# University of Alberta

An Internet-Based Intervention for Promoting and Maintaining Physical Activity

in Thai University-Aged Females: A Randomized Controlled Trial

by

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Faculty of Physical Education and Recreation



Fall 2013
Edmonton, Alberta

## Abstract

**Introduction:** Thai female students are not likely to participate in leisure-time physical activity (PA). This dissertation comprised two studies that examined the efficacy of a Social Cognitive Theory (SCT) based internet intervention PA designed to promote and maintain leisure-time PA in university-aged female students in Thailand.

**Methods:** *Study 1*. Three steps were used: (1) translation, back-translation and expert committee confirmation; (2) test-retest reliability; and (3) exploratory factor analysis. *Study 2*. SCT and intervention mapping (IM) were used as the theoretical frameworks in developing the SCT-based internet intervention PA program. A 3-month randomized control trial intervention was conducted employing a Solomon four-group design with a 3-month follow-up assessment.

**Results:** *Study 1* revealed that the Thai versions of the questionnaires have acceptable test-retest reliability, concurrent validity, construct validity, and internal consistency reliability. The questionnaires have suitable psychometric properties and can be used to assess leisure-time PA, exercise-related self-efficacy, outcome expectations and self-regulation in Thai female undergraduate students. *Study 2* revealed that there were no pretest sensitization effects on any outcome. The internet intervention significantly increased steps, leisure-time activity score (LTAS), SCT variables and reduced resting heart rate (RHR) at the end of the intervention. With the exception of RHR, the intervention effects on these variables also remained at the 3-month follow-up. The intervention had no effects on Predicted Vo2Max at either the end of the intervention or the 3-month

follow-up. The intervention effects on weekly LTAS at the end of the intervention were partially mediated by self-efficacy and self-regulation. Self-regulation also partially mediated changes in steps/day at the end of the intervention.

**Conclusions:** The Thai versions of the questionnaires were found to be valid and reliable measures and can be used for conducting research and interventions that target health behaviour changes in the Thai population. Also, the SCT-based internet intervention program is effective in promoting and maintaining leisure-time PA in university-aged female students in Thailand.

**Acknowledgement**

I would like to thank my supervisor, Dr. Tanya Berry, for all of her constant support, guidance, and patience over the years. I would like to sincerely thank her for specific contributions to my dissertation as well as to my academic growth during my time spent studying at the University of Alberta.

I would also like to thank my supervisory committee, Dr. John Spence, Dr. Gordon Walker, for their interest, feedback, and expertise throughout this dissertation. I would also like to acknowledge my examining committee, Dr**.** Kerry Mummery, Dr. Margie Davenport, and Dr. Corneel Vandelanotte for their questions, comments and feedback that improved this dissertation. I would also like to thank Dr.Tom Hinch who acts as the chair of my dissertation defense.

In addition, I would like to thank Dr. Wendy Rogers, Dr. Wanwisa Hunnok, Dr. Kunut Pitpornchikul, Dr. Apiluck Tiantong, Miss Anne-Marie Selzler, Mr. Nukul Nilwongsanuwat, and Mr. Jutikarn Jaroensuk for helping in back translation and committee approach for the first study, as well as to the graduate students from the department of Sports Science at Srinakharinwirot University who helped collect data for the second study. I would also like to thank all of the participants who volunteered their time to participate in my research.

Finally, I would like to thank my family. I extend a special thank you to my parents and parent-in-law who have provided much love and support throughout my academic journey. I especially thank my wife and my son for supporting me all the time.

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# CHAPTER 1: INTRODUCTION

## Background

Everyone should perform physical activity (PA) for enhancing health benefits (ACSM, 2010). Regular PA is associated with many health benefits such as reduced risk of chronic diseases (Buchner, 2009; Qin, Knol, Corpeleijn, & Stolk, 2010; Wolin, Yan, Colditz, & Lee, 2009), maintained quality of life (Culos-Reed, Robinson, Lau, O'Connor, & Keats, 2007), and reduced risk of premature death (Erikssen, 2001; Macera, Hootman, & Sniezek, 2003). Nonetheless, the majority of the world's population does not engage in enough PA to achieve health benefits (WHO, 2010). A survey study using accelerometers in Canada found that about 85 percent of Canadians adults did not participate in sufficient PA to get health benefits (Colley, Garriguet, Janssen, Craig, Clarke, & Tremblay, 2011). This trend is also found in Thailand.

A survey study in 2006 found that about 78 percents of Thai adults were sufficiently active to health benefits. Work and transportation were the main source of PA while leisure-time PA was less (Abouzeid, Macniven, & Bauman, 2008). However, since the country has moved from an agrarian society to an industrial society, it led to a change from high to low energy expenditure activities (Kosulwat, 2002). In particular, the modes of transportation and activities during leisure time have changed. A recent study found that transportation PA and recreational PA in urban areas were reduced. For example, walking and cycling were replaced by motorcycling (Churangsarit & Chongsuvivatwong, 2011). A survey study also showed that most of Thai people did not participate in leisure-time PA (Abouzeid et al., 2008). They spend their time in front of televisions, computers, or video games instead of performing PA during leisure time

(Aekplakorn et al., 2007). Females also reported lower PA rates than men across the lifespan and especially in university-aged students (National Statistical Office, 2007). Forty-two percent of female students and 34 percents of male students did not participate in leisure-time PA (Haase, Steptoe, Sallis, & Wardle, 2004). Moreover, compared to other countries, the prevalence of leisure-time PA at recommended levels was lowest in Thai female students--only about 2% of whom were active (Sisson & Katzmarzyk, 2008). This might be because of the influence of Thai culture. Generally, Thai women are shaped to be gentle, calm, and polite. This concept is opposite to participating in PA. Participation in PA may be viewed as ungentle, impolite, and inappropriate for women. Thus, they are not supported to participate in PA.

Studies in Canada and the United Kingdom have found that the prevalence of adequate PA is higher in children and adolescents than in adults (Colley et al., 2011; Pate, Freedson, Sallis, Taylor, Sirard, Trost, & Dowda, 2002). Similarly, studies found that PA decreases and body weight increases during the first two years of university (Hajhosseini, Holmes, Mohamadi, Goudarzi, McProud, & Hollenbeck, 2006; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005). These studies suggest that late adolescence and early adult life may be a critical period of transition (Leslie, Fotheringham, Owen, & Bauman, 2001). Thus, promoting and encouraging students, especially female students to continue PA will be necessary to offset declines in PA over the adult lifespan and to reduce health concerns.

It is well known that PA can be promoted through theoretically based interventions (Turner-McGrievy, Campbell, Tate, Truesdale, Bowling, & Crosby, 2009; Winett, Williams, & Davy, 2009). Social Cognitive Theory (SCT) is one useful theory that has been used in health behaviour interventions (Norman, Zabinski, Adams, Rosenberg, Yaroch, & Atienza, 2007). It can explain some variance of PA (Anderson, Wojcik, Winett, & Williams, 2006; Petosa, Suminski, & Hortz, 20003). The important determinants of SCT include self-efficacy, outcome expectations, and self-regulation which are highly associated with PA changes (Hallam & Petosa, 2004; Marcus et al., 2006). Studies normally showed that these variables play an important role in PA initiation and adherence (Gao, Xiang, Lee, & Harrison, 2008; Luszczynska & Haynes, 2009; Stadler, Oettingen, & Gollwitzer, 2009; Tavares, Plotnikoff, & Loucaides, 2009; Umstattd, Moti, Wilcox, Saunders, & Watford, 2009).

Also, it is possible to promote and maintain PA in a large portion of university students using the internet (Wadsworth & Hallam, 2010), particularly because universities have the resources to promote PA among their students. They have extensive technological networks that allow student access to the internet. For example, a study in Thailand found that 90 percents of undergraduate students accessed the internet, and 75 percents of those accessed the internet at university 1-3 hours a time and 1-3 times a week (Kitikannakorn & Sitthiworanan, 2009). The internet is accessible and convenient, and helps reduce barriers (e.g., time and travel) for seeking PA programs (Dunton & Robertson, 2008; Marcus, Ciccolo, & Sciamanna, 2009). In addition, internet-based interventions have been reported as

a cost-effective method for enhancing PA behaviour (Marcus et al., 2009; Norman et al., 2007). Internet-based interventions can provide an opportunity to promote PA. Thus, by focusing on increasing self-efficacy, outcome expectations, and self-regulation in an internet-based intervention, PA in Thai female students may be increased and maintained.

## Main Research Question

This dissertation combines two studies that seek to answer the following main research question: *Is a SCT-based internet intervention PA program effective in increasing and maintaining PA in university-aged females in Thailand?* The first study will examine the validity and reliability of the Thai version of questionnaires. The second study will be conducted to evaluate the efficacy of the SCT-based internet intervention PA program to promote and maintain PA in university-aged females in Thailand.

## Definitions

An overview of the definitions of concepts used in this study is provided in table 1-1 at the end of this chapter.

## Theoretical Framework

This dissertation uses SCT as the theoretical framework in developing an internet intervention PA program to promote and maintain PA in Thai female undergraduate students. IM is used as a framework to develop the SCT-based internet intervention PA program. The internet is used to deliver the program. Thus, SCT and intervention mapping (IM) will be discussed in the first and

second sections, respectively. Finally, the internet-based intervention will be discussed in the third section.

## Social Cognitive Theory

SCT explains and predicts health behaviour and describes methods to change health behaviour (Bandura, 2004). According to the theory, human behaviour is explained in term of a reciprocal determinism in which personal (e.g., demographic and psychosocial), behavioural (e.g., PA), and environmental factors (e.g., physical and social support) are interactions that result in reciprocal effects (Bandura, 1986). These factors always influence each other. A change in one factor has influences for the others (i.e., reciprocal effects; Bandura, 1986). According to reciprocal determinism, it is possible for interventions to be targeted at personal, behavioural, and environmental levels (Bandura, 1997). However, SCT focuses on increasing a person's behavioural capability (i.e., knowledge and skills) and self-confidence (i.e., self-efficacy) to engage in health behaviour (Bandura, 2004). It is believed that all behavioural changes are mediated by cognitive mechanisms (i.e., self-efficacy). It recognizes person-behaviour-environment interactions that are mediated by cognitive mechanisms (Spence & Lee, 2003). That is, environmental and behaviour factors directly influence individual's self-efficacy to perform healthier behaviours.

SCT has been one of the most important theoretical frameworks in health behaviour change intervention research (Painter, Borba, Hynes, Mays, & Glanz, 2008), and in PA (Marcus, Nigg, Riebe, & Forsyth, 2000; Wojcicki, White, & McAuley, 2009). In general, there is a positive relationship between SCT

constructs (e.g., self-efficacy) and PA change. For example, in college students, SCT could explain 55 percents of the variance in PA (Rovniak, Anderson, Winett, & Stephens, 2002) and predict 27.2 percents of the variance in vigorous PA (Petosa et al., 2003). In adult populations, SCT explained 46 percents of the variance in PA (Anderson et al., 2006). In Thai population, a study found that SCT and health belief model explained 45 percents of the variance in PA (Piaseu, Schepp, & Belza, 2002).

Among the SCT variables, self-efficacy, outcome expectations, and self-regulation are strong determinants of the initiation of a new behaviour and the maintenance of the behaviour (Hallam & Petosa, 2004; Marcus et al., 2006). Thus, a SCT-based internet intervention PA program designed to promote and maintain PA was focused on increasing individual's self-efficacy, outcome expectations, and self-regulation about PA.

### *Self-efficacy*

Self-efficacy is the person's confidence in ability to perform a particular behaviour; including confidence in overcoming the barriers to performing behaviour (Glanz, Lewis, & Rimer, 2002). It is an important determinant because it affects behaviour both directly and indirectly by its impact on the other determinants. It influences goals, aspirations, and outcomes. Individuals who have higher self-efficacy will set higher goals and put more effort to achieve their goals and expect higher outcomes. In contrast, those with lower self-efficacy will set lower goals and expect lower outcomes. Moreover, self-efficacy influences individuals' views about obstacles. People with high efficacy view obstacles as

challenging and go further distances to overcome obstacles. They maintain their behaviours even if they face obstacles. In contrast, those with low self-efficacy give up more easily, lower their goals or use less effort to reach them when they face obstacles (Bandura, 2004).

Many previous Western studies have found that self-efficacy is one of the strongest predictors of starting and maintaining PA (Allen, 2004; Anderson et al., 2006; McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006; Rovniak et al., 2002; Tavares et al., 2009), and is related to PA change (Luszczynska & Haynes, 2009; Tavares et al., 2009; McNeill et al., 2006*;* Dishman, Saunders, Motl, Dowda, & Pate, 2009; Koh, Miller, Marshall, Brown, & McIntyre, 2010; Motl, Gliottoni, & Scott, 2007; Taymoori, Lubans, & Berry, 2010). People with higher self-efficacy exercise more frequently and are more likely to adhere to exercise programs (Rodgers & Sullivan, 2001; Annesi, 2004; Hallam & Petosa, 2004; Jancey, Lee, Howat, Clarks, Wang, & Shilton, 2007). This construct could explain a range from 15-53 percents of the variance in PA (Allen, 2004), and has stronger effects on PA than other psychosocial determinants (Petosa et al., 2003). It may also be a mediator of PA change (Lubans & Sylva, 2009; Anderson, Winett, Wojcik, & Williams, 2010). Similarly, in the Thai population, studies have found that self-efficacy is a predictor of exercise behaviour in undergraduate students (Voraroon, 2005), adults (Kaewthummanukul, Brown, Weaver, & Thomas, 2006; Poomsrikaew, Berger, Kim, & Zerwic, 2012; Wongvilai, 2004), and older adults (Anunsuksawat, 2006). It can explain some of the variance in PA (Piaseu et al., 2002; Poomsrikaew et al., 2012).

Rodgers, Wilson, Hall, Fraser and Murray (2008) posited that self-efficacy is multidimensional, reflecting skill subsets required to produce the desired outcome. It can be divided into task efficacy, coping efficacy, and scheduling efficacy (Rodgers & Sullivan, 2001; Rodgers et al., 2008). Task, coping, and scheduling self-efficacy for exercise can be conceptually and statistically distinguished from each other (Rodgers & Sullivan, 2001). Task efficacy refers to a person's confidence in the ability to perform a task (e.g., confidence in the ability to exercise for 20 min at high intensity). Coping efficacy refers to a person's confidence in the ability to perform a task under challenging conditions (e.g., confidence in the ability to exercise even if lacking energy: Maddux, 1995). Scheduling efficacy refers to a person's confidence in the ability to effectively schedule a task (e.g., confidence in the ability to regularly exercise for 20 minutes at a high intensity: Rodgers & Sullivan, 2001).

According to Rodgers et al. (2008), task efficacy may be necessary but not sufficient to motivate long-term exercise behaviour. They found that exercisers have higher coping and schedule self-efficacy compared to those who are not exercisers and have no intention to exercise. Task self-efficacy did not distinguish between exercisers and those who are not exercisers with intention to exercise, but they have higher task efficacy than those who are not exercisers and have no intention to exercise. Thus, task self-efficacy may be a more critical factor for starting exercise while coping and schedule efficacy are important for exercise adherence.

Self-efficacy can be increased by integrating information from four primary sources: performance accomplishments, vicarious and imagined experiences, verbal persuasion, and physiological and emotional states (Allen, 2004; Maddux, 2009). It is known that perceptions of successful PA in the past will strengthen one's PA self-efficacy. Similarly, observation of other people's PA and the consequence of those PA, self-efficacy can be increased. In general, performance experiences have stronger effects on self-efficacy than do vicarious experiences. Also, by imagining oneself or others' PA, self-efficacy can be increased although it has less effect on self-efficacy than an actual experience (Maddux, 2009). Performance experiences and vicarious experiences had higher influences on self-efficacy than verbal persuasion (Maddux, 2009). A recent meta-analysis about the best way to change self-efficacy to promote lifestyle and PA found that interventions that used vicarious experience produced significantly higher levels of PA self-efficacy than interventions where these techniques were not used. In contrast, interventions that used verbal persuasion produced lower levels of self-efficacy than interventions where this technique was not used (Ashford, Edmunds, & Frenchet, 2010). In addition, physiological and emotional states can influence self-efficacy. Individuals generally feel confident in their ability to do PA if they have comfortable physiological sensations (Maddux, 2009).

### *Outcome Expectations*

Outcome expectation is an expectation that a given behaviour will produce a particular outcome (Williams, Anderson, & Winett, 2005). According to SCT,

outcome expectations flow from self-efficacy and directly impacts behaviour, with positive outcome expectations increasing behaviour and negative outcome expectations decreasing behaviour (Williams et al., 2005). For example, people with high positive outcome expectations will participate in behaviour more than those who have negative outcome expectations. The outcomes include physical, social, and self-evaluative reaction outcomes. For example, because people expect pleasurable effects of PA, they participate in PA. They participate in PA because they need a social life or interpersonal relationships. In addition, by the positive and negative self-evaluative reactions to one's health behaviour, which means that people evaluate whether a given behaviour produces the positive or negative results, people adopt personal standards and regulate their behaviour. That is, people will perform a behaviour if it increases self-satisfaction and self-worth, and avoid doing behaviour if it increases self-dissatisfaction (Bandura, 2004).

Moreover, behaviour is motivated by the values individuals place on expected outcomes of behaviour. Thus, outcome values are defined as the subjective value or perceived importance of an expected outcome and can moderate the effect of outcome expectations on behaviour. That is, a valued positive outcome will increase behaviour more than an outcome that is not valued (Williams et al., 2005). For PA behaviour, it is possible that outcome expectations operate to influence self-efficacy. If people decrease in negative outcome expectations or barriers of PA, they are more likely to perceive they are able to perform the PA. Similarly, if people increase in positive outcome expectations about PA, their self-efficacies about PA will increase (William et al., 2005).

It has been reported that outcome expectations plays an important role in the initiation of new behaviours but less of a role in behavioural maintenance (Williams et al., 2005). One study found that it played a more important role than self-efficacy in predicting PA intention and PA behaviour at the start of a program, but it failed to predict these two outcomes at the mid program, when self-efficacy was more important (Gao et al., 2008). In general, outcome expectations have a lower effect on PA (Rovniak et al., 2002) or have no influence on PA (Anderson et al., 2006). However, a literature review by Allen (2004) found evidence to show that outcome expectations predicted exercise adherence. Many interventions have failed to increase outcome expectations; however, it may be improved by broadening the conceptualization to include expected positive and negative outcomes of sedentary behaviour (William et al., 2005). One study among Thai people found that outcome expectations for exercise and functional activity play an important role in performing PA in older adults (Harnirattisai & Johnson, 2005).

### *Self-regulation*

Self-regulation is an individual's ability to set particular and achievable goals, use effective strategies for attaining goals, and self-monitor to evaluate the success in attaining goals (Schnoll & Zimmerman, 2001). It both predicts behaviour and accounts for the influence of self-efficacy on behaviour (Bandura, 1986). It is important for behaviour change (Stadler et al., 2009; Umstattd et al., 2009; Umstattd, Saunders, Wilcox, Valois, & Dowda, 2006). Self-regulation may mediate the relationship between self-efficacy and PA (Anderson et al., 2010;

Hallam & Petosa, 2004; Rovniak et al., 2002; Wadsworth & Hallam, 2010). It had medium to high relationships with self-efficacy and PA (Umstattd et al., 2009; Umstattd, Wilcox, Saunders, Watkins, & Dowda, 2008) and was related to exercise enjoyment and exercise adherence (Puente & Anshel, 2010). One study reported that of the social-cognitive variables, self-regulation had the strongest effect on PA (Anderson et al., 2006), if self-regulation was not used in an intervention, self-efficacy was less predictive of PA (Anderson et al., 2006; Umstattd et al., 2008).

Goal setting and self-monitoring are important skills of self-regulation for behaviour change (Anderson et al., 2006). Goal setting is a strategy that is commonly used to help people change their behaviour (Cullen, Baranowski, & Smith, 2001; Nothwehr & Yang, 2007). It helps people to guide and regulate their actions, thoughts, and emotions to achieve desired outcomes (Bandura, 2004). Thus, goal setting had positive effects on PA and could facilitate PA change (Carr et al., 2008).

Good goal characteristics include proximal, specific, and difficult but attainable goals (Locke, Shaw, Saari, & Lantham, 1981). For behaviour change, proximal goals were more effective than distal goals (Shilts, Horowitz, & Townsend, 2004). Specific goal setting produced higher self-efficacy (Ashford et al., 2010). Assigned goal setting was found to be more effective than collaborative and self-set goal setting. Additionally, adding feedback and rewards could increase motivation and behaviour (Mento, Steel, & Karren, 1987). Similarly, providing feedback via e-mail or on-line was associated with higher self-efficacy

(Ashford et al., 2010). Therefore, the goal characteristics (proximity, specificity, difficulty) and components (feedback, rewards) are very important to making goal-setting effective in promoting motivation, self-efficacy, and ultimately behaviour change (Neubert, 1998). Goal setting was also associated with self-monitoring (Nothwehr & Yang, 2007).

Self-monitoring is also important for behaviour change. Studies reported that regular self-monitoring of PA (e.g., stepping) was associated with exercise (Carels, Darby, Rydin, Douglass, Cacciapaglia, & O'Brien, 2005; Michie, Abraham, Whittington, McAteer, & Gupta, 2009). Monitoring and recording of steps/day promoted walking behaviour (Lauzon, Chan, Myers, & Tudor-Locke, 2008) and increasing self-monitoring improved PA (Helsel, Jakicic, & Otto, 2007).

In conclusion, SCT can be used as theoretical framework for PA interventions. It is associated with PA. Self-efficacy, outcome expectations, and self-regulation are important determinants of PA change. Self-efficacy and outcome expectations can influence PA directly and through the development and use of self-regulation (Bandura, 1997). Winett, Anderson, Wojcik, Winett, and Bowden (2007) suggested that an intervention for PA change should focus on increasing self-efficacy, outcome expectations, and self-regulation. Thus, to promote and maintain PA in Thai female students, a SCT-based intervention will be conducted. Figure 1-1 shows the SCT-based intervention model that will be used to develop the intervention program for promoting and maintaining PA in this dissertation.

In Thai population, there are only a few SCT-based intervention studies targeting PA change. Piaseu et al. (2002) conducted an intervention based on SCT among young women students. They found that the intervention could enhance knowledge and self-efficacy of exercise and self-efficacy mediated the relationship between knowledge and exercise. Another SCT-based intervention was conducted in Thai elders with knee replacement surgery (Harnirattisai & Johnson, 2005). They found that the intervention could improve self-efficacy for exercise, outcome expectations for exercise and functional activity, and physical performance in these samples. Therefore, SCT is an appropriate model to use in research with Thai people.

## Intervention Mapping (IM)

It is posited that although psychological theories may provide an essential contribution to health promotion practice, the gap between theory and practice is quite difficult to link (Kok, Schaalma, Ruiter, Van Empelen, & Brug, 2004). However, by using IM, this problem can be reduced. IM provides a framework for developing an effective intervention program (Bartholomew, Parcel, Kok, Gottlieb, & Fernandez, 2011). It contains six steps: needs assessment, matrices of change objectives, select-theory-based intervention methods and practical applications, intervention program, adoption and implementation, and evaluation plan (Bartholomew et al., 2011). The result of IM is a “map” that consists of matrices and plans that guide the design, implementation, and evaluation of an intervention (Bartholomew, Parcel, & Kok, 1998).

*Step 1: Needs Assessment*

The needs assessment suggested that an intervention for promoting and maintaining PA in university-aged female students in Thailand should be conducted. Regular PA is important for the health and wellbeing of people of all ages. It increases exercise capacity and physical fitness such as cardio-respiratory fitness, musculoskeletal fitness, flexibility, and body composition, which lead to many health benefits (Prasad & Das, 2009). PA can also improve emotional states and decrease depression and anxiety (Wifli, Rethorst, & Landers, 2008). Also, regular PA offers primary and secondary prevention of several chronic diseases such as coronary heart disease and hypertension (Buchner, 2009). In addition, increased levels of PA and physical fitness have been found to reduce the risk of premature death (Macera, Hootman, & Sniezek, 2003), and in turn decreased physical fitness has been found to increase the risk of premature death (Erikssen, 2001). However, people are not likely to participate in PA (WHO, 2010), especially Thai female undergraduate students (National Statistical Office, 2007; Sisson & Katzmarzyk, 2008).

The needs assessment leads to the *program objective* of the intervention that is: to promote and maintain PA in Thai undergraduate female students. The *behavioural outcome* of the intervention is: increased PA levels of students. *Health outcomes* of the intervention are: improved predicted maximum oxygen consumption (Predicted Vo2Max) and resting heart rate (RHR) of students. To obtain the behavioural and health outcomes, *performance objectives* (what the students need to do) are: students participate in moderate to vigorous PA (MVPA)

such as playing sports, walking, and cycling at least 30 minutes a day for 3 days a week, and students increase time spent in MVPA at least 9 minutes each week for 12 weeks. Thus, students will reach 63 minutes per day at the 12$^{th}$ week (or 189 minutes per week). PA guidelines generally recommended that adults should participate in MVPA at least 30 minutes a day for 5 day a week (i.e., 150 minutes per week: Haskell et al., 2007; Tremblay et al., 2011) and Thai Health Promotion Foundation (ThaiHealth) also used these guideines to promote PA in Thai populations. However, these guidelines are rarely used in Thailand and PA is often used interchangeably with the term exercise. When Thai people think about leisure-time PA, they think about exercise. ThaiHealth also used the word "daily exercise" instead of "daily PA" when they promoted PA. In addition, since Thais use the term exercise, they are normally advised to exercise for 3-5 days a week. Thus, suggesting Thai female students to participate in leisure-time PA for only 3 days a week and increase time spent in PA every week until reaching the PA guidelines (i.e., 150 minutes per week) might be suitable for them when encouraging participation and maintainance in the intervention program.

The next question is why will students perform *performance objectives*? From the previous section, the SCT suggested that self-efficacy, outcome expectations, and self-regulation are important determinants of PA change (Bandura, 1986, 1997, 2004). The SCT suggests that the initiation and the maintenance of PA are a function of the expectations about one's ability to perform PA (self-efficacy) and the expectations about the outcome resulting from performing that PA (outcome expectations). Both self-efficacy and outcome

expectations play a role in the adoption of PA and the maintenance of change (Bandura, 1991). Moreover, self-efficacy and outcome expectations are posited to influence PA directly and through the development and use of self-regulation skills (Bandura (1997). Thus, self-efficacy, outcome expectations, and self-regulation will be used as determinants of *behavioural outcome* (i.e., PA levels) in this dissertation. If these variables have been changed, the *behavioural outcome* will be changed as well as the *health outcome*s (i.e., Predicted Vo2Max and RHR).

*Step 2: Matrix of Change Objectives*

The next question is what needs to change related to the determinants of *behavioural outcomes* for students to do the *performance objectives*? First, students need to increase their self-efficacy. They have to express confidence in ability to participate in MVPA and increase the time spent in MVPA. Second, students need to increase their outcome expectations. They have to expect that participation in MVPA can improve their health outcomes, and expect that increasing the duration of MVPA can improve their health outcomes. Third, students need to use self-regulation skills. They need to show that they set PA goals and monitor their PA each week (see table 1-2).

*Step 3: Select-Theory-Based Intervention Methods and Practical Applications*

This step includes two tasks. The first task is to search and select theoretical methods of behavioural change. The second task is to translate these methods into practical applications (Kwak, Kremers, Werkman, Visscher, van Baak, & Brug, 2006).

*1. Selecting Theoretical Methods*

To change the determinants of *behavioural change* identified in step 1, the following theoretical methods are selected (see table 1-3).

First, self-efficacy will be increased by integrating information from four primary sources: performance accomplishments, vicarious experiences, verbal persuasion, and physiological and emotional states (Maddux, 2009). These sources can come in several forms. Performance accomplishments will include positive experiences in performing PA (for example being an exerciser at a younger age). Vicarious experience is the observation of others engaging in similar PA; for students this may include observing other students participating in PA regularly. Verbal persuasion may come from family or significant others. Physiological and emotional states may be the pleasure associated with playing sports with friend (Lee, Arthur, & Avis, 2008).

Based on the four information sources of self-efficacy, the first source is the most powerful source because it is based on direct information: people immediately experience success or failure. The other three sources are all based on indirect information. Modeling, seeing other people demonstrate the desired behaviour, can offer very important self-efficacy information but is not based on one's own experiences. Persuasion is a weaker source. This source usually is used to support the other sources. The last source is the least concrete. People rely on their physical and emotional states to judge their capabilities (van der Bijl & Shortridge-Baggett, 2001). However, Maddux and Lewis (1995) suggested that combining different sources of self-efficacy is the best for enhancement of self-

efficacy, and combining all four sources is the most effective. Bandura (1997) also found that a combination of sources produces the best results, and the combination of practicing and observing others was especially useful. Thus, for increasing self-efficacy in the intervention, the four sources of self-efficacy will be applied.

Second, outcome expectations and outcome values may be improved by focusing on increasing awareness of the potential benefits of PA and creating favorable PA outcome expectations (Williams et al., 2005).

Third, self-regulation is an individual's ability to set specific and attainable goals, employ effective strategies for attaining the goal, and self-monitor to evaluate his or her success in attaining the goal (Schnoll & Zimmerman, 2001). Goals setting and self-monitoring are important skills of self-regulation (Anderson et al., 2006) and will be used in this intervention.

Fourth, a practical application used to deliver information is the launch of a website and an e-mail. The internet has many advantages for delivery of a PA program. In general, internet-based interventions can increase PA (Marcus et al., 2009; Norman et al., 2007; Vandelanotte, Spathonis, Eakin, & Owen, 2007). The advantages of the internet to deliver PA interventions will be discussed in the next section.

*2. Translating Methods into Practical Applications*

To translate the selected theoretical methods into practical applications, the following strategies are used (see table 1-3).

