000									
4. Peer support	.010	-.044	-.058	1.000								
5. Parental support	-.039	-.026	.013	.457	1.000							
6. Parental restriction	-.064	-.078	.074	.005	.096	1.000						
7. Perceived barrier	-.067	.078	-.026	-.238	-.152	.204	1.000					
8. Self-efficacy	.125	-.094	.056	.456	.310	-.091	-.361	1.000				
9. Crime	.036	-.247	.226	.017	-.029	-.307	-.229	.089	1.000			
10. Aesthetic	-.062	-.199	.296	.113	.200	.151	-.079	.122	-.044	1.000		
11. Recreation facility	.037	-.011	.033	.106	.154	.047	.035	.038	.011	.155	1.000	
12. Accessibility	.015	-.178	.185	.128	.226	.005	-.133	.128	.043	.269	.160	1.000

Condition number = 6.517

Eigenvalues 2.388 1.788 1.594 1.134 1.021 .934 .848 .716 .647 .579 .519 .464 .367

Initial Model

A structural equation model analysis was conducted to generate an initial model consisting of twelve key variables hypothesized to have effects on adolescent physical activity levels. In the initial model, physical activity level was predicted by only two factors: 1) peer support (β=0.204, p=0.008, 95% CI 0.067- 0.324), and 2) crime (β= 0.210, p=0.007, 95% CI 0.105 - 0.311. The chi-square statistic, $\chi^2_{(865)}$ was 1450.563 and p<0.001. Although the RMSEA=0.047 and χ^2/df=1.677 was acceptable, other goodness-of-fit index, GFI (0.831), AGFI (0.807) and CFI (0.857) were below the cut-off point of 0.9. This model indicates a poor fit. A series of respecifications was conducted in search for a good model fit. The results of primary analyses are reported in Table 4.18 and Figure 4.7.

Table 4.18 Standardized regression weights of constructs in initial model

Parameter			Estimate	95% CI Lower	95% CI Upper	*p* value
PAL	←	Peer support	.204	.067	.324	.008
PAL	←	Crime	.210	.105	.311	.007
PAL	←	Parent restriction	-.102	-.203	.003	.112
PAL	←	Parent support	.076	-.076	.193	.404
PAL	←	Access	.118	-.016	.248	.150
PAL	←	Traffic safety	.138	-.035	.301	.189
PAL	←	Traffic hazard	-.107	-.276	.039	.215
PAL	←	Facility	-.053	-.158	.064	.477
PAL	←	Aesthetic	.090	.005	.199	.090
PAL	←	Self-efficacy	-.114	-.246	.039	.281
PAL	←	Perceived barrier	.093	-.020	.213	.167
PAL	←	Screen-time (ST)	.009	-.080	.100	.783
		Model Fit Statistics	χ^2	1450.563		
			df	865		
			p	<0.001		
			χ^2/df	1.677		
			GFI	0.831		
			AGFI	0.807		
			CFI	0.851		
			RMSEA	0.047		
			AIC	1700.563		

PAL – Physical Activity Level, measured by pedometer step count

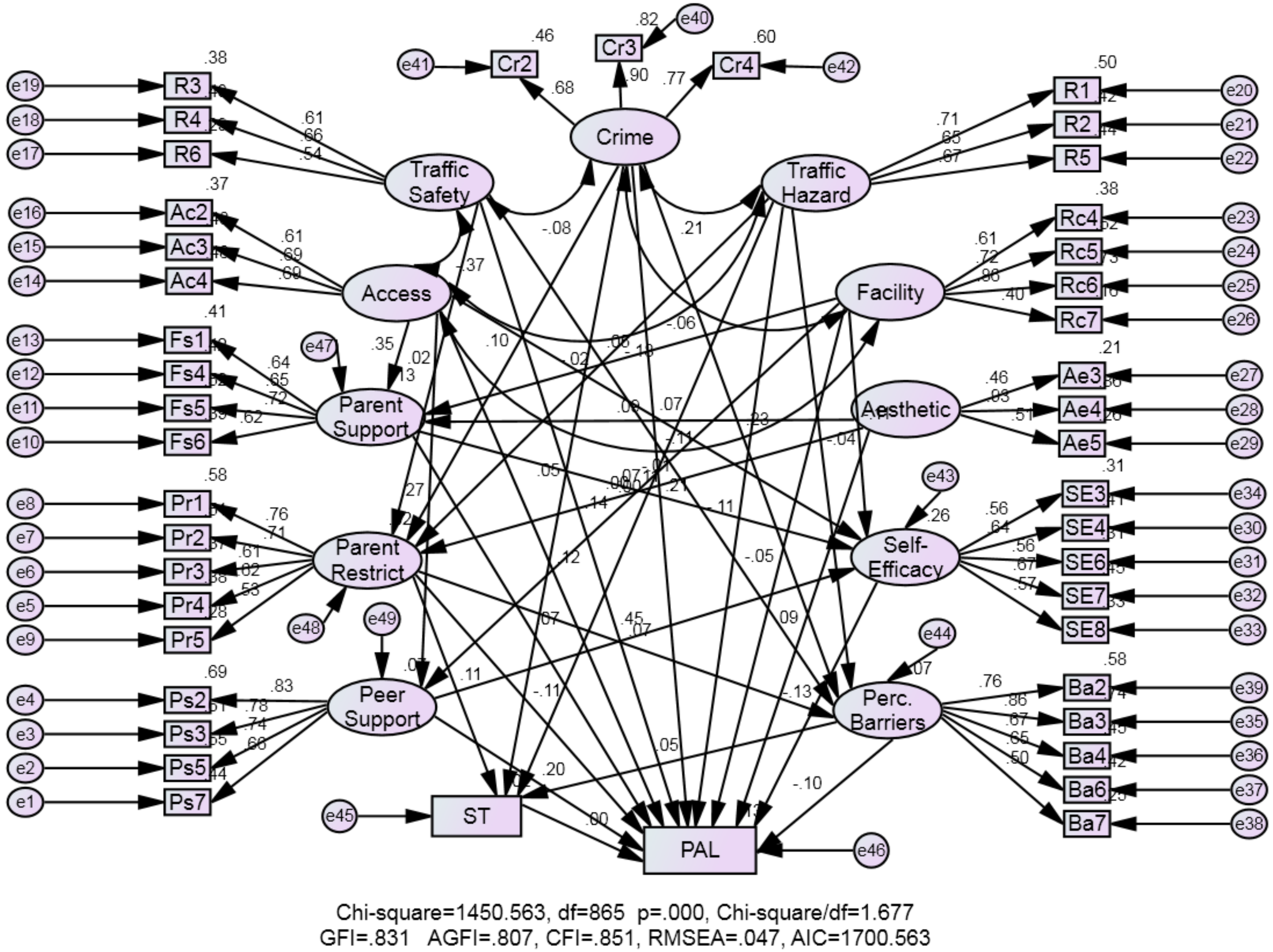


Figure 4.7 Initial structural equation model on twelve latent constructs

Model Respecification

In this model respecification stage, constructs that were not significant and had highest *p*-value were dropped. As shown in Table 4.19, the first five constructs: screen time, facility, parent support, self-efficacy and traffic hazard were dropped from the model one at a time.

Table 4.19 Constructs with highest *p*-value considered for deletion

Constructs	Estimate	95% CI		*p* value
		Lower	Upper	
Screen-time	.009	-.080	.100	.783
Facility	-.053	-.158	.064	.477
Parent support	.076	-.076	.193	.404
Self-efficacy	-.114	-.246	.039	.281
Traffic hazard	-.107	-.276	.039	.215
Traffic safety	.138	-.035	.301	.189
Perceived barrier	.093	-.020	.213	.167
Access	.118	-.016	.248	.150
Parent restriction	-.102	-.203	.003	.112
Aesthetic	.090	.005	.199	.090

The initial respecification model produced four significant predictors of physical activity level (PAL) as shown in Table 4.20. The four significant constructs were: peer support (β=0.189, *p*=0.008, 95% CI 0.074 - 0.2821, traffic safety (β=0.215, *p*=0.006, 95% CI 0.085-0.337), crime (β=0.206, *p*=0.004, 95% CI 0.109 - 0.302), and perceived barrier (β=0.129, *p*=0.041, 95% CI 0.035 - 0.228).

The respecification improved the goodness of fit indices. As shown in Table 4.20 and Figure 4.8, the respecified model provided a significant chi-square statistic, $\chi^2_{(311)}$ = 488.429, *p*<0.001. The ratio of chi-square to degree of freedom, χ^2/df = 1.571, was in the acceptable range of below 3. The goodness-of-fit index, a CFI = 0.926 was at an acceptable level of the recommended cut-off point (Hu & Bentler, 1999). The RMSEA was 0.043 below the cut-off point of 0.05. Nonetheless, the adjusted goodness of fit, AGFI = 0.872 and GFI = 0.895 were still below the cut-off point 0.9.

Table 4.20 Standardized regression weights of constructs after respecification (five constructs dropped)

Parameter		Estimate	95% CI		*p* value
			Lower	Upper	
PAL ←	Crime	.206	.109	.302	.004
PAL ←	Traffic safety	.215	.085	.337	.006
PAL ←	Peer support	.189	.074	.281	.008
PAL ←	Perceived barrier	.129	.035	.228	.041
PAL ←	Parent restriction	-.113	-.223	-.020	.056
PAL ←	Accessibility	.136	.011	.239	.067
PAL ←	Aesthetic	.072	-.006	.182	.129
	Model Fit Statistics	χ^2	488.429		
		df	311		
		p	<0.001		
		χ^2/df	1.571		
		GFI	0.895		
		AGFI	0.872		
		CFI	0.926		
		RMSEA	0.043		
		AIC	624.429		

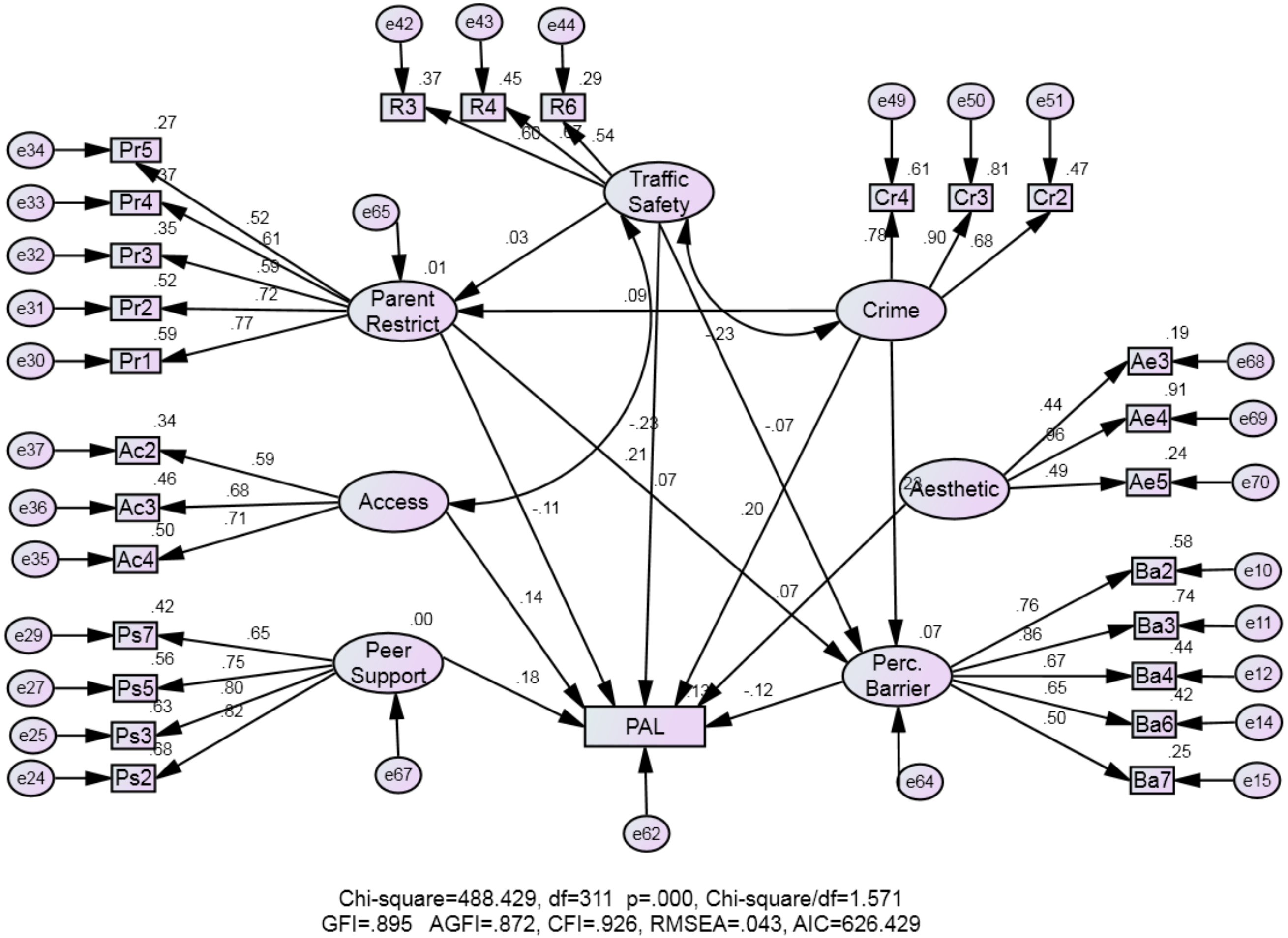


Figure 4.8 Respecified model after deletion of five constructs

There was a possibility of further improving the model by removing other constructs that were not significantly associated with physical activity levels. This led to the removal of the Aesthetic construct (β=0. 072, p=0.129, 95% CI -0.006 - 0.182) from the model. The modification indices in AMOS 18 were also assessed, which suggested the connection between e32 and e33. Theoretically, these two error terms under the "parent restriction" construct were interrelated thus were allowed to be connected. The respecified model provided a significant chi-square statistic, $\chi^2_{(237)}$=341.409, p<0.001. Table 4.21 shows that the ratio of chi-square to degree of freedom, χ^2/df=1.441 was in the acceptable range of below 3. The goodness-of-fit index, a CFI=0.954 and the GFI=0.918 are at an acceptable level of the recommended cut-off point (Saimon, Choo, & Bulgiba, 2013). The RMSEA was 0.038 below the cut-off point 0.05. Nonetheless, the adjusted goodness of fit, AGFI = 0.896 were still below the cut-off point 0.9, indicating a poor fit.

Table 4.21 Standardized regression weights of constructs after respecification (six constructs deleted)

Parameter			**Estimate**	**95% CI**		***p* value**
				Lower	**Upper**	
PAL	←	Crime	.190	.094	.285	.004
PAL	←	Traffic safety	.208	.075	.334	.006
PAL	←	Peer support	.191	.076	.286	.007
PAL	←	Perceived barrier	.133	.040	.235	.035
PAL	←	Parent restriction	-.119	-.221	-.017	.056
PAL	←	Accessibility	.140	.011	.242	.071
		Model Fit Statistics	χ^2	341.409		
			df	237		
			p	<0.001		
			χ^2/df	1.441		
			GFI	0.918		
			AGFI	0.896		
			CFI	0.954		
			RMSEA	0.038		
			AIC	467.409		

The Accessibility construct (β=0.140, p=0.071, 95% CI 0.011 - 0.242), which was also found to be not associated with adolescent physical activity levels and had the highest p-value (β=0.131, p=0.069, 95% CI -0.010 - 0.026), was removed from the model. The modification indices suggested the connection of e14 and e15, the error terms under the perceived barrier construct. These two error terms were conceptually related and allowed to be connected. After removing the Accessibility construct and connecting two error terms (e14 ←→e15), the goodness fit indices exceeded the recommended cut-off points. The chi-square statistic, $\chi^2_{(178)}$=267.009, p <0.001, χ^2/df=1.500, GFI=0.924, AGFI=0.902, CFI=0.957, RMSEA=0.040 and AIC=373.009), which indicated that this model has a good model fit for the sample. This was because all the t-values for path coefficients were significant at p<0.05 level. See Table 4.22 and Figure 4.9.