Performance Accomplishments: Practicing and Earlier Experiences

Practicing is the most important source of self-efficacy because it is based on a person's own experience. Experiences of success enhance self-efficacy while regular failure decreases self-efficacy, especially in the early stage of the learning process (Bandura, 1997). Thus, performance accomplishments are the most influential source among the four information sources of self-efficacy (Bandura, 1997; Maddux, 2009). A person's experiences of success may improve their self-efficacies and disappointments at the early stage may reduce it. Breaking behaviour down into small achievable pieces may be useful in order to build up and accumulate confidence (van de Laar & van der Bijl, 2001). Also, greater support is necessary in the early stage of the behaviour to enhance confidence and minimize frustration that may damage self-confidence (Bandura, 1995). In addition, goal setting is found to increase confidence in carrying out a desired behaviour (van de Laar & van der Bijl, 2001). Goals set to the individual needs and capacities of the participants and allowing for gradual progress has been suggested (Lachman, Jette, Tennstedt, Howland, Harris, & Peterson, 1997). If persons can reach their goals regularly, their self-efficacy can increase. Also, making an individual's effort and progress observable through the use of personal PA diaries is seen to be helpful (Lee, Arthur, & Avis, 2007). Thus, practical strategies for performance accomplishments in this intervention include: (1) students are provided the information about their PA and health outcomes at pretest and the end of the intervention; (2) students start PA at minimum levels; (3) students set PA goals by increasing 3 minutes each week; (4) students record

their PA every week; and (5) students receive positive feedback about their PA each week.

Vicarious Experience: Observation of Others

The second way of increasing self-efficacy is vicarious experience. In this way, the person's own capacities are then judged in relation to other people's achievements (Bandura, 1997). Seeing comparable others continue and succeed in the same task strengthens person's idea that they can do it themselves. The strength of this source of information about self-efficacy is strongly influenced by comparability of models (Bandura, 1995). Comparability of models is based on two criteria: shared experiences and similar personal characteristics (van de Laar & van der Bijl, 2001). People with a comparable lifestyle such as friends may serve as models for a specific behaviour and necessary skills (Lee et al., 2008). Observing others is a weaker source of self-efficacy than direct experience, but can contribute to a person's judgment of his or her own self-efficacy (Maddux, 2009). Choosing role models for the vicarious experience of regular PA among students may increase student's self-efficacy. Thus, practical strategies for vicarious experience in this intervention are: (1) students will receive information about PA of role models; and (2) students will receive the information about their own PA behaviour.

Verbal Persuasion: Feedback from Others

Persons will have more confidence in themselves if others have confidence in their capacities. By giving instructions, suggestions, and trying to convince persons that they can succeed in a difficult task, self-efficacy can

increase. This confidence results in more efforts and continuation in a task until the desired behaviour has been developed (van de Laar & van der Bijl, 2001). If people are convinced of their abilities, they are likely to continue their behaviour and will not give up easily. Also, some people may underestimate their achievements; thus, verbal support will help them to interpret the experience as a success (Bandura, 1997). Verbal persuasion may stimulate persons to set higher goals than they will have done by themselves (van de Laar & van der Bijl, 2001). In this way, students can be encouraged to set higher PA goals. Verbal support is often used in combination with other sources because it has limited power in itself (Bandura, 1997). Also, it may not work with persons who already think they are able to carry out a task and is useless if it is not realistic (Bandura, 1997). Verbal persuasion can be practiced in the form of positive feedback. Positive feedback on the actions a person has taken and a positive interpretation of possible mistakes can enhance self-efficacy (van de Laar & van der Bijl, 2001). Realistic positive feedback is important to induce individuals to carry out and maintain behaviour (Bandura, 1997). Thus, practical strategies for verbal persuasion in this intervention are: students receive positive feedback about their PA levels every week.

### Perceiving Physiological and Emotional States

Information on the human body can influence one's self-efficacy. In judging their own capacities, persons use information about their physiological and emotional states. They experience tension, anxiety, and depression as signs of personal deficiency. In PA, persons may interpret fatigue, pain, aching muscles as

indicators of physical inefficacy (van der Bijl & Shortridge-Baggett, 2001). Similarly, stress can have a negative influence on self-efficacy (Lee et al., 2008). Therefore, self-efficacy can be increased by improving student's physical states, reducing stress, and decreasing negative emotions, as well as by correcting false interpretations of the student's physical states (van de Laar & van der Bijl, 2001). For example, when students experience muscle fatigue in the early stages of participating in exercise, the researcher can help them interpret these as necessary steps to longer term health gain rather than perceiving them as negative consequences of exercise. Enhancing a positive physical status, reducing stress and negative emotional states, and offering alternative interpretations of what are perceived as negative physiological and psychological indicators has been found to be essential in enhancing self-efficacy among older adult participants (Resnick, 2002). A study also found reverse associations between self-efficacy and stress and health in adolescents (Moeini, Shafii, Hidarnia, Babaii, Birashk & Allahverdipour, 2008), and depression and anxiety in students and adults (Luszczynska, Gutierrez-Dona & Schwarzer, 2005). Self-efficacy is related with positive and negative emotions in students and adults (Luszczynska et al., 2005). Thus, practical strategies for improve physical and emotional states in the intervention are: reducing stress and negative emotion by advising students to participate PA at minimum levels and increase PA at lower rate each week.

Increasing Awareness of the Potential Benefits of PA

Increasing awareness of the potential benefits of PA may increase outcome expectations in Thai students, although a review found that this strategy

showed little success in changing outcome expectancies (Williams et al., 2005). Practical applications for increasing awareness of the potential benefits of PA in the intervention are: (1) students receive information about benefits of PA; (2) students receive information about general workouts; (3) students receive a personal guideline for PA; and (4) students receive information about their outcome expectations on PA goals each week.

### Creating Favorable PA Outcome Expectations

Williams and colleagues (2005) suggested that creating favorable PA outcome expectations may increase outcome expectations. They posited that it is necessary for people to experience more positive and fewer negative outcomes of PA. This is because if persons received a good outcome in the past, they will expect similar outcomes when they perform again. Thus, practical applications for creating favorable PA outcome expectancies in this intervention are: (1) students choose their own activities; (2) students start PA at minimum levels; and (3) students increase PA at a lower rate each week. The purpose is for enjoyment.

### Goal Setting

The important of goal setting is to enhance self-efficacy. Goal setting directs and causes motivation for a desired behaviour (Bandura, 1986). Goals direct person's attention, enhance their concentration and lead to new strategies for succeeding. If persons set goals, it will motivate them to try to reach the goals (Bandura, 1986). Goals should be specific and sufficiently challenging. Also, goals have to be realistic and achievable. Short-term goals are more motivating than long-term goals (Locke et al., 1981). In addition, adding feedback and

rewards can increase motivation and task performance, as well as self-efficacy (Gonzalez, Goeppinger, & Lorig, 1990). Feedback should be given on the goals of the preceding period, and students should report their achievements (van de Laar & van der Bijl, 2001). The goal characteristics (proximity, specificity, difficulty) and components (feedback, rewards) are important to making goal-setting effective in promoting motivation, self-efficacy, and behaviour changes (Neubert, 1998). Goals set by researchers produced higher self-efficacy (Ashford et al., 2010). Also, specific feedback through comparison with others' performance or past performance produced higher levels of PA self-efficacy. Providing feedback by an e-mail or on-line is associated with higher self-efficacy (Ashford et al., 2010). Thus, practical strategies for goal setting in this intervention are: (1) students set weekly PA goals by increasing time spent in MVPA at least 3 minutes each week; (2) students receive positive feedback about their PA; and (3) students receive information about their PA goals.

Self-monitoring

Self-monitoring is important for behaviour change. Regular self-monitoring of PA (e.g., step-counts) increases exercise levels (Carels et al., 2005; Michi et al., 2009). Monitoring and recording of steps/day are important techniques in promoting walking (Lauzon et al., 2008). Increased self-monitoring also improves behaviour outcomes (Helsel et al., 2007). Thus, practical strategies for self-monitoring in this intervention are: students monitor and record their PA (i.e., steps and duration per day) each week.

*Step 4: Intervention Program*

The program plan is for a 3 month intervention period and a 3-month follow-up period. A website and e-mails will be used to run the program. E-mails will be used to send questionnaires, feedback on PA, PA of role models, and a reminder message to participants. A website will be used to provide information about PA, general workouts, and PA photos. The website also contains student's profile which they can access their information about behaviour outcome, PA logs, and goal setting logs. In the intervention periods, students will be advised to access the website to get information, set PA goals, and record their PA behaviour at least one time per week. Also, students will receive an e-mail from the researcher at least one time per week. In the follow-up periods, students will be advised to access the website to get information and record their PA behaviour and also will receive an e-mail from the researcher at least one time per month (at the $4^{th}$ week of each month).

*Step 5: Adoption and Implementation Plan*

The SCT-based internet intervention PA program will be adopted and implemented by the researcher interested in increasing PA level in university-aged female students in Thailand.

*Step 6: Evaluation Planning*

In this intervention, indicators of success are improving in *determinants of behavioural outcomes, behaviour outcomes, and health outcomes*. To evaluate the effect of the intervention, outcome measures that are related to the objectives of the intervention will be used. Techniques that will be used to evaluate the

outcomes include indirect measures (e.g., self-report questionnaires) and direct measures (e.g., pedometers and Predicted Vo2Max). In order to determine the efficacy of the intervention, a 3-month randomized control trial intervention will be conducted employing a Solomon four-group design. At least 168 female students will be recruited into this intervention.

The *main outcome* measures are change in PA and physical fitness. Also, self-efficacy, outcome expectations, and self-regulation will be evaluated as possible mediators of PA and physical fitness changes. To measure PA levels, self-report questionnaires and pedometers will be used. To measure physical fitness, the Queen's college step test will be used to measure Predicted Vo2Max. RHR will be measured by counting the radial pulse rate. For measuring the determinant of behavioural outcome, self-report questionnaires will be used. Outcome measures will be collected at pretest, the end of the intervention, and 3 months later as a follow-up.

In conclusion, the IM provides six steps for developing the SCT-based internet intervention PA program in this dissertation.

## Internet Interventions

The use of the internet as a tool to promote health behaviour change is now increasing due to an increase in the number of people who have access to and use the internet (Internet World Stats, 2012). For example, over 27% of the Thai population had access to the internet in 2011, and the annual growth rate has increased from 17% in 2010 to 21% in 2011 (Internet World Stats, 2012). A study in Thailand also showed that 90% of Thai undergraduate students accessed the

internet, and 75% of those accessed the internet at university 1 to 3 hours at a time and 1 to 3 times a week (Kitikannakorn & Sitthiworanan, 2009).

### *Advantages of the Internet Intervention*

The internet intervention has many advantages for delivery of a PA program. It has advantages for program delivery because it combines the essential characteristics of the other forms of media. For example, internet interventions can provide written material, video or photographic materials, and direct communication and social support via e-mail, bulletin boards, or chat rooms (Proudfoot et al., 2011; Tate, Finkelstein, & Khavjou, 2009).

The internet intervention also has the potential to reach large numbers within the population with low cost (Marcus et al., 2009; Marcus et al., 2000). A large part of the population can be reached since so many people now have internet access. Also, internet interventions are accessible 24 hours a day and 7 days a week (Proudfoot et al., 2011). People can access the intervention program at any time and location and can work through the program at their own pace (Marcus et al., 2009; Napolitano & Marcus, 2002). Moreover, internet interventions increase the accessibility to programs for those restricted by geographical, transport, personal disability, or financial barriers. Internet interventions reduce delivery costs. In general, internet interventions cost less than traditional face-to-face intervention (Tate et al., 2009).

Further advantages are privacy and accuracy (Proudfoot et al., 2011). Internet interventions offer anonymity to users. They provide a feeling of anonymity to users that may encourage individuals to seek out sensitive health

information. For example, the internet offers anonymity for obese persons who may feel embarrassed in seeking weight-loss program. Furthermore, internet interventions are easier to keep information accurate and updated. They contain the availability of the program or support at any time and opportunity to review the material as often as desired. For example, web boards are always available so individuals can exchange information, receive support, and work at their convenience (Proudfoot et al., 2011).

In addition, internet interventions reduce traditional face-to-face barriers. They reduce many of the barriers that people may face when participating in traditional interventions (i.e., time, travel, and finance; Ritterband, Thorndike, Cox, Kovatchev, & Gonder-Frederick, 2009). It is known that most obese people prefer to lose weight without having to participate in a face-to-face program. Thus, internet interventions which offer an alternative method can provide an option to those who cannot or choose not to seek face-to-face treatment. People who are unable or unwilling to receive care may have access to internet prevention or treatment options at home. As a result, internet interventions can help reduced health disparities, particularly for those living in remote areas (Pullen, Hageman, Boeckner, Walker, & Oberdorfer, 2008).

Importantly, internet interventions are effective in changing behaviour. They can be used to change individual's cognition and behaviour. They produce favorable behaviour change outcomes such as increased PA levels (Davies, Spence, Vandelanotte, Caperchione & Mummery, 2012; Marcus et al., 2009; Norman et al., 2007; Vandelanotte et al., 2007), decreased sedentary behaviour

and unhealthy dietary behaviour (Norman et al., 2007), and improved quality of life (Ritterband & Tate, 2009). On average, internet interventions have small to medium effects on health behaviour (Davies et al., 2012; Dunton & Robertson, 2008; Vandelanott et al., 2007). Especially, interventions that targeted multiple behaviours had smaller effects on behaviour than did interventions that targeted a single behaviour. However, although internet interventions have small effects, they have the potential to have an impact on large numbers of people; thus, they are significant for population health. Moreover, effect sizes can be increased if interventions based on theoretical basis (e.g., SCT and TPB), usd more behaviour change techniques (e.g., goal setting and self-monitoring), and used additional methods of communicating with participants (e.g., messages and tailored feedback; Webb, Joseph, Yardley, & Michie, 2010).

### *Disadvantages of the Internet Intervention*

The internet is not without disadvantages. There are some disadvantages that researchers should consider when using internet interventions. First, interactive technologies are just a tool, not a living thing (Webb et al., 2010). They cannot do anything if individuals cannot motivate themselves to take advantage of what technologies have to offer. Thus, internet interventions need to be structured in ways that build motivational and self-management skills as well as guide behaviour changes. Otherwise, people who need the guidance may not use this tool (Webb et al., 2010).

Other disadvantages of internet interventions are low access and poor usage levels. It has been reported that the numbers of people engagement in

internet interventions are normally lower than initially expected. Also, people tend to leave the intervention website before completing it, or had few website log-ons. Log-on rates tended to decrease over time and attrition from intervention is generally high (Brouwer, Kroeze, Crutzen, de Nooijer, de Vries, Brug, & Oenema, 2011). However, a log-on rate, a longer visit, a revisit to website, and attrition rate could be improved if the internet intervention used intervention elements that make the intervention more attractive to use (e.g., multimedia features), used interactive behaviour change strategies (e.g., e-mail and/or phone contact, tailored feedback, goal setting, self-monitoring), frequently updated the intervention website, and used peer and counselor support (Brouwer et al., 2011). A study by Lewis et al. (2008) found that an internet intervention that was specifically designed and contained interactive and instantaneous features such as personalized feedback will promote participants to return to the website. These were related to the participants' feedback which rated the PA logs (self-monitoring) most useful, followed by goal setting, and the tailored feedback report when they were asked to rate the usefulness of the features of the program. Similarly, Ashford et al. (2010) recommended that PA interventions should include vicarious experience as a technique to enhance self-efficacy and PA, and interventions should provide participants with feedback by comparing an individual's performance with that of similar others. Monitoring behavioural performance without the focus on goal achievement might be useful for enhancing self-efficacy beliefs in PA interventions. A recent study also showed that internet

interventions were an effective method to increase self-regulation and PA (Wadsworth & Hallam, 2010).

In addition, studies normally reported that the internet use is lower among those who live in a rural area, those with less than a high school education, or those with low economic status (Madden, 2006). Thus, internet interventions may not be appropriate or limit those people in accessing to PA programs.

Finally, the internet intervention may seem contradictory to think if it could be a valuable tool for increasing PA because using the internet is a sedentary behaviour. Similarly, its benefit of reducing travel to and from an in-person session could result in less PA. However, sitting at the computer is sedentary, but reading text-based information in brochures or sitting in a support group are similar. Thus, using the internet is no more sedentary than traditional forms of communication, but it can offer great potential for increasing a user's motivation to modify PA through its interactive features and strategies for overcoming barriers, and opportunities to share support and encouragement with others. Additionally, materials can be distributed over the internet at a far lower cost than print materials, and its multimedia capabilities surpass what can be offered in print. For example, online video can provide instruction on how to correctly perform PA, thus reducing risk of injury and increasing probability of continued engagement in PA (Saperstein, Atkinson & Gold, 2007).

### *The Internet-based PA Intervention*

In general, internet-based PA intervention studies showed significant increases in PA (Davies et al., 2012; Marcus et al., 2009; Norman et al., 2007;

Vandelanotte et al., 2007; van den Berg, Schoones, & Vliet Vlieland, 2007). A review showed that most interventions commonly used website, e-mail, or both. The majority of studies were based on psychological theory such as the SCT, the TTM, or a combination of the two. A few studies had a follow-up after the intervention (Norman et al., 2007). The effect sizes of studies that found positive outcomes were small, and although the intervention was efficacious in the short-term (Davies et al., 2012; Vandelanotte et al., 2007), it did not produce longer-term adherence to PA (Carr, Bartee, Dorozynski, Broomfield, Smith, & Smith, 2009; Davies et al., 2012; Wadsworth & Hallam, 2010). Interventions shorter than 3 months had higher effects while interventions longer than 3 months had lower effects (Vandelanotte et al., 2007). However, Carr et al. (2009) and Wadsworth and Hallam (2010) suggested two factors that might play an important role in PA relapse. First, it was possible that participants did not receive follow-up contact or intervention delivery from the research teams during the follow-up period. Thus, for protection in PA relapse, it may be necessary to maintain contact with program participants for a longer time after the formal intervention program. Second, it was possible that participants did not receive enough of the intervention to facilitate permanency of behaviour change.

In addition, although internet-based PA interventions reported positive effects, there were some limitations in study designs that limited evidence of effectiveness (Marcus et al., 2009; van den Berg et al., 2007). For example, most of the studies used a single PA outcome measure, while objective measures such as activity monitors or pedometers were rarely used. Thus, many of the

interventions did not report their outcomes in term of changes in PA levels or fitness. Only a small number of internet-based PA intervention studies have used a control group, with just a few of those having used an adequately powered sample size. Moreover, some studies did not report any baseline PA levels. It is known that in general, active persons are more able to comply with PA interventions and maintain a healthy lifestyle than sedentary persons.

In conclusion, the internet is accessible and convenient, and helps reduce some barriers for seeking PA programs. Internet-based PA interventions are feasible and effective for enhancing PA, but some limitations of previous studies need to be addressed. Research is needed to examine internet-based PA interventions' effectiveness in promoting and maintaining PA changes. There is a need to determine how to maintain the effect over time and how to enable people to maintain their PA for a longer time. To answer such questions, this dissertation pays attention to methodological quality (i.e., sample size and outcome measures), and has long term follow up and a true control group. Also, this intervention enhances and maintains self-efficacy, outcome expectations, and self-regulation in order to develop and sustain PA changes. In addition, the Website contains interactive features such as PA and goal setting logs, and PA feedback reports.

## Main Research Goals

Three main research goals were set for the purpose of answering the main research question: *Is a SCT-based internet intervention PA program effective in increasing and maintaining PA in university-aged females in Thailand?*

***Goal 1*** was to exam the validity and reliability of Thai versions of questionnaires measuring leisure-time PA, exercise-related self-efficacy, outcome expectations, and self-regulation.

***Goal 2*** was to evaluate the efficacy of the SCT-based internet intervention PA designed to promote and maintain leisure-time PA in university-aged female students in Thailand.

***Goal 3*** was to examine whether SCT variables mediated changes in PA and physical fitness.

## Thesis Structure

This dissertation consists of four chapters (Chapters 2 and 3) describing the first and the second studies. Also, a final chapter (Chapter 4) presents a set of overall conclusions for the two studies and implications for future work. A literature review about Thailand, PA, validity and reliability concepts and translation procedure of questionnaires are presented in Appendix A.

***Study 1*** is entitled "Validity and reliability of Thai versions of questionnaires measuring leisure-time PA, exercise-related self-efficacy, outcome expectations, and self-regulation". This study responded to *Goal 1* of this dissertation. This paper has been accepted for publication and the version

presented here is the publication version and the co-authors provided feedback and input.

***Study 2*** is entitled “An internet-based intervention for promoting and maintaining PA in Thai university-aged females: a randomized controlled trial”. This study addresses *Goals 2 and 3* of this dissertation. This paper has been submited for publication and is under reviewing and the version presented here is the submited version and the co-authors provided feedback and input.

# Tables

Table 1-1 Definitions

| Concept | Definition |
|---|---|
| Concurrent validity (Sim & Wright, 2000). | The relationship between two (similar) measures of interest |
| Goal setting (Cullen, Baranowski, & Smith, 2001). | A four-step process starting with acknowledging the need of a goal, formulating the goal, involvement in goal-directed activities, and self-reward on goal achievement. |
| Metabolic equivalent (Ainsworth et al., 2000). | The ratio of the PA metabolic rate to the resting metabolic rate |
| Outcome expectations (Williams et al., 2005). | One's expectation that behaviour will produce a given outcome |
| Pedometers (Todor-Lock & Basset, 2004). | A body-worn motion sensor tools that are being used to assess and motivate PA behaviour |
| Physical activity (ACSM, 2010). | Any bodily movement produced by skeletal muscle that requires energy expenditure |
| Physical fitness (Warburton, Nicol, & Bredin, 2006). | A physiological state of well-being that allows individuals to have a capacity to live or work in daily living or that provides the basis for sport |

| | |
|---|---|
| | performance |
| Reliability (Thomas et al, 2011). | The repeatability or consistency or stability of a measure administered under similar circumstances |
| Self-efficacy (Glanz et al., 2002). | The person's confidence in the ability to perform a particular behaviour; including confidence in overcoming the barriers to performing that behaviour |
| Self-regulation (Schnoll & Zimmerman, 2001). | An individual's ability to set specific and attainable goals, employ effective strategies for attaining the goal, and self-monitor to evaluate his or her success in attaining the goal |
| Social cognitive theory (Bandura, 2004). | Theory that emphasizes the importance of increasing person's behavioural capability (i.e., knowledge and skills) and self-confidence (i.e., self-efficacy) to engage in particular health behaviour |
| Validity (Thomas et al., 2011). | The degree to which the scores from the test measure what it claims to measure |

Table 1-2 Matrixes of Change Objectives

| Behavioural Outcome: PA Level Changes | | | |
|---|---|---|---|
| Performance objectives | Determinants | | |
| | Self-efficacy | Outcome expectations | Self-regulation |
| Participate in MVPA at least 30 minutes per day for 3 days a week (i.e., 90 minutes per week) | SE.1: Express confidence in ability to participate in MVPA | OE.1: Expect that participation in MVPA can improve outcomes | SR.1: Set PA goals and monitor PA each week |
| Increase time spent in MVPA at least 9 minutes each week (i.e., 3 minutes per day for 3 days) | SE.2: Express confidence in ability to increase the duration in MVPA | OE.2: Expect that increasing the duration in MVPA can improve outcomes | SR.2 Set PA goals and monitor PA each week |

Table 1-3 Frameworks of Program Developments

| Determinants | Methods | Practical Strategies | How it can be accomplished through internet |
|---|---|---|---|
| Self-efficacy | Performance accomplishments | Students receive information about their behavioural and health outcomes at pretest and the end of the intervention. | Show a graph summarizing individual's behaviour and health outcomes at pretest and end of the intervention. |
| | | Students start PA at minimum level. | - |
| | | Students set PA goals by increasing 9 minutes each week. | Goal setting logs. |
| | | Students record their PA (steps & minutes) every week. | PA logs. |
| | | Students receive positive feedback about their PA levels each week. | Receive information by e-mails. |
| | Vicarious experience | Students receive information about PA of role models. | Receive information by e-mails. |
| | | Students received information about their PA. | Show a graph of PA goals and actual PA in each week. |
| | Verbal persuasion | Students receive positive feedback about their PA levels each week. | Receive information by e-mails. |
| | Improve physical and emotional state | Students participate in PA at minimum levels and increase PA at lower rate each week. | - |

| | | | |
|---|---|---|---|
| Outcome expectations | Increasing awareness of the potential benefits of PA | Students receive information about PA. | Post in the website. |
| | | Students receive information about PA workouts. | Post in the website. |
| | | Students receive general PA guidelines. | Post in the website. |
| | | Students know their outcome expectations on PA goals each week. | Show a graph of outcome expectations on PA goals in each week. |
| | Creating favorable PA outcome expectancies | Students choose their own activities | - |
| | | Students start PA at minimum level | - |
| | | Students increase PA at lower rate each week | - |
| Self-regulation | Goal setting | Students set PA goals by increasing 3 minutes each week | Goal setting logs. |
| | | Students receive positive feedback about their PA | Receive information by e-mails. |
| | | Students receive information about their PA goals | Show a graph of PA goals and actual PA weekly. |
| | Self-monitoring | Students record their PA (steps & minutes) each week | PA logs. |

Figures

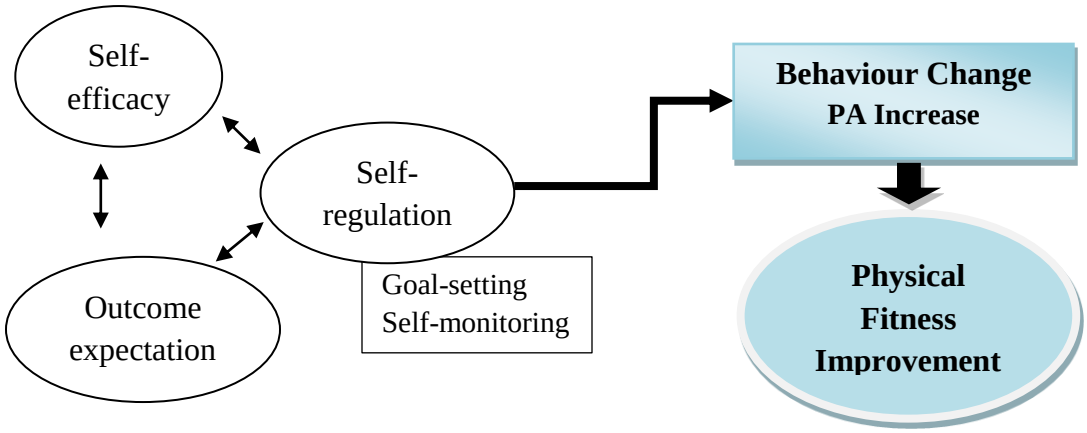


Figure 1-1 An illustration of the SCT-based intervention model (Modified from socio-cognitive causal model of Bandura, 2004).

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# CHAPTER 2: STUDY 1

# Validity and reliability of Thai versions of questionnaires measuring leisure-time PA, exercise-related self-efficacy, outcome expectations and self-regulation

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Acknowledgements

Gratitude is extended to Srinakharinwirot University and the University of Alberta for financial support to the author.

This chapter has been accepted for publication. Sriramatr, S., Berry, T. R., & Rodgers, W. (2013). *Pacific Rim International Journal of Nursing Research*, *17*, 203-216.

## Introduction

Regular physical activity (PA) is important for the health and wellbeing of people of all ages. Being regularly active can increase exercise capacity and physical fitness which, in turn, leads to many health benefits (Prasad & Das, 2009). PA can be promoted and maintained through theoretically based interventions (Turner-McGrievy et al., 2009; Winett, Williams, & Davy, 2009). For example, Social Cognitive Theory (SCT) has been used to explain and promote individual's PA behaviour (Anderson, Wojcik, Winett, & Williams, 2006; Petosa, Suminski, & Hortz, 2003). Self-efficacy, outcome expectations, and self-regulation are SCT constructs that are related to PA adoption and adherence (Gao, Xiang, Lee, & Harrison, 2008; Stadler, Oettingen, & Gollwitzer, 2009; Umstattd, Moti, Wilcox, Saunders, & Watford, 2009). Since increased self-efficacy, outcome expectations, and self-regulation levels are important factors in promoting and maintaining individual PA, it is necessary to have valid and reliable measures of these constructs for use in research and interventions. However, the majority of the research examining psychosocial correlates of physical inactivity has taken place with North American and European populations, and less research has examined work in developing countries. This may be due, in part, to the lack of translated instruments as well as the lack of any valid evidence that constructs such as self-efficacy are also relevant in non-Western cultures. An important first step in addressing this gap in evidence is to translate questionnaires, obtain validity evidence, and assess their relevance in the cultures of influence.

Evidence from epidemiological studies supports the idea that the health and quality of life-related burdens of physical inactivity, and overweight and obesity are increasing around the world, particularly in Asian and south-east Asian populations where the ill-health related outcomes seem to be even more severe than for predominantly Caucasian populations (James, Leach, Kalamara, & Shayeghi, 2001; Kosulwat, 2002). For example, Thailand is an Asia-Pacific country regarded as a developing economy which is showing increased prevalence of overweight and obesity as well as decreased PA frequently associated with an economic shift from traditional to western type economies (Kosulwat, 2002; Rerksuppaphol & Rerksuppaphol, 2010). As such, it is important to determine whether prognostic indicators that have been found to be important in Western countries (for example, SCT constructs) are meaningful in Thailand.

## Literature Review

In population-based research, PA, self-efficacy, outcome expectations, and self-regulation are typically measured by self-reported questionnaires. The Godin-Shephard Leisure-Time Physical Activity Questionnaire (GSLTPAQ) has been shown to be a valid and reliable measure of leisure-time PA (Gionet & Godin, 1987; Godin, 2011; Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993; Miller et al., 1994; Sallis et al., 1993). There also exist valid and reliable questionnaire measures of exercise-related self-efficacy (the multidimensional self-efficacy for exercise scale; MSES: Rodgers & Sullivan, 2001; Rodgers, Wilson, Hall, Fraser & Murray, 2008; Spence, Burgess, Rodgers,

& Murray, 2009), outcome expectations (Dishman et al., 2005), and self-regulation (Rovniak, Anderson, Winett, & Stephens, 2002). Tasks, coping, and scheduling self-efficacy as assessed by the MSES have been found to predict PA in a variety of settings including the general population (Murray, Rodgers, & Fraser, 2012); women initiating exercise (Murray, Rodgers, & Fraser., 2009); and cardiac rehabilitation (Fraser & Rodgers, 2010). Similarly, The Outcome Expectations Questionnaire (OEQ) and the Self-regulation Questionnaire (SRQ) have been found to be valid and reliable measures of outcome expectations in adolescence (Dishman et al., 2005) and self-regulation in undergraduate students, respectively (Rovniak et al., 2002). However, these self-report questionnaires were originally developed in North American populations and previous studies have shown that cultural and language differences could exist when an English version questionnaire is translated into other languages (Macfarlane, Lee, Ho, Chan, & Chan, 2006; 2007). It has also been shown that when previously developed instruments are adapted or translated to other languages, the internal structure of the instrument may change resulting in possibly lower validity and reliability than the original versions (Marin & Marin, 1991). Even though standard translation and back-translation procedures are used, the new version of the instrument may not capture proper emotion concepts of the original version (Barger, Nabi, & Hong, 2010). Thus, once an instrument has been translated, researchers must make sure that this version of the instrument is fully equivalent to the original version (Marin & Marin, 1991). That is, researchers should analyze the internal structure (for example, using factor analysis) and internal consistency

(for example, the alpha coefficient) of the questionnaire. Tests of the questionnaire's validity should also be conducted (Marin & Marin, 1991).