Table 4.22 Standardized regression weights of constructs after respecification (seven constructs deleted)

Parameter		Estimate	95% CI		p value
			Lower	Upper	
PAL ←	Peer support	.196	.095	.293	.004
PAL ←	Crime	.195	.099	.288	.005
PAL ←	Traffic safety	.178	.059	.302	.007
PAL ←	Parent restriction	-.128	-.233	-.030	.035
PAL ←	Perceived barrier	-.120	-.217	-.026	.046
	Model Fit Statistics	χ^2	267.009		
		df	178		
		p	<0.001		
		χ^2/df	1.500		
		GFI	0.924		
		AGFI	0.902		
		CFI	0.957		
		RMSEA	0.040		
		AIC	373.009		

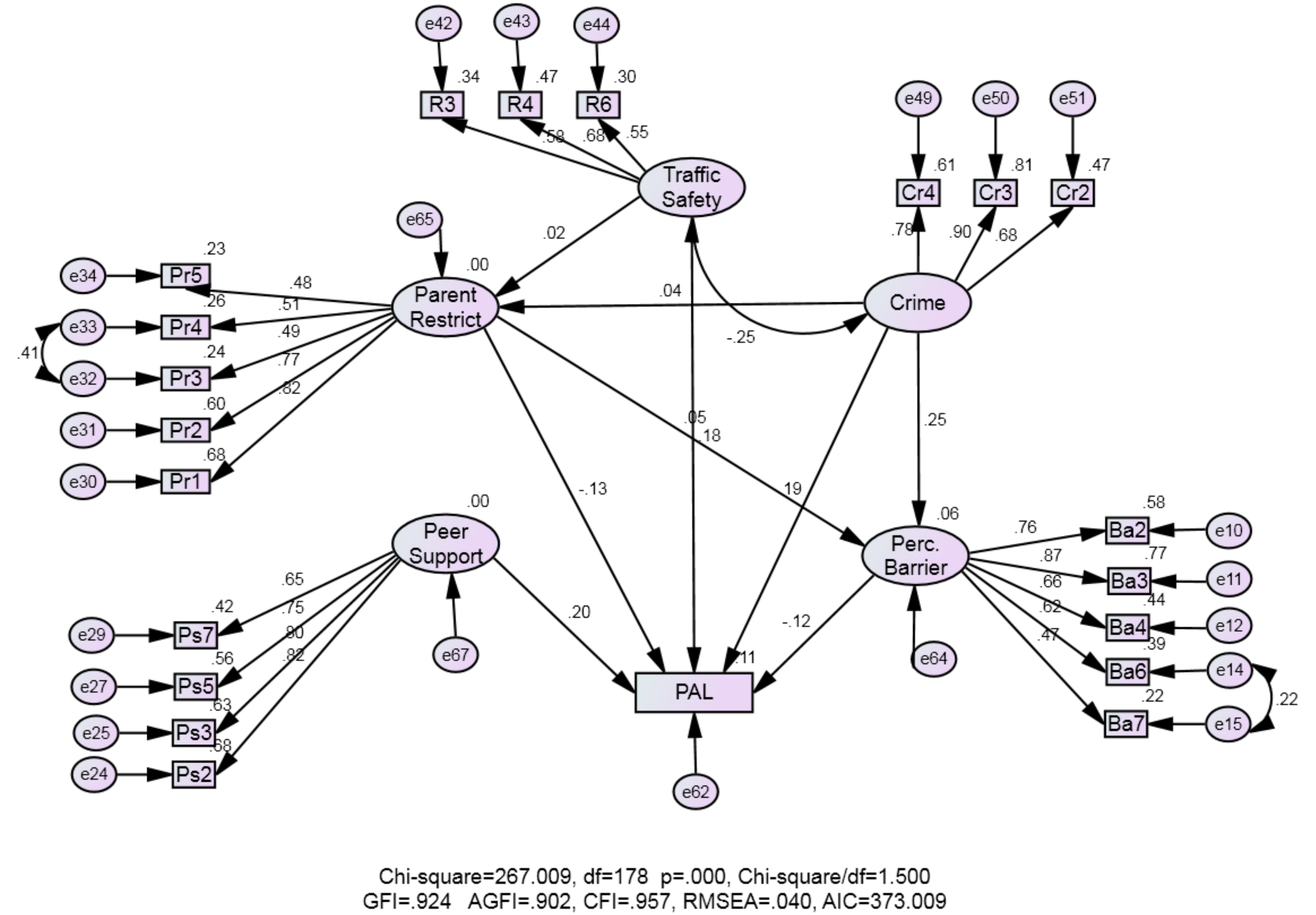


Figure 4.9 Respecified model (after seven constructs deleted)

Overall, after the removal of seven constructs and connecting two pairs of error terms, the model identified five significant predictors of adolescent physical activity. These five predictors were;

1. Fear of crime (β=0.195, p=0.005, 95% CI 0.102, 0.291);
2. Peer support (β=-0.203, p=0.005, 95% CI 0.098, 0.298);
3. Traffic safety (β= -0.177, p=0.007, 95% CI 0.057, 0.303);
4. Perceived barrier (β= -0.126, p=0.047, 95% CI -0.229, -0.030); and
5. Parental restriction (β= -0.124, p=0.049, 95% CI -0.229, -0.023).

4.2.5.4 Mediation Analysis

Although the model shown in Figure 4.9 suggested the presence of meaningful relationships between the predictors (fear of crime, peer support, traffic safety, perceived barrier, parental restriction, and PAL), it is recommended to test the effect of the mediator variables. Mediators may elucidate the mechanisms through which an intervention functions and the sequence by which behaviour change occurs (Patrick & Williams, 2012).

The first step for establishing mediation was to examine the effect of fear of crime, traffic safety, parental restriction, and peer support (independent variables) on parent restriction, peer support, and perceived barrier (mediators). The second step was to examine the effect of mediator variables on physical activity level (PAL). The third step for establishing mediation was to determine whether the effect of fear of crime, traffic safety, parental restriction and peer support on PAL was satisfied after accounting for mediator variables. The detailed statistics of the mediation analysis models are provided in Table 4.23.

Table 4.23 Test of mediation model

Parameter			Estimate	95% CI		*p* value
				Lower	Upper	
Parent restriction	←	Crime	.045	-.120	.189	.685
Parent restriction	←	Traffic safety	.016	-.120	.197	.777
Perceived barrier	←	Parent restriction	.051	-.084	.182	.502
Perceived barrier	←	Crime	.246	.148	.359	.003
PAL	←	Peer support	.196	.095	.293	.004
PAL	←	Crime	.195	.099	.288	.005
PAL	←	Traffic safety	.178	.059	.302	.007
PAL	←	Parent restriction	-.128	-.233	-.030	.035
PAL	←	Perceived barrier	-.120	-.217	-.026	.046

The path diagrams of mediational relationships are displayed in the following figures, Figure 4.10 to Figure 4.13. In Figure 4.10, the effect of traffic safety and parental restriction on PAL were significant: The effect of Traffic safety → PAL (β=0.178, p=0.007 and 95% CI 0.059 - 0.302) and Parental restriction → PAL, β=-0.128, p=0.035 and 95% CI -0.233, -0.030). But mediation was not established because the effect of traffic safety on parental restriction (mediator) (β=0.016, p=0.777, 95% CI -0.120, 0.197) was not significant. This suggests the single arrow of Traffic safety→ Parental restriction can be removed from the overall model.

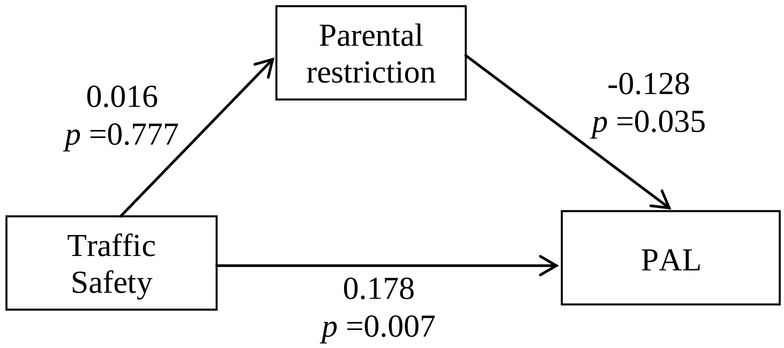


Figure 4.10 Simple mediation - Standardized regression coefficients for the relation between traffic safety and physical activity level (PAL) as mediated by parental restriction

In Figure 4.11, the researcher examined another plausible mediation relationship between Crime and PAL mediated by Parental restriction. The effect of Crime and Parental restriction were both significant (Crime → PAL, β=0.195, *p*=0.005, 95% CI -0.099, 0.288) and Parent Restriction → PAL, β=-0.128, *p*=0.035, 95% CI -0.233, -0.030). But the effect of Crime on Parental Restriction was not significant (β=0.045, *p*=0.685, 95% CI -0.120, 0.189). Thus, mediation could not be established. The single arrow of Crime → Parental Restriction can be also removed from the overall model.

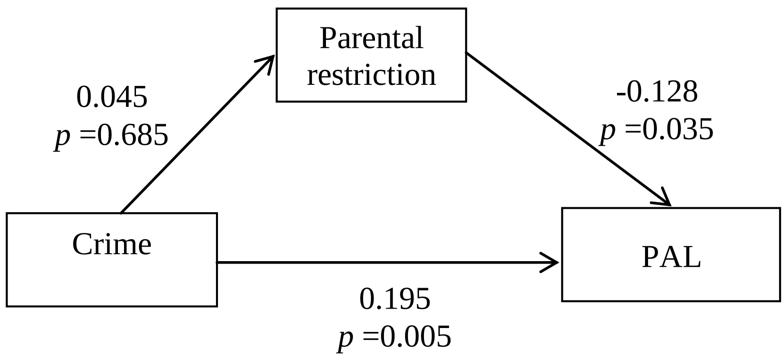


Figure 4.11 Simple mediation - Standardized regression coefficients for the relation between crime and physical activity level as mediated by parent restriction

In the following mediation analysis, the plausible mediator between Parental restriction and PAL was Perceived barriers. Perceived barriers constitute factors that inhibit or fully disrupt one's ability to perform a physical activity behaviour. Both Parental restriction (β=-0.128, *p*=0.035, 95% CI -0.233, -0.030) and Perceived barriers (β=-0.120, *p*=0.046, 95% CI -0.217,-0.26) were significant predictors of PAL. However, the criteria for mediation could not be fulfilled because the effect of parental restriction on perceived barriers was not significant (β=0.052, *p*=0.502, 95% CI -0.084, 0.182) (See Figure 4.12). The single arrow of Parental Restriction → Perceived barriers can also be removed from the overall model.

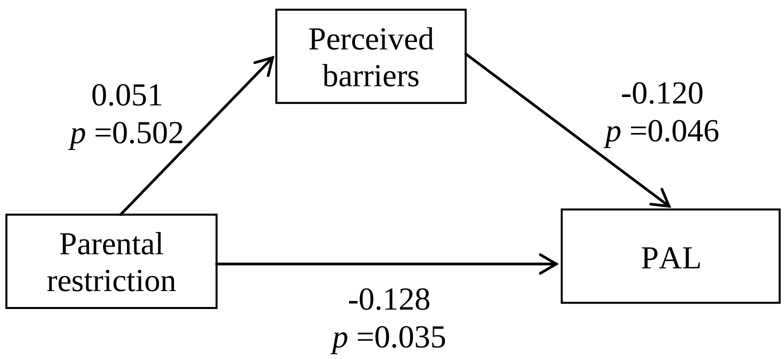


Figure 4.12 Simple mediation - Standardized regression coefficients for the relation between parent restriction and physical activity level (PAL) as mediated by perceived barriers

The only significant mediator between Crime and PAL was Perceived barriers. As shown in Figure 4.13, the standardized regression coefficient between Crime and PAL decreased substantially when controlling for Perceived barriers. Crime was a significant predictor of PAL (β=0.195, *p*=0.005, 95% CI -0.099, 0.288) and Perceived barriers (β=0.246, *p*=0.003, 95% CI 0.148, 0.359), while Perceived barriers (β=-0.120, *p*=0.046, 95% CI -0.217,-0.26) was a significant predictor to PAL. Thus, a perceived barrier was a partial mediator between crime and PAL.

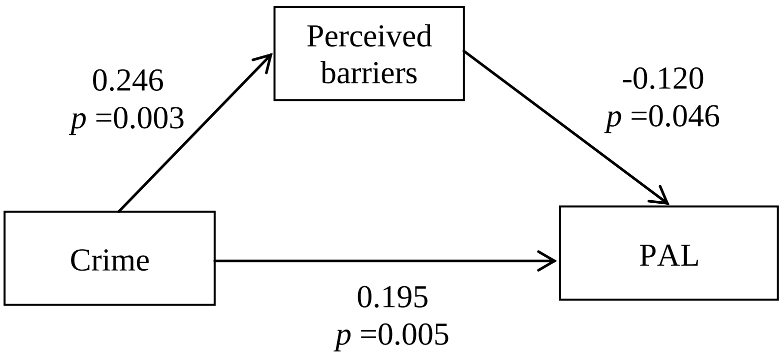


Figure 4.13 Simple mediation - Standardized regression coefficients for the relation between crime and physical activity level (PAL) as mediated by perceived barriers

4.2.5.5 Final Model

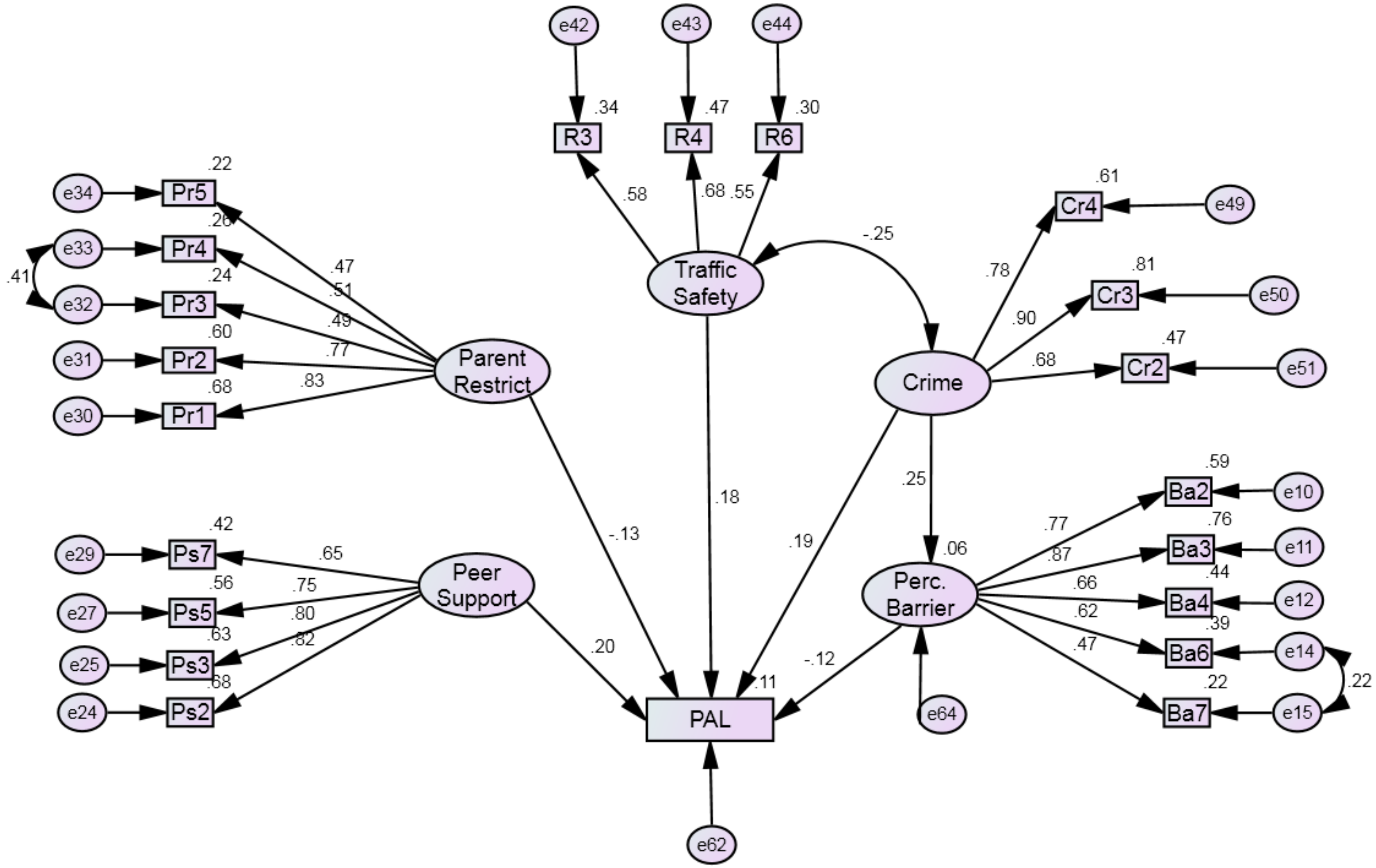
Based on the mediation analysis, the "Traffic safety" and "Crime" parameters were not correlated with "Parental restriction", and "Parental restriction" was not correlated with "Perceived barriers". Arrows from "Traffic safety"→"Parental restriction", from "Crime" → "Parental restriction", and from "Parental restriction" → "Perceived barriers" were removed.

This procedure produced a final model with a significant chi-square statistic ($\chi^2_{(181)}$=268.024, p<0.001). A good fit index was obtained as GFI (0.924), AGFI (0.903, and CFI (0.958) exceeded the recommended cut-off of 0.9 (Saimon et al., 2013). The low level of RMSEA of 0.039 suggested a good fit of the proposed model to the observed data. The lowest AIC (368.024) was also obtained, which adjusted for the number of parameters (See Table 4.24).

Table 4.24 Standardized regression weights and goodness of fit of final model

Parameter			**Estimate**	**95% CI Lower**	**95% CI Upper**	***p* value**
Perceived barrier	←	Crime	.248	.150	.349	.004
PAL	←	Peer support	.196	.095	.292	.004
PAL	←	Crime	.194	.102	.286	.004
PAL	←	Traffic safety	.178	.061	.300	.007
PAL	←	Parent restriction	-.128	-.227	-.034	.026
PAL	←	Perceived barrier	-.121	-.218	-.031	.042
Traffic safety	←→	Crime	-.254	-.398	-.095	.011
		Model Fit Statistics	χ^2	268.024		
			df	181		
			p	<0.001		
			χ^2/df	1.481		
			GFI	0.924		
			AGFI	0.903		
			CFI	0.958		
			RMSEA	0.039		
			AIC	368.024		

←→ Correlation



Chi-square=268.024, df=181 p=.000, Chi-square/df=1.481
GFI=.924 AGFI=.903, CFI=.958, RMSEA=.039, AIC=368.024

Figure 4.14 Final model after mediation analysis

Indirect, direct and total effects of independent variables in the final model were examined. Table 4.25 contains the indirect, direct and total effects of the five independent variables (fear of crime, traffic safety, peer support, parental restriction, and perceived barriers) on physical activity level. All path coefficients included in the model were significant at the 0.05 level. All the five predictor variables had intermediate overall effects on physical activity level: fear of crime (19 percent), traffic safety (18 percent), parental restriction (13 percent), peer support (20 percent) and perceived barriers (12 percent); and all the effects were direct.

Table 4.25 Path coefficients of the independent predictor variables on Physical Activity Level (PAL)

Type of Effect	Crime		Traffic Safety		Parent Restriction		Peer Support		Perceived Barriers	
	Effect	(%)	Effect	(%)	Effect	(%)	Effect	(%)	Effect	(%)
Total	0.164	100	0.178	100	-0.128	100	-0.196	100	-0.121	100
Direct	0.194	118	0.178	100	-0.128	100	-0.196	100	-0.121	100
Indirect	-0.030	-18	0	0	0	0	0	0	0	

Table 4.26 shows only fear of crime had the overall effect of 25 percent on perceived barriers. This model indicated that fear of crime was a significant predictor for perceived barriers to engage in physical activity behaviour among adolescents.

Table 4.26 Path coefficients of the intermediate dependent variable, perceived barriers

Type of Effect	Crime		Traffic Safety		Parent Restriction		Peer Support	
	Effect	(%)	Effect	(%)	Effect	(%)	Effect	(%)
Total	0.248	0	0	0	0	0	0	0
Direct	0.248	0	0	0	0	0	0	0
Indirect	0	0	0	0	0	0	0	0

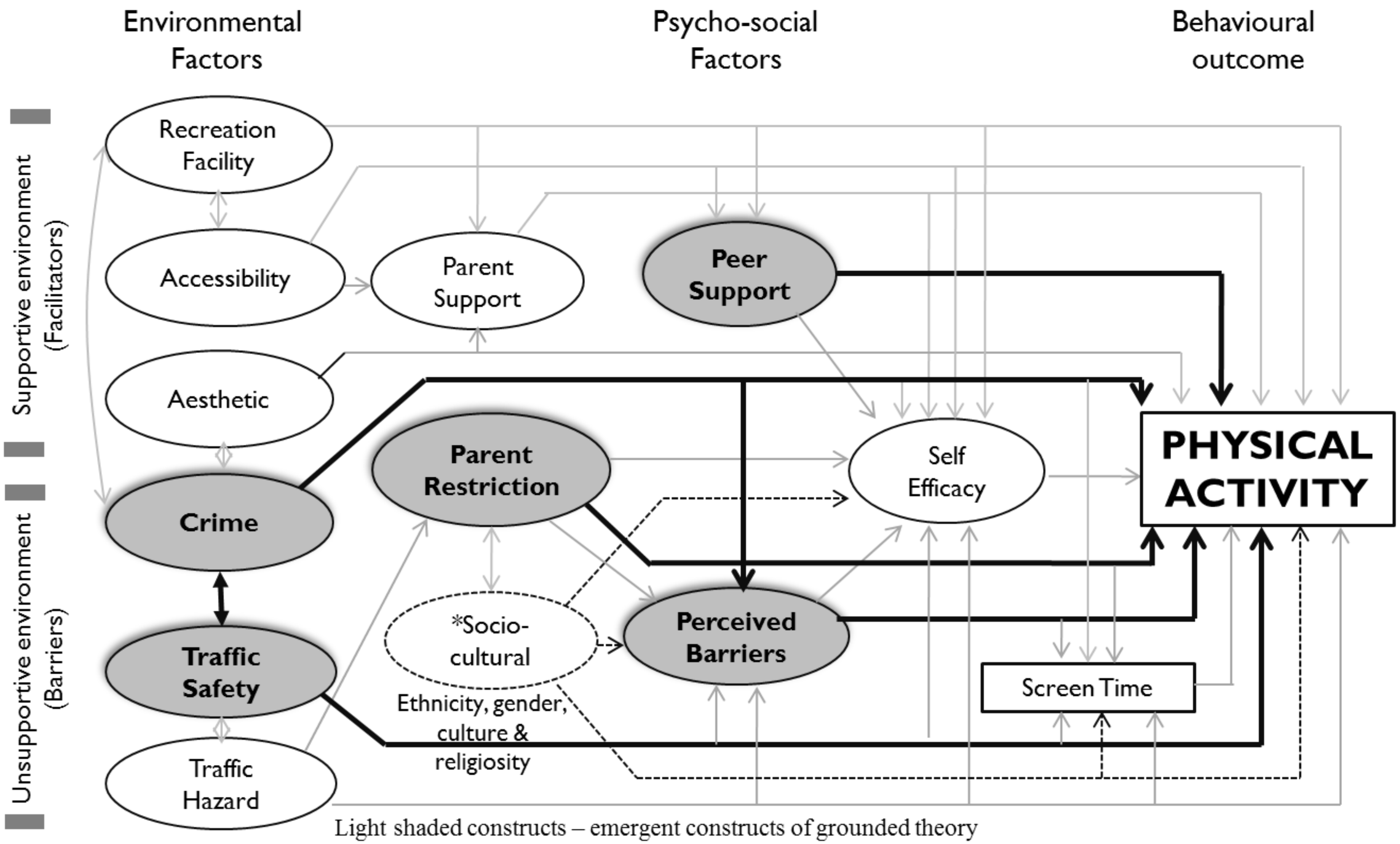
Overall, the final model consisting of five significant constructs: fear of crime, traffic safety, parental restriction, peer support and perceived barriers accounted for 11 percent of the total variance in adolescent physical activity level (R^2=0.11). The variance explained for the intermediate dependent variable (perceived barriers) was 6 percent (R^2=0.06). The final model also identified that traffic safety and crime negatively intercorrelated (β=-0.254, p=0. 011, 95% CI -0.398, -0.095).

4.3 SUMMARY OF MIXED METHODS FINDINGS ON FACTORS INFLUENCING ADOLESCENT PHYSICAL ACTIVITY

Physical inactivity was found to be common among adolescents in Kuching, Sarawak. Factors against adolescents being physically active in the neighbourhood were explored using a mixed methods research. The Phase I study using qualitative grounded theory searched for domains that influence physical activity among adolescents. The *photovoice* discussion recruited 22 adolescents and 8 parents. Seven major themes, 16 concepts, 342 codes in adolescents and 647 codes in adults emerged from 151 photographs. The Phase I study produced an abridged theoretical framework in which the researcher proposed 12 constructs to influence adolescent physical activity. The constructs include; fear of crime, traffic safety, recreation facility, accessibility, aesthetics, parental restriction, parental support, cultural sanctions, pees support, perceived barriers, self-efficacy and screen time. The central theme was “feeling unsafe” when being outdoors.

The Phase II study developed a survey instrument based on the 12 constructs proposed by the qualitative study. The instrument underwent test-retest reliability and factor analysis procedures using a sample of 116 adolescents in EFA and a sample of 150 in CFA. The final version of the instrument retained 11-factors /42 items. The deleted items had the issues of cross-loading, low loadings (less than 0.40) or were ambiguous. The survey instrument was administered on 443 adolescents to generalise the domains of the abridged theoretical model generated in Phase I. The structural equation model supported five out of 12 tested constructs. Unfortunately, the socio-cultural constructs were not tested because the measures for Asian populations are still unavailable.

Figure 4.15 shows five significant predictors (shaded), which are fear of crime, traffic safety, peer support, parent restriction and perceived barriers. Fear of crime has an indirect effect on physical activity through perceived barriers. Fear of crime is also interrelated with traffic safety and combined their direct effects on adolescent physical activity. Parental restriction and peer support are stand-alone predictors of adolescent physical activity.



Light shaded constructs – emergent constructs of grounded theory
Dark shaded constructs – emergent constructs of grounded theory supported by structural equation modeling
— Significant relationships
Note: Descriptively assessed but not assessed in structural equation modeling

Figure 4.15 Abridged theoretical model factors explaining adolescent's participation in physical activity

This study ensured trustworthiness of the data and its interpretation through triangulation of data (*photovoice*, focus group, in-depth interviews and questionnaire) and validity procedures. Participants' debriefing sessions and participant call-backs were performed to ensure the results of qualitative research were believable from the perspective of the participants in the research (Lincoln & Guba, 1985). In a quantitative study, structural equation modelling tested the abridged theoretical framework to ensure the results of qualitative research can be generalized or transferred to other contexts or settings.

Overall, this mixed methods research demonstrates the value of using formative research in assessing the role of individual, social and environmental factors on physical activity behaviour. There is reason to believe that adolescents are more vulnerable and may experience the social and neighbourhood environments differently than adults. This research contributed to the literature by identifying ecological factors such as street-crime, perceived barriers, parental restriction, and peer support, which may uniquely affect adolescent physical activity behaviour.

CHAPTER 5: DISCUSSION

The qualitative and quantitative results from this thesis yield several interesting findings. To review briefly, the main research questions addressed were: 1) What influences adolescents to become physically active in the neighbourhood? 2) How do factors / people / events interrelate in influencing adolescents' participation in physical activity?

In the first section of this chapter, the researcher discusses the patterns and physical activity levels, followed by demographic variables. The next section discusses the factors influence adolescent physical activity. These influencing factors are subdivided into direct effects and interaction effects. Also in this section, the core findings of qualitative and quantitative data are discussed concurrently. This is to reflect the flow of mixed methods design - how the data get connected or set in to answer research questions. The findings of the research were compared and contrasted with those of previous studies presented in the literature review. Next, the limitations and strengths of this research are discussed.

5.1 Descriptive findings

5.1.1 Pedometer-assessed physical activity levels

The present research found about four percent of boys and five percent of girls met the pedometer step count recommendations of 15,000 steps/day for boys and 12,000 steps/day for girls (Tudor-Locke et al., 2004). The median daily steps was 6,225 (IQR=2,917). The boys had significantly more daily steps (median=6,556, IQR=3,923) than the girls (median=6,147, IQR=2,518). This is supported by Malaysian current evidence (Dan & Mohd Nasir, 2008; Kirby et al., 2011; Santos et al., 2009; Seabra et al., 2011; Slater et al., 2010)

Wilson (2008) reported about 11 percent of Malaysian urban girls (aged between 13 and 18 years old) met the recommended step count. Wilson's study used a lower step recommendation of 12,000 in boys and 10,000 in girls. Adolescent girls in Wilson (2008) study recorded daily mean steps of 9,164 (±3,914). Meanwhile, Dan, Mohd, and Zalilah (2011) reported only three percent of Malaysian adolescents in Pahang achieved the high physical activity level category. Dan's study used a self-reported Physical Activity Questionnaire for Older Children (PAQ-C).

The small percentage of Malaysian adolescents meeting step recommendations in this study are comparable to American adolescents. About 6.1 percent of American adolescent girls, with a mean age of 12 (±0.96 years) exceeded the recommended 12,000 steps a day (Huiping & Gao, 2012). This American study used similar step recommendations as in the present study.

Higher levels of activity were reported among boys and girls from European and Western Pacific regions (Australia and New Zealand) (Beets, Bornstein, Beighle, Cardinal, & Morgan, 2010). For example, about one-third of Australian adolescent boys and girls satisfied the step recommendations. The mean steps/day collected by Australian adolescents were 11,865 (±3,997) in boys and 9,466 (±3,195) in girls (Lubans & Morgan, 2009). But these studies used lower step count recommendations (girls 11,000 steps/day and boys 13,000 steps/day).