It is known that there is a positive relationship between PA levels and SCT variables (Marcus, Nigg, Riebe, & Forsyth, 2000; Wojcicki, White, & McAuley, 2009). Also, self-efficacy, outcome expectations, and self-regulation are positively related. For example, individuals who have higher self-efficacy were likely to set higher goal and expect higher outcome (Bandura, 2004). Moreover, previous studies have found gender and activity level effects on rating scales of exercisers (Sriramatr, Berry, Rodgers, & Stolp, 2012), and on rating scales of self-efficacy (Netz & Raviv, 2004; Rodgers et al., 2008). In general, men rated higher self-efficacy than women (Netz & Raviv, 2004; Rodgers et al., 2008). Exercisers rated higher self-efficacy than non-exercisers (Netz & Raviv, 2004). In addition, it is known that Thai female undergraduate students were not likely to participate in PA compared with Thai male undergraduate students (Sisson & Katzmarzyk, 2008). Thus, it is essential for this present study to target only females when these findings have been taken into account.

Despite considerable research showing the benefits of PA (Warburton, Nicol, & Bredin, 2006), and the role of self-efficacy, outcome expectations, and self-regulation (Bandura, 1997; Marcus et al., 2006) in PA behaviour, there are no validated Thai language questionnaires of these constructs. The development of such measures is important in measuring PA in this country. For example, only about 2% of Thai female university students are active enough to achieve health benefits (Sisson & Katzmarzyk, 2008). Prior to developing interventions targeting

this population, adequate measurement tools are needed. Thus, the purpose of this study was to translate the GSLTPAQ, MSES, OEQ, and SRQ into Thai, and then to examine the validity and reliability of these versions of the questionnaires.

## Method

### *Measures*

The GSLTPAQ. This Questionnaire, developed by Godin and Shephard (1985), includes three questions that measure weekly frequencies of mild, moderate, and strenuous PA for periods of more than 15 minutes during free time (see appendix B). The weekly frequency of mild, moderate, and strenuous activities can be converted into leisure-time activity score (LTAS) by multiplying by 3, 5, and 9 Metabolic equivalents (METs) respectively. The sum of these scores provides a total weekly LTAS. Also, the MET value of moderate and strenuous activities can be used to compute a health contribution score (Godin, 2011). Participants are also asked to report how frequently they are involved in an exercise activity long enough to work up a sweat on a scale of often, sometimes, and never/rarely. The GSLTPAQ demonstrated a one-month test-retest reliability of 0.62 and concurrent validity coefficients of 0.32 with an objective indicator (accelerometer), 0.56 with $Vo_2Max$, and 0.43 with percentage body fat (Jacobs et al., 1993).

The MSES. A 9-item self-report questionnaire was developed by Rodgers and Sullivan (2001) and Rodgers and colleagues (2008) to measure the magnitude and strength of self-efficacy (see appendix B). The Questionnaire begins with the following definition of exercise, *"Three thousand to six thousand steps are the*

*equivalent of performing moderate intensity PA (MPA) for 30 to 60 minutes"*. Three items each measure task, coping, and scheduling efficacy for performing the PA behaviours (that is, MPA at least for 30 min/day for 3 days a week). The question in each item starts with the statement, *"How confident are you that you can...",* and follows with the specific statement to measure the task, coping and scheduling efficacies. Example questions include: "*How confident are you that you can complete MPA at least 30 min/day for 3 days a week?"* (task)*, "How confident are you that you can perform MPA at least 30 min/day for 3 days a week when you feel discomfort when performing PA?"* (coping), and *"How confident are you that you could include MPA at least 30 min/day for 3 days a week in your daily routine?"* (scheduling). All items are rated on a scale ranging from 0% (no confidence) to 100% (complete confidence).

The OEQ. A 9-item self-report questionnaire was developed by Dishman and colleagues (2005) to assess outcome expectations (see appendix B). In this study, the Questionnaire began with the following statement, *"Some people think performing MPA at least 30 min/day for 3 days a week will improve their health, others think it will improve their mood. Do you think the following benefits and values of performing MPA will occur to you?"* The statements are followed by 9 items which are rated on belief and value scales. For example, item 1 states "It would help me spend more time with my friends." Each item is rated on a belief scale using a 5-point scale ranging from disagree a lot (1) to agree a lot (5), then on a value scale using a 5-point scale ranging from very unimportant (1) to very important (5). Outcome expectations values are obtained as the sum of all the

beliefs items and all the values items. Dishman and colleagues (2005) reported internal consistency coefficients of 0.72 and test-retest reliability correlations of 0.72 across one week. In the current study, one additional open-ended question about outcome expectations was asked in the third (EFA) study: "*In addition to the benefits and values mentioned in the table, what other benefits and values did you expect when you participated in MPA?".* This question was added in case there were other beliefs and values specific to Thai culture not captured in the original questionnaire.

The SRQ. The 10-item Exercise Goal-Setting Scale (EGS) and the 10-item Exercise Planning and Scheduling Scale (EPS) self-report scales developed by Rovniak and colleagues (2002) measure self-regulation (see appendix B). The EGS includes items related to goal setting, self-monitoring, and problem solving. For example, Item 1 states: *"I often set PA goals."* The EPS includes items related to scheduling and planning exercise as part of one's daily routine. For example, Item 1 states: *"I never seem to have enough time to have PA."* The answers range on a 5-point scale from 1 (does not describe) to 5 (describes completely). The Scale showed internal consistency coefficients 0.89 for the EGS and 0.87 for the EPS and test-retest reliability correlations were 0.87 for the EGS and 0.89 for the EPS.

### *Procedure*

Based on the recommendations of Marin and Marin (1991), three steps were used to develop the Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ.

Step 1: Back-translation and committee approach. This step contained three stages. First, the original questionnaires were translated into Thai language by two bilingual translators. Second, the Thai version questionnaires were back-translated by two new bilingual translators. Third, two native English speakers compared the original English version and the back-translated English version. The recommendations from the two native English speakers were used to improve the questionnaires and the procedure was repeated from the first step. After the equivalence between the original and back-translated versions was accepted, Thai versions of the questionnaires were developed.

Step 2: The test-retest procedure. Participants in the test-retest procedure were 29 female bilingual Thai undergraduate students studying in North America universities (two Canadian and two American). The mean age, weight, and height of participants was 21.59 ± 2.03 years old, 54.18 ± 10.22 kilograms, and 161.70 ±4.41 centimeters, respectively. A minimum of 20 participants is needed for this procedure (Banville, Desrosiers, & Genet-Volet, 2000). Participants were recruited by e-mails and questionnaires and information letters were sent by e-mails to interested participants. First, the recruitment letters were sent to the President of Thai Students' Association of universities in Canada and USA to ask whether their members were willing to participate in this study. Second, information letters and the questionnaires were sent to Thai students who were willing to participate in this study. Twenty-nine female bilingual Thai undergraduate students replied to the recruitment letters and completed the questionnaires. The English and Thai versions of the questionnaires were sent via

e-mails to participants at pretest and two weeks later. At each time, roughly half completed the English version followed by the Thai version. The remainder completed the questionnaires in the opposite order. Spearman correlation coefficients ($r_s$) were calculated to evaluate the test-retest reliability and concurrent validity between the English and Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ.

Step 3: Exploratory factor analysis (EFA). EFA was chosen to assess the validity of the Thai versions of MSES, OEQ, and SRQ instead of confirmatory factor analysis (CFA). This decision was made because, according to Gerbing and Hamilton (1996), although the original versions of the questionnaires were analyzed and the numbers of factors were already known, they do not always hold when the questionnaires are translated into different languages and used in populations that differ in culture and way of life. These differences can lead to misfit in CFA, which can be misleading given that such approaches are essentially hypothesis-test driven. Thus, the EFA was used as a precursor for further studying these constructs with a Thai population.

Participants in EFA were 364 Thai female undergraduate students studying at two universities in Thailand. The mean age, weight, and height of participants were 21.53 ± 1.85 years old, 54.34 ± 12.67 kilograms, and 162.92 ± 7.06 centimeters, respectively. Generally, 300 participants are considered to be good in EFA (Comrey & Lee, 1992). Participants were recruited by e-mails and questionnaires and information letters were sent by e-mails to interested participants. First, recruitment letters were sent by e-mails into list serves of

Bangkok University and Silpakorn University in Thailand. Second, information letters and the questionnaires were sent by e-mails to participants who were interested to participate in this study. Three hundred and sixty four Thai female undergraduate students replied to the recruitment letter and completed the questionnaires. Among those, 300 participants returned the questionnaires in the first week and the remainder (n = 64) returned the questionnaire in the second week after e-mails had been sent.

### *Data Analysis*

Data analysis in the EFA proceeded in three steps. First, descriptive statistics were calculated to check if the data set was appropriate for factor analysis. Second, principal components analysis was performed for factor extraction. The Keiser-Guttman rule (eigen-values > 1.0) and the scree plot were used for factor retention. Direct oblimin rotation was performed for factor rotation. Finally, internal consistency coefficients (Cronbach's α) were calculated for items retained from the EFA procedures. All data were analyzed using the Statistical Package for Social Sciences (SPSS for Windows 18.0, SPSS Inc., Chicago, IL). The significance level was set at 0.05.

## Results

Step 1 (Back-Translation and Committee Approach)

The Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ were appropriately developed after two translations.

Step 2 (Test-Retest Procedure)

The English and Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ were highly correlated to each other (see table 2-1). Similarly, the test-retest reliability coefficients of the English and Thai versions of the GSLTPAQ, MSES, and OEQ were very strong; but the test-retest reliability of the SRQ was only moderate to high (see table 2-2).

Step 3 (Exploratory Factor Analysis)

The MSES (Thai Version). The Kaiser-Meyer-Olkin measure of sampling adequacy (0.886) and Bartlett's test of sphericity ($x^2$ = 3252.056, *df = 36, p* < .001) suggested that the data set was appropriate for an EFA. A principal component analysis showed two factors with eigen-values >1. Based on the scree plot, the number of factors appeared to range from 2 to 3. Given that the original version of questionnaire contained three factors, we decided to use a three-factor solution in further analysis. Then a principle factoring method was used to extract the three factors. The results are shown in Table 2-3. The three factors explained 88.18% of common variance, with saturations that ranged between .86 and .98, which are considered to be good (Comrey, 1973). Also, simple structure was found in the sense that each item only loaded on one factor. As shown in Table 2-3, factor 1 (task efficacy; eigen-value = 6.07, α = .93), explained 67.46% of the common variance. Factor 2 (coping efficacy; eigen-value = 1.03, α = .93), explained 11.41% of the variance. Factor 3 (scheduling efficacy; eigen-value = 0.84, α = .93) explained 9.30% of the variance. The correlation coefficients

showed moderate correlation between the three factors, indicating appropriate classification.

The OEQ (Thai Version). The Kaiser-Meyer-Olkin measure of sampling adequacy (0.896) and Bartlett's test of sphericity ($x^2$ = 1364.48, *df = 36, p* < .001) suggested that the data set was appropriate for an EFA. The factor analysis yielded two factors that explained 63.52% of the common variance, with saturations that ranged between .45 and .93, which are considered to be good (Comrey, 1973). Factor 1 (eigen-value = 4.55, α = .84) explained 50.59% of the common variance. Factor 2 (eigen-value = 1.16, α = .82) explained 12.93% of the variance. The factors were moderately correlated (see table 2-4).

The results from the open-ended question of OEQ demonstrated that Thai female undergraduate students expected that PA would result in benefits such as: physical (that is, stronger, healthier, look better, good shape, and prevent disease), mental (that is, relax from stress of studying, sleep well, and fun), and social (that is, good for leisure time activity, spend more time with friends or family, and meet new friends).

The SRQ (Thai Version). The Kaiser-Meyer-Olkin measure of sampling adequacy (0.915 and Bartlett's test of sphericity ($x^2$ = 2811.58, *df = 190, p* < .001) suggested that the data set was appropriate for an EFA. A principal component analysis showed three factors with eigen-values greater than 1 (see table 2-5). The three factors explained 53.96% of common variance, with saturations that ranged between .51 and .84, which are considered to be good (Comrey, 1973). Factor 1 (eigen-value = 6.74, α = .72), explained 33.68% of the

common variance. Factor 2 (eigen-value = 2.58, α = .89), explained 12.89% of the common variance and Factor 3 (eigen-value = 1.48, α = .82), explained 7.39% of the common variance. The correlations among the three factors were low, indicating three distinct factors.

The low-to-moderate correlations among the Thai version of the GSLTPAQ, MSES, OEQ, and SRQ are presented in table 2-6.

## Discussion

The purpose of this study was to examine the validity and reliability of the Thai version of the GSLTPAQ, MSES, OEQ, and SRQ in assessing PA, self-efficacy, outcome expectations, and self-regulation in female undergraduate students in Thailand. To the best of our knowledge, this is the first study translating these questionnaires and examining their validity and reliability in Thailand.

The results of the test-retest procedure demonstrated high reliability for the Thai version of the GSLTPAQ reliability and also high concurrent validity compared with the English version. The reliability of the Thai version of the GSLTPAQ was comparable with the original reliability studies of the GSLTPAQ (Gionet & Godin, 1987; Godin & Shephard, 1985; Jacobs et al., 1993; Miller et al., 1994; Sallis et al., 1993). Specifically, we found low reliability of mild PA in both English (.55) and Thai (.58) questionnaires. This is similar to previous research with the GSLTPAQ which showed low two week test-retest reliability (0.48) for mild PA (Godin, 1985). Thus, it is suggested that the moderate to vigorous scales be used. Indeed, Godin (2011) also made this recommendation.

In addition, the test-retest procedure showed high reliability and concurrent validity of the Thai version of the MSES compared with the English version in assessing self-efficacy. Further, the EFA results demonstrated that the Thai version of MSES had construct validity to measure self-efficacy in Thai female undergraduate students. Similar to the English version of MSES (Rodgers et al., 2008), our results demonstrated a three-factor solution for the Thai version of MSES that measures task, coping, and scheduling efficacies. Items loading on the three factors in the analyses presented here were similar to the English version factor analysis and the internal reliability of the Thai version that was comparable with the original internal reliability studies (Rodgers et al., 2008; Spence et al., 2009). These results indicate that the Thai version of MSES can be used to measure individual self-efficacy levels in Thai female undergraduate students.

The Thai version of the OEQ demonstrated high reliability and concurrent validity compared with the English version in measuring outcome expectations in Thai female undergraduate students. The reliability of the Thai version of the OEQ was comparable with the original (Dishman et al., 2005). Two factors were extracted for the Thai version; four items in the first factor were related to physical benefits and values and six items in the second factor were related with social and mental benefits and values. These two factors can reflect outcome expectations about PA consistent with the purposes of the original English version. These factors also related to the answers received from the open-ended question. The National Statistical Office of Thailand in 2008 reported that among Thais who exercise, they did so for health benefits (76.9%), because friends

invited them (8.5%), because of health problems (6.6%), stress relief and being less tense (3.1%), weight loss (2.6%), and other reasons (2.3%). Thus, the Questionnaire reflects the expectations in this Thai population. Fixing the number of extracted factors to one, resulted in comparable internal consistency correlations among items ($\alpha$ = .876) with the original version study (Dishman et al., 2005).

Finally, our results showed that the Thai version of SRQ demonstrated high reliability and concurrent validity compared with the English version in measuring self-regulation in Thai female undergraduate students. The original SRQ reported test-retest reliability correlations of 0.87 for the goals scale (EGS) and 0.89 for the planning and scheduling scale (EPS: Rovniak et al., 2002); however, our study found lower test-retest reliability correlations for both the English and Thai versions (0.64 & 0.75 for the English version and 0.74 & 0.72 for the Thai version). Three factors were extracted for the Thai version of SRQ. All items about goal setting loaded on one factor. Four items of planning and scheduling loaded on the second factor and six items on the third factor. The items in the second factor are related to negative statements. For example, Item 1 states that "*I never seem to have enough time to exercise."* In contrast, the items in the third factor are related to positive statements. For example, Item 4 states that: *"I schedule all events in my life around my exercise routine."* The internal consistency of these three factors was acceptable and compatible with the original version study (Rovniak et al., 2002). Also, these three factors were not highly correlated, which indicates that they can separately reflect PA goal setting,

scheduling and planning of respondents. These results indicated that the Thai version of SRQ can be used to measure individual's SR in Thai female undergraduate students.

This study also found correlations among scores from the Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ. The obtained PA score (LTAS), three types of self-efficacy, outcome expectations, and self-regulation scores were low to moderately correlated with each other. This supports other studies that have posited the importance of the relationship of SCT constructions to PA behaviours (Bandura, 2004; Gao et al., 2008; Stadler et al., 2009; Umstattd et al., 2009). Also, the correlations among three types of self-efficacy were consistent with the English version (Rodgers et al., 2008).

In sum, these results indicate that the constructs of self-efficacy, outcome-expectations and self-regulation seem to exist in Thai female students and that the structure of the constructs is similar to North American samples. This is promising and allows for further examination of these constructs in relation to PA in ways that are theoretically consistent but have received minimal testing in Thai or other Asia Pacific groups. This is important as we cannot assume that constructs that have been shown to be valid in Western populations will generalize to other cultures and in other languages. Thus, more studies based on psychometric work, such as that reported in this study, are needed prior to using measures of these constructs in different populations.

### *Strengths and Limitations*

This study followed the recommendation of Marin and Marin (1991) in developing the Thai questionnaires from the English versions. However, some limitations of the study should be mentioned. First, data were collected via e-mails, therefore the findings are limited to students who can access the internet. Somewhat mitigating this concern however are data reporting that 90% of Thai undergraduate students access the internet and 75% of those access the internet at university in sessions lasting 1 to 3 hours at a frequency of 1 to 3 times a week (Kitikannakorn & Sitthiworanan, 2009). An additional limitation is that although most participants completed and returned the questionnaire in the first week, the rest of participants completed and returned the questionnaire in the second week after the questionnaire was sent. However, the results did not differ when all data were analyzed compared to data just the first week.

## Conclusion

The results of this research provide validation of SCT constructs in a non-North American sample. The results also showed that the Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ have suitable psychometric properties for use with Thai female undergraduate students. The findings are consistent with previous psychometric work on the English versions. The Thai versions of the questionnaires had satisfactory factor structure, test-retest stability, and internal consistency reliability. Thus, they would be valuable tools for assessing leisure-time PA, and exercise-related self-efficacy, outcome expectations and self-regulation in female university students in Thailand. The results of this research

suggest that the Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ are valid and reliable with Thai people and are valuable for future studies that target health behaviour changes in Thai population. However, future psychometric studies should be done with other Thai populations including men and different age groups. The GSLTPAQ can be used to monitor PA levels related to health benefits (Godin, 2011), and monitoring and reporting this information to Thai people may motivate them to participate in PA regularly. Since self-efficacy, outcome expectations and self-regulation are important determinants of behaviour changes, valid and reliable measures of these constructs are useful for conducting research and interventions for health promotion. Health practitioners such as nurses can use these constructs to try to effect changes in PA behaviour among Thai people.

Tables

Table 2-1 Concurrent validity between the Thai version and the English version of the GSLTPAQ, MSES, OEQ, and SRQ administered at the same time

| Questionnaires | English version | | Thai version | | $r_s$ |
|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | |
| **GSLTPAQ (LTAS)** | **26.52** | **17.15** | **28.72** | **20.41** | **.952** |
| Strenuous PA | 1.40 | 1.28 | 1.46 | 1.41 | .987 |
| Moderate PA | 1.46 | 1.60 | 1.64 | 1.86 | .905 |
| Mild PA | 2.21 | 2.26 | 2.45 | 2.18 | .967 |
| Frequency | 2.11 | .73 | 2.11 | .74 | 1.000 |
| **MSES** | **36.79** | **23.23** | **37.11** | **23.73** | **.989** |
| Task efficacy | 44.39 | 31.71 | 46.81 | 31.73 | .973 |
| Coping efficacy | 28.62 | 20.61 | 28.33 | 21.07 | .949 |
| Scheduling efficacy | 37.36 | 24.50 | 36.19 | 22.75 | .927 |
| **OEQ** | **67.17** | **13.77** | **67.72** | **11.87** | **.929** |
| **SRQ** | **52.96** | **8.77** | **52.65** | **9.12** | **.932** |
| EGS | 25.93 | 6.24 | 25.10 | 7.59 | .908 |
| EPS | 27.03 | 4.98 | 27.55 | 4.08 | .824 |

Note: $r_s$ = Spearman correlation coefficient. All $r_s$ in the table are significant at $p < .01$ (two-tailed significance).

Table 2-2 Test-retest reliability of the English and the Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ

| Variables | English version | | | | | Thai version | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Test 1 | | Test 2 | | $r_s$ | Test 1 | | Test 2 | | $r_s$ |
| | *M* | *SD* | *M* | *SD* | | *M* | *SD* | *M* | *SD* | |
| **GSLTPAQ (LTAS)** | **25.91** | **17.15** | **27.00** | **17.80** | **.942** | **28.70** | **21.25** | **27.83** | **21.08** | **.956** |
| Strenuous PA | 1.46 | 1.29 | 1.52 | 1.35 | .960 | 1.54 | 1.45 | 1.52 | 1.45 | .965 |
| Moderate PA | 1.54 | 1.68 | 1.70 | 1.55 | .954 | 1.76 | 1.98 | 1.78 | 1.88 | .969 |
| Mold PA | 1.70 | 1.92 | 1.61 | 1.47 | .553 | 2.00 | 1.88 | 1.74 | 1.42 | .578 |
| Frequency | 2.09 | .73 | 2.17 | .65 | .825 | 2.09 | .73 | 2.17 | .65 | .825 |
| **MSES** | **34.83** | **22.98** | **33.53** | **23.35** | **.973** | **35.24** | **23.67** | **32.88** | **23.12** | **.976** |
| Task-SE | 41.45 | 30.13 | 38.70 | 28.88 | .939 | 44.49 | 40.44 | 41.01 | 29.33 | .967 |
| Coping-SE | 26.45 | 21.26 | 25.55 | 20.27 | .949 | 26.09 | 21.79 | 24.46 | 20.14 | .979 |
| Scheduling-SE | 36.59 | 25.41 | 36.35 | 27.40 | .951 | 35.13 | 23.18 | 33.16 | 24.07 | .954 |
| **OEQ** | **66.65** | **14.68** | **66.13** | **11.08** | **.840** | **67.43** | **12.35** | **66.87** | **10.61** | **.778** |
| **SRQ** | **52.09** | **8.83** | **50.87** | **10.62** | **.658** | **51.61** | **9.18** | **51.09** | **11.09** | **.614** |
| EGS | 25.43 | 6.24 | 23.48 | 7.019 | .639 | 24.22 | 4.63 | 23.74 | 8.03 | .743 |
| EPS | 26.65 | 5.29 | 27.39 | 5.72 | .752 | 27.39 | 4.32 | 27.35 | 5.68 | .722 |

Note: $r_s$ = Spearman correlation coefficient. All $r_s$ in the table are significant at $p < .01$ (two-tailed significance).

Table 2-3 A principal analysis with oblique rotation and pattern matrix of the Thai version of MSES

| Item abbreviations | *M* | *SD* | I | II | III |
|---|---|---|---|---|---|
| Task self-efficacy (Cronbach's α = 0.93) | | | | | |
| ...follow directions to complete MPA... | 53.05 | 21.83 | 0.93 | | |
| ...complete MPA... using proper technique | 53.86 | 22.09 | 0.91 | | |
| ...perform all activities required for complete MPA... | 52.58 | 22.28 | 0.87 | | |
| Coping self-efficacy (Cronbach's α = 0.93) | | | | | |
| ...perform MPA... when you lack energy | 42.03 | 20.86 | | 0.98 | |
| ...perform MPA... when you do not feel well | 40.98 | 21.44 | | 0.87 | |
| ...perform MPA... when you feel discomfort when performing PA | 44.29 | 19.78 | | 0.86 | |
| Scheduling self-efficacy (Cronbach's α = 0.93) | | | | | |
| ...arrange your schedule to include MPA... | 45.90 | 22.50 | | | 0.93 |
| ...include MPA... in your daily routine | 46.30 | 22.14 | | | 0.92 |
| ...consistently perform MPA... | 45.30 | 21.63 | | | 0.87 |
| % variance explained | | | 67.46 | 11.41 | 9.30 |
| Eigen-value | | | 6.07 | 1.03 | 0.84 |
| Interfactor correlations | | | 1. | 2. | 3. |
| 1. Task self-efficacy | | | - | | |
| 2. Coping self-efficacy | | | .57 | - | |
| 3. Scheduling self-efficacy | | | .63 | .63 | - |

Note. MPA = moderate intensity physical activity. All items followed the same stem question *("How confident are you that you can...* and after MPA following by... *at least 30 min/day for 3 days a week"*).

Table 2-4 A principal analysis with oblique rotation and pattern matrix of the Thai version of OEQ

| Item abbreviations | *M* | *SD* | I | II |
|---|---|---|---|---|
| Physical benefits and values (Cronbach's α = 0.84) | | | | |
| It would make me look better | 8.07 | 1.72 | 0.93 | |
| It would help me control my weight | 7.97 | 1.72 | 0.80 | |
| It would help get or keep me in shape | 8.20 | 1.71 | 0.76 | |
| I would feel better about myself | 8.03 | 1.74 | 0.71 | |
| Mental and Social benefits and values (Cronbach's α = 0.82) | | | | |
| It would be fun | 7.57 | 1.88 | | 0.82 |
| It would help me spend more time with my friends | 7.49 | 1.82 | | 0.82 |
| I would make new friends | 7.17 | 2.07 | | 0.80 |
| It would put me in a better mood | 7.75 | 1.85 | | 0.61 |
| It would make me better in sports or other activities | 7.74 | 1.88 | | 0.45 |
| % variance explained | | | 50.59 | 12.93 |
| Eigen-value | | | 4.55 | 1.16 |
| Interfactor correlations | | | 1. | 2. |
| 1. Physical benefits and values | | | - | |
| 2. Mental and social benefits and values | | | .53 | - |

Table 2-5 A principal analysis with oblique rotation and pattern matrix of the Thai version of SRQ

| Item abbreviations | *M* | *SD* | I | II | III |
|---|---|---|---|---|---|
| EGS (Cronbach's α = 0.89) | | | | | |
| I often set PA goals | 3.01 | .90 | 0.84 | | |
| I usually have more than one major PA goal | 3.08 | .93 | 0.79 | | |
| My PA goals help to increase my motivation for doing physical activities | 3.24 | .89 | 0.78 | | |
| I usually keep track of my progress in meeting my PA goals | 3.12 | 1.00 | 0.74 | | |
| I usually achieve the PA goals I set for myself. | 3.12 | .93 | 0.70 | | |
| I have developed a series of steps for reaching my PA goals | 3.02 | 1.04 | 0.65 | | |
| I tend to break more difficult PA goals down into a series of smaller goals | 3.00 | .96 | 0.65 | | |
| I usually set dates for achieving my PA goals | 3.00 | .93 | 0.63 | | |
| If I do not reach a PA goal, I analyze what went wrong | 3.01 | 1.01 | 0.54 | | |
| I tell other people about my PA goal | 3.07 | 1.04 | 0.51 | | |
| EPS-negative statements (Cronbach's α = 0.72) | | | | | |
| I never seem to have enough time to have PA | 3.15 | .97 | | 0.80 | |
| Finding time for PA is difficult for me | 3.13 | .98 | | 0.73 | |
| PA is generally not a high priority when I plan my schedule | 3.07 | .87 | | 0.69 | |
| When I am very busy, I cut out my PA | 3.54 | 1.07 | | 0.69 | |
| EPS-positive statements (Cronbach's α = 0.82) | | | | | |
| I write my planned activity sessions in an appointment book or calendar | 2.89 | 1.12 | | | 0.81 |
| I plan my weekly PA schedule | 2.98 | 1.05 | | | 0.80 |
| I schedule my PA at specific times each week | 3.05 | 1.01 | | | 0.69 |
| Everything is scheduled around my PA routine—both classes and work. | 3.08 | .93 | | | 0.68 |
| I schedule all events in my life around my PA routine | 3.06 | .89 | | | 0.60 |
| I try to have PA at the same time and same day each week to keep a routine going | 3.13 | .97 | | | 0.60 |
| % variance explained | | | 33.68 | 12.89 | 7.39 |
| Eigen-value | | | 6.74 | 2.58 | 1.48 |
| Interfactor correlations | | | 1. | 2. | 3. |
| 1. EGS | | | - | | |
| 2. EPS (Negative statements) | | | .04 | - | |
| 3. EPS (Positive statements) | | | .47 | .17 | - |

Note. PA = physical activity. EGS = exercise goal-setting scale. EPS = exercise planning and scheduling scale.

Table 2-6 Descriptive statistics and bivariate correlations between the GSLTPAQ, MSES, OEQ, and SR

| Variables | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| 1. LTAS | 38.179 | 23.973 | - | | | | | |
| 2. Task efficacy | 53.166 | 20.606 | .468 | - | | | | |
| 3. Coping efficacy | 42.434 | 19.388 | .328 | .612 | - | | | |
| 4. Scheduling efficacy | 45.835 | 20.759 | .346 | .675 | .670 | - | | |
| 5. Outcome expectations | 69.997 | 11.634 | .217 | .297 | .297 | .253 | - | |
| 6. Self-regulation | 60.206 | 10.123 | .305 | .414 | .414 | .411 | .435 | - |

Note. M = Mean; SD = Standard deviation; LTAS = Leisure-time activity score. All r in the matrix are significant at $p < .01$ (two-tailed significance).

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# CHAPTER 3: STUDY 2

# An internet-based intervention for promoting and maintaining PA in Thai university-aged females: a randomized controlled trial

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Acknowledgements

Gratitude is extended to Srinakharinwirot University and the University of Alberta for financial support to the author.

An abstract based on this chapter has been accepted to oral presentation in the 2013 ASICS Conference of Science and Medicine in Sport, October 23, in Phuket, Thailand.

A version of this chapter has been submitted for publication in American Journal of Health Behavior.

## Introduction

Thai female students are not likely to participate in leisure-time physical activity (PA) for enhancing health benefits (Haase, Steptoe, Sallis, & Wardle, 2004; Sisson & Katzmarzyk, 2008). This suggests that they need to change their behaviour by increasing participation in leisure-time PA. It is well known that PA can be increased through theoretical based interventions. One useful model that has been used as theoretical framework in PA interventions is Social Cognitive Theory (SCT) as previous studies have found that it can predict and explain some variance of PA (Anderson, Wojcik, Winett, & Williams, 2006; Petosa, Suminski, & Hortz, 2003; Rovniak, Anderson, Winett, & Stephens, 2002). Among the SCT variables, self-efficacy, outcome expectations, and self-regulation variables are highly associated with PA changes (Hallam & Petosa, 2004; Marcus et al., 2006).

Similarly, it has been suggested that intervention mapping (IM) should be used as a framework to develop health promotion intervention programs (Bartholomew, Parcel, & Kok, 1998). By using IM, the gap between theory and practice can be reduced and thus it contributes to a more effective program and enhances knowledge on the effectiveness of the program (Bartholomew, Parcel, Kok, & Gottlieb, 2001). IM describes the process of health promotion program development in six steps (Bartholomew, Parcel, Kok, Gottlieb, & Fernandez, 2011) and the result is “map” that consists of matrices and plans that guide the design, implementation, and evaluation of an intervention (Bartholomew et al., 1998).

In addition, the internet can be used as tool to deliver PA programs (Marcus, Nigg, Riebe, & Forsyth, 2000; Marshall, Owen, & Bauman, 2004). By using the internet, users can access large amounts of information at their convenience (Marcus, Ciccolo, & Sciamanna, 2009; Napolitano & Marcus, 2002). It is quicker to access information and easier to keep information accurate and updated (Napolitano & Marcus, 2002). The internet also reduces numerous barriers that would otherwise prevent participants from seeking PA programs (Marcus et al., 2009), particularly among women who may face barriers, such as travel, time, and costs, to participate in the other PA programs (Dunton & Robertson, 2008). Moreover, internet-based PA interventions have been reported as a cost-effective method for promoting PA (Dunton & Robertson, 2008), and are related to significant increases in PA behaviour (Marcus et al., 2009; Norman, Zabinski, Adams, Rosenberg, Yaroch, & Atienza, 2007; Vandelanotte, Spathonis, Eakin, & Owen, 2007). Thus, to increase and maintain PA in Thai female students, this intervention program will use SCT and IM as the theoretical framework in developing an intervention program and will use the internet as tool to deliver the intervention program.

It is suggested that when people complete a questionnaire about a behaviour, they were more likely to perform that behaviour (Conner, Godin, Norman, & Sheeran, 2011; Godin, Sheeran, Conner, & Germain, 2008; Williams, Block, & Fitzsimons, 2006). Intention questions have been shown to influence respondent's behaviour (Levav & Fitzsimons, 2006; Morwitz & Fitzsimons, 2004). That is, when people were asked about their intentions to participate in a

particular behaviour, they were more likely to participate in that behaviour (Conner, Sandberg, & Norman, 2010; Levav & Fitzsimons, 2006; Morwitz & Fitzsimons, 2004; Williams et al., 2006). For example, when asking students about intentions to exercise, they increased exercise rates from 14 to 26% (Williams et al., 2006). This phenomenon is known as the mere measurement effect (Morwitz, Johnson, & Schmittlein, 1993). Moreover, it is posited that unanticipated increases in the level of PA of the control group are frequently observed in randomized controlled trials on PA promotion (van Sluijs, van Poppel, Twisk, & van Mechelen, 2006). This phenomenon is known as pretest sensitization (Campbell & Stanley, 1963). To explain these phenomena, the effect of measurement on participant's behaviour has been suggested. Ogden (2003) argues that by completing a questionnaire, new cognitions may be created. Because of the new cognitions that have been formed, participant's behaviour may change. Also, exposure to a pretest may increase participant's sensitivity to the experimental treatment (Rosenthal & Rosnow, 1991). The pretest can result in an increased awareness of one's own level of PA, possibly resulting in behaviour change (Rooney, Smally, Larson, & Havens, 2003). Thus, the pretest sensitization may then be seen as an intervention effect itself, which may have unwanted side effects in PA promotion program, and could impact the actual effect of the intervention (van Sluijs et al., 2006). Moreover, it is unknown whether a possible measurement effect differs between the intervention group and the control group. This can have serious consequences for the results of an evaluation of the PA intervention. If we do not have this information, it is hard to establish to what

extent the results found in a PA promotion program represent the actual effectiveness of the intervention (van Sluijs et al., 2006).

One method of studying and controlling for the effects of pretest sensitization is to use a Solomon four-group design. This specific design allows studying of both the intervention effect and the pretest sensitization effect by adding in two groups that have not been part of the pretest (Braver & Braver, 1988). Thus, the total study group is randomly divided into four groups: (1) pretest-posttest control group, (2) posttest-only control group, (3) pretest-posttest experimental group, and (4) posttest-only experimental group. In general, although studies that applied the Solomon four-group design were not likely to report the influence of the pretest sensitization effect, they reported about pretest effects (Spence & Blanchard, 2001; Spence, Burgess, Rodgers, & Murray, 2009; van Sluijs et al., 2006). For example, Spence and Blanchard (2001) found no influence of the pretest on feeling states or self-efficacy at posttest as a result of participating in a bout of moderate to high intensity exercise. van Sluijs et al. (2006) found no influence of the pretest sensitization effect on PA and determinants of PA; but, they found a positive pretest effect on PA as well as on some determinants of PA. Similarly, Spence et al. (2009) found no influence of the pretest on walking intention, behaviour and self-efficacy; however, they found the main effect of the pretest on walking intention and behaviour.

This study used SCT and IM as frameworks for developing PA intervention program, and used internet as the method to deliver the PA program. Also, a 3-month randomized control trial intervention was conducted: a Solomon

four-group design was used for establishing the actual effectiveness of the PA intervention program. The purpose of the study was to evaluate the efficacy of the SCT-based internet intervention PA designed to promote and maintain PA in university-aged female students in Thailand.

## Research Question

This study addressed the following main research question: *Is a SCT-based internet intervention PA designed effective in increasing and maintaining PA in university-aged females in Thailand?*

This study addressed *Research Goals 2 and 3* of this dissertation: to evaluate the efficacy of the SCT-based internet intervention PA designed to promote and maintain leisure-time PA in university-aged females in Thailand, and to examine whether SCT variables mediated changes in PA and physical fitness.

## Hypotheses

It is hypothesized that:

1. There will be no significant interaction effect of the pretest by the intervention on a total weekly LTAS, steps, Predicted Vo2Max, resting heart rate (RHR), self-efficacy, outcome expectations, and self-regulation.

2. There will be no significant main effect of pretesting on the total weekly LTAS, steps, Predicted Vo2Max, RHR, self-efficacy, outcome expectations, and self-regulation.

3. Participants in the intervention groups will have significantly higher improved of the total weekly LTAS, steps, Predicted Vo2Max, RHR, self-

efficacy, outcome expectations, and self-regulation as compared with those in the control groups.

4. The SCT variables will mediate the intervention effects on the total weekly LTAS, steps, Predicted Vo2Max, and RHR.

## Methods

### *Participants and Selection Procedure*

Sample size calculations were performed using Power and Precision 4 software, which can be seen in the following website: http://www.power-analysis.com/. The number of participants was based upon a power analysis conducted on the factor of the intervention (2 levels), the factor of pretest (2 levels) and the interaction effect of the intervention by pretest. Setting a power of 0.80, the effect size of 0.25 (medium effects), and an alpha level of 0.05 for the main effects and the interaction effect, 32 participants per group were needed. A review of literature about the internet-based PA intervention found that an average attrition rate was about 30% (Vandelanotte et al., 2007). Thus, a sample of at least 42 participants per group would be recruited.

Students were recruited by advertising placed on university notice boards and in newsletters, and postings on the university websites' internet and e-mail advertisements. Participants were screened for eligibility via interview. Eligibility criteria included: (1) female students age 18-24, (2) access to the internet, (3) able to use a computer with minimal assistance to complete an internet survey, (4) would not participate in other PA programs during the study and (5) answer "no" to all questions on the Physical Activity Readiness Questionnaire (PAR-Q)

(Thomas, Reading, & Shephard, 1992). 224 female undergraduate students of Srinakharinwirot University (SWU) expressed interest in this study and 220 students were eligible to participate in the study. Four students were ineligible since they had health problems. Once their willingness to participate had been verified, participants signed an informed consent form. This study was reviewed and approved by the Research Ethics Boards of the University of Alberta and the Srinakharinwirot University prior to the study implementation.

*SCT-based internet intervention PA designed*

The intervention program was developed based on SCT and IM framework. Self-efficacy, outcome expectations, and self-regulation were used as determinants of behavioural outcomes (see table 1-2 and table 1-3).

First, self-efficacy was targeted by integrating information from four primary sources: performance accomplishments, vicarious experiences, verbal persuasion, and physiological and emotional states (Maddux, 2009). For performance accomplishments and verbal persuasion, practical strategies included: (1) students were provided the information about their behavioural and health outcomes at pretest and the end of the intervention; (2) started PA at minimum levels; (3) set PA goals by increasing at least 9 minutes per week. We advise participants to increase at least 9 minute per week since PA goals are at least 150 minute in 12 weeks; (4) recorded their PA every week; and (5) received positive feedback about their PA each week. For vicarious experience, practical strategies were: students received information about their PA and PA of role

models. For PA of role models, an example about participating in PA of a role model at the goal setting target was sent to participants (see Appendix C).

Second, outcome expectations and outcome values were targeted by focusing on increasing awareness of the potential benefits of PA and attempting to create favorable PA outcome expectancies (Williams, Anderson, & Winett, 2005). Practical applications for increasing awareness of the potential benefits of PA were: (1) students received information about the benefits of PA; (2) students received information about general workouts; (3) students received a personal guideline for PA; and (4) students received information about their outcome expectations on PA goals each week. The question "Do you expect that completing your PA goal will improve your physical fitness?" will be used to ask participants each week. The answer will be rated on "0% (no expectation) to 100% (complete expectation)". The score will be shown to participants. Practical applications for creating favorable PA outcome expectancies were: (1) students chose their own activities; (2) started PA at minimum levels; and (3) increased PA at lower rate each week. The purpose was for enjoyment. According to Bolles (1972), behaviours that have resulted in certain outcomes in the past are expected to result in similar outcomes when they were performed again. Thus, to create favorable PA outcome expectancies by promoting participants to experience more positive and fewer negative outcomes of PA, outcome expectations may be changed (Williams et al., 2005).

Third, goal setting and self-monitoring were used for self-regulation (Anderson et al., 2006). Practical strategies for goals setting were: (1) students set

weekly PA goals by increasing 9 minutes every week. Practical strategies for self-monitoring were: students monitored and recorded their PA behaviour (i.e., pedometers for steps and watch for time spent in PA) each week.

Fourth, a practical application used to deliver information was the launch of a website and an e-mail. A website, "www.sport-exercise.com" was created. The Website contained a main page, a registration page, and a login page (see figure 3-1 and appendix D). When participants had registered to the Website, their profile page would be shown into the login page. The participant's profile page mainly contained PA materials, record and setting, and outcome pages. The PA materials included PA guidelines (i.e., PA intensities and METs) and information about PA (i.e., PA knowledge, benefits of PA, and examples of PA workouts). The record and setting page would be posted every week. Thus, participants in the intervention groups could record their weekly average PA (i.e., exercise duration [minutes & steps] for 3 days in the prior week), set their PA goals (i.e., exercise duration [minutes] for the next week), and identify their self-efficacy and outcome expectations on their PA goals that they had set. The outcome page showed a table and a graph of participant's actual PA behaviour data and other dependent variable outcomes.

E-mails contained a message to direct participants to the Website, gave personal feedback, and provide PA of role models

*Research Design*

Intention-to-treat (ITT) analysis in a 3-month randomized control trial intervention was conducted employing a Solomon four-group design. A Solomon

four-group design was used to control for possible effects of either pretest sensitization or interaction between pretest and intervention on the outcome measures (Kvalem, Sundet, Rivo, Eilertsen, & Bakketeig, 1996). In this design, only half of the participants in the pretest and no pretest conditions received the intervention. The intervention ran for a period of 3 months with a follow-up 3 months later.

Two hundred and twenty eligible students were randomized to four groups: (1) intervention with pretest group (I-P), (2) intervention with no pretest group (I-NP), (3) control with pretest group (C-P), and (4) control with no pretest group (C-NP; see figure 3-2). However, six students randomized to the pretest groups (5 of I-P and 1 of C-P) did not participate in the pretest testing. Five of I-P informed that they were anxious that they would not finish the intervention; thus, they decided not to participate. One of C-P was injured from motorcycle accident. Similarly, six students in the I-NP did not participate in the face- to- face orientation to the Website. Those students informed that they were anxious they would not complete the intervention since they expected to participate in the control group. However, those students consented to provide their demographic data and some dependent variables (i.e., the total weekly LTAS and SCT variables) to the researcher.

The retention strategies used for keeping participants in the study included monetary payment and direct contact with participants. Each participant in the intervention groups and in the control groups was paid 900 Baht (~$ 30 CAD) and 300 Baht (~$ 10 CAD) respectively, for participating in this study. Each

participant was paid one-third of payment when she participated at the pretest, the end of the intervention (posttest 1), and the 3 months later as a follow-up (posttest 2). The direct contact entailed sending an e-mail and calling by mobile phone. During intervention periods, e-mails were sent and the mobile phone was called to participants who did not access the Website and complete information for asking about their progress and encouraging them to monitor and continue with the program. The mobile phone was used in case participants did not respond to the e-mail. In average, 5-10 persons were sent e-mails and 1-2 persons were called each week. Similarly, if participants did not participate in the testing date, the mobile phone were used after an e-mail had been sent to them and they did not reply to its. In average, 10-15 persons were sent e-mails and 3-5 persons were called each time.

### *Procedure*

#### The Intervention Groups (I-P and I-NP)

Face-to-face orientation to the Website and self-monitoring information methods were taught to participants in the intervention groups (I-P and I-NP) before starting the study. To ensure that all participants had a sufficient level of computer and internet knowledge, the basics of navigation and login procedures were demonstrated on a computer. A detailed written guide outlining login procedures, internet navigation, and self-monitoring information methods were given to each participant as well.

Intervention Periods

During the 3 month intervention periods, every Friday the researcher sent e-mails to participants in the intervention groups to ask them to access the Website and to record their average PA in that week, set their PA goal for the next week, and identify their self-efficacy and outcome expectations on PA goals that they had set. Moreover, every Sunday the researcher sent e-mails to each participant in the intervention groups to give her a personal positive feedback and PA of role models (see figure 3-3).

It is well known that for health benefits, adults should accumulate at least 150 minutes (or 30 min on 5 days) of MVPA per week (Haskell et al., 2007; Tremblay et al., 2011). However, at the first week, this study advised participants to accumulate at least 90 minutes of MVPA (i.e., 30 min on 3 days) and advised them to increase their PA goals by at least 9 minutes per week (i.e., 3 min on 3 days). If they were to adhere to the advice to increase 9 minutes per week every week, they would meet the recommendation of PA for health benefits at the eighth week (i.e., 150 minutes per week) and they would spend their time in PA more than 180 minutes per week (i.e., 60 min on 3 days) at the end of the intervention.

Follow-up Periods

During 3 month follow-up periods, researcher sent three e-mails to participants in the intervention groups to advise them to access to the Website and record their average PA (minutes). E-mails were sent at the $4^{th}$ week of each month during the 3 month follow-up period. Participants reported their PA for 3

days a week of the 4th week of those months. In both intervention and follow up periods, participants who did not access the Website and complete information were sent e-mails asking about their progress and encouraging them to monitor and continue with the program. The mobile phone was also used in case participants did not respond to the e-mail.

The Control Groups (C-P and C-NP)

Participants in the control groups did not receive any treatments, but they were tested for dependent variables.

*Data Collection*

The primary dependent variable measures were PA, physical fitness, and SCT variables. Participants in the I-P and C-P groups were tested for dependent variables at the pretest, the end of the intervention, and the 3 months later as the follow-up. Participants in I-NP and C-NP groups were tested for dependent variables at the end of the intervention and the 3 months later as the follow-up.

PA Variables

PA variables include the total weekly leisure-time activity score (LTAS) and steps per day. The total weekly LTAS were measured using the Thai version of GSLTPAQ and steps per day were measured using a Yamax Digi-Walker SW-701 pedometer. The previous study showed that the Thai version of GSLTPAQ was reliable and valid to measure PA in Thai female undergraduate students (Sriramatr, Berry, & Rodgers, 2013). According to Crouter Schneider, Karabulut, and Bassett (2003) the Digi-Walker SW-701 pedometer is accurate for assessing steps. To measure steps, participants wore pedometers for 3 days (i.e., Tuesday,

Wednesday, and Thursday) at the pretest (only the pretest groups), the end of the intervention, and the 3-month follow-up. Participants received a pedometer with instructions for placement, use, and logging of steps to record their steps.

Physical Fitness Variables

Physical fitness variables include maximum oxygen consumption (Predicted Vo2Max) and resting heart rate (RHR). These variables were measured in the laboratory of Department of Sports Science at SWU. RHR was initially measured after participants had sat quietly for 5 minutes. To control the variability of RHR, participants were asked to control their PA levels, foods consumption, drug used, and amount of sleep before the testing date. Room temperature and humidity were also controlled. Weight, height, and body composition were measured by female research assistants first and followed by Predicted Vo2Max. Body weight in kilograms was measured by using a digital Tettler Toledo—Wildcat® weighting machine. Height was measured to the nearest 0.1 cm using a stadiometer (YL-65, Yagami Inc., Japan). Body weight and height were measured with the participants wearing light clothing and no shoes. Body mass index (BMI) was calculated by dividing the body weight in kilograms by the square of height in meters ($kg.m^{-2}$).

The Queen's College Step Test (McArdle, Katch, Pechar, Jacobson, & Ruck, 1972) was used to measure an estimate of Predicted Vo2Max. The step test was performed on a bench of 16.25 inches (41.3 cm) height for a total duration of 3 minutes at the rate of 22 steps per minute, set by a metronome at 88 beats per minute. After completion of the exercise, participants remained standing and the

carotid pulse rate was measured for 15 second from 5–20 seconds of the recovery period. The 15 second recovery pulse rate was converted to beats per minute (15-s HR x 4) and predicted the maximum oxygen uptake capacity $PVo_2Max$ (ml/kg/min) received by the following equation: $PVo_2Max = 65.81 – (0.1847$ x pulse rate [beats/min]). The Queen's College Step Test was a valid and reliable measure for Predicted Vo2Max in female university students (Bolboli, Siahkouhian, Poorrahim, & Narimani, 2008; McArdle et al., 1972). Predicted Vo2Max from the step test results was strongly correlated (r = 0.95) with actual $Vo_2max$ scores in young males aged 23 years (Chatterjee, Chatterjee, Mukherjee, & Bandyopadhyay, 2004). There is a significant correlation (r = -0.83) between Predicted Vo2Max and heart rate following the step test in young females aged 22 years (Chatterjee, Chatterjee, & Bandyopadhyay, 2005).

SCT Variables

SCT variables include self-efficacy, outcome expectations, and self-regulation. The Thai version of MSES, OEQ, and SRQ was used to measure self-efficacy, outcome expectations, and self-regulation, respectively. These questionnaires were a valid and reliable measure for self-efficacy, outcome expectations, and self-regulation in Thai female undergraduate students (Sriramatr et al., 2013).

### *Independent Variables*

Independent variable was the SCT-based internet intervention PA program.

### *Dependent Variables*

Dependent variables included the total weekly LTAS, steps, Predicted Vo2Max, RHR, self-efficacy, outcome expectations and self-regulation variables. Also, demographic information such as age, body weight, height, and BMI were reported.

### *Data Screening*

Prior analyzing any of the data, scores were checked for the quality. We first checked if the data were coded properly and the values entered properly within an expected range. We also checked whether we have any missing data or outliers and deal with them at this stage. Cases that were deemed to be outliers were excluded from the analyses. Then, we evaluated any assumptions underlying our statistical test of choice.

### *Data Analysis*

According to the definition presented by Polit and Gillespie (2010), a true or classic ITT was used in this study. A classic ITT is one that removes none of the participants from the final analysis. This definition follows a "once randomized, always analyzed" philosophy (Schulz & Grimes, 2002, p.781). Since one participant in the C-P group dropped out after pretest testing because of a car accident, according to Polit & Gillespie (2010), the outcome data of this participant was considerable as missing at random (MAR). MAR means that missingness is unrelated to the data of missing outcome, but is related to other variables that can be identified (Polit & Gillespie, 2010). Also, since other participants dropped out because of lacking of time to participate in the program

and in the testing, according to Polit & Gillespie (2010), the outcome data of these participants were missing completely at random (MCAR). MCAR means that the probability that the data missing is totally unrelated to either the missing data itself, to treatment group status, or to any other variables (Polit & Gillespie, 2010). Thus, imputation of the missing data, that is estimating what the data would be if it was not missing, by using multiple imputation (MI) was used. MI approach is the current gold standard imputation method for data that are MAR (McCleary, 2002; Patrician, 2002; Polit, 2010). MI can be calculated by using the Statistical Package for Social Sciences (SPSS). According to Polit and Gillespie (2010) MI contains a three step process. The first step is replacing each missing data with a possible estimate data. The missing data are estimated based on participants' pretest data or characteristics related to the data. The result is a new dataset without missing data. The second step is analyzing a new dataset. The imputations and primary analyses are done *m* times, with *m* newly created complete datasets. An element of randomness is introduced for each imputation, and so the *m* estimates for the missing values are all different. It is suggested that three to five new datasets are usually sufficient if missingness is lower than 20% (Little & Rubin, 2002). The third step is pooling results from the *m* analyses to arrive at parameter estimates of intervention effects.

Data was analyzed using the SPSS version 19.0 for Windows software. The significance level was set at 0.05. Descriptive statistics were used to describe the sample. To assess the presence of pretest sensitization and the main effects of the intervention, statistical methods for the Solomon four-group design provided

by Braver and Braver (1988) were used. To detect the presence of pretest sensitization, a 2x2 between-groups analysis of variance (ANOVA) was performed on the four scores at the end of the intervention. The factors were intervention (yes vs. no) and pretest (yes vs. no). Based on the outcome of the test of the interaction between the intervention and the pretest, the main effects of the pretest and the main effects of the intervention could be interpreted. That is, if a significant interaction was detected, pretest sensitization was present. The main effects of the pretest and the main effects of the intervention could be interpreted based on pretest sensitization condition. In contrast, if the interaction was not significant, pretest sensitization was not present. If this is the case and the main effect of the intervention was significant, we could conclude that there were intervention effects. If the main effect was not significant, Braver and Braver suggested that a two-group analysis of covariance (ANCOVA) on the posttest scores should be performed to detect the main effects of the intervention in the two pretest groups. If the ANCOVA was significant, there were intervention effects. If the test was not significant, independent-sample *t* test should be performed on the scores of the two no pretest groups. If the *t* test was significant, the intervention effects were present. If the test was not significant, meta-analysis should be performed from the following formula.

$$z_{meta} = \sum_i z_{pi}/\sqrt{k}$$

Where $z_{pi}$ is the *z* value corresponding to the one-tailed *p* value of the *i* th statistical test and *k* is the number of such test.

If the meta-analysis is significant, there are the intervention effects. If the test is not significant, there are no the intervention effects. To aid in the interpretation of findings, Cohen's (1988) categorization of partial eta-squared ($n_p^2$) as small (0.01), medium (0.06), and large (0.16) effects was adopted.

A mediation analysis using the end of the intervention and the follow-up data was used to address hypotheses 4. The mediation analyses were based on the framework proposed by Baron and Kenny (1986). Baron and Kenny specify a procedure using a multiple regression model focusing on 3 variables: A (the independent variable), B (the mediator), and C (the dependent variable). To establish mediation, the following conditions must be established. (1) A must be related to B. (2) A must also be related to C. (3) when C is regressed on both A and B, B must be significantly related to C, and the relationship between A and C lessened.

## Results

### *Descriptive Statistics*

Based on Godin's (2011) suggestion, the numbers of participants in each category were shown in table 3-1. Most participants in both the control and the intervention groups at the baseline were active. However, based on steps/day categories provided by Tudor-Locke, Craig, Thyfault, and Spence (2013), by average at the baseline participants in this sudy were in the low-end of steps recommendations (i.e., < 7,500: see table 3-3).

Descriptive statistics for demographic, PA, physical fitness, and SCT variables for the intervention and the no intervention groups are shown in tables

3-2 to 3-4. Briefly, the average age and BMI of participants in each group were about 19 years and 21 kg/m$^2$, respectively. There were no statistically significant differences between participants in the intervention and the no intervention groups on any of the demographic variables at pretest. Also, there were no significant pretest differences between the I-P and the C-P groups on any of PA behaviour, physical fitness, and SCT variables (see table 3-5).

*At the End of the Intervention*

Pretest Sensitization

Based on statistical methods for the Solomon four-group design provided by Braver and Braver (1988), we first detected the presence of pretest sensitization by performed a 2x2 between-groups ANOVA on the four scores at the end of the intervention.

No significant interaction between the pretest and the intervention was observed for any of the dependent variables, $F(1, 216) = 0.01$, $p = 0.90$ for steps/day; $F(1, 216) = 0.31$, $p = 0.58$ for LTAS; $F(1, 216) = 0.07$, $p = 0.79$ for Predicted Vo2Max; $F(1, 216) = 0.09$, $p = 0.77$ for RHR; $F(1, 216) = 0.01$, $p = 0.92$ for SE; $F(1, 216) = 0.06$, $p = 0.81$ for OE; and $F(1, 216) = 0.27$, $p = 0.60$ for SR. The observed statistical power was low, effect size analysis revealed that the amount of variance explained in the dependent variables by the interaction was very small (observed power = 0.05, $n_p^2 = 0.000$ for steps/day; observed power = 0.09, $n_p^2 = 0.001$ for LTAS; observed power = 0.06, $n_p^2 = 0.000$ for Predicted Vo2Max; observed power = 0.06, $n_p^2 = 0.000$ for RHR; observed power = 0.05, $n_p^2 = 0.000$ for SE; observed power = 0.06, $n_p^2 = 0.000$ for OE; observed power =

0.08, $n_p^2$ = 0.001 for SR). Therefore, pretest sensitization did not occur for any of the outcome measures (see table 3-3 and 3-4 for descriptive statistics).

Main Effects of the Intervention

Since pretest sensitization was not present, we secondly interpreted the main effect of the intervention.

The main effect of the intervention on steps/day was significant, *F*(1, 216) = 97.69, *p* = 0.00 ($n_p^2$ = 0.31). Examination of means revealed that after participating in the intervention for 3 months, those in the intervention groups had more steps/day (M = 11,222.73) than those in the control groups (M = 7298.74). The main effect of the intervention was observed for LTAS, *F*(1, 216) = 31.05, *p* = 0.00 ($n_p^2$ = 0.13), with those participants in the intervention groups (M = 52.36) reporting higher LTAS than the controls (M = 37.08). No main effect of the intervention was observed for Predicted Vo2Max, *F*(1, 216) = 0.27, *p* = 0.61 ($n_p^2$ = 0.001). The main effect of the intervention was observed for RHR *F*(1, 216) = 5.78, *p* = 0.017 ($n_p^2$ = 0.026), with those participants in the intervention groups (M = 78.34) had lower RHR than the controls (M = 80.89). For the SCT constructs, significant main effects of the intervention were found for SE, *F*(1, 216) = 29.56, *p* = 0.00 ($n_p^2$ = 0.12), OE, *F*(1, 216) = 7.02, *p* = 0.009 ($n_p^2$ = 0.032), and SR, *F*(1, 216) = 7.72, *p* = 0.006 ($n_p^2$ = 0.035), with those participants in the intervention groups (M = 62.43, 85.41, and 63.21, respectively) reporting higher SE, OE, and SR than the controls (M = 52.39, 81.97, and 59.60, respectively).

Since the main effect of the intervention on steps/day, LTAS, RHR, SE, OE, and SR was significant, we did not do any further analysis. However, since

the main effect of the intervention on Predicted Vo2Max was not significant and because of concerns about the limited power provided by the main effects test, we next tested the intervention effect in the two pre-post (I-P and C-P) groups with a two-group analysis of covariance (ANCOVA) on the posttest scores for Predicted Vo2Max, while covarying pretest scores. The test showed that no significant effects of the intervention were observed for Predicted Vo2Max, $F(1, 107) = 0.72$, $p = 0.398$ ($n_p^2 = 0.007$).

Since the ANCOVA test was not significant, we further performed independent-sample *t* tests on the scores of the two no pretest groups. Independent-sample *t* tests comparing the two post-only (I-NP and C-NP) groups indicated no significant difference between the groups for Predicted Vo2Max, $t(108) = 0.17$, $p = 0.862$).

Having found no significant main effects for Predicted Vo2Max at this stage, we run final analysis that takes full advantage of the power provided by the multiple groups included in this design. The *p* level from each of the latter two statistical tests (ANCOVA and t test) was converted to a normal deviate (z) value, and then the resulting zs were combined into a single $z_{meta}$ which was then converted back into a *p*-value from which significance was determined. With this combined test, a non-significant *p*-value was found for Predicted Vo2Max ($z_{meta} = 0.725$, $p = 0.468$). Therefore, the intervention had no effect on Predicted Vo2Max at the end of the intervention.

There was a significant effect of the pretest condition for SE, $F(1, 216) = 6.46$, $p = 0.012$ ($n_p^2 = 0.029$), which indicates that participating in the pretest

influenced participants' SE. However, the lack of significant interactions between the pretest condition and the intervention condition suggested this effect was similar for both the intervention and the control groups.

*At the 3-Month Follow-up*

To detect the presence of pretest sensitization and the main effect of the intervention at the 3-months follow-up, we similarly performed statistical methods as we previously performed at the end of the intervention.