In the current research, adolescent boys recorded a shortfall of 8,444 daily steps and adolescent girls required another 5,418 steps to achieve health gains. The shortfall in Malaysian boys is higher than those reported in Singapore, but the shortages in girls are comparable to those of Singapore adolescents (Chia, 2010). Singaporean adolescents aged 13 to 16 years old have an average daily step count of 9,913 (±7,660) in males and 8,637 (±6,401) in females.

Obviously, direct comparisons across the studies for the physical inactivity index are difficult because of different step count recommendations and measurement tools used by researchers. Nonetheless, the present research estimates that about 91 percent of Malaysian adolescents may not gain health benefits from physical activity. The worldwide prevalence of a high physical inactivity index among adolescents, currently reported to be 80.3 percent (95% CI 80.1-80.5) (Hallal et al., 2012).

5.1.2 Patterns of physical activity levels

5.2.2.1 Weekdays versus weekends physical activity levels

The present research found that adolescents were significantly more active on weekdays than on weekends. The weekday physical activity levels peaked on Tuesday and Thursday, but slipped down steeply on weekends. This could be contributed by the school physical activity programmes. In Malaysian schools, besides participation in physical education sessions (scheduled once a week for 60 minutes), students are required to take part in at least one sport and one co-curriculum activity throughout the year. This is in line with the new “One-Student-One-Sport” (1M1S) school policy. 1M1S is organised after-school time, once a week and for 90 minutes (Sports Division

Ministry of Education, 2011). In the present research, the school time contributed up to 78 percent of the total step count. On the same note, a study conducted in the United States by Brusseau, Kulinna, Tudor-Locke, and Ferry (2013), reported that physical education provided the single largest source of physical activity during school for both boys (25 percent or 3,117 steps/day) and girls (23 percent or 2,638 steps/day). The present findings are also consistent with other research, which found adolescents to be less active during weekends (Duncan, Schofield, & Duncan, 2006; Duncan, Al-Nakeeb, Woodfield, & Lyons, 2007; Wilson, 2008).

Although school setting is the major source of physical activity, most adolescents still did not meet the health-related cut-off. Physical activity achieved in school needs to be supplemented by non-school time physical activity. The non-school (home and neighbourhood) setting is equally important and provides a unique period where adolescents have the discretion to choose their own activities (Stanley, Boshoff, & Dollman, 2013). Differing from organisational settings such as schools, neighbourhoods should be a more natural setting for active living and free play. They are shaped by the built environment and the social context and are the arena of everyday life for all citizens (World Health Organisation, 2010). The feasibility of neighbourhoods designed for physical activity behaviour is discussed further in the next section.

On the contrary, there was previous research reporting adolescents as being more active during the weekends than the weekdays (Devís-Devís et al., 2012; Sheu-jen et al., 2010). The difference in physical activity patterns across studies could be because of localised programmes and policies being implemented in the studied population.

5.2.2.2 Socio-demographic variables and physical activity levels

In terms of ethnicity, the present research found the Indigenous adolescents are the most active group followed by the Chinese and the Malays. This is because the Indigenous groups historically led an active and healthy lifestyle (Foulds, Bredin, & Warburton, 2011). In addition, they are more likely to have active commuting (Dogra, Meisner, & Ardern, 2010). In this research, the category ‘Indigenous’ is mainly represented by the Bidayuhs and the Ibans, widely known as the Dayaks. The term 'Dayak' refers collectively to non-Muslim or non-Malay natives of Borneo in general (King, 1993). The Indigenous people are traditionally characterized by cultural practices, such as headhunting, hunting, nomadic lifestyle, and gathering and living communally in longhouses (Maunati, 2005).

However, only a small proportion of Indigenous groups (6.6 percent) met the step recommendations. From the qualitative data, the researcher pointed out that the older generation of Indigenous people may be heavily involved in farming, but the younger generations are not. Adolescents are dutifully encouraged to study hard and excel academically so as not to perpetuate the poverty of their parents. This is especially a concern among Bidayuh parents because the Bidayuhs are one of the poorest ethnic groups in Sarawak (Minos, 2000). Secondly, certain types of physical activity are viewed to be inappropriate among the Indigenous groups. For example, the Indigenous people in the rural areas felt that jogging was an improper activity. A person who jogs in the neighbourhood could be labelled as “out of the ordinary” because there are many other worthy activities that can be done which give similar health benefits, such as gardening or farming. In general, younger Indigenous generations may be unable to keep to their ancestors’ healthy lifestyle. The influence of urbanisation (Chaolin, Liya,

& Cook, 2012) and acculturation (Yu & Zinman, 2007), such as modern transportation and entertainment are already affecting them. Indigenous adolescents spend less time in traditional physical activities, such as food gathering, hunting and dancing (Young, 2010).

In terms of gender, this research found that girls were significantly less active than the boys. The qualitative data provided some explanations for this variable, which is specific to Malaysian adolescents. The girls described some physical activities (for example football, and martial arts, among others) as being inappropriate for them. They were concerned about being labelled as “tomboy” or “masculine” if they took part in male dominated activities, such as football. The girls’ perspective about attending a gymnasium differs among the ethnic groups. The Muslim girls viewed going to the gymnasium as inappropriate for girls, thinking it “exposes” them to men or makes them “masculine”. Besides, most recreation or sports facilities in Malaysia viewed as culturally inappropriate for the Muslim girls (for example, mixed-sex swimming pools, gyms, and self-defence classes, among others) (Babakus & Thompson, 2012). Especially, in Malaysian culture, boys and girls do not mingle around freely to avoid any untoward relationships. In addition, adolescent girls were expected to fulfil a woman’s role – that is, to be responsible for household chores and tasks (Babakus & Thompson, 2012; Seo, Torabi, Jiang, Fernandez-Rojas, & Park, 2009).

This gender stereotyping, limits inter-gender friendships, and name-calling (Babakus & Thompson, 2012) convinced adolescent girls to take part only in culturally gender-appropriate activities. These activities are mainly low intensity activities, such as walking and dancing (Seabra et al., 2012). Similar to Olds et al. (2009), girls in the present research spent more time talking on the phone or texting, doing chores, playing with pets, playing board games (e.g. Scrabble), playing guitar, sewing, and selling vegetables in the market. Adolescent girls preferred indoor games partly to avoid the effect of sunlight on their skins. Culturally, girls with dark skin is considered “ugly”.

On the contrary, boys in the present research were significantly more active than girls during weekdays and school time. This finding recalls other studies’ findings (Olds et al., 2009; Slater & Tiggemann, 2011). The boys in the present research liked ball games that made them sweat. In addition, the boys had greater enjoyment of games and sports participation (Butt et al., 2011; Lee et al., 2010), and had fewer social, cultural/religious limitations (Berger & Peerson, 2009) compared to girls. In summary, descriptive statistics and qualitative findings of the present research suggest the potential of socio-cultural aspects such as ethnicity, gender and culture to play a part in adolescent girls becoming active.

5.2 Factors influencing physical activity among adolescents

An understanding of factors in influencing adolescent physical activity and how they interact is important to provide a novel point of intervention. The present research provided some support for the social ecological model predicted interactions between built environment and psychosocial factors in explaining physical activity among adolescents. Summarizing the findings, five significant factors were found: fear of crime, traffic safety, parental restriction, peer support, and perceived barriers.

5.2.1 Factors with direct effects influencing adolescent physical activity

5.2.1.1 Fear of crime

Fear of crime has been noted to be a bigger problem than the crime itself (Scarborough, Like-Haislip, Novak, Lucas, & Alarid, 2010), as it has been associated with social withdrawal, and poorer mental and physical health (Foster, Giles-Corti, & Knuiman, 2010; Scarborough et al., 2010). Supporting this notion, the results of this research show that fear of crime were the most important predictor to influence adolescent outdoor activities. This is contrary to Bauman et al. (2012) who reported perceived safety from crime is not associated with physical activity in the US.

The qualitative findings of the present research showed fear of crime was the main source of "feeling unsafe" when being outdoors. In addition, the qualitative findings of the current research revealed fear of crime was related to public drunkenness, stranger-danger, drug addiction, glue-sniffers, and juvenile delinquency. As stated by Ferguson and Mindel (2006), hearing news of crime either from relatives, friends, neighbours or from the media manifest the level of anxiety among individuals.

The fear of crime has gained importance as Malaysians' feelings of fear and anxiety about the personal safety of their children have increased during the past decade. In 2011, police records showed that 1,275 children aged 17 and below went missing while being outdoors. In 2012 (January to October) itself, the police recorded 1,177 disappearances of young children in the same age group (Royal Malaysia Police, 2012). Many parents traumatised by the seriousness of missing children in this country, which lead parents to restrict physical activity of adolescents, particularly unsupervised physical activity or active commuting in one's neighbourhood (Ding et al., 2012).

However, contrary to the hypothesis generated from qualitative results, the quantitative results in this research found a positive cross-sectional effect of crime on adolescent physical activity. This means when perceived neighbourhood crime is high, physical activity level is also high. This finding is inconsistent with previous studies that reported an inverse relationship between fear of crime and physical activity (Foster et al., 2010; Lorenc et al., 2012; Yu et al., 2011). There are several possible explanations for this result. First, adolescents may avoid activities in view of the criminal activities in their neighbourhood, but they do perform activities at school which contribute to their step counts. The pedometer data showed that the school step count was significantly higher than the non-school step count among adolescents.

Second, parents are more positive for adolescents to be more active in school rather than playing in the neighbourhood. Parents felt children are safer playing in the school compound than playing in the neighbourhood area. This indicates parents' preferences for supervised activities within the school boundary because adolescents are vulnerable to traffic and criminal dangers if they were outside. In addition, some parents from the qualitative study had suggested that parents should monitor their children's outdoor activities closely up to the age of 18 or until they enter university. This finding corroborated with a study by Gleave and Cole-Hamilton (2012) that reported 43 percent of adults felt children under the age of 14 should not be allowed to go out unsupervised. Another 22 percent of adults thought children should not venture out alone until they are 16 years old. U.S. parents cited that only children aged above 12, or those entering the seventh grade, could be allowed to walk or bike to school independently (Faulkner, Richichi, Buliung, Fusco, & Moola, 2010). Experts advise that most children are not ready to begin walking alone until age 10, due to their developing physical, cognitive and psychosocial abilities (Stewart, Vernez Moudon, & Claybrooke, 2012). In summary, in a situation where adolescents are vulnerable to crime and traffic safety, the finding of this research suggests for supervised activities to increase physical activity levels among Malaysian adolescents.

5.2.1.2 Perceived barriers

Perceived barriers, a key component of the Health Belief Model, are obstacles that people experience when engaging in preventive health practices, and are specific to that health practice (Ya-Wen et al., 2011). In the present research, perceived barriers were negatively associated with physical activity level. Previous literature suggests that the association between perceived barriers and physical activity has mixed results in adolescents, although such associations have been found to be consistent in children (Allison et al., 1999; Ya-Wen et al., 2011). The common barriers reported by adolescents based on qualitative analysis of the present study include fear of crime, traffic safety, lack of recreation facilities, far from facilities, animal threats; parental restriction, no friend to be active with and hot weather. These barriers seem to be consistent with Meyer, Sharkey, Patterson, and Dean (2013) who reported barriers such as unleashed dogs in the street, heat, bad weather, traffic, no streetlights, and no place like a park to exercise.

5.2.1.3 Self-efficacy

The present research found there was no association between self-efficacy and adolescent physical activity, which is in contrast to the widely-reported effect of self-efficacy on physical activity (Bauman et al., 2012; Craggs, Corder, van Sluijs, & Griffin, 2011; Dan & Mohd Nasir, 2008; Deforche et al., 2010; Lee, 2010; Van Der Horst, Paw, Twisk, & W., 2007). Self-efficacy refers to a person's belief or confidence in their ability to adopt physical activity consistently even in difficult circumstances (Bandura, 1997). Bandura (1997) indicated that individuals with high confidence in their ability to perform a given task would be more likely to engage in that task.

The non-significant association between self-efficacy and physical activity can be explained in part by the mediating effects of fear of crime on perceived barriers and physical activity. In the present research, fear of crime significantly heightens perceived barriers, instead of supporting one's self-efficacy to be physically active outdoors. There are another two assumptions for self-efficacy to be a predictor of physical activity behaviour (Bandura, 1994).

First, in self-efficacy theory, adolescents are viewed as being proactively engaged in their own development and exerting control over their thoughts, feelings, and actions to be active outdoors (Davidson et al., 2010). However, in the present research, this assumption was not supported. Both qualitative and quantitative data showed a strong influence of parental restriction on adolescents' outdoor activities. Adolescents have limited control over their thoughts, feelings and actions. For example, they were not allowed to be out unsupervised under the age of 18. Besides, cultural inhibitions controlled adolescent physical activity behaviour.

This suggests when studying self-efficacy, culture is an important thing to keep in consideration. According to Baines (2009), Asian countries are primarily collectivist in nature, where the people are less autonomous and not self-determined but instead controlled by external factors in their motivation (Abesha, 2012). Triandis and Suh (2002) stated that people in collectivist cultures see the environment as fixed and themselves as changeable, ready to “fit in”. For example, among the Indigenous, there is a resilient structure of strong social relations that facilitates a system of labour cooperation, kinship relations, and social relations which control individual’s behaviour in that community (Maunati, 2005). Thus, the individual focuses on how to change themselves and improve the fit between the self and the demands of the social environment (Triandis & Suh, 2002).

Second, there are four sources of self-efficacy; namely mastery skills, social models, social persuasion and positive mood (Bandura, 1994) being unfulfilled in the present research. The quantitative data show that, except for peer support, the main sources of adolescent self-efficacy, such as parental support, facility availability and accessibility to facilities, were not associated with physical activity. The social and physical environment seems to be not supporting adolescent self-efficacy to be physically active in the neighbourhood. Again, according to Bandura (1997), having low self-efficacy in such an unresponsive environment may aggravate the feeling of apathy and helplessness. Hence, adolescents may opt for indoor activities rather than being active outdoors. This finding was supported by Shores et al. (2010). Shores and colleagues identified low self-efficacy, low social support, and no access to physical activity areas as being related to lower levels of physical activity participation among rural youth.

In conclusion, this finding suggests physical activity self-efficacy may be less relevant in Malaysia compared to in Western cultures. Malaysian adolescents conform to and fit into familial and societal norms. Moreover, fear of neighbourhood crime low the confidence level to perform physical activity and benefits of being active outdoors.

5.2.1.4 Parental restriction

Another hypothesised variable proposed by the qualitative grounded theory in this research and supported by the structural equation model is parental restriction. In this research, parental restriction on outdoor activities is negatively associated with physical activity levels. This finding is in agreement with Carver, Timperio, Hesketh, and Crawford (2010), which showed that parent-constrained behaviour resulted in lower levels of active transport and of moderate-vigorous physical activity outside school hours among adolescent girls in Australia.

As adolescents, particularly girls, are prime targets (Ferraro, 1995), most parents – especially mothers – employed a few strategies to reduce “outdoor risks” on their children and to ease their fear of crime. First, parents commonly employed “scare tactics”, such as spinning ghost stories to make them timid and docile; therefore discouraging them from venturing far or engaging in dangerous outdoor activities. This is culturally unique to some Malaysian communities. Second, similar to Ferraro (1995), parents limited the time, place and frequency of outdoor activities and provided children withh mobile phones. Third, since parents felt that being at home was safer, parents allowed adolescents to indulge in media entertainment. As a result, adolescents in this research were noted to spend an average of 3.22 (± 1.86) hours per day on screen time, which is above the cut-off point of less than two hours/day (Tremblay et al., 2011).