Pretest Sensitization

No significant interaction was observed for any of the dependent variables, $F(1, 216) = 0.52$, $p = 0.47$ for steps/day; $F(1, 216) = 0.89$, $p = 0.35$ for LTAS; $F(1, 216) = 0.003$, $p = 0.96$ for Predicted Vo2Max; $F(1, 216) = 0.72$, $p = 0.40$ for RHR; $F(1, 216) = 0.18$, $p = 0.67$ for SE; $F(1, 216) = 0.16$, $p = 0.69$ for OE; and $F(1, 216) = 3.59$, $p = 0.059$ for SR. The observed statistical power was low, effect size analysis revealed that the amount of variance explained in the dependent variables by the interaction was very small (observed power = 0.11, $n_p^2 = 0.002$ for steps/day; observed power = 0.16, $n_p^2 = 0.004$ for LTAS; observed power = 0.05, $n_p^2 = 0.000$ for Predicted Vo2Max; observed power = 0.13, $n_p^2 = 0.003$ for RHR; observed power = 0.07, $n_p^2 = 0.001$ for SE; observed power = 0.07, $n_p^2 = 0.001$ for OE; observed power = 0.47, $n_p^2 = 0.016$ for SR). Therefore, pretest sensitization did not occur for any of the outcome measures (see table 3-3 and 3-4 for descriptive statistics).

Main Effects of the Intervention

The main effect of the intervention on steps/day was significant, $F(1, 216) = 119.12$, $p = 0.00$ ($n_p^2 = 0.35$). Examination of means revealed that at the 3-month follow-up, those in the intervention groups had more steps/day (M = 11,127.87) than those in the control groups (M = 7882.37). The main effect of the intervention was observed for LTAS, $F(1, 216) = 93.38$, $p = 0.00$ ($n_p^2 = 0.30$), with those participants in the intervention groups (M = 56.82) reporting higher LTAS than the controls (M = 38.45). No main effect of the intervention was observed for either Predicted Vo2Max, $F(1, 216) = 1.76$, $p = 0.19$ ($n_p^2 = 0.008$), or RHR $F(1, 216) = 5.78$, $p = 0.46$ ($n_p^2 = 0.003$). For the SCT constructs, significant main effects of the intervention were found for SE, $F(1, 216) = 24.09$, $p = 0.00$ ($n_p^2 = 0.10$), OE, $F(1, 216) = 15.72$, $p = 0.00$ ($n_p^2 = 0.068$), and SR, $F(1, 216) = 13.83$, $p = 0.00$ ($n_p^2 = 0.06$), with those participants in the intervention groups (M = 65.56, 86.79, and 65.97, respectively) reporting higher SE, OE, and SR than the controls (M = 60.30, 81.78, and 61.48, respectively).

We next tested the intervention effect in the two pretest (I-P and C-P) groups with a two-group analysis of covariance (ANCOVA) on the follow-up scores for Predicted Vo2Max and RHR, while covarying pretest scores. No significant effects of the intervention were observed for either Predicted Vo2Max, $F(1, 107) = 0.84$, $p = 0.361$ ($n_p^2 = 0.008$), or RHR, $F(1, 107) = 0.26$, $p = 0.612$ ($n_p^2 = 0.002$). Further, independent-sample $t$ tests comparing the two no pretest (I-NP and C-NP) groups indicated no significant difference between the groups for either Predicted Vo2Max, $t$ (108) = 1.01, $p = 0.312$, or RHR, $t$ (108) = 1.01, $p$ =

0.920. With $z_{meta}$ test, a non-significant *p*-value was found for Predicted Vo2Max ($z_{meta}$ = 1.36, $p$ = 0.17) and RHR ($z_{meta}$ = 0.43, $p$ = 0.67). Therefore, the intervention had no effect on Predicted Vo2Max and RHR at the 3-month follow-up.

There was a significant effect of the pretest condition for steps/day, $F(1, 216) = 7.96$, $p = 0.005$ ($n_p^2 = 0.036$), which indicates that participating in the pretest influenced participant's steps. However, the lack of significant interactions between the pretest condition and the intervention condition suggested this effect was similar for both the intervention and the control groups.

Since there were no interaction effects of the pretest by the intervention, the main effect results can be interpreted. The intervention groups had higher steps, LTAS, self-efficacy, outcome expectations, and self-regulation and lower RHR than did the no intervention groups at the end of the intervention. These results were also found at follow-up, but not for RHR. Predicted Vo2Max was not significantly different between those groups both at the end of the intervention and the 3-months follow-up. These results show a treatment effect from the intervention groups for steps, LTAS, RHR, self-efficacy, outcome expectations, and self-regulation to a greater degree compare to the no intervention groups.

### *Mediation Testing*

Given that self-efficacy, outcome expectations, and self-regulation were impacted positively by the intervention, those variables could possibly mediate steps, LTAS, and RHR at the end of the intervention and the 3-months follow-up. Therefore, regression analyses were conducted to test the linkages of self-efficacy,

outcome expectations, and self-regulation to steps, LTAS, and RHR (at the end of the intervention) and steps and LTAS (at the 3-months follow-up). Three regression equations were tested for each SCT variable. For each mediation analysis, equation 1 tests the effect of the intervention on hypothesized mediators (i.e., SCT variable); equation 2 tests the effect of the intervention on dependent variables (i.e., steps, LTAS & RHR). And equation 3 tests the effect of hypothesized mediators on dependent variables when the intervention effect is controlled.

Steps

*Self-efficacy*

The mediation model with self-efficacy as the mediator, the results for each of the 3 equations can be seen in table 3-6.

At the end of the intervention: in the first equation, the intervention was used to predict self-efficacy, $F = 28.97$, $p < .01$, $R^2 = .12$. In the next equation, the intervention was used to predict steps, $F = 98.15$, $p < .01$, $R^2 = .31$. In the final equation, both the intervention and self-efficacy were used to predict steps, $F = 50.58$, $p < .01$, $R^2 = .32$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-efficacy was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on steps at the end of the intervention was not mediated by differences in self-efficacy.

At the 3-month follow-up: in the first equation, the intervention was used to predict self-efficacy, $F = 24.07$, $p < .01$, $R^2 = .10$. In the next equation, the intervention was used to predict steps, $F = 115.68$, $p < .01$, $R^2 = .35$. In the final equation, both the intervention and self-efficacy were used to predict steps, $F = 58.74$, $p < .01$, $R^2 = .35$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-efficacy was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on steps at the 3-month follow-up was not mediated by differences in self-efficacy.

*Outcome Expectations*

The mediation model with outcome expectations as the mediator, the results for each of the 3 equations can be seen in table 3-7.

At the end of the intervention: in the first equation, the intervention was used to predict outcome expectations, $F = 6.99$, $p < .01$, $R^2 = .03$. In the next equation, the intervention was used to predict steps, $F = 115.68$, $p < .01$, $R^2 = .35$. In the final equation, both the intervention and outcome expectations were used to predict steps, $F = 48.86$, $p < .01$, $R^2 = .31$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for outcome expectations was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the

intervention on steps at the end of the intervention was not mediated by differences in outcome expectations.

At the 3-month follow-up: in the first equation, the intervention was used to predict outcome expectations, $F = 15.59$, $p < .01$, $R^2 = .07$. In the next equation, the intervention was used to predict steps, $F = 115.68$, $p < .01$, $R^2 = .35$. In the final equation, both the intervention and outcome expectations were used to predict steps, $F = 58.34$, $p < .01$, $R^2 = .35$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for outcome expectations was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on steps at the 3-months follow-up was not mediated by differences in outcome expectations.

*Self-regulation*

The mediation model with self-regulation as the mediator, the results for each of the 3 equations can be seen in table 3-8.

At the end of the intervention: in the first equation, the intervention was used to predict self-regulation, $F = 7.71$, $p < .01$, $R^2 = .03$. In the next equation, the intervention was used to predict steps, $F = 98.15$, $p < .01$, $R^2 = .31$. In the final equation, both the intervention and self-regulation were used to predict steps, $F = 52.84$, $p < .01$, $R^2 = .33$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-regulation was statistically different from

zero. Based on the results of these analyses, the data supported a mediation model that suggests that the effect of the intervention on steps at the end of the intervention was partially mediated by differences in self-regulation.

At the 3-months follow-up: in the first equation, the intervention was used to predict self-regulation, $F = 13.51$, $p < .01$, $R^2 = .06$. In the next equation, the intervention was used to predict steps, $F = 115.68$, $p < .01$, $R^2 = .35$. In the final equation, both the intervention and self-regulation were used to predict steps, $F = 59.73$, $p < .01$, $R^2 = .35$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-regulation was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on steps at the 3-months follow-up was not mediated by differences in self-regulation.

LTAS

*Self-efficacy*

The mediation model with self-efficacy as the mediator, the results for each of the 3 equations can be seen in table 3-9.

At the end of the intervention: in the first equation, the intervention was used to predict self-efficacy, $F = 28.97$, $p < .01$, $R^2 = .12$. In the second equation, the intervention was used to predict LTAS, $F = 31.18$, $p < .01$, $R^2 = .12$. In the final equation, both the intervention and self-efficacy were used to predict LTAS, $F = 25.82$, $p < .01$, $R^2 = .19$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different

from zero, and the regression coefficient for self-efficacy was statistically significantly different from zero. Based on the results of these analyses, the data supported a mediation model that suggests that the effect of the intervention on LTAS at the end of the intervention was partially mediated by differences in self-efficacy.

At the 3-months follow-up: in the first equation, the intervention was used to predict self-efficacy, $F = 24.07$, $p < .01$, $R^2 = .10$. In the second equation, the intervention was used to predict LTAS, $F = 92.38$, $p < .01$, $R^2 = .30$. In the final equation, both the intervention and self-efficacy were used to predict LTAS, $F = 45.99$, $p < .01$, $R^2 = .30$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-efficacy was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on LTAS at the 3-months follow-up was not mediated by differences in self-efficacy.

*Outcome Expectations*

The mediation model with outcome expectations as the mediator, the results for each of the 3 equations can be seen in table 3-10.

At the end of the intervention: in the first equation, the intervention was used to predict outcome expectations, $F = 7.00$, $p < .01$, $R^2 = .03$. In the next equation, the intervention was used to predict LTAS, $F = 31.18$, $p < .01$, $R^2 = .12$. In the third equation, both the intervention and outcome expectations were used to predict LTAS, $F = 17.50$, $p < .01$, $R^2 = .14$. In terms of testing the mediation

model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for outcome expectations was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on LTAS at the end of the intervention was not mediated by differences in outcome expectations.

At the 3-month follow-up: in the first equation, the intervention was used to predict outcome expectations, $F = 15.59$, $p < .01$, $R^2 = .07$. In the next equation, the intervention was used to predict LTAS, $F = 92.38$, $p < .01$, $R^2 = .30$. In the third equation, both the intervention and outcome expectations were used to predict LTAS, $F = 47.11$, $p < .01$, $R^2 = .30$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for outcome expectations was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on weekly LTAS at the 3-months follow-up was not mediated by differences in outcome expectations.

*Self-regulation*

The mediation model with self-regulation as the mediator, the results for each of the 3 equations can be seen in table 3-11.

At the end of the intervention: in the first equation, the intervention was used to predict self-regulation, $F = 7.71$, $p < .01$, $R^2 = .03$. In the next equation, the intervention was used to predict LTAS, $F = 31.18$, $p < .01$, $R^2 = .12$. In the

final equation, both the intervention and self-regulation were used to predict steps, $F = 23.90$, $p < .01$, $R^2 = .18$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-regulation was statistically significantly different from zero. Based on the results of these analyses, the data supported a mediation model that suggests that the effect of the intervention on LTAS at the end of the intervention was partially mediated by differences in self-regulation.

At the 3-month follow-up: in the first equation, the intervention was used to predict self-regulation, $F = 13.51$, $p < .01$, $R^2 = .06$. In the next equation, the intervention was used to predict LTAS, $F = 92.38$, $p < .01$, $R^2 = .30$. In the final equation, both the intervention and self-regulation were used to predict steps, $F = 47.15$, $p < .01$, $R^2 = .30$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-regulation was not statistically significantly different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on LTAS at the 3-months follow-up was not mediated by differences in self-regulation.

Resting Heart Rate

Given that RHR was significantly impacted by the intervention only at the end of the intervention, the regression analyses were conducted to test the proposed mediation models for RHR only at the end of the intervention. Separate

analyses were conducted with self-efficacy, outcome expectations, and self-regulation as the respective mediator of RHR.

*Self-efficacy*

The mediation model with self-efficacy as the mediator, the results for each of the 3 equations can be seen in table 3-12. In the first equation, the intervention was used to predict self-efficacy, $F = 28.97$, $p < .01$, $R^2 = .12$. In the second equation, the intervention was used to predict RHR, $F = 5.81$, $p < .05$, $R^2 = .03$. In the final equation, both the intervention and self-efficacy were used to predict RHR, $F = 3.23$, $p < .05$, $R^2 = .03$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-efficacy was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on RHR was not mediated by differences in self-efficacy.

*Outcome Expectations*

The mediation model with outcome expectations as the mediator, the results for each of the 3 equations can be seen in table 3-12. In the first equation, the intervention was used to predict outcome expectations, $F = 7.00$, $p < .01$, $R^2 = .03$. In the next equation, the intervention was used to predict RHR, $F = 5.81$, $p < .05$, $R^2 = .03$. In the third equation, both the intervention and outcome expectations were used to predict steps, $F = 2.90$, $p = .057$, $R^2 = .03$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for

outcome expectations was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on RHR was not mediated by differences in outcome expectations.

*Self-regulation*

The mediation model with self-regulation as the mediator, the results for each of the 3 equations can be seen in table 3-12. In the first equation, the intervention was used to predict self-regulation, $F = 7.71$, $p < .01$, $R^2 = .03$. In the next equation, the intervention was used to predict RHR, $F = 5.81$, $p < .05$, $R^2 = .03$. In the final equation, both the intervention and self-regulation were used to predict RHR, $F = 2.93$, $p = .055$, $R^2 = .03$. In terms of testing the mediation model, the regression coefficient for the intervention was statistically significantly different from zero, and the regression coefficient for self-regulation was not statistically different from zero. Based on the results of these analyses, the data did not support a mediation model that suggests that the effect of the intervention on RHR was not mediated by differences in self-regulation.

## Discussion

The primary purpose of this study was to evaluate the efficacy of a SCT-based internet intervention designed to promote and maintain PA in university-aged female student in Thailand. The secondary purpose was to determine whether or not the SCT variables mediate changes in PA and physical fitness. Overall, the SCT-based internet intervention PA program was effective in promoting and maintaining PA in Thai female students. SCT variables partially

mediated PA changes. Specifically, this study found that there was no pretest sensitization effect for any of the outcomes of the intervention. The intervention had significant effects on steps/day, weekly LTAS, self-efficacy, outcome expectations, and self-regulation at the end of the intervention and the 3-month follow-up. The intervention successfully improved RHR at the end of the intervention but this was not sustained at the 3-months follow-up. The intervention had no effect on Predicted Vo2Max. The intervention effects on weekly LTAS at the end of the intervention were partially mediated by self-efficacy and self-regulation. The intervention effects on steps/day at the end of the intervention were partially mediated by self-regulation.

### *Pretest Sensitization Effects*

We found no pretest sensitization effect for any of the outcome of the intervention which is similar to previous studies that found no influences of the pretest sensitization effect (e.g., Spence & Blanchard, 2001; Spence et al., 2009; van Sluijs et al., 2006). This result does not support Ogden's (2003) argument about the pretest effects. Even though participants in the pretest groups were measured on steps/day and weekly LTAS using pedometers and a self-report questionnaire (i.e., GSLTPAQ), Predicted Vo2Max using a step test (i.e., Queen's College Step Test), and SCT variables using self-report questionnaires, completing these measured at the pretest did not create and change both cognitions and behaviours of participants which refutes Ogden's criticism. The result supports Spence and colleague's (2009) suggestion that the pretest sensitization effect was less relevant for experimental designs.

*Intervention Effects on PA and SCT Variables*

This is the first reported study using the internet as a PA promoting tool in Thai female students and overall the study was successful. The intervention was effective in promoting and maintaining PA and SCT variables at the end of the intervention and 3-month follow-up. This finding is consistent with previous studies in female university students (Huang, Hung, Chang, & Chang, 2009; Wadsworth & Hallam, 2010) and reviews reporting the efficacy of internet-based interventions in promoting PA (Davies et al., 2012; Marcus et al., 2009; Norman et al., 2007; Vandelanotte et al., 2007; van den Berg, Schoones, & Vlietland, 2007). In this study, the SCT-based internet intervention PA program was aimed to enhance and maintain self-efficacy, outcome expectations, and self-regulation, which in turn, would increase PA. It is known that SCT is a good model for health behaviour change and maintenance (Bandura, 1986) and SCT constructs are related to PA (Anderson et al., 2006; Petosa et al., 2003; Rovniak et al., 2002). Bandura (1997) posited that self-efficacy and outcome expectations influence PA directly and through the development and use of self-regulation. This suggestion was supported by Winett and colleagues (2007). Also, many studies have found that by enhancing self-efficacy, outcome expectations, and self-regulation, PA can be increased and maintained (Allen, 2004; Anderson et al., 2006; Dishman et al., 2009; Hallam & Petosa, 2004; Koh et al., 2010; Marcus et al., 2006; Tavares et al., 2009). People with higher self-efficacy exercise more frequently and are more likely to adhere to exercise programs (Annesi, 2004; Hallam, & Petosa, 2004; Jancey et al., 2007; Rodgers & Sullivan, 2001). Similarly, people with high

positive outcome expectations will participate in behaviour more than those who have negative outcome expectations (Bandura, 2004). In the same way, self-regulation is important skills for behaviour change and maintenance (Anderson et al., 2006).

The intervention increased PA through increases of SCT variables. This supports the suggestion that SCT variables are important determinants of PA change as our findings found increases of SCT variables and PA at the end of the intervention and the 3-month follow-up. Students in the intervention groups had higher PA and SCT variables than those in the no intervention groups (see figure 3-4 to 3-8). Similarly, there are many studies that found a relationship between self-efficacy and PA (Dishman et al., 2009; Koh et al., 2010; Luszczynska & Haynes, 2009; McNeill et al., 2006*;* Motl et al., 2007; Tavares et al., 2009; Taymoori et al., 2010), outcome expectations and PA (Allen, 2004; Gao et al., 2008; Rovniak et al., 2002; Williams et al., 2005), and self-regulation and PA (Anderson et al., 2006; Carr, Bartee, Dorozynski, Broomfield, Smith, & Smith, 2008; Carels et al., 2005; Michie et al., 2009; Puente & Anshel, 2010). A recent study in Thai adults also found the relationship among self-efficacy, outcome expectations and PA (Poomsrikaew, Berger, Kim, & Zerwic, 2012). Thus, enhancing and maintaining of SCT variables would be the important explanation for the increase in PA in this study.

Also, participants' PA was maintained at the 3-month follow-up. This finding is similar to Huang and colleagues' (2009) study reporting that PA of Taiwanese female university students was increased at 5 months post intervention.

However, our findings were different from a similar study in North America. Wadsworth and Hallam (2010) found that PA of female university students was not maintained at the 3-month follow-up. Also, there are previous studies and reviews in adult populations reporting that an internet-based PA intervention was efficacious in the short-term but did not produce longer-term adherence to PA (Carr et al., 2008; Carr et al., 2013; Davies et al., 2012; Vandelanotte et al., 2007; van den Berg, Schoones, & Vlietland, 2007). However, participants in those studies (e.g., Carr et al., 2008; Wadsworth & Hallam, 2010) received no follow-up contact or interactive features during the follow-up period. Participants were just advised of their continued access to Website during the follow-up period. In contrast, participants in our studies received monthly follow-up contact and interactive features during follow-up period. Marcus, Dubbert et al. (2000) also suggested that the lack of contact with participants during the follow-up period might have played role in PA relapse. Thus, the short-term only improvement in PA in previous studies may be because most Web-based programs are not interactive enough to fully engage participants resulting in irregular use of the Website during the follow-up period (Carr et al., 2008; Hurling et al., 2006). In contrast, our Websites contained PA logs and participants could access to the Website every month to record their PA during the follow-up period. This is related to previous suggestions that the use of some form of interaction post intervention when using internet-delivered programs may prevent PA relapse (Rejeski et al., 2007). However, we did not know whether or not our participants would maintain their PA if they did not receive any contact or could not access to

the Website to record their PA as participants in previous studies. We suggested that the maintenance of PA in this study may be because participants received contacts and could record their PA during the follow-up period. Future studies should examine the influence of receiving a contact or accessing to the Website during the follow-up period on the maintenance of PA.

It is well known that Thailand is a Buddhist country. It has characteristics of Buddist culture in almost all aspects of everyday activities. The main teaching of Buddhism is on the concept of reincarnation and emphasizes the Law of Karma, which teaches that persons will receive (effects) the consequences of their behaviours (causes) either in this or future lives (Chamratrithirong et al., 2010). Thus, an essential part of Buddhist life is to do good Karma and avoid bad Karma. In addition, Thais are taught to maintain smooth, harmonious interactions with others by avoiding situations they do not prefer, or by doing or offering to the wishes of others (McCarty et al., 1999). To maintain harmonious relations with others, they place importance and value on outward forms of good manners such as politeness, respect, warm manner, and self-control. Also, Thais are taught to be soft or quiet and obedient to their parents, elders, teachers, the Buddha and other religious symbols and authority figures and showing signs of loyalty. They are normally reminded that they are deeply in debt to their parents and teachers who have provided them with care, vital information, and essential knowledge, thus, strengthening the feeling of moral responsibility (Ekintumas, 1999). Moreover, Thailand is a hierarchical society. Based on a social rank defined by age, wealth or status, all relationships in Thai society are defined as one person being superior

to the other. For example, parents are superior to their children, teachers to students, adults to children, and bosses to subordinates, etc. In general, a lower status person will show obedience and respect to a higher status person. In return, a higher status person is obligated to care for and offer assistance to a lower status person. By the influence of the Buddist beliefts, participants in this study (who were students) may have increased and maintained their PA behaviour at the researcher's suggestion since the researcher was a professor in the university. Although all participants did not study with the researcher, they might feel uncourteous, disrespectful, or uncomfortable if they did not practice as the researcher suggested.

The culture influence on behaviour may be confirmed by considering similar studies in Taiwanese and American female university students that found that PA adherence was different. That is, PA of Taiwanese students was increased at 5 months post intervention (Huang et al., 2009) while PA of American students was not maintained at 6 months post intervention (Wadsworth & Hallam, 2010). It is known that cultural background and experiences influence self; the way that people live, think, and behave, as well as their personal health are influenced by culture (Lim, Waters, Froelicher, & Kayser-Jones, 2008; Markus & Kitayama, 1991). It is known that people in Western countries are more likely to be independent while people in Asian countries are more likely to be interdependent (Markus & Kitayama, 1991). According to Markus and Kitayama (1991), the independent self refers to become independent from others and to discover and express one's unique attributes. Achieving cultural goal requires construing

oneself as an individual whose behaviour is organized and made primarily by reference to one's own internal range of thoughts, feelings, and action, rather than by reference to the thoughts, feelings, and actions of others. In contrast, the interdependent self refers to the maintainance of connectedness and interdependence among individuals. Interdependence entails seeing oneself as part of an encompassing social relationship and recognizing that one's behaviour is determined by what the actor perceives to be the thoughts, feelings, and actions of others in the relationship. Therefore, Thai culture may have influenced the maintainance of PA in this population. This can be confirmed by the low attrition rate (~20%) in this study compared to studies reporting in previous Western studies (Davies et al., 2012; Vandelanotte et al., 2007). However, since we did not know whether or not our participants maintained their PA levels after this study has finished, future studies should examine the efficacy of the intervention during the follow-up period without receiving any contact or any source of program in this population and other populations to evaluate the influence of culture and the efficacy of the SCT-based internet intervention PA program.

Moreover, the relationship between the self and SCT variables in Thai students may be stronger than those in Western students. According to Bandura (1986, 1997, 2004), SCT operates at interpersonal levels. SCT assumes humans are social beings who develop their sense of self and personal efficacy from others through interpersonal exchanges, and that the interpersonal environment is critical in affecting and predicting one's health behaviour and, in turn, health outcomes. Therefore, the interdependent self in Thai students may have a stronger influence

to SCT variables than did the dependent self in Western students. A cross-cultural study also found that regular PA is influenced by culture. A study comparison of lack of regular PA among university students in United States, Costa Rica, India, and South Korea found that PA is more transversal value than universal value (Seo, Torabi, Jiang, Fernandez-Rojas, & Park, 2009). This means that lack of regular PA of students depended on culture. That is, cultural specificity might lead to different determinants of PA in different cultures (Seo et al., 2009).

*Intervention Effects on Predicted Vo2Max and RHR*

It has been found that Vo2max can be increased within 8 weeks of an endurance training program (Daussin et al., 2007). However, Pollock and colleagues (1998) suggested that 15 to 20 weeks may be an adequate minimum standard to evaluate the efficacy of exercise program on fitness variables, and it may take longer if want to evaluate health-related variables. Specifically, if lower dose of exercise was used, the improvement of Vo2max will be at a slower rate. In this study, there was no significant increase in Predicted Vo2Max at the end of the intervention and the 3-month follow-up (see figure 3-9). There was a significant decrease in RHR at the end of the intervention; however, the decrease was not maintained at the 3-month follow-up (see figure 3-10). Our findings suggested that although the SCT-based internet intervention PA program could increase and maintain PA, the increased in PA could not significantly improve Predicted Vo2Max. This finding agrees with previous studies in adult women. The study found that although 12-week e-mail-based walking programs could improve 1-mile walk test time, it could not improve Predicted Vo2Max (Rovniak,

Hovell, Wojcik, Winett, & Martinez-Donate, 2005). Similarly, the study compared tailored versus standard internet-delivered interventions to promote PA in older women found that participants in tailored program had no changes in Predicted Vo2Max while participants in standard program decreased in Predicted Vo2Max (Hageman, Walker, & Pullen, 2005).

It is known that PA participation is one important factor to determine cardiovascular fitness which is measured by Vo2max (Bouchard et al., 1998). Regular PA is also known to enhance cardiovascular fitness (Starling et al., 1998). This may intuitively suggest that increased PA leads to an increased cardiovascular fitness (Hunter et al., 2000). There are many studies that found a significant correlation between PA level and cardiovascular fitness (Brochu et al., 1999; Dvorak et al., 2000; MacAuley et al., 1998; Starling et al., 1998; Tuero et al., 2001). However, this association was stronger for higher intensity PA whereas the association was weaker for lower intensity PA, suggesting that a high PA volume (frequency, duration, and intensity) will promote higher cardiovascular fitness (Dionne, Ades, & Poehlman, 2003). Since the relationship is not straightforward, we suggest that the PA done by our participants may not be sufficiently intens to improve cardiovascular fitness. This suggestion is associated with the weekly LTAS obtained from a self-report GSLPAQ measured at the end of the intervention and the 3-month follow-up, in which participants in the intervention groups reported higher participation in moderate and mild PA rather than strenuous PA. A previous study also found that low levels of PA such as yoga and walking on a treadmill at 3.2 kph (3 METs) did not meet

recommendations for improving or maintaining cardiovascular fitness (Hagins, Moore, & Rundle, 2007).

According to the American College of Sports Medicine (ACSM) Position Stand, for developing and maintaining cardiovascular fitness, exercise should achieve 55–90% of the maximal heart rate (MHR), be performed 3–5 days per week, and last 20–60 minutes (Pollock et al., 1998). Participants in our studies were advised to participate in at least MPA (≥ 3.0 METs) 30-60 minutes per day for 3 days a week. This suggestion was based on the recommendation from the Canadian Society for Exercise Physiology (CSEP: Tremblay et al., 2011) and ACSM and the American Heart Association (AHA: Haskell et al., 2007). To meet this advice, participants could participate in any kind of PA based on their favorites and they also were asked to increase duration of PA (3 minutes every week) until it reached 60 minutes. From participants' reported PA, participants participated in an average of about 52 minutes or 12,160 steps per days during the intervention period and about 62 minutes or 14,080 steps per days during the follow-up period (see figure 3-11 and 3-12). These report showed that participants met our recommendations.

Although the increase in PA in this study was insufficient to create gains in cardiovascular fitness, it may serve to increase health benefits. As the ACSM Position Stand recommendations that lower levels of PA than those recommended may provide health benefits for those who are quite unfit, particularly in the area of metabolic fitness (Pollock et al., 1998). Metabolic fitness describes the ability of metabolic systems predictive of risk of cardiovascular disease (e.g., diabetes) to

improve through intensities of PA which do not produce change in aspects of performance such as Vo2max (Despres et al., 1990, 1991). For example, among the non-obese, PA performed at levels insufficient to influence Vo2max can still improve insulin action (Oshida, Yamanouchi, Hayamizu, & Sato, 1989). This finding is in agreement with studies which have found that low levels of PA (i.e., yoga) could improve factors associated with metabolic fitness such as insulin resistance (Malhotra et al., 2002) and lipid profiles (Vyas & Dikshit, 2002). Future research should focus more on the intensity of PA and include evaluating metabolic component of fitness.

### *Mediator Effects*

The SCT-based internet intervention PA program was developed with reference to SCT which self-efficacy, outcome expectations, and self-regulation have been identified as important determinants of PA changes (Bandura, 1997; Winett et al., 2007). Based on SCT, many strategies were used to enhance and maintain SCT variables. The findings suggest that these strategies were effective in enhancing and maintaining SCT variables. In turn, the intervention successfully increased PA (i.e., weekly LTAS and steps/day) at the end of the intervention and the 3-month follow-up. The effect of the intervention on the total weekly LTAS at the end of the intervention was partially mediated by self-efficacy and self-regulation. The effect of the intervention on steps/day at the end of the intervention was partially mediated by self-regulation.

To our knowledge, this is the first study that examined mediators in the PA intervention that PA was measured by both indirect (i.e., GSLTPAQ; weekly

LTAS) and direct (i.e., pedometers; steps/day) measures. The current finding was consistent with previous studies when PA was measured by indirect methods. Self-efficacy mediated the effects of the intervention on PA in adolescent girls (Dishman et al., 2004) university female students (Sallis et al., 1999) and adults (Anderson et al., 2010; Miller et al., 2002). Dishman and colleagues (2004) developed the Lifestyle Education for Activity Program (LEAP), a school-based intervention to increase PA and fitness among adolescent girls, based on SCT (i.e., self-efficacy, outcome expectations, goal setting, and satisfaction). They reported that the intervention had direct effects on self-efficacy, goal setting, and PA. The effect of the intervention on PA was partially mediated by self-efficacy. Similarly, self-efficacy mediated PA changes in Project GRAD (an intervention targeting university students; Sallis et al., 1999). Also, Anderson et al. (2010) found that self-efficacy mediated the effects of Guide-to-Health trial (GTH) treatment on PA. Miller and colleagues (2002) found that self-efficacy mediated PA changes in sedentary women with young children. In the current study, participants increased their self-efficacy by integrating information from four primary sources: performance accomplishments, vicarious experiences, verbal persuasion, and physiological and emotional states (Maddux, 2009). The finding suggests that these methods are effective in increasing self-efficacy in Thai female students. Self-efficacy is an important determinant and may be a mediator of PA change in Thai female students.