However, the structural equation model failed to establish relationships between screen-time and physical activity levels.

In this research, parental restriction towards adolescent physical activity hypothesized to be mediated by fear of crime. Nevertheless, the structural equation model failed to support this proposition. This signals parental restriction as a stand-alone predictor of adolescent physical activity. Culturally, Malaysian parents tend to be protective of their children's safety. Parents are strict and demanding, make most of the decisions for their children and expect them to be followed without any questions. This is the most basic and traditional parenting technique where the families are adult centred (Tam, Chong, Kadirvelu, & Khoo, 2012) practiced in Malaysia. Amongst Malaysian parents, firm control is not considered as a negative style of parenting (Keshavarz & Baharudin, 2012), especially when a child's safety is a top priority. This is partly because the emotional ties between children and parents remain strong even during adolescence (Heng-Chieh & Van Egeren, 2010).

5.2.1.5 Traffic safety

Neighbourhood streets always offer children of all ages endless opportunities to play outdoors. Residential streets as play spaces for children provide the sense of independence and spontaneity which is an important preparation for adult life (Tranter & Doyle, 1996). Similarly, the qualitative data of this research show that streets were commonly used as a "play space" in the neighbourhood among adolescents. The most frequent physical activity performed on the streets includes badminton, skateboarding, street soccer and football. This finding was also shared by previous studies (Carlson et al., 2011; Sugiyama, Leslie, Giles-Corti, & Owen, 2009).

As neighbourhood streets are commonly used as a “playground”, traffic safety was a generalised concern affecting adolescent participation in physical activity. The qualitative and quantitative data from the current research reported the most common major problem reported was speed of traffic. This finding was supported by Nelson and Woods (2009) showing traffic speed and paths separated from the road were significant factors among female physical activity.

A few reasons for the common use of streets for play space were explained by the qualitative data. First, the availability of physical activity facilities is lacking in the neighbourhood. Even though boys could use a proper playing field for football games, the facility could be too far from their home, or facilities perceived as unsafe. For example, playing fields were reported to be “carpeted” by thorny creepers (*mimosa pudica)* and sharp objects (broken bottles, construction debris etc.), making it unsafe to use them. For girls, facilities such as football playing fields only suit the boys, while equipped playgrounds only suit the younger children. Second, parents usually restrict adolescents from venturing far from the house. Thus, the immediate and convenient place for physical activity was the neighbourhood streets near home. Also the presence of pedestrians and seeing other people being active in a neighbourhood may correlate with the use of streets near home for recreational physical activity (Sugiyama et al., 2009).

5.2.1.6 Peer support

Adolescents spent increasing time with peers, intensifying the potential for the norms and behaviours of peers to influence their physical activity levels (Duncan, Duncan, Stryker, & Chaumeton, 2002). This is true in the present research. Peer support was positively associated with physical activity as revealed by qualitative and quantitative data where, especially for adolescent girls, friends are needed when being outdoors partly to lessen the fear of crime. According to Fitzgerald et al. (2012), peer and/or friend domains may be related to physical activity behaviours through peer norms, peer acceptance and friendships, peer crowd affiliation, and peer victimisation among adolescents.

5.2.1.7 Screen-based media entertainment

Screen-based media entertainment consistently emerged as an important construct in the present qualitative study. Adolescents commonly used screen-based media entertainment, such as *Facebook* to relieve boredom, share jokes and exchange gossip. They also engaged in various electronic games on portable devices, such as personal game consoles and smartphones. Thus, it is not surprising that for both boys and girls exceeded the screen-time guideline of no more than two hours a day (Tremblay et al., 2011). However, the structural equation model in this research found no significant associations between screen-based media entertainment and adolescent physical activity.

Similarly, Fakhouri, Hughes, Brody, Kit, and Ogden (2013) found no association between reported physical activity levels and the amount of time spent on screen-based sedentary behaviours. Fakhouri et al. suggested that screen time viewing and physical activity may be two separate constructs and that low levels of screen-time viewing do not necessarily predict higher levels of physical activity among adolescents. In another large prospective cohort study of US children and adolescents, Taveras et al. (2007) found that TV viewing was not associated with changes in physical activity. Taveras et al. also suggested health programmes to intervene to reduce sedentary behaviour and increase physical activity should be two separate foci of behaviour change interventions.

However, Melkevik et al. (2010) in their cross national investigation from 39 countries in Europe and North America, suggested the time spent playing video games displaced physical activity in adolescent males, but not females. This study was further echoed by systematic review findings by Costigan et al. (2012). Costigan et al. identified a consistent inverse association between screen time and physical activity among adolescent girls.

Contradicting findings could be related to the use of screen time measurement as a surrogate for total sedentary behaviour. Olds, Maher, Ridley, and Kittel (2010) argued that screen sedentary time should not be substituted with non-screen sedentary time (e.g. reading, sleeping). The energy demand of screen sedentary time (mean = 1.3 METs) is estimated to be lower than non-screen sedentary time (mean = 1.5 METs). Additionally, non-screen sedentary time is often considered to be more socially valuable than screen sedentary time (Olds et al., 2010).

5.2.2 Interaction among factors

5.2.2.1 Interrelationship between fear of crime and traffic safety affecting physical activity

The majority of the participants in the qualitative study have been the victims of street crime such as snatch-thieves. The structural model of the present research confirmed this finding. Fear of crime is negatively interrelated with traffic safety in their effects on adolescent physical activity. This suggests that fear of "street crime" is the main reason against adolescents being physically active outdoors. According to Loukaitou-Sideris and Eck (2007) since significant portions of walking and cycling take place in neighbourhood streets, the physical characteristics of a setting can affect fear of crime.

The qualitative findings of the present research identified the main source of fear of street crimes was from seeing strangers. These strangers were short-term tenants in the neighbourhood who were working, doing businesses, or studying. Hunter and Baumer (1982) stated that an increased number of strangers on the street, may heighten the fear of crime. Being alone in a setting can produce stress and fear, but the presence of others can also be threatening, if they are of different race, gender, and class (Hunter & Baumer, 1982; Loukaitou-Sideris & Eck, 2007).

Loukaitou-Sideris and Eck (2007 pointed out that fear-inducing factors in neighbourhood streets include darkness, desolation, lack of opportunities for surveillance of the general public, lack of maintenance, and poor environmental quality. In particular, Loukaitou-Sideris and Eck (2007) explained there are two categories of spaces noted to be particularly frightening. These spaces include: (1) enclosed spaces with limited exit opportunities, such as multi-storey car parks, underground passages, and subway stations; and (2) anonymous and deserted open spaces, such as empty parks, forests, recreational areas, and desolate transit stops. Bus stops and large parks are more crime-ridden than other public facilities (Loukaitou-Sideris & Eck, 2007).

5.2.2.2 Perceived barriers as partial mediator between fear of crime and physical activity

Assessed by the structural equation model, the researcher found that fear of crime had a significant indirect effect on physical activity through perceived barriers. This finding supports the principles of social cognitive theory. Social cognitive theory described the triadic reciprocal determinism involving the environment, person, and behaviour (Motl et al., 2005). The influence of the perceived physical environment on physical activity is likely to be mediated by personal variables, such as self-efficacy (Motl et al., 2005) and perceived barriers (obstacles) (Rye, Rye, Tessaro, & Coffindaffer, 2009). Essentially, there are bidirectional direct and mediated effects among environmental (fear of crime), personal (perceived barriers), and behavioural variables (physical activity levels) and the mediation interaction of the present research is consistent with such a notion (Bandura, 2004; Motl et al., 2005). In the present research, perceived barriers were a direct predictor and partial mediator between fear of crime and physical activity with a total variance of six percent. The variance of the present research was higher than the variance reported by Duncan et al. (2012). Duncan et al. reported that perceived barriers accounted for 3.7 percent of the variance. In general, perceived barriers explain less physical activity behaviour compared to self-efficacy (30 percent) (Foley et al., 2008).

In summary, the mediation patterns in the present research showed that fear of crime was mediated by perceived barriers to influence adolescent physical activity. This interaction is infrequently reported in the literature, so needs to be replicated in future studies. Most studies from Western countries reported the positive role of self-efficacy instead of perceived barriers. This could be because their social environment (Fitzgerald et al., 2012; Kim & Cardinal, 2010; Lee, Loprinzi, & Trost, 2010) and physical environment (Davidson, Simen-Kapeu, & Veugelers, 2010a; Dowda et al., 2012; Mota, Almeida, Santos, & Ribeiro, 2009; Nelson & Woods, 2010; Ries et al., 2009) were in support to adolescents' self-efficacy to carry out physical activities.

Overall, the qualitative and quantitative findings of the present research identified five significant predictors of adolescent physical activity: 1) fear of crime; 2) traffic safety; 3) parental restriction; 4) peer support; and 5) perceived barriers. Two constructs, namely fear of crime and traffic safety, were interrelated in their effects on adolescent physical activity. The effect of fear of crime on adolescent physical activity was partially mediated by perceived barriers.

5.2.3 Total variance explained by five significant variables

Although the present research combined and included a wide range of social ecological constructs, the structural model explained about 11 percent of the total variance. The structural model supported five influencing factors (traffic safety, crime, peer support, parental restriction and perceived barriers) on physical activity. The total variance of the current research is comparable to other studies that assessed multifactorial correlates of physical activity. A study conducted in Singapore by Lee et al. (2010) assessed the psychosocial and environmental factors among 1,814 Singaporean adolescents, and reported a small variance in physical activity behaviour; 10 percent in boys and eight percent in girls. Self-efficacy, enjoyment of physical activity, parental support, and participation in sports teams were found to be significant correlates of physical activity. This study, however, used 3-day physical activity recall as a measurement tool of physical activity level. One reason for low *R*-squared was that other salient variables (such as land use policies and friendliness of community design) were not being assessed. In the present quantitative study, the structural equation model did not assess socio-cultural domains, which could have reduced the total variance.

Another study that combined social-cognitive constructs with pedometer-assessed physical activity levels reported an even smaller proportion of the variance in physical activity behaviours (two percent) (Ramirez et al., 2012). Four of the constructs (self-efficacy, outcome expectations, social support and goals) were found to be predictors of physical activity. Another study assessed social cognitive constructs and also reported little variance (nine percent) in self-reported moderate-to-vigorous physical activity (Martin, McCaughtry, & Shen, 2008). These studies justified their low *R*-squared due to limited constructs being investigated within the scope of social cognitive theory.

Other studies in the USA reported a seven percent to 16 percent variance explained for pedometer-assessed physical activity (Morgan et al., 2003). Similar variance of 16 percent was reported in Australia a (Lubans & Morgan, 2009). Both studies claimed that correlates have more explanatory power for vigorous physical activity measured by self-reported physical activity recall questionnaires than physical activity measured by accelerometer (Lubans & Morgan, 2009; Morgan et al., 2003). This indicates that self-reported physical activity and correlates may explain inflated associations (Lubans & Morgan, 2009).

Despite using different measurement tools, most studies assessing multifactorial correlates consistently report a small *R*-squared. However, according to Newman and Newman (2000), replicability is more useful that mere significance and the focus should be on the determinants of *R*-squared rather than in *R*-squared itself. The term *R*-squared refers to the fraction of variance explained by the model, also referred to as the coefficient of determination (Hair et al., 2010). In addition, in the social sciences, the predictor variables have small effects (Newman & Newman, 2000).

5.3 Limitations and strengths

Interpretation of the findings of this research should be considered because of several limitations. First, the sample was restricted to participants of one state in Malaysia. The findings might not be generalisable to other adolescents from other states in Malaysia. In addditition, the research was conducted among adolescents of Form One and Form Two, attending the afternoon school sessions[5]. The afternoon school session begins at 12.45 noon and ends at 6.00 pm, limiting the window period of leisure physical activity. It is unlikely for this group to be active in the morning (before school) as they need to finish their school work and make the journey to school. Neither can they be active in the evening after school, as some students live a long-distance from school; they arrive home around 7.00 or 8.00 pm. Future studies should, therefore, include samples from the morning sessions to detect differences in physical activity outcomes.

Second, in grounded theory, the snowball sampling technique, where friends recruited friends could lead to "premature" theoretical saturation. Adolescents were required to take photographs within a one kilometre-radius of their neighbourhood. There was a possibility they moved around in a group, took similar pictures and provided similar themes. In grounded theory, when no more new themes emerge, theoretical saturation is assumed, as in this research.

The quantitative study suffered from a large number of missing pedometer data and the unusual distribution of the physical activity variable, which were dealt with log transformation and bootstrapping. Replacement with the mean was not attempted to minimize heteroscedastic error (Schreiber et al., 2006). According to Cheng (2012)

[5] Malaysian schools applied two-session system. The lower secondary (Form 1 and 2) attends school in the afternoon.

when the disturbance process in a regression model entails heteroscedasticity, the standard inference procedure becomes invalid due to the inappropriate estimation of the standard error. Heteroscedastic data can cause ordinary least squares estimates of the variance of the coefficients to be biased, possibly above or below the true or population variance. Biased standard errors lead to biased inference, so the results of hypothesis tests are possibly wrong. The predictors for boys and girls could not be obtained because of sample size limitations. Future studies, therefore, should obtain larger samples of adolescents from a wider range of ethnic backgrounds.

Third, the structural model was unable to examine all constructs identified in the abridged theoretical model. Socio-cultural domains may be salient that would account for the variance in adolescent physical activity but these were not tested. Furthermore, in structural equation modelling, the use of incremental fit indices as “rules of thumb” to evaluate the model fit should be considered (Marsh, Hau, & Wen, 2004). The conventional cut-off point of > 0.90 may not work well with various types of fit indices, sample sizes, estimators, or distributors. Thus, when deciding on the validity of the model, researchers should consider other aspects such as the adequacy and interpretability of parameter estimates, model complexity, and theoretical issues underlying the posited model (Hu & Bentler, 1998; Marsh et al., 2004).

Fourth, the measurement of neighbourhood environment constructs is challenging, as the neighbourhood environment is contextual. Some adopted measures coming from developed countries might not reflect some local concepts. The results of exploratory and confirmatory factor analysis in the pilot study shows cross loadings. The number of large standardised residuals suggests the model may not accurately predict the relations among several pairs of items. The findings also do give some insight into the need for a shorter questionnaire.

Fifth, the use of pedometers and their inability to record activities such as cycling or water-based activities is a main limitation. Pedometers also were not worn during activities that involved body contact such as the martial arts (e.g. Taekwondo and karate), thus pedometer step count may underestimate the actual physical activity levels performed by adolescents in this study.

Finally, a comparison between studies using pedometer step counts is problematic due to different cut-off points. A standardized guideline has yet to be established for adolescents. The common use of BMI referenced standards for children's pedometer assessed physical activity (aged 6 to 12 years) set at 15,000 steps for boys and 12,000 steps for girls (Tudor-Locke et al., 2004) should be cross-validated on adolescents from other populations. Despite these weaknesses, there are still important findings that merit discussion.