In addition, self-regulation mediated the intervention effects on PA (i.e., weekly LTAS and steps). This is consistent with previous findings (Anderson et

al., 2010; Hallam & Petosa, 2004; Hortz & Petosa, 2008; Wadsworth & Hallam, 2010). For example, Wadsworth and Hallam (2010) used Web pages that targeted self-efficacy, outcome expectations, and self-regulation in university female students have found that the frequency of MPA was increased and was mediated by SR. In our study, two important self-regulation skills were used, that is goal setting and self-monitoring. Participants set goals and monitored their PA in each week because of the intervention, and subsequently, made greater improvements in their PA behaviours. This study suggests that self-regulation is an important determinant and may be a mediator of PA change in Thai female students. However, since mediator effects of self-efficacy and self-regulation on PA changes measured were not sustained at the 3-month follow-up while PA was maintained, the mediator effects of self-efficacy and self-regulation on PA changes may be needed a further study.

On the other hand, outcome expectations were not supported as mediators of change in the current study. This finding is consistent with previous studies (Anderson et al., 2010; Hallam & Petosa, 2004). Anderson and colleagues (2010) found that the GTH intervention increased outcome expectations for PA, but these changes did not mediate PA change. Similarly, Hallam and Petosa (2004) found that the intervention increased outcome expectations in adults, but these changes did not mediate PA change. In this study, outcome expectations and outcome value were increased by focusing on increasing awareness of the potential benefits of PA and attempting to create favorable PA outcome expectancies (Williams et al., 2005). These methods could successfully increase and maintain outcome

expectations in Thai female students although previous studies have reported that outcome expectations was not likely to be changed by the intervention (Dishman et al., 2004; Hortz & Petosa, 2008; Lubans & Sylva, 2009; William et al., 2005).

Mediation analysis also showed that self-efficacy, outcome expectations, and self-regulation met the first three criteria of mediation for mediating PA both at the end of the intervention and the 3-month follow-up. However, despite not meeting the fourth criterion of mediation, these results provide preliminary evidence that self-efficacy, outcome expectations, and self-regulation may be important mediators of PA changes. We also support using of SCT variables in developing an internet intervention PA program. The findings that SCT variables were partial mediators and were not mediators either at the end of the intervention or the 3-month follow-up suggest that the SCT-based internet intervention PA program is successful in increases and maintains PA.

*Strengths and Limitations*

This study has some significant methodological and theoretical strengths. First, this study used SCT as the theoretical framework in developing the intervention program to produce increases in selected SCT variables. As previous study has suggested that interventions to increase PA should be guided by a behavioural science model (e.g., SCT) this is predictive of behaviour and identifies mechanisms responsible for behaviour change (Baranowski, Anderson, & Carmack, 1998). A thorough review of the PA behaviour literature also identifies three SCT variables (i.e., self-efficacy, outcome expectations, and self-

regulation) that are highly associated with PA behaviour (Bandura, 1997; Hallam & Petosa, 2004; Winett et al., 2007).

The secondary strength of this study is that IM was used as a framework to develop the SCT-based internet intervention PA program. Kok and colleague (2004) suggested that by using IM, the gap between theory and practice is better link. IM provides six steps of a framework for developing an effective intervention program (Bartholomew et al., 2011). The result of IM is a "map" that consists of matrices and plans that guide the design, implementation, and evaluation of an intervention (Bartholomew et al., 1998). We believe that by using IM in this study, the SCT-based internet intervention PA program was effectively developed and the gap between SCT and practice was reduced.

Third, the internet was used as a mode of delivery for PA program. Delivery of the program by the internet has many benefits for promoting PA (Tate et al., 2009). The internet has ability to provide efficient, interactive, and tailored content to the user. It offers a variety of multimedia interactivity and connectivity formats (Proudfoot et al., 2011). People can access the intervention program at any time and location and can work through the program at their own pace (Marcus et al., 2009; Napolitano & Marcus, 2002). Internet interventions also offer anonymity to user (Proudfoot et al., 2011) and reduce traditional face-to-face barriers (Ritterband et al., 2009). Previous studies have found that internet interventions can be used to change individual's cognition and behaviour. They produce behaviour change such as increased PA (Marcus et al., 2009; Norman et al., 2007; Vandelanotte et al., 2007). Moreover, some limitations of previous

internet interventions reported in reviews of Marcus et al. (2009) and van den Berg et al. (2007) have been addressed in this study. For example, this study paid attention to methodological quality (i.e., sample size and outcome measures), and had long term follow up and a true control group. Also, this intervention enhanced and maintained SE, OE, and SR in order to develop and sustain PA behaviour. In addition, the Website contains interactive and immediate features such as PA log, goal setting log, and PA feedback reports to increase logging rate.

The next strength of this study is that a randomized controlled trial intervention was conducted. The Solomon four-group design was used. Randomized controlled trial designs are considered the gold standard for testing the effects of an intervention because randomization to different groups can provide unbiased estimates of outcomes among groups exposed to different treatment conditions (Higgins & Green, 2008; Polit & Beck, 2008; Shadish, Campbell, & Cook, 2002). Random assignment to treatment groups aims to ensure that participant characteristics that may affect the outcome are balanced. This, in turn, supports inferences that any group differences in post-intervention outcomes are actually the result of the intervention. The Solomon four-group design was used for establishing the actual effectiveness of the program (van Sluijs et al., 2006). To our knowledge, this is the first internet intervention study that used the Solomon four group design. This design allows us studying both the intervention effect and the pretest sensitization effect (Braver & Braver, 1988). Thus, the results in this study were the actual effectiveness of the SCT-based internet intervention PA program.

The last strength of this study is that a true or classic ITT analysis was used. ITT in randomized controlled trials involves keeping participants in the treatment groups to which they were randomized regardless of whether they withdraw following randomization. ITT is a strategy for maintaining the integrity of randomization and strengthening the trial's internal validity (Polit, 2010). To include all participants in the final analysis, imputation of the missing data by using multiple imputations (MI) was used. MI approach is considered as the current gold standard imputation method (McCleary, 2002; Patrician, 2002; Polit, 2010). Thus, results from this study were obtained from every participant that was randomized to the intervention. As a result, a bias of participant's withdrawals from this study was reduced.

Some limitations should be mentioned as well. Participants in this study were university female students. In general, students in university are likely to have ability to access to the internet compared to other Thai population. Also, previous studies in Thai population have found influences of age and gender on SCT (Poomsrikaew, Berger, Kim, & Zerwic, 2012). Thus, the results are not generalizable to the other population. Further studies may examine the effects of the internet intervention in other Thai population.

Also, the Queen's College Step Test was used to measure Predicted Vo2Max in this study. To predict Vo2max, the immediately carotid pulse rate post exercise was used. Thus, accurate measurement of the carotid pulse rate is critical for valid testing. Although heart rate obtained by palpation is used commonly, the accuracy of this method depends on the experience and technique

of evaluators. In this study, heart rate was measured by graduate female students who were trained for the carotid pulse rate measurement. However, an error or mistake could happen. Also, heart rate response is easy changed by a number of environmental (e.g., temperature, humidity), dietary (e.g., caffeine, time since last meal), and behavioural (anxiety, previous activity) factors (ACSM, 2010). Thus, to have a valid prediction, these factors must be controlled. Also, the Queen's College Step Test was developed in Western population. The researcher noticed that the height of step is quite high compared to the height of Thai female students in this study. Thus, the height of step may influence participants' feeling and as well as the accuracy of Predicted Vo2Max. Future studies may use other indirect methods to predict Vo2max.

This study was also limited by self-report of PA. It is known that self-report of PA questionnaires still have limited validity and reliability (Shepard, 2003). However, participants' PA levels obtained from the GSLTPAQ and pedometers in this study were in the same direction. Thus, self-report of PA may be appropriate for using in large population studies.

In addition, pedometers have some limitations. Pedometers only measure ambulatory activities (e.g., walking, jogging); thus, if participants participate in other types of activities such as swimming or bicycling, pedometers cannot report such activities. Also, pedometers do not provide information about the intensity of the activity. Thus, using other types of objective monitors such as accelerometers may provide more complete information of PA since they can provide the intensity of the activity and energy expenditure. By using accelerometers,

participants in the intervention groups can monitor their PA levels and also the intensity or energy expenditure of PA. Future studies may use accelerometers as objective monitors.

Finally, participants in the control groups did not receive any treatments while participants in the intervention groups received the SCT-based internet intervention PA program, including weekly e-mail contact, interaction with the Website, and weekly self-monitoring their PA behavior. Thus, we did not know whether the increase and maintainance of PA behaviour in this study was influenced by e-mail contact, interaction, or self-monitoring. Future studies may conduct the SCT-based internet intervention by comparing the effective of these interventions on PA promotion.

## Conclusion

The result from this study found that the SCT-based internet intervention PA program successfully promoted and maintained PA in university-aged female students in Thailand. This finding is consistent with previous studies conducted in Western and Asian countries. However, increases in PA did not develop changes in cardiovascular fitness. Self-efficacy and self-regulation were partially responsible for increases in PA at the end of the intervention, but these effects did not remain at the 3-months follow-up. This study suggests that SCT can be used as a model for promoting and maintaining PA in Thai female university students.

Tables

Table 3-1 Numbers of participants in each category using only moderate and strenous PA scores at the baseline from GSLTPAQ

| Catagories | Physical activity level | Numbers of Participants | |
|---|---|---|---|
| | | Control Group | Intervention Group |
| Active | 24 METs | 34 (61.82%) | 33 (60.00%) |
| Moderately active | 14-23 METs | 15 (27.27%) | 10 (18.18%) |
| Insufficiently active | Less than 14 METs | 6 (10.91%) | 12 (21.82%) |

Table 3-2 Demographic characteristics (mean and standard deviation) by study groups

| Variable | Pretest Groups | | | | No Pretest Groups | | | | *p-value* |
|---|---|---|---|---|---|---|---|---|---|
| | Intervention | | Control | | Intervention | | Control | | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | |
| Age | 19.11 | .90 | 19.09 | .93 | 19.40 | .78 | 19.04 | .77 | .108 |
| Weight | 52.90 | 9.53 | 51.98 | 9.93 | 52.46 | 6.49 | 55.37 | 8.45 | .176 |
| Height | 158.91 | 4.29 | 160.85 | 6.04 | 158.88 | 4.50 | 160.87 | 5.87 | .053 |
| BMI | 20.94 | 3.60 | 20.02 | 3.06 | 20.74 | 1.99 | 21.68 | 3.93 | .066 |

Note. BMI = Body mass index.

Table 3-3 Mean score for PA, physical fitness, and SCT variables at pretest, end of the intervention, and the 3-month follow-up for the pretest groups

| Variable | Intervention with Pretest | | | | | | Control with Pretest | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pretest | | End of the intervention | | Follow-up | | Pretest | | End of the intervention | | Follow-up | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Steps | 7375.29 | 2944.18 | 11002.88 | 2059.49 | 11654.56 | 1982.56 | 7274.92 | 2380.27 | 7126.88 | 2265.00 | 8194.50 | 2303.04 |
| LTAS | 43.14 | 23.43 | 51.89 | 21.89 | 54.14 | 11.36 | 41.45 | 17.30 | 35.07 | 17.42 | 37.58 | 12.46 |
| RHR | 80.72 | 10.14 | 78.54 | 8.52 | 80.11 | 12.63 | 82.57 | 7.80 | 81.41 | 7.44 | 81.98 | 7.60 |
| PVo2Max | 37.43 | 3.22 | 37.79 | 3.44 | 37.44 | 2.53 | 37.90 | 3.33 | 37.43 | 3.15 | 37.04 | 2.17 |
| SE | 63.14 | 12.15 | 64.86 | 10.93 | 64.59 | 8.28 | 57.95 | 19.92 | 54.65 | 16.62 | 59.78 | 7.99 |
| OE | 82.73 | 5.57 | 86.66 | 7.66 | 88.25 | 7.85 | 79.59 | 20.11 | 82.91 | 8.45 | 82.74 | 8.48 |
| SR | 60.34 | 9.52 | 61.97 | 10.36 | 63.66 | 7.71 | 59.93 | 11.57 | 59.04 | 8.18 | 61.46 | 8.99 |

Note. LTAS = Leisure-time activity score; RHR = Resting heart rate; PVo2Max = Predicted Vo2Max; SE = Self-efficacy;

OE = Outcome expectations; and SR = Self-regulation

Table 3-4 Mean score for PA, physical fitness, and SCT variables at the end of the intervention, and the 3-month follow-up for the no pretest groups

| Group | Intervention with No Pretest | | | | Control with No Pretest | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | End of the intervention | | Follow-up | | End of the intervention | | Follow-up | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Steps | 11442.59 | 4452.12 | 10601.18 | 2883.21 | 7470.60 | 2341.38 | 7570.25 | 1380.78 |
| LTAS | 52.83 | 24.73 | 59.50 | 19.63 | 39.09 | 16.11 | 39.32 | 11.22 |
| RHR | 78.14 | 8.44 | 80.16 | 5.02 | 80.38 | 7.04 | 80.03 | 7.91 |
| PVo2Max | 37.52 | 4.81 | 37.51 | 2.41 | 37.40 | 1.43 | 37.09 | 1.92 |
| SE | 59.99 | 14.78 | 66.54 | 7.33 | 50.14 | 11.62 | 60.83 | 8.14 |
| OE | 84.16 | 9.00 | 85.33 | 10.96 | 81.04 | 12.64 | 80.82 | 9.84 |
| SR | 64.45 | 11.14 | 68.28 | 11.11 | 60.15 | 8.63 | 61.57 | 7.54 |

Note. LTAS = Leisure-time activity score; RHR = Resting heart rate; PVo2Max = Predicted Vo2Max; SE = Self-efficacy; OE = Outcome expectations; and SR = Self-regulation

Table 3-5 Independent t-test between the I-P and the C-P at pretest

| Variable | Group | | | | *t* | *p-value* |
|---|---|---|---|---|---|---|
| | I-P | | C-P | | | |
| | *M* | *SD* | *M* | *SD* | | |
| Steps | 7375.29 | 2944.18 | 7274.92 | 2380.27 | .20 | .845 |
| LTAS | 43.14 | 23.43 | 41.45 | 17.30 | .43 | .669 |
| RHR | 80.72 | 10.14 | 82.57 | 7.80 | 1.06 | .292 |
| PVo2Max | 37.43 | 3.22 | 37.90 | 3.33 | .75 | .451 |
| SE | 63.14 | 12.15 | 57.95 | 19.92 | 1.65 | .103 |
| OE | 82.73 | 5.57 | 79.59 | 20.11 | 1.11 | .269 |
| SR | 60.34 | 9.52 | 59.93 | 11.57 | .20 | .839 |

Note. I-P = Intervention with pretest; C-P = Control with pretest; LTAS = Leisure-time activity score; RHR = Resting heart rate; PVo2Max = Predicted Vo2Max; SE = Self-efficacy; OE = Outcome expectations; and SR = Self-regulation

Table 3-6 Regression analyses demonstrating mediation effects of self-efficacy on steps

| Equations | Outcome | Predictors | B | SE | β | t | *p* |
|---|---|---|---|---|---|---|---|
| End of the intervention | | | | | | | |
| 1 | Self-efficacy | Intervention | -10.03 | 1.86 | -.34 | -5.38 | .000 |
| 2 | Steps | Intervention | -3923.99 | 396.08 | -.56 | -9.91 | .000 |
| 3 | Steps | Intervention | -3701.85 | 420.25 | -.53 | -8.81 | .000 |
| | | Self-efficacy | 22.14 | 14.34 | .09 | 1.54 | .124 |
| 3-months follow-up | | | | | | | |
| 1 | Self-efficacy | Intervention | -5.26 | 1.07 | -.31 | -4.91 | .000 |
| 2 | Steps | Intervention | -3245.50 | 301.75 | -.59 | -10.75 | .000 |
| 3 | Steps | Intervention | -3121.99 | 317.60 | -.57 | -9.83 | .000 |
| | | Self-efficacy | -23.49 | 19.05 | .07 | -1.23 | .219 |

Table 3-7 Regression analyses demonstrating mediation effects of outcome expectations on steps

| Equations | Outcome | Predictors | B | SE | β | t | *p* |
|---|---|---|---|---|---|---|---|
| End of the intervention | | | | | | | |
| 1 | OE | Intervention | -3.44 | 1.30 | -.18 | -2.64 | .009 |
| 2 | Steps | Intervention | -3923.99 | 396.08 | -.56 | -9.91 | .000 |
| 3 | Steps | Intervention | -3916.43 | 403.31 | -.56 | -9.71 | .000 |
| | | OE | 2.19 | 20.67 | .01 | .11 | .915 |
| 3-months follow-up | | | | | | | |
| 1 | OE | Intervention | -5.01 | 1.27 | -.26 | -3.95 | .000 |
| 2 | Steps | Intervention | -3245.50 | 301.75 | -.59 | -10.75 | .000 |
| 3 | Steps | Intervention | -3164.79 | 312.36 | -.57 | -10.13 | .000 |
| | | OE | 16.12 | 16.12 | .06 | 1.00 | .318 |

Note. OE = Outcome expectations

Table 3-8 Regression analyses demonstrating mediation effects of self-regulation on steps

| Equations | Outcome | Predictors | B | SE | β | t | *p* |
|---|---|---|---|---|---|---|---|
| End of the intervention | | | | | | | |
| 1 | SR | Intervention | -3.62 | 1.30 | -.18 | -2.78 | .006 |
| 2 | Steps | Intervention | -3923.99 | 396.08 | -.56 | -9.91 | .000 |
| 3 | Steps | Intervention | -3750.99 | 398.93 | -.53 | -9.40 | .000 |
| | | SR | 47.82 | 20.39 | .13 | 2.35 | .020 |
| 3-months follow-up | | | | | | | |
| 1 | SR | Intervention | -4.49 | 1.22 | -.24 | -3.67 | .000 |
| 2 | Steps | Intervention | -3245.50 | 301.75 | -.59 | -10.75 | .000 |
| 3 | Steps | Intervention | -3370.99 | 309.67 | -.61 | -10.89 | .000 |
| | | SR | -27.95 | 16.66 | -.09 | -1.68 | .095 |

Note. SR = Self-regulation

Table 3-9 Regression analyses demonstrating mediation effects of self-efficacy on LTAS

| Equations | Outcome | Predictors | B | SE | β | t | p |
|---|---|---|---|---|---|---|---|
| End of the intervention | | | | | | | |
| 1 | Self-efficacy | Intervention | -10.03 | 1.86 | -.34 | -5.38 | .000 |
| 2 | LTAS | Intervention | -15.28 | 2.74 | -.35 | -5.58 | .000 |
| 3 | LTAS | Intervention | -11.20 | 2.80 | -.26 | -3.99 | .000 |
| | | Self-efficacy | .41 | .10 | .28 | 4.25 | .000 |
| 3-months follow-up | | | | | | | |
| 1 | Self-efficacy | Intervention | -5.26 | 1.07 | -.31 | -4.91 | .000 |
| 2 | LTAS | Intervention | -18.37 | 1.91 | -.55 | -9.61 | .000 |
| 3 | LTAS | Intervention | -18.28 | 2.02 | -.54 | -9.05 | .000 |
| | | Self-efficacy | .02 | .12 | .01 | .15 | .882 |

Note. LTAS = Leisure-time activity score

Table 3-10 Regression analyses demonstrating mediation effects of outcome expectations on LTAS

| Equations | Outcome | Predictors | B | SE | β | t | *p* |
|---|---|---|---|---|---|---|---|
| End of the intervention | | | | | | | |
| 1 | OE | Intervention | -3.44 | 1.30 | -.18 | -2.64 | .009 |
| 2 | LTAS | Intervention | -15.28 | 2.74 | -.36 | -5.58 | .000 |
| 3 | LTAS | Intervention | -14.37 | 2.76 | -.33 | -5.20 | .000 |
| | | OE | .26 | .14 | .12 | 1.87 | .064 |
| 3-months follow-up | | | | | | | |
| 1 | OE | Intervention | -5.01 | 1.27 | -.26 | -3.95 | .000 |
| 2 | LTAS | Intervention | -18.38 | 1.91 | -.55 | -9.61 | .000 |
| 3 | LTAS | Intervention | -17.73 | 1.98 | -.53 | -8.97 | .000 |
| | | OE | .13 | .10 | .07 | 1.26 | .209 |

Note. OE = Outcome expectations; and LTAS = leisure-time activity score

Table 3-11 Regression analyses demonstrating mediation effects of self-regulation on LTAS

| Equations | Outcome | Predictors | B | SE | β | t | *p* |
|---|---|---|---|---|---|---|---|
| End of the intervention | | | | | | | |
| 1 | SR | Intervention | -3.62 | 1.30 | -.18 | -2.78 | .006 |
| 2 | LTAS | Intervention | -15.28 | 2.74 | -.35 | -5.58 | .000 |
| 3 | LTAS | Intervention | -13.37 | 2.70 | -.31 | -4.95 | .000 |
| | | SR | .53 | .14 | .24 | 3.83 | .000 |
| 3-months follow-up | | | | | | | |
| 1 | SR | Intervention | -4.49 | 1.22 | -.24 | -3.67 | .000 |
| 2 | LTAS | Intervention | -18.37 | 1.91 | -.55 | -9.61 | .000 |
| 3 | LTAS | Intervention | -17.77 | 1.97 | -.53 | -9.03 | .000 |
| | | SR | .14 | .11 | .07 | 1.28 | .201 |

Note. SR = Self-regulation; and LTAS = Leisure-time activity score

Table 3-12 Regression analyses demonstrating mediation effects of SE, OE, and SR on RHR

| Equations | Outcome | Predictors | B | SE | β | t | *p* |
|---|---|---|---|---|---|---|---|
| Self-efficacy | | | | | | | |
| 1 | SE | Intervention | -10.03 | 1.86 | -.34 | -5.38 | .000 |
| 2 | RHR | Intervention | 2.55 | 1.06 | .16 | 2.41 | .017 |
| 3 | RHR | Intervention | 2.87 | 1.13 | .18 | 2.54 | .012 |
| | | SE | .03 | .04 | .06 | .81 | .417 |
| Outcome expectations | | | | | | | |
| 1 | OE | Intervention | -3.44 | 1.30 | -.18 | -2.64 | .009 |
| 2 | RHR | Intervention | 2.55 | 1.06 | .16 | 2.41 | .017 |
| 3 | RHR | Intervention | 2.53 | 1.08 | .16 | 2.35 | .020 |
| | | OE | -.01 | .05 | -.01 | -.12 | .907 |
| Self-regulation | | | | | | | |
| 1 | SR | Intervention | -3.62 | 1.30 | -.18 | -2.78 | .006 |
| 2 | RHR | Intervention | 2.55 | 1.06 | .16 | 2.41 | .017 |
| 3 | RHR | Intervention | 2.61 | 1.08 | .16 | 2.41 | .017 |
| | | SR | .01 | .05 | .02 | .27 | .789 |

Note. SE = Self-efficacy; OE = Outcome expectations; SR = Self-regulation; and RHR = Resting heart rate

Figures

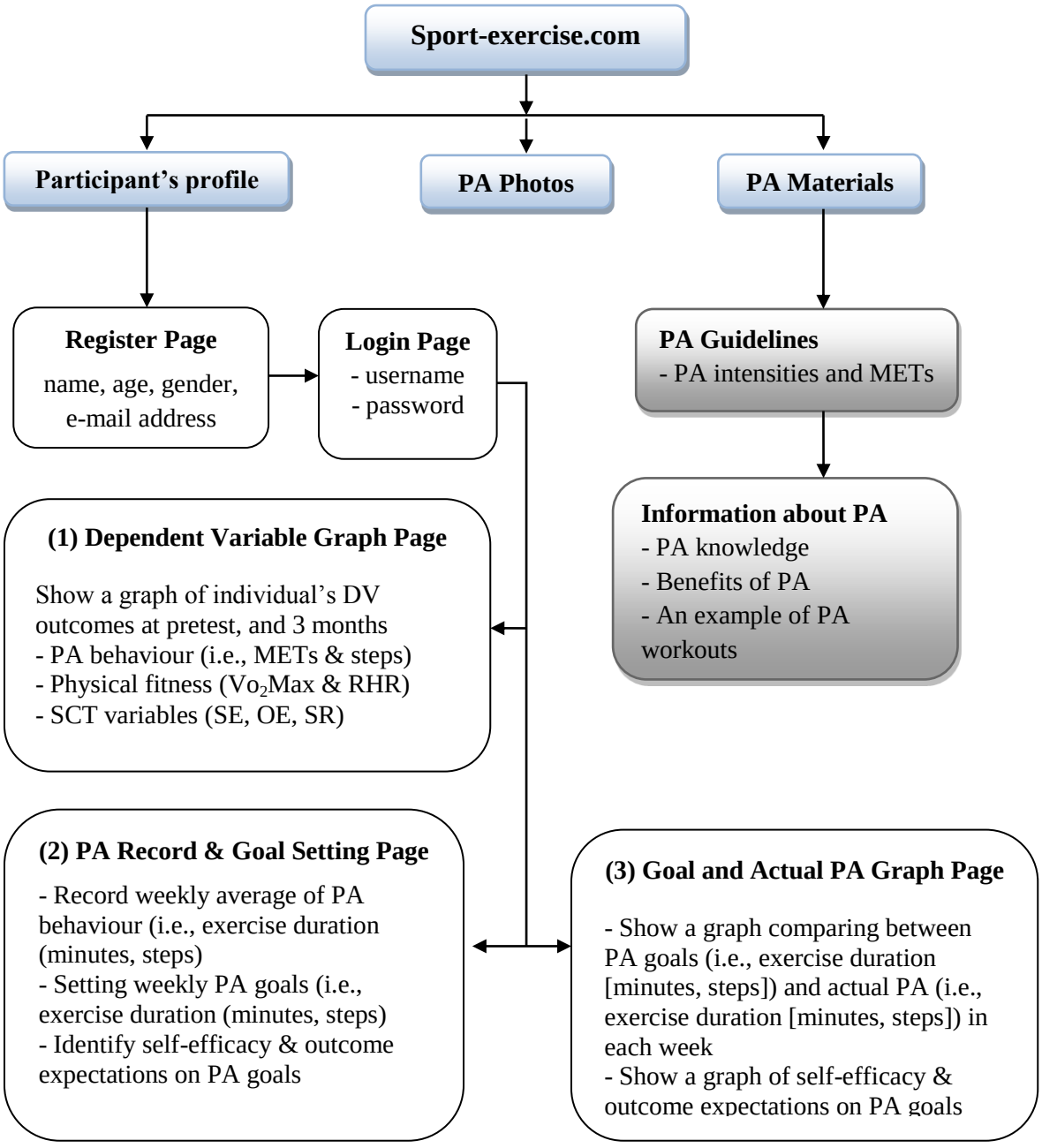


Figure 3-1 A website flowchart

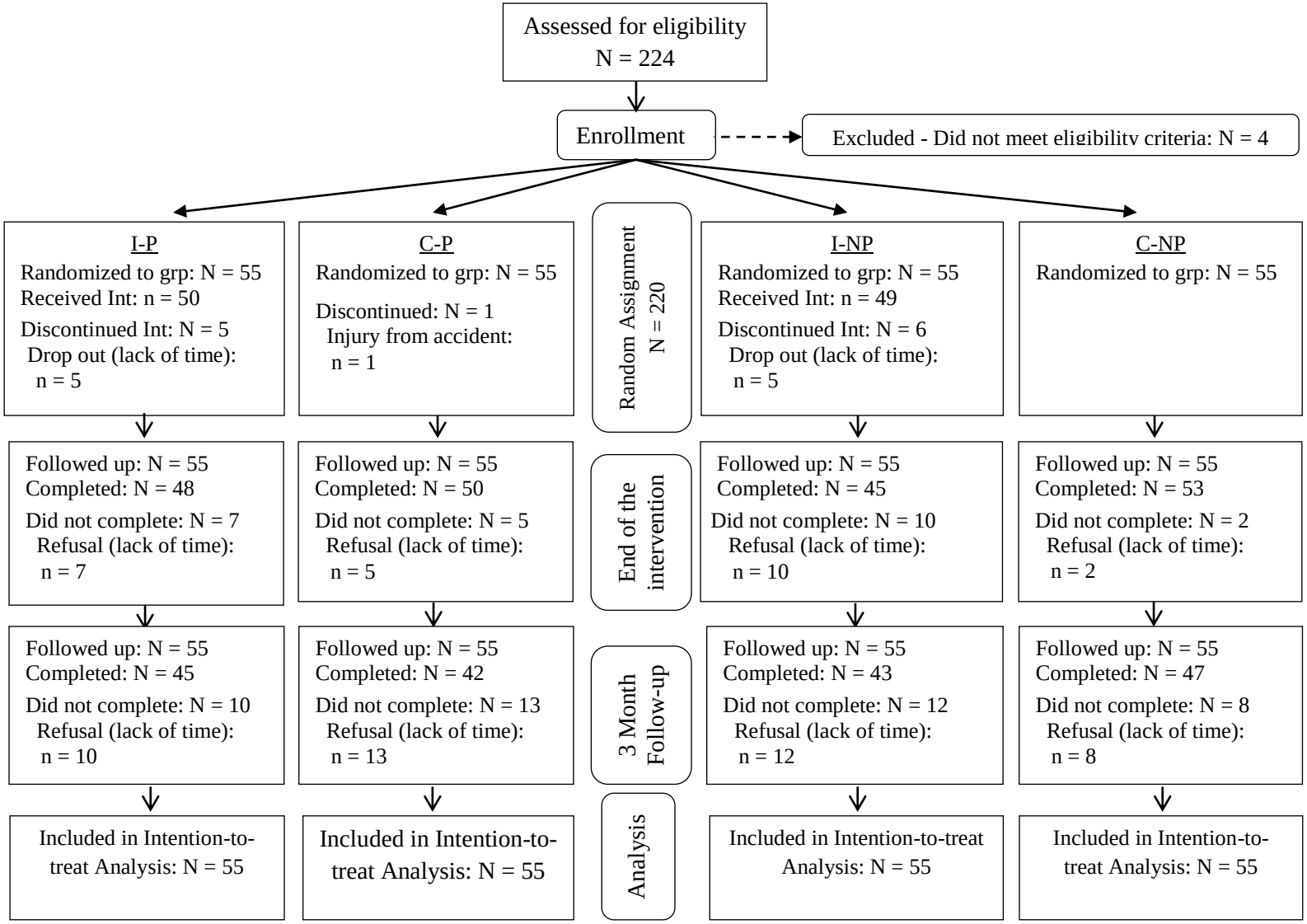


Figure 3-2 Participants flow chart

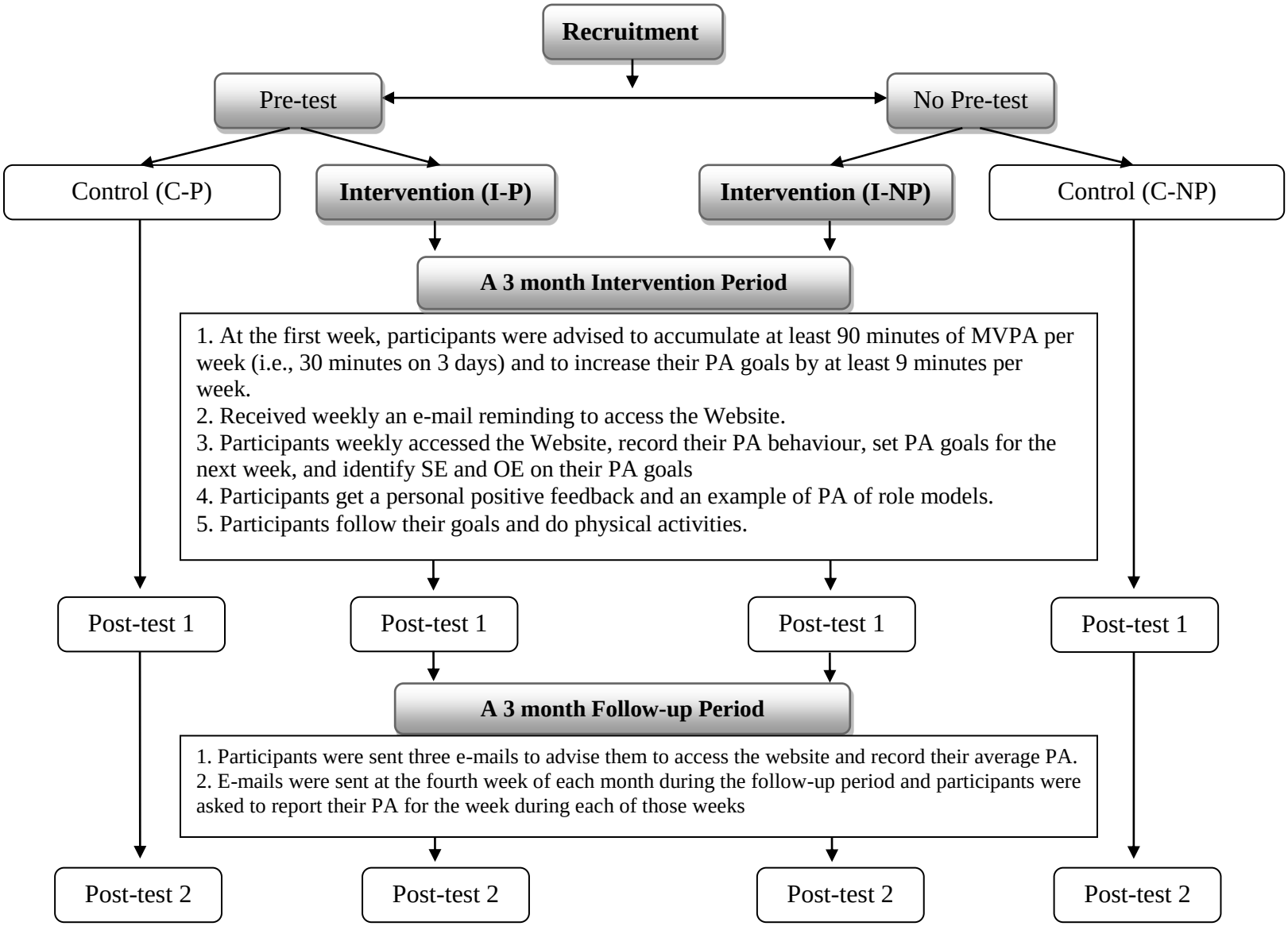


Figure 3-3 A study process flowchart.

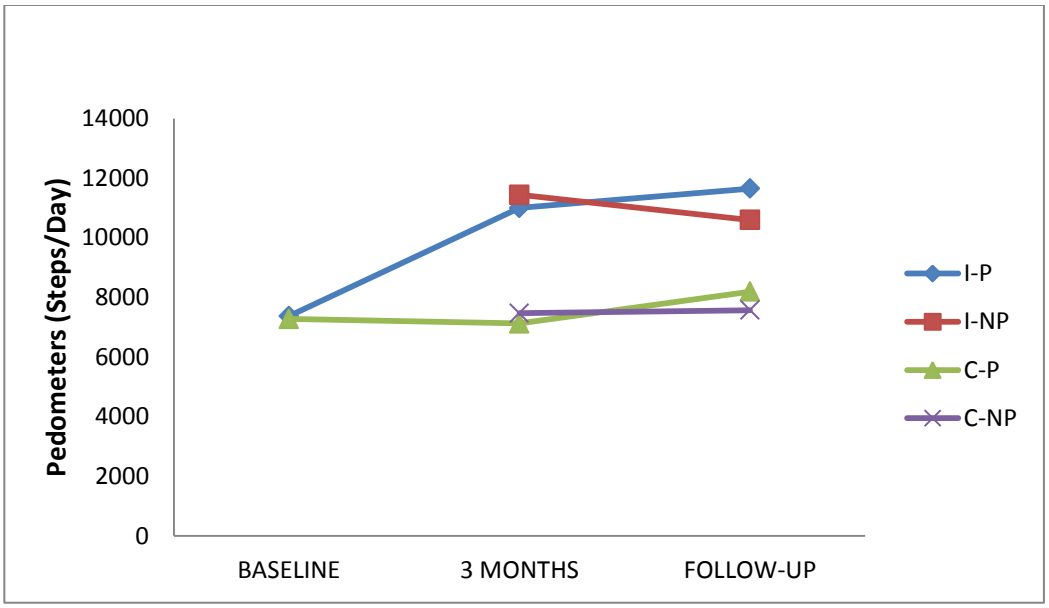


Figure 3-4 Means of steps/day at pretest, end of the intervention, and the 3-month follow-up

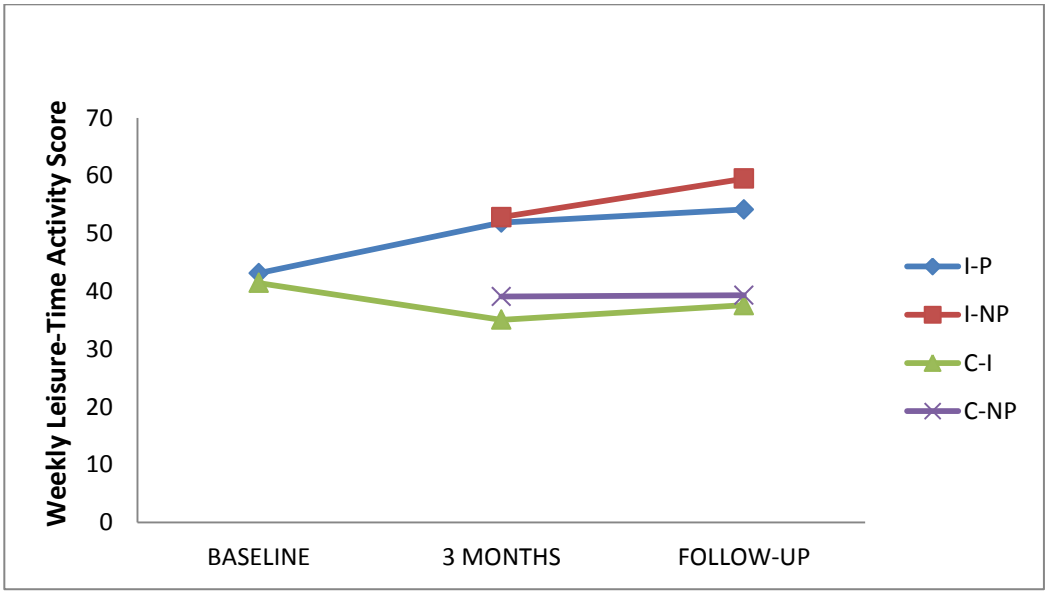


Figure 3-5 Means of total weekly LTAS at pretest, the end of the intervention, and the 3-month follow-up

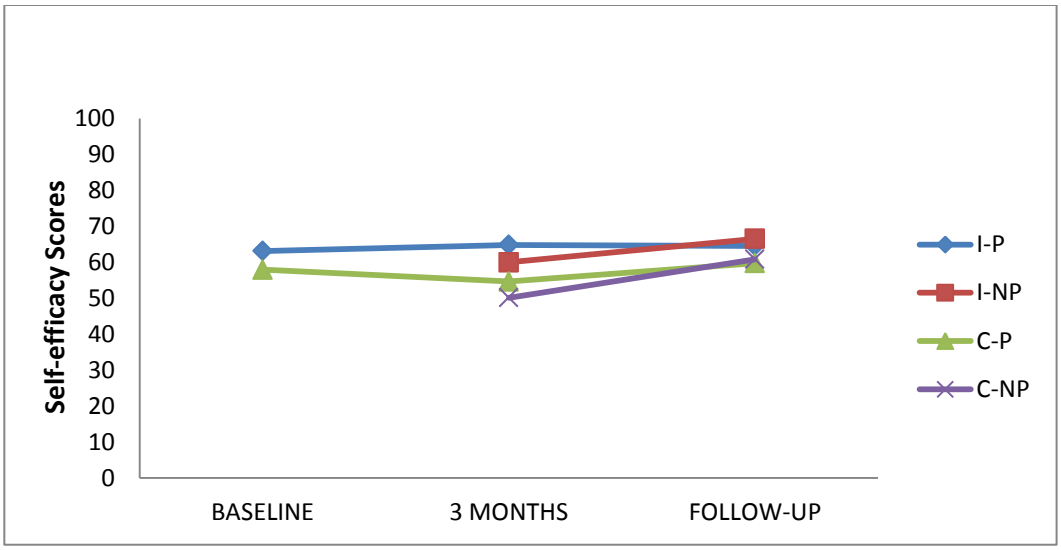


Figure 3-6 Means of self-efficacy scores at pretest, end of the intervention, and the 3-month follow-up

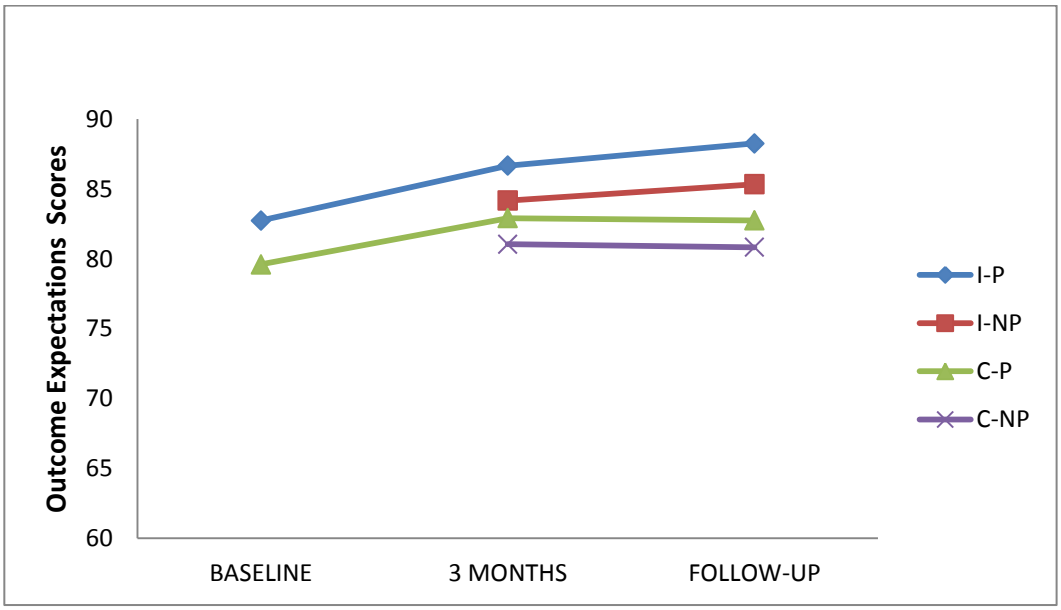


Figure 3-7 Means of outcome expectations scores at pretest, the end of the intervention, and the 3-month follow-up

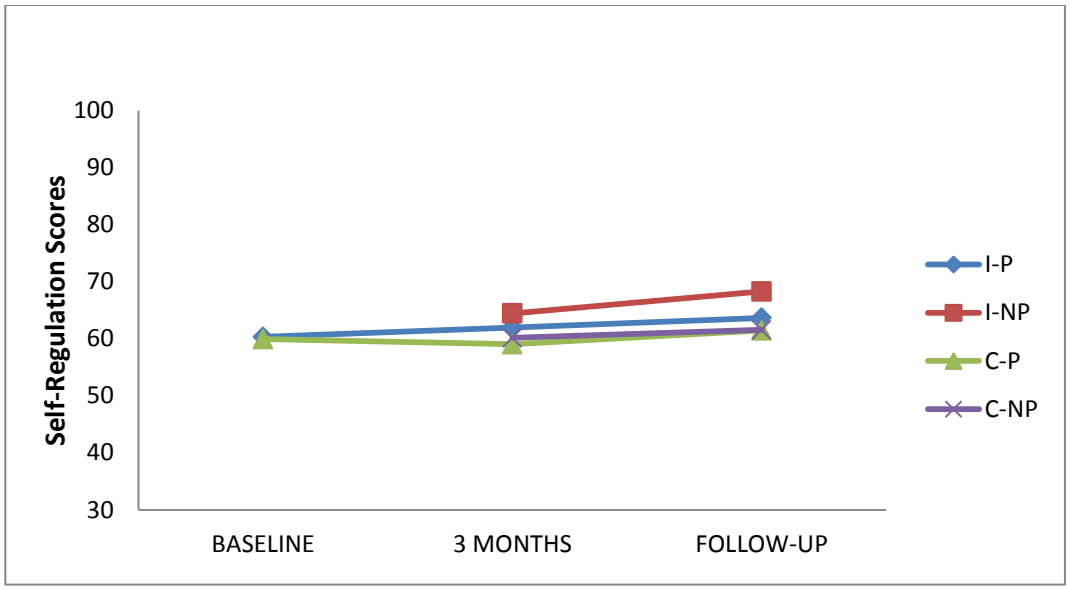


Figure 3-8 Means of self-regulation scores at pretest, end of the intervention, and the 3-month follow-up

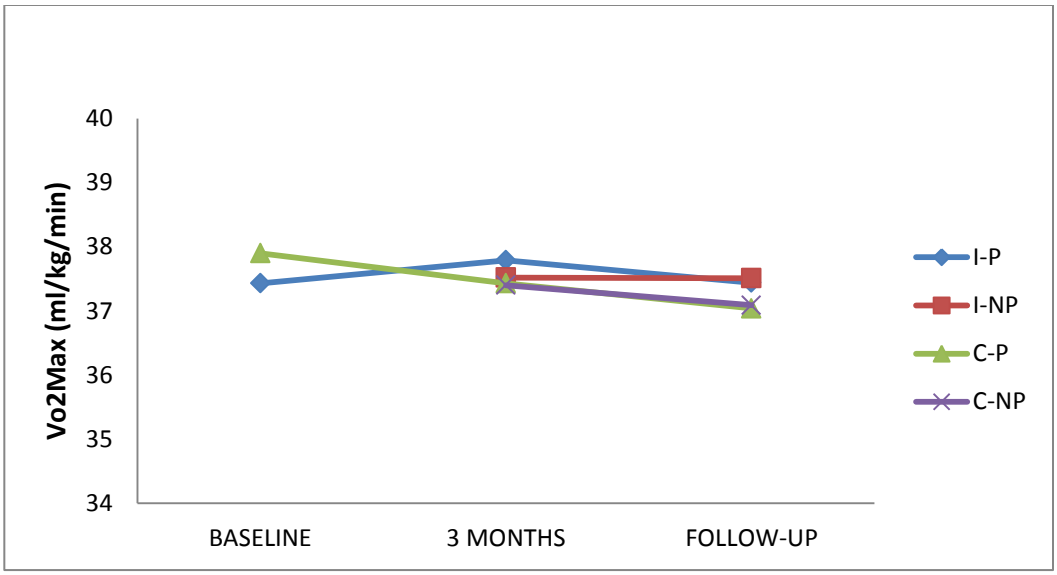


Figure 3-9 Means of Predicted Vo2Max at pretest, the end of the intervention, and the 3-month follow-up

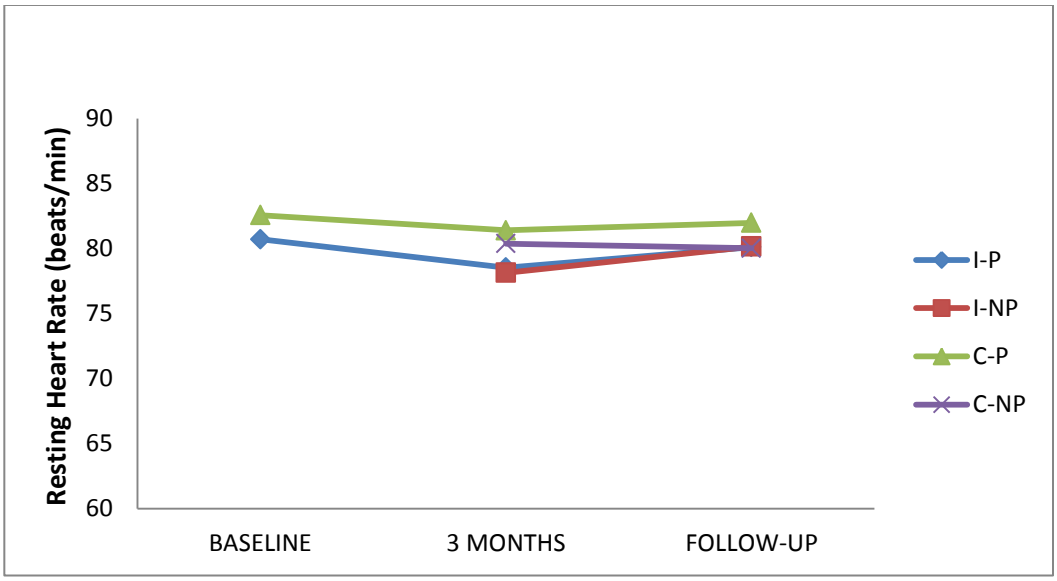


Figure 3-10 Means of RHR at pretest, end of the intervention, and the 3-month follow-up

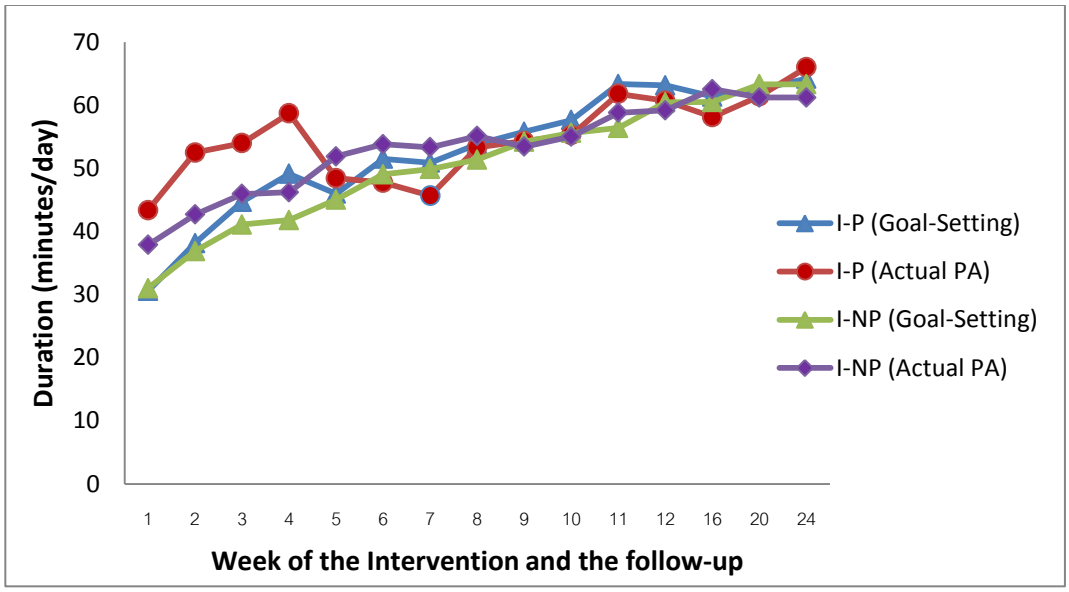


Figure 3.11 Daily physical activity goal setting (minutes/day) and actual PA

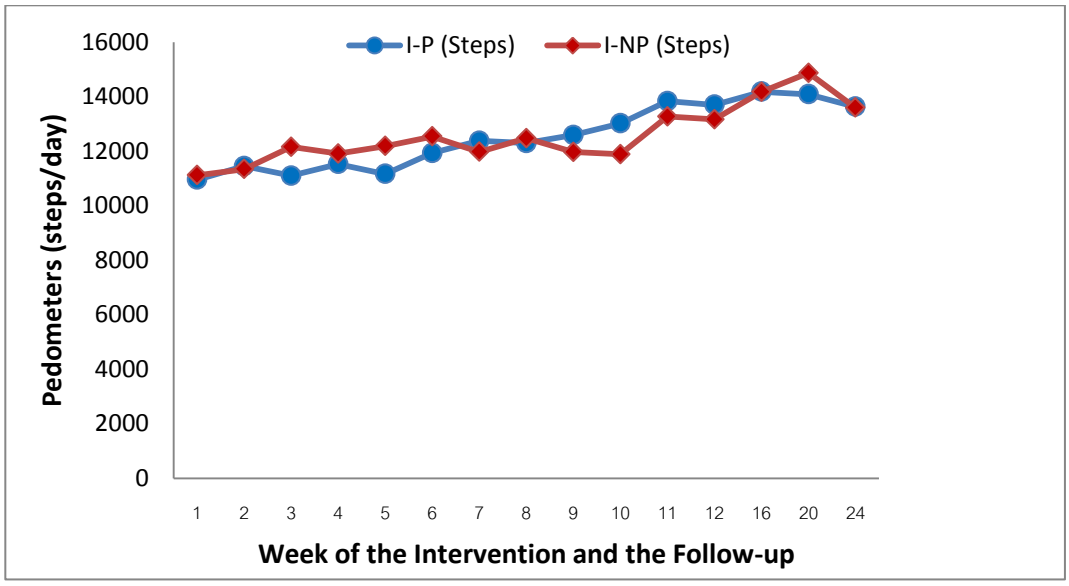


Figure 3-12 Daily pedometer step count averages for the intervention groups

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# CHAPTER 4: CONCLUSION AND IMPLICATIONS FOR FUTURE WORK

## Conclusions

This dissertation comprises two studies that seek to answer the following main research question: *Is a SCT-based internet intervention PA program effective in increasing and maintaining PA in university-aged females in Thailand?* This dissertation examined three specific research goals, as follows. *Goal 1* was to exam validity and reliability of Thai versions of questionnaires measuring leisure-time PA, and exercise-related SE, OE and SR. *Goal 2* was to evaluate the efficacy of the SCT-based internet intervention PA program to promote and maintain PA in university-aged female students in Thailand. *Goal 3* was to examine whether SCT variables mediated changes in PA and physical fitness.

Study # 1

In chapter 2 (study 1), we examined the validity and reliability of the Thai version of questionnaires measuring leisure-time PA, and exercise-related SE, OE and SR, answering *Research Goal 1* of this dissertation. Three steps were used to develop the Thai version of questionnaires from English versions. The first step, the back translation method and the committee approach were used to translate the English version into Thai language. The second step, the test-retest procedure was used to assess concurrent validity and reliability between the Thai and the English versions. The third step consisted of an exploratory factor analysis to assess the construct validity of the Thai version of questionnaires.

This study found that the Thai version of questionnaires has suitable psychometric properties for use with Thai female undergraduate students. The

findings are consistent with previous psychometric work on the English versions. The Thai versions of the questionnaires had satisfactory factor structure, test-retest stability, and internal consistency reliability. Thus, they would be valuable tools for assessing leisure-time PA, and exercise-related SE, OE and SR in female university students in Thailand. Further, since this study provides the validity and reliability of Thai versions of the GSLTPAQ, MSES, OEQ, and SRQ in Thailand, it will be valuable for future studies that target PA changes in Thai population. As previous studies suggested that although self-report questionnaires do not provide accurate estimates of the absolute amount of PA, they can be used to monitor PA changes and collect data from a large number of people at low cost (Shephard, 2003). Thus, availability of these questionnaires in Thai language may motivate Thai people to measure their PA levels regularly, which in turn, may motivate them to participate in PA. Also, the Thai version of questionnaires can be used by health promotion agencies and other researchers. Since weekly LTAS scores obtained from GSLTPAQ are related to health benefits (Godin, 2011), the results obtained from the testing will classify people if they are active (i.e., substantial health benefits) or moderate active (i.e., some health benefits) or insufficiently active (i.e., less substantial or low benefits). Providing PA levels and health benefits to people may motivate them to participate more in PA.

Study # 2

In chapter 3 (study 2), we evaluated the efficacy of the SCT-based internet intervention PA program to promote and maintain PA in university-aged female students in Thailand, answering *Research Goal 2 and 3* of this

dissertation. It found that pretest sensitization effects were not existed in this study. This finding supports the suggestion that the pretest sensitization effect was less relevant for experimental designs (Spence et al., 2009). In support of our hypotheses, we reported female students who received the intervention program had significantly higher mean scores on steps, LTAS, SCT variables compared to female students who did not receive the intervention program. These results were also maintained at the follow-up. This suggests that the SCT-based internet intervention PA program had effective in promote and maintain PA in Thai university-aged female students. However, increases of these variables had no effects on cardiovascular fitness. We suggest that the intensity of the intervention program may be not high enough to affect changes on cardiovascular system. Nonetheless, the intervention program may have positive effects on other health outcomes such as metabolic fitness. Further, we reported mediation effects of SCT variables on PA in Thai university-aged female students. Mediation analyses reported that the intervention effects on weekly LTAS were partially mediated by self-efficacy and self-regulation. The intervention effects on steps were partially mediated by self-regulation. Our data suggest that SCT variables are important determinants of PA in this sample of female students and SCT-based internet intervention to facilitate PA should focus on building self-efficacy, outcome expectations, and self-regulation. Intervention research in other populations suggests a critical role for SCT in the PA domain (Anderson et al., 2006, 2010; Hallam & Petosa, 2004). Indeed, Bandura (1997) and Winett and colleagues

(2007) have posited that interventions for PA changes should focus on increasing self-efficacy, outcome expectations, and self-regulation.

The findings from this study have implications for health practitioners or program planners to develop intervention programs for promote PA. The efficacy of the intervention program to increase and maintain PA and SCT variables in this study may add to the PA knowledge base as well as internet PA interventions designed for other populations. Through the application of SCT and analyses of the potential moderators and mediators of PA changes, researchers and practitioners can understand how to develop and implement theoretically based interventions that maximize opportunities for PA change (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003).

In conclusion, the findings from these studies could be used to guide future research projects that test the efficacy and cost-effectiveness of the internet-based intervention PA program in promoting and maintaining PA.

## Implications for Future Work

This dissertation has theoretical, methodological, and practical implications for future research.

Some theoretical implications should be mentioned. It is posited that PA can be promoted through theoretically based interventions (Turner-McGrievy et al., 2009; Winett et al., 2009). The SCT is valuable theoretical framework for developing theoretically based PA interventions (Wojcicki et al., 2009). IM is a useful framework for developing an effective intervention program (Bartholomew et al., 2011). Also, the internet is an effective tool for delivering PA interventions

(Davies et al., 2012; Tate et al., 2009). This dissertation supports these suggestions and suggests that SCT and IM framework should be used as a framework for developing PA interventions.

Given that this is the first study to evaluate the efficacy of the SCT-based internet intervention PA program in Thai population, further theoretical study is necessary to investigate the efficacy of this intervention in other Thai populations. Researchers should further explore the efficacy of the SCT-based internet interventions in other Thai populations, particularly people not studying in universities. SCT are built on the principle of triadic reciprocal causation, in which personal (e.g., cognitive and demographic), environmental (e.g., social environments), and behavioural (e.g., characteristics of PA, such as intensity) factors are thought to be reciprocally influential (Bandura, 1986). However, this dissertation focused on personal and behavioural factors since environmental factor (e.g., sport facilities) in the university is already supported. Thus, the efficacy of the SCT-based internet intervention PA program in other populations that environmental factors are not supported needs to be investigated.

Also, methodological implications should be mentioned. The internet is very useful for developing the SCT-based intervention PA program. It provides many advantages for program delivery because it offers a variety of multimedia interactivity and connectivity formats (Proudfoot et al., 2011). For example, it can provide written or photographic materials and direct contact and social support via e-mail or chat rooms. In this dissertation, the SCT-based internet intervention PA program contained interactive and immediate features (i.e., written and

photographic materials, PA and goal setting logs) and direct contact and social support (i.e., e-mails). Also, after initial costs to develop programs especially when delivered over the internet, gain little incremental cost with the addition of each new user and thus have the potential to reach large numbers of individuals with personalized interactive materials (Marcus et al., 2006). However, internet interventions are not suitable for those who may not have internet access or those who prefer face-to-face contact. Thus, further research is necessary to test their efficacy, cost-effectiveness, and reach, especially to underserved populations. Also, intervention characteristics that need additional study should include a comparison between moderate-intensity and higher-intensity intervention programs since the intervention in this dissertation had no effects on cardiovascular fitness.

Moreover, effective testing of theoretical models within an intervention study requires assessment of theoretical constructs at regular intervals throughout the intervention trial, followed by a mediator analysis to test whether or not increases in PA are actually due to change in the theoretical constructs (Baranowski, Anderson, & Carmack, 1998). Research on theoretical mediators of PA change is crucial to moving the field forward (Lewis, Marcus, Pate, & Dunn, 2002). Thus, it is crucial that more intervention researchers construct and adequately test specific hypotheses about what theoretical factors will be changed and at what times during the course of the intervention (Marcus et al., 2006).