One of the major strengths was the use of mixed methods design to tease out the complex nature of physical activity behaviour. The qualitative and quantitative studies compliment to each other by tightening its attention to measurement error, incomplete information, omitted variables, estimating the certainty of conclusions, and so on (Fielding, 2012). Statistical data can be dry, and a clip from *photovoice* data can bring the issue alive. Equally, qualitative data can be dense, and a statistic can provide focus. In the present research, the use of several methods of data collection such as *photovoice,* focus group discussions, in-depth interviews, and questionnaires provided a sense of completeness and confirmation. In this sense, the qualitative material can be useful in work for policy sponsors, where qualitative material can give policymakers a sense of the effects of policies in the real world beyond government (Fielding, 2012).

Integration is the heart of the mixed methods design because the purpose of mixing methods is to get information from multiple sources. This consequently increases the validity and reliability of studies through increased trustworthiness of the data and its interpretation (Halcomb, 2005). This can be achieved when the data are interpreted ‘‘blind’’ by several research team members before comparing and agreeing on interpretations of two researchers or more (Fielding, 2012). The present research recognized the contribution of qualitative data as vital to an analysis that also draws on a survey.

The grounded theory gave the opportunity to “ground” the theory within the marginalized adolescent population. The aim was to honour the voices of participants and map the complexity of physical activity behaviour. *Photovoice* data collection technique was noted to be capable of capturing adolescents’ voices and adding to research rigour. Subsequently, the structural equation modelling provided a substantial theory building technique to understand the relationship among variables to support the story proposed by grounded theory.

The use of a pedometer and its strict inclusion criteria (required at least two weekdays and two weekend days of pedometer counts) was a strength of this study. Although the strict inclusion criteria reduced the sample size, it is likely to improve precision since there would be reduced measurement error.

CHAPTER 6: CONCLUSION

In this chapter, the findings are summarized and their implications discussed. This section includes suggestions for future research.

6.1 Review of main findings

This research updates and provides insights into the nature and complexity of Malaysian adolescents' physical activity behaviour. Physical inactivity is common among adolescents in Kuching, Sarawak, especially during non-school time and on weekends. A theoretical framework formulated in this research served as a general framework to tease out individual, social and environmental factors influencing adolescent physical activity behaviour. The abridged theoretical model generated from the qualitative study proposed 12 factors. The structural model in the quantitative phase supported five influencing factors: perceived neighbourhood crime, traffic safety, parental restriction, peer support and perceived barriers. Parental restriction and peer support are stand-alone predictors of adolescent physical activity.

Perceived barriers mediated the effect of fear of crime on physical activity, while fear of crime was interrelated with traffic safety. The sources of fear of crime are many such as abduction, rape, murder, drug addicts, drug trading, bullying, and gangsters. In confirmation, the structural equation model interrelated fear of crime with traffic safety, suggesting a construct of fear of "street crime". This shows how structural equation models can provide a focus to qualitative data. However, the structural model of the present research identified a positive relationship between fear of crime and physical activity. Adolescents accumulate less physical activity in the neighbourhood but collect more during school time, suggesting the importance of school physical activity to top up neighbourhood physical activity. This research found that self-efficacy has no impact on physical activity, which is unique to Malaysian adolescents. These results have not previously been described elsewhere.

The quantitative results provide a strong confirmation of the qualitative findings through triangulation and elaboration of the constructs and their interrelationships in the emergent theory. This research offers theoretical implications and suggestions for future research, guiding principles and actionable recommendations. The findings may benefit health planners and various authorities, such as town and urban planners, and local governments as discussed next.

6.2 Contribution to theory and practice

Healthy children and adolescents are the foundation for a healthy nation. This subsection highlights three major contributions of the present study; 1) community-based interventions, 2) salutogenic approaches of health, and 3) school-based interventions.

6.2.1 Community-based intervention

In the present research, the interrelationships among variables (fear of crime, traffic safety, and perceived barriers) affecting physical activity suggest the point of intervention should target reducing fear of neighbourhood crime. Ferraro (1995) indicated the most widely accepted premise for fear of crime has centred on reducing crime in the community. According to Hedayati Marzbali, Abdullah, Razak, and

Maghsoodi Tilaki (2012) crime offenders prefer to commit criminal acts in places with less surveillance, lower access control, lower territoriality, and lower maintenance. Thus, the Crime Prevention Through Environmental Design (CPTED) has been identified to be one of the most influential and effective tools used in developed countries (Lorenc et al., 2012). CPTED is developed on the basic hypothesis that the proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime. CPTED is based on four dimensions: natural surveillance, natural access control, territoriality and maintenance.

However, in Malaysia, Hedayati Marzbali et al. (2012) found no direct significant relationship between CPTED and fear of crime. A negative indirect relationship between CPTED and fear of crime was observed through victimisation. This suggests that CPTED has indirect positive effects on the built environment, leading to a reduction of fear of crime through the reduction of victimisation. Another study by Abdullah, Salleh, and Sakip (2012) reported Malaysians who occupy individual gated residential areas demonstrate a higher fear of crime when compared to their counterparts who live in non-gated residential areas. This situation is believed to be linked to factors involving community relations, lifestyle and the surrounding environment, which all influence the fear of crime. To make matters more complex, it could be possible the fear of crime is unintentionally heightened by crime prevention strategies, as they serve to remind people of their vulnerability (Crawford, 1998).

According to Loukaitou-Sideris and Eck (2007), if people adopt sedentary habits because they are fearful of using a place, these habits are hard to break, as rehabilitating a place in the minds of the public is difficult. Thus, it is unsurprising, the preliminary approaches (e.g. CPTED and gated residential) to alleviate fear of crime among Malaysians have limited success.

Besides the difficulty to intervene to reduce fear of crime in the neighbourhood, the difficulty of inducing population-level change in physical activity is further addressed by Bauman, Murphy, and Matsudo (2013). After a decade since the 1996 Surgeon General's Report on Physical Activity and Health, the prevalence of physical activity among Americans remained essentially unchanged. A rare example of successful community-wide efforts to increase physical activity participation resulted from the Canadian ParticipACTION initiative. This intervention combined social marketing, worksite, school, and health sector programs with policy links to health, sport, and recreation over three decades. However, these massive multi-sectoral and sustained efforts to change population physical activity produce up to a one percent increase in participation each year (Bauman et al., 2013).

Another Cochrane Review conducted by Baker, Francis, Soares, Weightman, and Foster (2011) found no multi-component community-based interventions capable of increasing population levels of physical activity. This review included only trials with a minimum follow-up of 6 months. Reviewed interventions included environmental changes (10 studies), building partnerships with local governments or NGOs (22 studies), health education (18 studies), mass media and other forms of communication (25 studies). This review found noticeable inconsistency of the findings of the available studies and methodological issues within the included studies, which confound the findings.

No doubt the literature on physical activity interventions is still in its early stage (Sallis, Millstein, & Carlson, 2011), but there is a critical challenge to promote physical activity at community level. Especially in Malaysia, the main source of physical inactivity was related to fear of street crime. Child abduction rates are high in Malaysia and such crime is likely to make a bigger impact on people over a longer period (Ferraro, 1995), affecting health and well-being (Lorenc et al., 2012).

6.2.2 Salutogenic approaches to promote physical activity

One way to solve this problem is to consider salutogenic approaches of health (Antonovsky, 1996). Historically, approaches to promote population health have been based on a deficit model, which defines communities and individuals in negative terms, neglecting what is positive and works well in particular populations (Morgan & Ziglio, 2007). The salutogenic approach, as an asset model, focused on producing health, as opposed to pathogenesis which analyses the causes of sickness and death (Charlton & White, 1995). Assets are the necessary building blocks for adolescents. For example, adolescents need to be active and eat dairy products to have strong bones, and, similarly, adolescents need opportunities for skill development to gain a sense of self-efficacy. These developmental assets can be external dimensions that comprise the young person's environment, such as positive relationships in families, peer groups, schools, and the community. The more assets youth possess and have available to them, the less likely they are to engage in "risky behaviours" and the more likely they are to engage in healthy and positive behaviours (Perkins, Borden, & Villarruel, 2001).

Ward Thompson (2013) stated there is a renewed interest in the physical environment focused on identifying and understanding salutogenic environments. Recognising environments that support healthy behaviours and responses may have more permanent and population-wider effects than other forms of public health intervention targeted at individuals (Antonovsky, 1996). Thus, it is an asset to continue and strengthen the agenda of the Kuching Healthy City in Sarawak. The Kuching Healthy City programme was started in 1994 (Sarawak Planning Unit, 2002). The idea of Healthy City is harmonised with the salutogenic approaches (Antonovsky, 1996). Healthy city is defined as a "City that improves the quality of life of its citizens" (Sarawak Planning Unit, 2002). This World Health Organisation's Healthy Cities Project is a long-term development project that seeks to improve the physical, mental, social and environmental well-being of the people who live and work in urban areas (Werna & Harpham, 1996). The healthy city idea refers to involving built environment and community participation in creating a sustainable development (Pathak & Dongre, 2011). Built environment refers to the man-made surroundings modified by humans, such as homes, workspaces, schools, parks, recreation areas, business areas and roads (Handy et al., 2002). These built environmental aspects heavily influence physical activity and human behaviour (Handy et al., 2002; Pathak & Dongre, 2011).

Therefore, for adolescents to be active, the researcher proposes that government official, national and local leaders of youth programmes, and policy makers should consider adolescents' need for gender- and age-specific physical activity facilities. Nonetheless, these facilities may only be utilised provided adults are available to supervise the place and its activities. This is where community members, especially parents, can wisely invest their resources to provide their young people with opportunities to connect to others and develop skills, and a way to contribute their time, talents, and skills to their community.

6.2.3 School-based physical activity interventions

Besides the family, no other social institution has greater influence on the lives of adolescents than schools. The current school-based physical activity programmes in Malaysia contributed up to half of the adolescents' recommended daily physical activity. According to a Cochrane review carried out by Dobbins, Husson, DeCorby, and LaRocca (2013) there is good evidence that school-based physical activity interventions are effective in increasing the duration of physical activity. Other past research also supported the effect of school programmes on physical activity (Taverno Ross, Dowda, Colabianchi, Saunders, & Pate, 2012; Trost, Rosenkranz, & Dzewaltowski, 2008), affecting variables which include improved fitness outcomes and motor skills, and reduced cardiovascular disease risk factors (Heath et al., 2012; Kargarfard et al., 2012).

Most important, engagement in school physical activity is effective in easing parent safety concerns about traffic and crime outside the school compound (Stewart et al., 2012). In Western countries, there is a trend to share school sport and recreational facilities, which may be worth implementing in Malaysia. A single school session, for example, may allow community members to use a track, or basketball court free when school is not in session in the afternoons or on weekends. In most communities, schools are centrally located within a community and have facilities such as sports fields, courts, tracks, or indoor and outdoor facilities. These facilities are cost-effective ways to promote physical activity among residents of all ages (Active Living Research, 2012) and are likely to enhance physical activity participation among community members (Evenson, Wen, Lee, Heinrich, & Eyler, 2010).

6.3 Future studies

The findings of current the research suggest the need to consider the physical environment affecting adolescent physical activity. These findings require the contribution of the integrated multifactorial model to understand the transactional relationship between person and place. However, little research was specifically done to justify how much of an environmental barrier is sufficient to deter adolescent activity; and how much of an environmental supportiveness or attraction is necessary to produce new levels of physical activity. According to Ward Thompson (2013), if individuals are to be encouraged to engage more in physical activity, then it is precisely in this kind of area that good theory, as well as evidence from interventions, is needed.

Another consideration for future research is on adolescents' motives for their leisure time behaviour. Examination of the motives for leisure time activity could help to clarify whether sedentary entertainment is popular because of outdoor physical activity is dangerous, or whether adolescents prefer those pursuits because of their inherent interest.

In the present research, the constructs emerged from the qualitative study inevitably identified the negative variables as the major factors influencing physical activity. This limit the wide range of factors that have been shown to promote participation in physical activity, such as fun, enjoyment, skill development, and being with friends. These factors may throw further light on the relative roles in explaining physical activity behaviour among adolescents.

It may also be interesting to investigate the decline of physical activity among young Indigenous groups. The Indigenous groups of Malaysia represent around 12 percent of the 28.6 million people in Malaysia (International Work Group for Indigenous Affairs, 2013). In Sabah and Sarawak, the Indigenous groups make up around 50 percent of each State's population. Indigenous peoples have their own distinct cultures, social and political institutions that are very different from those of mainstream society.

6.4 Conclusion

The findings of this research suggest new ways to understand the impact of environment on psychosocial factors and adolescent physical activity in a developing nation. First, the interrelationship between fear of crime and traffic safety suggests that fear of "street crime" is the major factor militating against adolescents being physically active outdoors. Second, perceived barriers mediated the effect of fear of crime on physical activity. In this situation, perceived barriers outweigh the role of self-efficacy or adolescents' confidence to be active outdoors. Third, the findings show a positive direct relationship between fear of crime and physical activity levels. School physical activity is effective in increasing physical activity levels among adolescent. Opening the school sport and recreational facilities to public can be a cost-effective way to promote physical activity among residents of all ages, especially adolescents. This approach is in part of the salutogenic asset model of health, examining factors that support human health and well-being, rather than on factors that cause diseases. The findings of this research suggest the unique needs of Malaysian adolescents should be considered while planning interventions. Overall, this research highlights a recurrent finding: the physical environment is significant and plays an important role in influencing psychosocial factors, including moderation of adolescents' barriers to be active.

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Appendix A: Research Information and Consent Form

RESEARCH INFORMATION & CONSENT FORM

Physical Activity Research for Adolescents

Faculty of Medicine University of Malaya

Socio-Environmental Factors, Physical Activity and Adolescents' Body Weight

Background

Physical inactivity increases the risk for developing chronic diseases such as heart attack, diabetes, hypertension, stroke, and colon cancer without age limit.

Malaysian prevalence of physical inactivity among children is 17.6% to 35% and dramatically dropped at adolescent's age. This trend may be going unnoticed by parents and caregivers.

Recent health promotion approach suggested the need to shift from focusing on individual characteristics to social and environmental context of behaviour. Neighbourhood design, traffic safety, access to green spaces and recreation locations has been recently recognized as an important determinants to physical activity in developed countries but still unknown in Malaysia.

Purpose of Study

This study aims to examine personal, social and environmental aspects associated with adolescents' engagement in physical activity.

The participants

This study would recruit adolescent aged between 13 to 15 years old <u>and</u> his/her parent.
(Adolescent on medical treatment for serious illnesses SHOULD NOT enter this study).

Study procedures

<u>Adolescent</u> is required to;
1. Answer a set of questionnaire (in school),
2. Weigh height and weight (in school),
3. Wear a pedometer for 7 days, and
4. Fill up an activity diary for 7 days.

<u>Parent</u> is required to answer a set of questionnaire.

Benefits of study to you

Both parents and adolescent will be informed about their physical activity level and body mass index for preventive purposes. In cases where preventive measures cannot totally overcome the influence of hereditary factors, parent education on building self esteem and psychological issues should be addressed.

The findings of this study can prompt the authorities to shape policy on obesity preventive measures that include personal, social and physical environmental aspects particularly in the neighbourhood setting.

Possible drawbacks / risk

There is no foreseeable risk for participating in this study.

Can I refuse to take part in the study?

Your participation is on voluntary basis and you may refuse to participate from the study at any time.

Contact the Researcher

Rosalia Saimon Telephone: 013 8168771
Department of Social and Preventive Medicine
Faculty of Medicine
University of Malaya, 50603 Kuala Lumpur

INFORMASI KAJIAN & BORANG PERSETUJUAN

Faktor Sosial-Alam Bina, Aktiviti Fizikal dan Berat Badan Remaja

Latarbelakang

Gaya hidup tidak aktif meningkatkan risiko penyakit kronik seperti jantung, diabetis, darah tinggi, strok dan kanser kolon tanpa mengira peringkat usia.

Prevalen tidak aktif di kalangan kanak kanak Malaysia adalah 17.6% hingga 35% dan menjunam jatuh di usia remaja. Tren ini mungkin tidak disedari oleh ibubapa.

Pendekatan promosi kesihatan mencadangkan keperluan untuk memfokuskan kepada individu dan juga faktor sosial dan alam bina di mana individu tersebut wujud. Rekabentuk perumahan, keselamatan jalanraya, akses ke kawasan lapang dan kawasan beriadah adalah penentu kepada penglibatan aktiviti fizikal di negara maju, tetapi kurang diketahui ciri cirinya di Malaysia.

Tujuan Kajian

Kajian ini bertujuan mengenalpasti faktor faktor individu, sosial dan alam bina yang mempengaruhi penglibatan remaja dalam aktiviti fizikal.

Peserta Kajian

Kajian ini akan melibatkan remaja berumur 13 15 tahun <u>dan</u> ibu/bapa/penjaga.
(Remaja yang menerima rawatan perubatan dinasihatkan untuk TIDAK menyertai kajian).

Prosedur Kajian

<u>Remaja</u> perlu membuat perkara perkara berikut;
1. Menjawab borang soalselidik (di sekolah)
2. Mengukur tinggi dan berat badan (di sekolah),
3. Memakai alat pedometer selama 7 hari, dan
4. Mengisi Diari Aktiviti selama 7 hari.

<u>Ibu/bapa/penjaga</u> perlu mengisi borang soaselidik.

Faedah Kajian Kepada Anda

Kedua ibu/bapa/penjaga dan remaja akan diberitahu mengenai ujian aktiviti fizikal dan jisim berat badan remaja untuk pencegahan. Sekiranya pencegahan tidak dapat dilaksanakan kerana faktor keturunan, pembangunan kendiri remaja dan isu isu psikologi yang berkaitan akan ditekankan kepada ibubapa.

Hasil kajian boleh memangkinkan perubahan polisi agar pencegahan kegemukan dan promosi aktiviti fizikal merangkumi aspek individu, sosial dan alam bina dalam khasnya di kawasan kediaman.

Risiko Penyertaan

Kajian ini tidak mendatangkan sebarang risiko.

Bolehkah saya berhenti menyertai kajian?

Penyertaan anda adalah suka rela.Anda boleh berhenti menyertai kajian pada bila bila masa.

Hubungi Penyelidik

Rosalia Saimon Telephone: 013 8168771
Department of Social and Preventive Medicine
Faculty of Medicine
University of Malaya, 50603 Kuala Lumpur

CONSENT FORM TO PARTICIPATE IN RESEARCH

I have read the nature of the research in terms of topic, methodology / procedures benefits and possible risks. After knowing and understanding, I voluntarily consent my child (as name printed below) to participate in this research.

I understand that my child can withdraw from this research at any time without assigning any reason.

Name of the Child: ______________________________

Name of Parent/Guardian: ______________________________

IC No. of Parent/Guardian: ______________________________

Parent/Guardian Signature: ______________________________

Date: ______________________________

Researcher's Name: ROSALIA SAIMON

Researcher's Signature: ______________________________

Date: ______________________________

BORANG KEIZINAN MENYERTAI KAJIAN

Setelah membaca dan memahami kajian ini dari segi topik, metodologi /prosedur, faedah dan risiko penyertaan, saya secara sukarela membenarkan anak di bawah jagaan (seperti nama di bawah) untuk menyertai kajian.

Saya faham bahawa anak saya boleh menarik diri dari penyelidikan in pada bila-bila masa tanpa memberi sebarang alasan.

Nama Anak: ______________________________

Nama Ibubapa/Penjaga: ______________________________

No.KP Ibubapa/Penjaga: ______________________________

T/Tangan Ibubapa/Penjaga: ______________________________

Tarikh: ______________________________

Nama Penyelidik: ______________________________

T/Tangan Penyelidik: ______________________________

Appendix B: Ethics Approval

UNIVERSITI MALAYA
KUALA LUMPUR
PUSAT PERUBATAN UM

JAWATANKUASA ETIKA PERUBATAN
PUSAT PERUBATAN UNIVERSITI MALAYA
ALAMAT: LEMBAH PANTAI, 59100 KUALA LUMPUR, MALAYSIA
TELEFON: 03-79494422 samb. 3209 FAKSIMILI: 03-79494638

NAME OF ETHICS COMMITTEE/IRB: Medical Ethics Committee, University Malaya Medical Centre **ADDRESS:** LEMBAH PANTAI 59100 KUALA LUMPUR	**ETHICS COMMITTEE/IRB REFERENCE NUMBER:** 756.9
PROTOCOL NO: **TITLE:** Physical Activity And Physical Fitness: The Need Of Adolescents For Built Environment Structures In Local Neighbourhoods	
PRINCIPAL INVESTIGATOR: Cik Rosalia bt. Saimon **TELEPHONE:** **KOMTEL:**	**SPONSOR:** Ministry of Higher Education

The following item [✓] have been received and reviewed in connection with the above study to be conducted by the above investigator.

[✓] Borang Permohonan Penyelidikan	Ver date: 03 Nov 09
[✓] Study Protocol	Ver date:
[ ] Investigator's Brochure	Ver date:
[✓] Patient Information Sheet	Ver date:
[✓] Consent Form	Ver date:
[✓] Questionnaire	
[✓] Investigator(s) CV's (Cik Rosalia bt. Saimon)	

and have been [✓]

[✓] Approved
[ ] Conditionally approved (identify item and specify modification below or in accompanying letter)
[ ] Rejected (identify item and specify reasons below or in accompanying letter)

Comments:

i. *Investigator is required to follow instructions, guidelines and requirements of the Medical Ethics Committee.*
ii. *Investigator is required to report any protocol deviations/violations through the Clinical Investigation Centre and provide annual/closure reports to the Medical Ethics Committee.*

Date of approval: 25th NOVEMBER 2009

s.k Ketua
Jabatan Perubatan Kemasyarakatan & Pencegahan

Timbalan Dekan (Penyelidikan)
Fakulti Perubatan, Universiti Malaya

Setiausaha
Jawatankuasa Penyelidikan Pusat Perubatan
Fakulti Perubatan, Universiti Malaya

....
PROF. LOOI LAI MENG
Chairman
Medical Ethics Committee

BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
KEMENTERIAN PELAJARAN MALAYSIA
ARAS 1 - 4, BLOK E - 8,
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA

Telefon : 03-88846591
Faks : 03-88846579

Rujukan kami : KP(BPPDP)603/5/JLD.11 (452)
Tarikh : 12 Nov 2009

Puan Rosalia Bt Saimon **IC: 700909125778**
NO.43, Kitang Heights, Batu Kitang
93400 Kuching
Sarawak

Tuan/Puan,

Kelulusan Untuk Menjalankan Kajian Di Sekolah, Institut Perguruan, Jabatan Pelajaran Negeri dan Bahagian-Bahagian di Bawah Kementerian Pelajaran Malaysia

Adalah saya dengan hormatnya diarah memaklumkan bahawa permohonan tuan/puan untuk menjalankan kajian bertajuk:

Physical Activity And Physical Fitness: The Need Of Adolescents For Built Environment Structures In Rural And Urban Community In Kuching, Sarawak

diluluskan.

2. Kelulusan ini adalah berdasarkan kepada cadangan penyelidikan dan instrumen kajian yang tuan/puan kemukakan ke Bahagian ini. Kebenaran bagi menggunakan sampel kajian perlu diperoleh dari Ketua Bahagian / Pengarah Pelajaran Negeri yang berkenaan.

3. Sila tuan/puan kemukakan ke Bahagian ini senaskah laporan akhir kajian setelah selesai kelak. Tuan/Puan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak dibentangkan di mana-mana forum atau seminar atau diumumkan kepada media

Sekian untuk makluman dan tindakan tuan/puan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(DR. SOON SENG THAH)
Ketua Sektor,
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan
Dasar Pendidikan
Kementerian Pelajaran Malaysia

Appendix C: Questionnaire (Bahasa Malaysia Version)

Jabatan Perubatan Kemasyarakatan dan Pencegahan, Fakulti Perubatan Universiti Malaya, Kuala Lumpur

Kajian Aktiviti Fizikal Untuk Remaja (Sekolah Menengah Rendah)

UNIVERSITY OF MALAYA

Penyelidik:

Rosalia Saimon, Prof. Awang Bulgiba AM & Dr. Claire Choo WY

Sekolah: SMK ______________________

Nama Pelajar: ____

Umur : ________tahun

Jantina: ☐ Lelaki ☐ Perempuan

Bangsa: ☐ Melayu ☐ Bidayuh ☐ Melanau
☐ Iban ☐ Cina ☐ Lain-lain

Alamat rumah kediaman:

____

____

____

No. Handphone
Sendiri :
Ibu / bapa :

Berat badan ☐ kg **Tinggi** ☐ cm

Arahan:

1. Nyatakan jangkamasa yang diambil untuk anda **berjalan kaki** dari rumah ke tempat-tempat berikut.

2. Sila tanda (√) dalam kotak masa yang disediakan walaupun anda mungkin tidak pergi ke tempat tersebut.

A. Kemudahan Rekreasi di Kawasan Kediaman

	Berjalan kaki dari rumah ke…	**1-5 minit**	**6-10 minit**	**11-20 minit**	**21-30 minit**	**Lebih 31 minit**	**Tiada kemudahan**
1.	Gelanggang permainan (cth. basketball, futsal, badminton)	☐	☐	☐	☐	☐	☐
2.	Padang permainan (cth. bolasepak)	☐	☐	☐	☐	☐	☐
3.	Tempat berbasikal,mendaki,berjalan	☐	☐	☐	☐	☐	☐
4.	Kawasan untuk berjoging	☐	☐	☐	☐	☐	☐
5.	Taman permainan yang mempunyai kelengkapan (cth. gelongsor, buaian)	☐	☐	☐	☐	☐	☐
6.	Taman awam	☐	☐	☐	☐	☐	☐
7.	Kolam renang awam	☐	☐	☐	☐	☐	☐
8.	Pantai, tasik, sungai	☐	☐	☐	☐	☐	☐
9.	Ruang kosong yang bukan taman	☐	☐	☐	☐	☐	☐

B. Akses Terhadap Kemudahan	Sangat tidak bersetuju	Tidak bersetuju	Bersetuju	Sangat bersetuju
1. Sekolah berada dalam lingkungan *jarak berjalan kaki.	▢	▢	▢	▢
2. Kedai-kdai boleh dikunjungi dngan berjalan kaki.	▢	▢	▢	▢
3. Banyak tempat boleh dikunjungi dalam lingkungan *jarak berjalan kaki dari rumah.	▢	▢	▢	▢
4. Saya boleh *berjalan kaki dari rumah ke perhentian bas bersendirian ataupun ditemani.	▢	▢	▢	▢
5. Terdapat banyak halangan untuk berjalan kaki dar satu tempat ke tempat lain	▢	▢	▢	▢
6. Sukar ntuk berjalan kaki kerana jalan berbukit bukau.	▢	▢	▢	▢

Nota: Jarak **berjalan kaki** bermakna tempoh masa berjalan kaki ialah selama 10-15 minit dari rumah ke tempat destinasi.

C. Keselamatan Jalanraya	Sangat tidak bersetuju	Tidak bersetuju	Bersetuju	Sangat bersetuju
1. Sukar berjalan kaki kerana banyak kenderaan.	▢	▢	▢	▢
2. Kenderaan biasanya dipandu erlahan (< 30 mph)	▢	▢	▢	▢
3. Kebanyakan pemandu melebihi tahap kelajuan semasa memandu di kawasan kediaman.	▢	▢	▢	▢
4. Tiada tanda had kelajuan kenderaan di jalanraya di kawasan kediaman.	▢	▢	▢	▢
5. Tiada bonggol jalan dan lampu isyarat untuk membantu pejalan kaki melintas jalan.	▢	▢	▢	▢
6. Terdapat banyak asap kenderaan semasa berjalan di kawasan kediaman.	▢	▢	▢	▢
7. Lampu jalanraya tidak dipasang di kawasan kediaman.	▢	▢	▢	▢
8. Terdapat banyak anjing liar semasa berjalan di kawasan kediaman.	▢	▢	▢	▢

D.	**Pemandangan di Kawasan Kediaman**	**Sangat tidak bersetuju**	**Tidak bersetuju**	**Bersetuju**	**Sangat bersetuju**
1.	Terdapat banyak pokok rendang ditanam di sepanjang jalanraya di kawasan kediaman.	☐	☐	☐	☐
2.	Terdapat banyak pemandangan menarik semasa berjalan di kawasan kediaman.	☐	☐	☐	☐
3.	Terdapat banyak bangunan cantik yang menarik perhatian	☐	☐	☐	☐
4.	Kawasan kediaman saya bebas daripada kehadiran anjing liar.	☐	☐	☐	☐
5.	Kawasan kediaman saya umumnya bebas daripada sampah sarap dan sisa binaan.	☐	☐	☐	☐
6.	Rumput di kawasan kediaman sentiasa dipotong pendek dan kemas.	☐	☐	☐	☐

E.	**Jenayah**	**Sangat tidak bersetuju**	**Tidak bersetuju**	**Bersetuju**	**Sangat bersetuju**
1.	Kadar jenayah sangat tinggi di kawasan kediaman saya.	☐	☐	☐	☐
2.	Kadar jenayah menyebabkan rasa tidak selamat untuk berjalan sendiri atau dengan kawan pada siang hari.	☐	☐	☐	☐
3.	Saya berasa tidak selamat berada di luar rumah bersendirian atau bersama kawan kerana bimbang diragut, diculik atau dicederakan.	☐	☐	☐	☐
4.	Saya berasa tidak selamat bermain atau berjalan bersendirian di jalanraya.	☐	☐	☐	☐
5.	Saya berasa tidak selamat berada di luar rumah bersendirian kerana takut dibuli.	☐	☐	☐	☐
6.	Saya berasa tidak selamat berada di luar rumah kerana bimbang dengan kumpulan samseng / penagih dadah.	☐	☐	☐	☐

Arahan:

1. Sila tanda (**√**) dalam kotak masa yang disediakan.
2. Nyatakan kekerapan ahli keluarga dan kawan-kawan melakukan perkara berikut pada **2 minggu yang lepas**.

F.	**Sokongan ahli keluarga**	**Tidak pernah**	**Jarang**	**Kadang kadang**	**Selalu**	**Sangat selalu**
1.	Aktif (berjoging, bermain) bersama saya.	☐	☐	☐	☐	☐
2.	Menawarkan untuk aktif bersama.	☐	☐	☐	☐	☐
3.	Mengingatkan saya agar selalu aktif.	☐	☐	☐	☐	☐
4.	Memberi dorongan untuk aktif.	☐	☐	☐	☐	☐
5.	Menukar rancangan mereka untuk menemani saya untuk aktif.	☐	☐	☐	☐	☐
6.	Merancang untuk aktiviti rekreasi (cth. berkelah)	☐	☐	☐	☐	☐
7.	Berbincang mengenai aktiviti fizikal yang diminati.	☐	☐	☐	☐	☐

G	**Sokongan kawan-kawan**	**Tidak pernah**	**Jarang**	**Kadang kadang**	**Selalu**	**Sangat selalu**
1.	Aktif (berjoging, bermain) bersama saya.	☐	☐	☐	☐	☐
2.	Menawarkan untuk aktif bersama.	☐	☐	☐	☐	☐
3.	Mengingatkan saya agar selalu aktif.	☐	☐	☐	☐	☐
4.	Memberi dorongan untuk aktif.	☐	☐	☐	☐	☐
5.	Menukar rancangan mereka untuk menemani saya untuk aktif.	☐	☐	☐	☐	☐
6.	Merancang untuk aktiviti rekreasi (cth. berkelah)	☐	☐	☐	☐	☐
7.	Berbincang mengenai aktiviti fizikal yang diminati.	☐	☐	☐	☐	☐

H.	Keupayaan Diri Untuk Aktif	Tidak benar	Sedikit benar	Kadang-Kadang benar	Selalu benar
1.	Saya boleh meminta ibubapa menghantar saya ke tempat bersukan spt ke gym, kolam renang, pusat taekwando dll.	▢	▢	▢	▢
2.	Saya boleh mengajak kawan-kawan untuk aktif bersama.	▢	▢	▢	▢
3.	Saya boleh aktif selepas waktu sekolah.	▢	▢	▢	▢
4.	Saya boleh aktif secara fizikal selepas waktu sekolah walaupun saya masih menonton TV dan bermain video / computer game.	▢	▢	▢	▢
5.	Saya boleh menjadi aktif secara fizikal walaupun saya mempunyai banyak kerja sekolah.	▢	▢	▢	▢
6.	Saya boleh menjadi aktif secara fizikal selepas waktu sekolah walaupun ibubapa mahukan saya membuat perkara lain.	▢	▢	▢	▢
7.	Saya boleh menjadi aktif secara fizikal walaupun cuaca panas atau hujan.	▢	▢	▢	▢
8.	Saya boleh menjadi aktif secara fizikal walaupun saya berada di dalam rumah.	▢	▢	▢	▢

I. Halangan Untuk Menjadi Aktif	Tidak pernah	Jarang	Kadang kadang	Selalu	Sangat selalu
1. Saya tidak mempunyai masa untuk aktiviti fizikal / sukan.	▢	▢	▢	▢	▢
2. Saya terlalu penat untuk aktiviti fizikal / sukan.	▢	▢	▢	▢	▢
3. Saya tidak bertenaga untuk aktiviti fizikal / sukan.	▢	▢	▢	▢	▢
4. Saya tidak gemar aktiviti fizikal / sukan.	▢	▢	▢	▢	▢
5. Beriadah dan bersukan membuang masa.	▢	▢	▢	▢	▢
6. Saya malas untuk bersenam kerana cuaca terlalu panas.	▢	▢	▢	▢	▢
7. Saya tidak dapat bersenam kerana tiada tempat yang sesuai dan selamat.	▢	▢	▢	▢	▢

J. Larangan Ibubapa	Tidak pernah	Jarang	Kadang kadang	Selalu	Sangat selalu
1. Ibubapa melarang saya bermain di luar rumah bersendirian.	▢	▢	▢	▢	▢
2. Ibubapa melarang saya bermain di luar rumah bersama kawan-kawan.	▢	▢	▢	▢	▢
3. Ibubapa melarang saya berada di luar rumah selepas senja.	▢	▢	▢	▢	▢
4. Ibubapa melarang saya berjalan atau berbasikal selepas waktu senja.	▢	▢	▢	▢	▢
5. Ibubapa melarang saya bermain bersendirian di jalanraya	▢	▢	▢	▢	▢
6. Ibubapa melarang saya bermain dengan kawan-kawan di jalanraya.	▢	▢	▢	▢	▢

K. Masa Menonton TV / Permainan Elektronik / Komputer

ARAHAN: Tuliskan jumlah masa dalam jam di dalam kotak yang disediakan

Pada hari persekolahan biasa

1. Berapa ama msa diluangkan untuk menonton TV dalam sehari

   Jam sehari

2. Berapa ama msa diluangkan untuk permainan elektronik (computer, video dn lain-lain permainan elektronik)

   Jam sehari

Pada hujung minggu

1. Berapa ama msa diluangkan untuk menonton TV dalam sehari

   Jam sehari

2. Berapa ama msa diluangkan untuk permainan elektronik (computer, video dn lain-lain permainan elektronik).

   Jam sehari

Questionnaire (English Version)

Instructions:

1. About how long would it take you to walk from your home to the nearest places listed below?
2. Please (√) the time it would take you to walk to each place, even if you don't normally go there.

A. Recreation Places in Your Neighborhood

		1-5 min	6-10 min	11-20 min	21-30 min	> 31 min	No facilities
1.	Playing courts (e.g basketball, futsal, badminton, skate park etc.)	☐	☐	☐	☐	☐	☐
2.	Playing fields (e.g football)	☐	☐	☐	☐	☐	☐
3.	Bike/hiking/walking trails, paths	☐	☐	☐	☐	☐	☐
4.	Walking /jogging track	☐	☐	☐	☐	☐	☐
5.	Public playground with equipment	☐	☐	☐	☐	☐	☐
6.	Public park	☐	☐	☐	☐	☐	☐
7.	Swimming pool	☐	☐	☐	☐	☐	☐
8.	Beach, lake, river	☐	☐	☐	☐	☐	☐
9.	Public open space (grass or sand/dirt) that is not a park	☐	☐	☐	☐	☐	☐

B.	**Access to services**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
1.	School within easy walking distance of my home.				
2.	Stores are within easy walking distance of my home.				
3.	There are many places to go (alone or with someone) within easy walking distance of my home.				
4.	From my home, it is easy to walk to a bust stop alone or with someone.				
5.	There are major barriers to walking (alone or with someone) in my local area that make it hard to get from place to place (for example, freeways, railway lines, rivers).				
6.	The streets in my neighborhood are hilly, making my neighborhood difficult to walk in (alone or with someone).				

Note: Walking distance mean within a 10-15 minute walk from your home.

C.	**Neighborhood safety**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
1.	There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in my neighborhood .				
2.	The speed of traffic on most nearby streets is usually slow (30 mph or less).				
3.	Most drivers go faster than the posted speed limits in my neighborhood.				
4.	There are no speed limits sign posted along nearby streets that it makes it difficult or unpleasant.				
5.	There are no crosswalks and signals to help walkers cross busy streets in my neighborhood.				
6.	When walking in my neighborhood there are a lot of exhaust fumes.				
7.	My neighborhood streets do not have good lighting at night.				
8.	There are many stray dogs raoming at nearby streets that it makes it unsafe, difficult, and/ or unpleasant.				

D.	Neighborhood surroundings	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	There are planted trees along the streets in my neighborhood.	☐	☐	☐	☐
2.	There are many interesting things to look at while walking in my neighborhood.	☐	☐	☐	☐
3.	There are many buildings/homes in my neighborhood that are nice to look at.	☐	☐	☐	☐
4.	My neighbourhood is free from stray dogs.	☐	☐	☐	☐
5.	My neighbourhood is free littering.	☐	☐	☐	☐
6.	There are many beautiful natural things to look at in my neighborhood (e.g., gardens, views).	☐	☐	☐	☐

E.	Crime safety	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	There is a high crime rate in my neighborhood.	☐	☐	☐	☐
2.	The crime rate in my neighborhood makes it unsafe to go on walks alone or with someone at Even at daytime.	☐	☐	☐	☐
3.	I am worried about being outside alone or with friend around my home (like in the yard, driveway, or apartment common area) because I am afraid of being taken or hurt by a stranger.	☐	☐	☐	☐
4.	I am worried about being or walking alone or with friends in my neighborhood and local streets because I am afraid of being taken or hurt by a stranger.	☐	☐	☐	☐
5.	I am worried about being in a outside because I am afraid of being bullied by other teenagers.	☐	☐	☐	☐
6.	I am worried about being in a local/nearby park because I am afraid of those gangsters or drug addicts.	☐	☐	☐	☐

During the past TWO WEEKS, my family (or members of my household);

F	Family members	None	Rarely	Few times	Often	Very often
1.	Exercised with me.	☐	☐	☐	☐	☐
2.	Offered to exercise with me.	☐	☐	☐	☐	☐
3.	Gave me helpful reminders to exercise.	☐	☐	☐	☐	☐
4.	Gave me encouragement. to stick with my exercise program.	☐	☐	☐	☐	☐
5.	Changed their schedule so we could exercise together.	☐	☐	☐	☐	☐
6.	Planned for exercise on recreational outings.	☐	☐	☐	☐	☐
7.	Talked about how much they like to exercise.	☐	☐	☐	☐	☐

During the past TWO WEEKS,friends;

G	Friends	None	Rarely	Few times	Often	Very often
1.	Exercised with me.	☐	☐	☐	☐	☐
2.	Offered to exercise with me.	☐	☐	☐	☐	☐
3.	Gave me helpful reminders to exercise.	☐	☐	☐	☐	☐
4.	Gave me encouragement. to stick with my exercise program.	☐	☐	☐	☐	☐
5.	Changed their schedule so we could exercise together.	☐	☐	☐	☐	☐
6.	Planned for exercise on recreational outings.	☐	☐	☐	☐	☐
7.	Talked about how much they like to exercise.	☐	☐	☐	☐	☐

H.	**Self-Efficacy**	**Not at true**	**Rarely rue**	**Moderately true**	**Always true**
1.	Ask my parents to take me to a physical activity or sport practice.				
2.	Ask my best friend to be physically active with me.				
3.	Be physically active most days after school.				
4.	Be physically active after school even if I could watch TV or play video games.				
5.	Be physically active even if I have a lot of homework.				
6.	Be physically active even if my parent wants me to do something else.				
7.	Be physically active even if it is raining or hot.				
8.	Be physically active even if I have to stay at home.				

I.	**Perceived barriers**	**Never**	**Seldom**	**Some-times**	**Often**	**Very often**
1.	I don't have enough time for physical activity.					
2.	I am too tired for physical activity.					
3.	I don't have the energy to do physical activity.					
4.	I don't like physical activity or sports.					
5.	Physical activity or sports are a waste of time.					
6.	I feel lazy to do physical activity because of hot weather.					
7.	There are no proper facilities to perform physical activity near my home.					

J. Parental restriction

J.	Parental restriction	Never	Seldom	Some-times	Often	Very often
1.	My parents prevent me from playing alone outdoors in our neighbourhood.					
2.	My parents prevent me from playing with friends outdoors in our neighbourhood.					
3.	My parents prevent me to spend time outside after dark.					
4.	My parents prevent me to walk/cycle on the street after dark.					
5.	My parents prevent from playing alone on local streets in our neighbourhood.					
6.	My parents prevent from playing with friends on local streets in our neighbourhood.					

K. Television viewing / Electronic Games

During **weekdays:**

1. In a day, how many hours spent on TV viewing?

Hour/day

2. In a day, how many hours spent on computer, video games or other screen-based electronic games?

Hour/day

During **weekends:**

1. In a day, how many hours spent on TV viewing?

Hour/day

3. In a day, how many hours spent on computer, video games or other screen-based electronic games?

Hour/day

Appendix D: 7-Day Activity Diary

Maklumat adalah sulit & untuk kegunaan kajian sahaja

my diari

@remaja • aktiviti harian

____
[Nama]

____
[Nama Sekolah]

____
[Alamat Kediaman]

____

____
[No. Telefon]

Hari pertama

1

Aktiviti *Remaja*

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / Street soccer
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar muzik
- ☐ Bermain instrumen muzik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari pertama

Hari ke **2**

Aktiviti *Remaja*

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / Street soccer
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar musik
- ☐ Bermain instrumen musik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari kedua

Hari ke **3**

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / Street soccer
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar musik
- ☐ Bermain instrumen musik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari ketiga

Hari ke

4

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / *Street soccer*
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar musik
- ☐ Bermain instrumen musik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari keempat

Hari ke

5

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / *Street soccer*
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar musik
- ☐ Bermain instrumen musik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari kelima

Hari ke 6

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / Street soccer
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar musik
- ☐ Bermain instrumen musik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari keenam

Hari ke 7

Aktiviti fizikal

- ☐ Berjalan kaki
- ☐ Berjoging
- ☐ Berbasikal
- ☐ Bermain bola
- ☐ Permainan raket
- ☐ Berenang
- ☐ Basketball
- ☐ Futsal / Street soccer
- ☐ Bowling
- ☐ Skipping rope
- ☐ Skating
- ☐ Seni pertahanan diri
- ☐ Kerja rumah
- ☐ Gymnasium
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Aktiviti ringan

- ☐ Buat kerja sekolah
- ☐ Tuisyen
- ☐ Menonton TV
- ☐ Bermain game
- ☐ Internet
- ☐ Bertelefon / sms
- ☐ Mendengar musik
- ☐ Bermain instrumen musik
- ☐ Board games / kad
- ☐ Membaca
- ☐ Seni dan kraftangan
- ☐ Lain-lain, nyatakan

____

____

Jumlah masa untuk kesemua aktiviti fizikal

jam minit

Rekod bacaan pedometer hari ketujuh

Appendix E: How to use pedometer

Hello adik-adik!

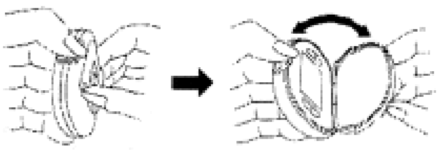
kami memohon dua perkara berikut daripada adik-adik.

1. Memakai alat pedometer di sepanjang hari selama 7 hari, kecuali semasa mandi dan tidur. Ini penting untuk kami mengukur tahap aktiviti fizikal remaja secara harian.

2. Merekod bacaan pedometer harian di dalam Buku Rekod Pedometer.

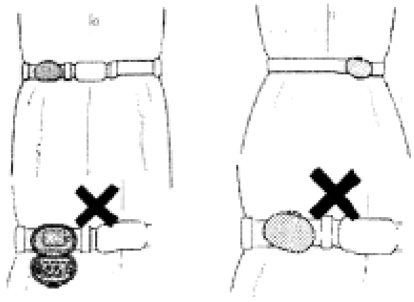
Cara pemakaian Pedometer

1 Pegang tali dan tekan klip besi dengan tangan kiri. Letakkan ibujari kanan di tombol hitam, flipkan ibujari kanan dan buka.



2 Perhatikan klip besi berkilat. Klipkan ke talipinggang, pinggang seluar atau skirt/sarung. Pastikan alat ini diklipkan secara menegak.

3 Selepas diklipkan ke pinggang, sepitkan klip bertali ke pakaian agar pedometer tidak terjatuh.



Arahan:

- ✔ Pakai pedometer sebaik saja bangun pagi (selepas mandi) sehingga masuk tidur malam.
- ✔ Tuliskan masa ianya dipakai dan ditanggalkan di dalam buku rekod.
- ✔ Rekodkan bacaan pedometer pada pukul 11.00 pagi setiap hari persekolahan.
- ✔ Tanggalkan pedometer ketika mandi atau berenang. Pedometer adalah TIDAK KALIS air.
- ✔ Letakkan pedometer di tempat yang mudah nampak semasa adik bangun pagi.
- ✔ Jauhkan pedometer dari binatang peliharaan.
- ✔ Jauhkan pedometer dari kanan-kanak kecil.

Jangan!

- ✘ Basahkan.
- ✘ Buang atau jatuhkan pedometer.
- ✘ Goncang.