Some practical implications need to be mentioned. The SCT-based internet intervention could potentially be used as modality as this dissertation

demonstrates positive effects of this intervention with university-aged female students. The internet intervention will become increasingly important as the proportion of the population that engages in unhealthy lifestyles continues to increase. The current intervention should be tested in a variety of population over a longer period before wide scale implementation (Bickmore, Gruber, & Picard, 2005). Moreover, after Website is designed, there is a little need to make further adaptations to the layout and program of the intervention for use with a target population. However, although the intervention program is ready to use and the results effective, adaptations that might increase its effectiveness should be investigated in the future. Also, the long-term impact of the intervention should be investigated (Haerens, Deforche, Vandelanotte, Maes, & Bourdeaudhuij, 2007).

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# APPENDIX A: LITERATURE REVIEWS

## Thai Culture

Thailand is a Buddhist society. It has a distinctive Buddhist culture and Buddhism practices almost all aspects of everyday cultural activities. Almost 96% of the population is Buddhist (National Statistical Office, 2008). The majority of Thai Buddhists belong to Theravada Buddhism. The teaching of Theravada Buddhism is on the concept of reincarnation and emphasizes the Law of Karma (the cumulative impact of past deeds), which teaches that individuals will experience the consequences of their behaviours either in this or future lives (Chamratrithirong et al., 2010). If doing well, a person will receive well. If doing bad things, a person will receive bad things. Then, Karma is linked to unpleasant, disturbing or dangerous events in a person's life. Thus, practice good Karma and avoidance of bad Karma is an essential part of Buddhist life. The main principles of the Buddha's teachings are the Four Noble Truths (mainly on the nature and cessation of suffering) including the Eight-Fold Path of Enlightenment, which leads individuals toward the end of suffering. However, the Five Precepts are common practice for a layperson, which include nonparticipation from killing, stealing, sexual misconduct, lying, and the consumption of alcohol and other intoxicants (Chamratrithirong et al., 2010).

Merit making is also common practice for Buddhist. Merit making consists largely of doing good and is often expressed by a person visiting temples, offering alms to monks or offer food to the monks who come to their homes or their neighborhoods in the morning. Merit making has at least two functions. First, it is a demonstration of a person's commitment to the Buddhist principles of

living a ‘good’ life: it is a good thing to ‘do well’ for its own sake. Second, it is sometimes felt to be a method of run off the effects of bad Karma (accrued from this or a previous life: Chamratrithirong et al., 2010).

By the influence of the Buddhist, Thais are taught not to face others openly, but rather to conceal anger, doubt, anxiety, or grief (Kulick & Wilson, 1992). To be openly angry with someone might attract the anger of the spirits, which in turn, could cause violence and tragedy. Moreover, Thais are taught to be Krengjai. Krengjai is observed in one's reticence to seek help or ask for something desired from a superior except it is absolutely necessary (Klausner, 1993). That is, extremely reluctant to impose on others or disturb their personal equilibrium by expressing one's own feelings or wishes openly, particularly in relation to elders and respected authority figures (Limanonda, 1995).

Studies have found that Buddhist beliefs have a strong influence on Thai health beliefs and practices (Burnard & Naiyapatana, 2004; Lundberg & Trichorb, 2001). However, past investigations of the relationship between Buddhism and health behaviour in Thailand are limited. One study found that both Buddhist practices and beliefs were negatively related to alcohol use among Thai adolescents (Newman, Shell, Li, & Innadda, 2006). Buddhism influences Thais’ perceptions and management of diabetes (Sowattanangoon, Kotchabhakdi, & Petrie, 2006). A recent study also found that both parent and youth spirituality is important in decreasing risky behaviours for youth in Thailand (Chamratrithirong et al., 2010).

## Thai Lifestyles

The lifestyles of populations within the Asia and Pacific region have changed over the past two decades because of rapid socio-economic development accompanied by increased urbanization and Westernization (Vorster, 1999). Modernization and open trade markets have resulted in changes to the levels of physical activity (PA) throughout Asia (Gill, 2006). For example, improved transport systems and the use of vehicles have replaced walking or bicycling and reduced people's PA (Bell, Ge, & Popkin, 2002). This decrease in PA likely relates to why China, Japan and Korea showed higher trends in the incidence of chronic diseases such as obesity, hypertension, diabetes mellitus, heart diseases, stroke, certain cancers, and osteoporosis (Kim, Moon, & Popkin, 2000). Similarly, because of the push for socio-economic development, Thailand has moved from a subsistence agrarian society into an industrial society. Social structure and lifestyle have changed from a rural orientation to an urbanized society. A shift in economic structure has not only led to Thailand's societal changes, it has also led to a change from high to low energy expenditure activities (Kosulwat, 2002), resulting in less PA (James, Leach, Kalamara, & Shayeghi, 2001). In addition, the increase in urbanization has led to a change in people's living and working conditions (Wang & Lobstein, 2006). One major change is related to the modes of transportation and activity patterns during leisure times (Popkin & Gordon, 2004). For example, instead of performance PA during leisure time, Thai people nowadays spend their time in the front of television, computers, or video games (Aekplakorn et al., 2007).

## Health Problems in Thailand

The rapid changes in lifestyle patterns in Thailand have had a negative influence on Thai people's health status, and the increase in a sedentary lifestyle has significantly increased the health problems of the Thai population. One common health problem related to a sedentary lifestyle is overweight and obesity and other risk factors for cardiovascular disease (Aekplakorn & Mo-Suwan, 2009).

A study showed that the age-adjusted mean Body Mass Index (BMI) in Thai adults aged ≤ 18 years had increased dramatically from 22.0 $kg/m^2$ in 1991 to 22.7 $kg/m^2$ in 1997 to 23.2 $kg/m^2$ in 2004. The prevalence of obesity with BMI ≥ 25 $kg/m^2$ in adults increased from 18.2% in 1991 to 24.1% in 1997 to 28.1% in 2004. These increases were found in both sexes, from 13.0% and 23.2% in 1991 to 18.6% and 29.5% in 1997, to 22.4% and 34.3% in 2004, in men and women respectively (Aekplakorn & Mo-Suwan, 2009; Aekplakorn et al., 2007). The increase in mean BMI in the Thai population is of concern because the BMI cut-off points for overweight and obesity are lower in Asian populations.

According to the World Health Organization (WHO), the BMI cut-off points in European populations are underweight (≤18.5 $kg/m^2$), normal weight (18.5–24.9 $kg/m^2$), overweight (25.0–29.9 $kg/m^2$), and obese (≥30.0 $kg/m^2$) (WHO, 2000a). However, these BMI cut-off points, which were developed from studies in Caucasian populations, underestimate the risk in Asian populations (Pan et al., 2004). Therefore, in the Asia-Pacific region, according to the International

Obesity Task Force, the BMI cut-off points are normal and underweight (≤23 kg/m$^2$), overweight (≥23 and ≤25 kg/m$^2$), and obese (≥25 kg/m$^2$) (WHO, 2000b).

The scientific evidence shows that Asian populations have different associations between BMI, percentage of body fat, and health risks than European populations. At a similar BMI level, percentages of body fat accumulation in Asians are likely higher than in Caucasians (WHO Expert Consultation, 2004). For example, body fat composition at BMI 30 for Caucasians was equivalent to that at BMI 27.2 for Chinese in Singapore (Deurenberg, Deurenberg-Yap, & Guricci, 2002). In Thailand, a study suggested that the BMI cut-off points for diagnosing obesity should be lowered to 27 kg/m$^2$ in men and 25 kg/m$^2$ in women (Pongchiyakul et al., 2006). Moreover, the proportion of Asian people with a high risk of diabetes and cardiovascular disease is considerable at BMI lower than the WHO cut-off point for overweight (Park, Lee, Kim, Choe, & Jee, 2008; WHO Expert Consultation, 2004). In Asian populations, weight-related disease occurs least when BMI is about 22 or less (Kanazawa, Yoshiike, Osaka, Numba, Zimmet, & Inoue, 2005), but significantly increases when BMI is more than 23 (WHO, 2000a). Therefore, the increase of mean BMI in the Thai population to more than 23 kg/m$^2$ is concerning because it is related to an increase in health risk factors for other diseases.

A study confirmed that the prevalence of all major risk factors for cardiovascular disease among adult Thais has significantly increased (Chuprapawan, 1991, 2000; Kosulwat, 2002). For example, a survey conducted in 1991 indicated that 2.2 million adult Thais suffered from hypertension

(Chuprapawan, 1991). Diseases of the cardiovascular system have become the number one cause of death in Thailand since 1989 and ischemic heart disease mortality has been increasing progressively each year (Tatsanavivat et al., 1998).

## Physical Activity

### *Physical Activity and Physical Fitness*

PA is defined as any bodily movement produced by skeletal muscle that requires energy expenditure (ACSM, 2010), whereas exercise is defined as the systematic PA for a specific purpose (Bouhard & Shephard, 1994). Both PA and exercise terms refer to large-muscle activities that may be aerobic (e.g., walking or running) or anaerobic (e.g., weight lifting). Physical fitness refers to a physiological state of well-being that allows individuals to have a capacity to live or work in daily living or that provides the basis for sport performance (Warburton, Nicol, & Bredin, 2006). Physical fitness includes cardiovascular fitness, muscular strength, muscular endurance, flexibility, and body composition (U.S. Department of Health and Human Services [USDHHS], 2000). PA and physical fitness are strongly related. In general, physical fitness is mainly determined by PA. That is, increases in PA would result in increases of physical fitness (Blair, Cheng, & Holder, 2001). PA levels also matched very well with physical fitness (Stofan, DiPietro, Davis, Kohl, & Blair, 1998). Nonetheless, physical fitness is commonly used as a more accurate measure of PA than self-report (Williams, 2001) and is more strongly predictive of health outcomes than PA (Blair et al., 2001; Williams, 2001).

However, the assessment of physical fitness is not feasible or practical in large population-based investigations (Warburton et al., 2006). Blair and colleagues (2001) suggested that it is better to encourage individuals to become more physically active rather than to become physically fit, because individuals will likely achieve physical fitness if they do PA. Thus, many studies have measured PA levels instead of physical fitness. To obtain accurate estimates of PA, researchers normally use motion sensors such as pedometers (Warburton et al., 2006).

### *The Health Benefits of Physical Activity and Physical Fitness*

The health benefits of PA and physical fitness are well known. Regular PA is truly important for the health and wellbeing of people of all ages. PA results in increased exercise capacity and physical fitness such as cardio-respiratory fitness, musculoskeletal fitness, flexibility, and body composition, which lead to many health benefits (Prasad & Das, 2009). Also, regular PA offers primary and secondary prevention of several chronic diseases such as coronary heart disease, hypertension (Buchner, 2009), type 2 diabetes (Qin, Knol, Corpeleijn, & Stolk, 2010), colon cancer (Wolin, Yan, Colditz, & Lee, 2009), depression and anxiety (Wifli, Rethorst, & Landers, 2008), bone and joint diseases (osteoporosis and osteoarthritis), and depression (Blair et al., 2001; Taylor et al., 2004; Warburton et al., 2006). In addition, increased levels of PA and physical fitness have been found to reduce the risk of premature death (Erikssen, 2001; Macera, Hootman, & Sniezek, 2003; Macera & Powell, 2001) and decreased physical fitness has been found to increase the risk of premature death (Erikssen, 2001). For example, an

increase in energy expenditure from PA of 1000 kcal per week or increase in physical fitness of 1 MET (metabolic equivalent) increased mortality benefit by approximately 20% (Myers et al., 2004).

Although regular PA can reduce the risk of both chronic diseases and premature mortality, the majority of the population maintains a sedentary lifestyle. It has been estimated that at least 60% of the world's population do not have sufficient PA to maintain health benefits (WHO, 2010). For example, in the United States, only a half of the population undertakes sufficient PA to get health benefits (Carlson, Densmore, Fulton, Yore, & Kohl, 2009). In fact, studies have found that PA levels measured with accelerometers are substantially lower than those measured using self-report (Troiano, Berrigan, Dodd, Mâsse, Tilert, & McDowell, 2008). Thus, the actual number of the world's population who are undertaking PA may be much lower. This can be confirmed by a study using accelerometers to measure PA in Canada, which showed that only about 15% of Canadians met the minimum PA recommendations (i.e., accumulated 150 minutes of moderate-to-vigorous PA (MVPA) per week). Surprisingly, of those, only 5% of the population performed 30 minutes of activities on 5 or more days per week. Also, only 35% of Canadian adults achieved the recommended 10,000 steps/day (Colley, Garriguet, Janssen, Craig, Clarke, & Tremblay, 2011).

### *Physical Activity Levels in Thais*

The report by the Asia Pacific Physical Activity Network (APPAN) showed that the trend in the Thai population participating in leisure time PA was quite low (Figure A-1). In 2006, for example, only 28.1% of Thai people

participated in leisure time PA (Abouzeid, Macniven, & Bauman, 2008). Moreover, based on data from the International Health and Behaviour Survey, a cross-sectional questionnaire study of health behaviours and attitudes in 19,298 university students aged 17-30 years from 23 countries carried out between 1999 and 2001 showed that the lowest prevalence of leisure-time PA at recommended levels was found in Thai university female students (Haase, Steptoe, Sallis, & Wardle, 2004). The study reported that the prevalence of inactivity in leisure time PA averaged 23% in North-Western Europe and the United States, 30% in Central and Eastern Europe, 39% in the Mediterranean region, 42% in Asia-Pacific, 44% in developing countries and 38% in Thailand, with more Thai women (42%) than Thai men (34%) reporting no leisure-time PA (Haase et al., 2004). In addition, leisure-time PA at recommended levels (i.e., exercise 6 times in two weeks) was more common in Thai men (~23%) than Thai women (~2%; Sisson & Katzmarzyk, 2008).

*Physical Activity Recommendations*

For health benefits, the Canadian Society for Exercise Physiology (CSEP), suggested that [1] adults aged 18–64 years should accumulate at least 150 min of moderate- to vigorous-intensity aerobic PA per week and [2] participate in muscle- and bone-strengthening activities that use major muscle groups, at least 2 days per week (Tremblay et al., 2011). Similarly, the American College of Sports Medicine (ACSM) and American Heart Association (AHA) has suggested that adults 18-64 years need [1] moderate intensity aerobic PA for a minimum of 30 min on five days each week or [2] vigorous-intensity aerobic activity for a

minimum of 20 min on three days each week or [3] combinations of moderate- and vigorous-intensity activity and [4] should exercise to improve and maintain muscular strength on two or more days each week (Haskell et al., 2007). Moreover, moderate intensity aerobic PA can be accumulated toward the 30 minute minimum by performing in bouts of 10 min or more (Haskell et al., 2007; Tremblay et al., 2011). In Thailand, the Thai Health Promotion Foundation (ThaiHealth) also used these guidelines to promote PA in the country.

These recommendations are a minimum dose of PA for health benefits. In order to increase further health benefits and physical fitness individuals should perform PA above the minimum recommended amounts (Elizabeth et al., 2009; Haskell et al., 2007; Lee, 2007; Tremblay et al., 2011). In particular those who want to improve physical fitness or further reduce risk for premature chronic health conditions and mortality related to physical inactivity should do more (Kesaniemi, Danforth, Jensen, Kopelman, Lefebvre, & Reeder, 2001).

### *Physical Activity Dose*

Dose can be inferred as the total amount of PA (i.e., total energy expenditure). The total amount of PA is a result of its intensity, duration and frequency. In general, there is a dose-response relation between PA and health outcomes (Church, Earnest, Skinner, & Blair, 2007; Dalleck, Allen, Hanson, Borresen, Erickson, & De Lap, 2009; Kim, Shin, Nam, Choi, & Kim, 2008; Martin, Church, Thompson, Earnest, & Blair, 2009). For example, exercise intensity and aerobic fitness are correlated. That is, the higher exercise doses people performed, the greater aerobic fitness increased (Church et al., 2007).

Also, exercise duration and health outcomes are correlated. That is, the greater exercise duration, the greater health outcomes (Dalleck et al., 2009). Rhodes, Warburton, and Murray (2009) found that PA dose (i.e., frequency, intensity, duration, and mode of PA) had no relationship to PA adherence. That is, participating in a regular PA was not determined by PA dose. For example, when holding intensity of activity constant, a total volume of activity has no effect on PA adherence. Similarly, when holding volume of activity constant, a total intensity of activity has no effect on PA adherence. However, the study found that PA dose that had higher energy expenditure than 2000 kcal/week may lower PA adherence.

*Physical Activity Dose and Metabolic Equivalents (METs)*

To assess PA dose, we can estimate energy expenditure during PA by using METs. According to Ainsworth and colleagues (2000), MET is the ratio of the PA metabolic rate to the resting metabolic rate. One MET is defined as 1 kcal/kg/hour and is roughly equivalent to the energy cost of sitting quietly. MET is also defined as oxygen uptake in ml/kg/min with one MET equal to the oxygen cost of sitting quietly, equivalent to 3.5 ml/kg/min.

From the fact that the energy expenditure increases with more PA, and based on the MET definition, Ainsworth and colleagues (2000), found MET and PA equivalents. For example, walking at 4.0 mph on a flat level expends about 5.0 METs and running at 6 mph on the similar surface expends about 10.0 METs. Thus, if individuals walked at 4.0 mph (moderate intensity) for 30 min they would accumulate 150 MET minutes of activity (5.0 METs x 30 minutes = 150). If they

run at 6 mph (vigorous intensity) for 20 minutes they would accumulate 200 MET minutes (10 METs x 20 minutes = 200). Similarly, if individuals exercise by walking at 4 mph for 30 minutes/day on 5 days a week, they would accumulate about 750 MET-minutes / week, and exercise by running at 6 mph for 20 minutes on 3 days they would accumulate 600 MET minutes/week.

### *Physical Activity Dose Goals*

Based on the PA recommendations and MET values of PA, we can set PA dose goals. That is, individuals should set the minimum goal at 450 MET-minutes per week for moderate intensity and 360 MET-minutes / week for vigorous intensity. These values are based on the lower MET range of moderate intensity activity (3.0-6.0 METs) and 150 minutes/week (3 x 150 = 450), and the lower MET range of vigorous intensity (>6 METs) and 60 minutes/week (6 x 60 = 360). In addition, if individuals want to combine moderate and vigorous intensity activity to meet the recommendation, the minimum goal should be set in the range of 450 to 750 MET minutes per week. These values are based on the MET range of 3 to 6 for moderate-intensity activity and 150 minutes/week (3 x 150 = 450 and 5 x 150 = 750) (Haskell et al., 2007). Thus, based on the METs of PA, individuals could achieve a PA dose recommendation. The MET values provided in the compendium, which can be found in the following Web site: http://prevention.sph.sc.edu/tools/docs/documents_compendium.pdf, can be used as a guideline for achieving PA recommendations (Ainsworth et al., 2000).

*Physical Activity and Pedometers*

In addition to MET values of PA, the ability to track daily accumulated PA can be achieved by using a body-worn motion sensor technology (i.e., pedometers). Pedometers are simple and inexpensive body-worn motion sensors that are being used by researchers and practitioners to assess and motivate PA behaviours (Tudor-Locke, & Bassett, 2004). Although they are not designed to detect PA intensity, pedometers have acceptable accuracy and can be used to detect the volume of daily activity. A study has shown that most pedometers gave mean values that were within ± 1% of actual steps per day (Crouter, Schneider, Karabulut, & Bassett, 2003). They are reliable (Felton, Tudor-Locke, & Burkett, 2006) and valid (Tudor-Locke & Myers, 2001).

Pedometers support a technique of self-monitoring, personalized feedback, and self-selected goal-setting because they reflect individual behaviour (Tudor-Locke & Lutes, 2009). Monitoring daily step count scores served as self-referent feedback and may result in increased daily step counts (Shimon & Petlichkoff, 2009). Two meta-analysis studies reported that participants who used pedometers increased their PA behaviour and decreased in BMI (Bravata et al., 2007; Richardson, Newton, Abraham, Sen, Jimbo, & Swartz, 2008). Pedometer users significantly increased their steps/day (Clemes & Parker, 2009; Pal, Cheng, Egger, Binns, & Donovan, 2009). It is suggested that pedometer users increased their activities because using pedometers influenced participants' activity participation (Jackson & Howton, 2008). Pedometers may serve as a motivational tool because they directly show the number of steps taken by the user, (Lauzon,

Chan, Myers, & Tudor-Locke, 2008; Schneider, Crouter, & Bassett, 2004). Spence, Burgess, Rodgers, and Murray (2009) found that pedometer users increased self-reported walking behaviour. These results support the effectiveness of pedometers on PA behaviour.

### *Physical Activity Recommendations and Pedometer*

The minimum PA recommendation (i.e., 30 minutes of moderate intensity on 5 days a week) can be achieved by walking. The evidence showed that 30 minutes of moderate intensity can translate directly to 3,000–4,000 steps (Marshall et al., 2009; Tudor-Locke, Jones, Myers, Paterson, & Ecclestone, 2002; Tudor-Locke, Sisson, Collova, Lee, & Swan, 2005). It is also known that a minimal stepping rate of 100 steps per minute is equivalent to moderate-intensity (i.e., 3 METs) walking in adults (Marshall et al., 2009; Tudor-Locke et al., 2005; Tudor-Locke, Craig et al., 2011). Thus, to meet minimum PA guideline, individuals should walk 3,000 steps at a stepping rate of at least 100 steps per minute. Three bouts of 1,000 steps in 10 minutes each day can also be used to meet the recommendation (Marshall et al., 2009).

In addition, 30 minutes of moderate PA recommendations is also equivalent to an accumulation of walking approximately 8,000 steps/day (Aoyagi & Shephard, 2009; Macfarlane, Chan, Chan, Ho, & Lee, 2008; Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002; Tudor-Locke, Leonardi, Johnson, Katzmarzyk, & Church, 2011). This can be confirmed by considering the concept that an accumulation of 5,000 steps/day are defined as sedentary and 30 minutes of moderate intensity are approximately 3,000-4,000 steps (Tudor-Locke, Hatano,

Pangrazi, & Kang, 2008; Tudor-Locke, Jones et al., 2002). Thus, an accumulation of at least 8,000–9,000 steps/day may be appropriate for PA recommendation and health benefits (Tudor-Locke et al., 2008). Similarly, a recent article recommended that walking approximately 7,000-8,000 steps/day is associated with 30 minutes of moderate PA guideline and health benefits (Tudor-Lock, Craig et al., 2011).

## Reliability

Reliability is the consistency of a measure administered under similar circumstances (Thomas, Nelson, & Silverman, 2011). A reliable test reflects its ability to yield the same result if it is used on successive trials. In contrast, an unreliable test will produce results that are subject to high variability or measurement error (Sim & Wright, 2000). Reliability can be reported using either test–retest reliability or internal consistency (Sim & Wright, 2000). The test–retest reliability refers to how stable the position of a given score is in a distribution of scores when measured at different times (Sim & Wright, 2000). If the test administered under similar conditions shows high stability, then the test-retest reliability is confirmed (Thomas et al., 2011). For example, if a pedometer is used to measure steps, then each time the pedometer is administered to a participant, the results should be approximately the same. Pearson's or Spearman's correlation coefficients are normally used to establish the test-retest reliability (Brown, Hume, & ChinAPaw, 2009). However, the intraclass correlation coefficient (ICC) for continuous data and Kappa statistic for dichotomous or ordinal data is the most appropriate test to establish the test-retest reliability (Thomas et al., 2011). A

recently published checklist of attributes of PA questionnaires used 0.70 for both ICC and Kappa for a minimum standard for reliability coefficients (Terwee, Mokkink, van Poppel, Chinapaw, van Mechelen, & de Vet, 2010). The internal consistency refers to the homogeneity of a multi-item scale and the extent to which constituent items are all measuring the same underlying construct (Sim & Wright, 2000). The internal consistency can be detected using either a factor analysis or a Cronbach's alpha coefficient correlations. The Cronbach's alpha above 0.60 is considered to be reliable (Sim & Wright, 2000).

## Validity

Validity is the degree to which the scores from the test measure what it claims to measure (Thomas et al., 2011). There are four basic types of validity: face, content, criterion, and construct validities. In this study, concurrent validity will be tested for the Thai version against the English version of the GSLTPAQ, MSES, OEQ, and SRQ. Also, construct validity will be tested for the Thai version of MSES, OEQ, and SRQ. However, all types of validities will be discussed in the following section.

### *Face Validity*

Face validity is defined as the extent to which a measure obviously reflects the concept of interest being measured (Sim & Wright, 2000). Face validity can be obtained by interviewing respondents, or asking them to think aloud while completing the questionnaire, to examine how well they understand the questions (Terwee et al., 2010).

### *Content Validity*

Content validity is the degree to which a test adequately samples what was covered in the course (Thomas et al., 2011). It also refers to the suitability of the included individual questions in questionnaires (Terwee et al 2010).

### *Criterion Validity*

Criterion validity is defined as the degree to which the scores on a test are related to some criterion or a gold standard (Thomas et al., 2011). A criterion is an instrument that measures the same construct and has perfect reliability and validity (criterion validity). For example, for the validation of field methods of assessing PA, the doubly labeled water (DLW) method has been used as the gold standard (Westerterp, 2009). Criterion validity includes concurrent and predictive validities. *Concurrent validity* is the relationship between two (similar) measures of interest (Sim & Wright, 2000). Concurrent validity is usually used when the researcher need to use a shorter or more easily administered test for a criterion that is more difficult to measure (Thomas et al., 2011). For example, the concurrent validity of direct Vo2max tests against indirect Vo2max tests. To measure the concurrent validity, the two similar measures must be administered at exactly the same time (i.e., concurrently). *Predictive validity* is the degree to which scores of predictor variables can predict criterion scores (Thomas et al., 2011). This could be the correlation between physical fitness scores at pretest and PA behaviour of participant at 6 months after participating in PA program. Multiple regression analysis is normally used to establish predictive validity

because several predictors are likely to have a greater validity coefficient than the correlation between any one test and the criterion (Thomas et al., 2011).

### *Construct Validity*

Construct validity is the degree to which scores from a test are consistent with hypotheses based on the assumption that the test validly measures the construct to be measured (Sim & Wright, 2000). This could be shown by comparing the construct validity of self-report PA questionnaire with other (validated) instruments that measure closely related constructs such as pedometers. Construct validity includes convergent and discriminant. Convergent validity is positive correlations between concept of interest and other concepts to which it is theoretically positively related (Sim & Wright, 2000). The example can be the convergent validity of self-report PA measures and the objective PA measurement, or objective and questionnaire and physical fitness measures. Discriminant validity is negative correlations between concept of interest and other concepts to which it is theoretically negatively related (Sim & Wright, 2000). To obtain construct validity, the data collection from each method must take place at the exact same time frame. For example, participants wear pedometers for 1 week and then complete a self-report PA questionnaire which asks about PA behaviour at that week.

It has been suggested that coefficient values of less than 0.2 were considered a weak correlation, 0.21–0.4 were considered fair, 0.41–0.6 were regarded as moderate, 0.61–0.8 were considered strong and 0.81–1.0 very strong (Landis & Koch, 1977). Reis, Dubose, Ainsworth, Macera, and Yore (2005)

suggested that a correlation of at least 0.4 is considered acceptable for criterion and construct validities.

**Reliability and Validity of Self-report PA Measures**

Self-report PA questionnaires are frequency used to measure PA and other variables in large population studies because they are easy to administer and inexpensive (Friedenreich et al., 2006). In general, self-report questionnaires typically showed high reliability but low validity (Jacobs, Ainsworth, Hartman, & Leon, 1993; Sallis & Sealens, 2000). For example, studies normally found that the reliability of the IPAQ-Short Form (IPAQ-SF) was high (Craig et al., 2003; Deng et al., 2008). But, a recently systemic review found that the validity of IPAQ-SF and objective measures (criterion validity) or fitness (construct validity) was lower than the acceptable standard (Lee, Macfarlane, Lam, & Stewart, 2011).

An evaluation of ten commonly used PA questionnaires found that one month test-retest reliability was high (Jacobs et al., 1993). A review, summarized reliability and criterion validity results for seven self-report PA measures evaluated in adults, reported reliability correlations ranged from 0.34 to 0.89, with a median of about 0.80 which was considered a strong reliability (Sallis & Sealens, 2000). Similarly, the concurrent validity and the criterion validity of self-report PA questionnaires was strong (Bull, Maslin, & Armstrong, 2009; Craig et al., 2003; Torun, 2005); however, the criterion validity of self-report PA measures against objective PA measures was weak (Bull et al., 2009; Craig et al., 2003; Sallis & Sealens, 2000). A review of Sallis and Sealens (2000) found that criterion

validity of seven self-report PA measures ranged from 0.14 to 0.53, with a median of about 0.30.

## Translation Procedure of Questionnaires

To conduct linguistically equivalent of questionnaires, many procedures have been introduced to translate questionnaires. However, the most commonly used is the double or back translation approach (van de Vijver & Leung, 1997). A first bilingual individual independently translates an original version of questionnaires into the target language. Then a second bilingual individual translates it back to the original version. To identify inconsistencies between the two versions in the original language, comparisons are made of both versions. This method has been considered as the most adequate translation procedure (Marin & Marin, 1991). Nonetheless, there are some limitations that researchers need to consider. For example, translators may share educational or socioeconomic background and make sense of badly translated version. Translators can produce a second original language version that is identical to the first one although the target language translation is of poor quality (Marin & Marin, 1991). Also, translators may pay more attention to the semantics and less to connotations, naturalness, and comprehensibility (van de Vijver & Leung, 1997). In order to avoid such problems, translators should be bicultural, explicitly told not to try to infer what the original version may have said but rather to consider the target language version as the original version (Marin & Marin, 1991).

Another approach for obtaining linguistically equivalent questionnaires is a committee approach. Two or more bilingual individuals translate separately an original version of questionnaires into the target language. After the translation has been finished, a final version can be produced by meeting and discussing among translators and researchers (Marin & Marin, 1991). The major strength of the committee approach is the cooperative effort, which can improve the quality of the translation, especially if committee members have a variety of backgrounds (van de Vijver & Leung, 1997). However, this approach has some limitations. For example, translators can share a common world view because of their education, social class, or linguistic experience that may affect the accuracy of translation. Also, discussion among committees may be affected by cultural norms. These social norms may produce the appearance of consensus among the members of the committee which conceals disagreements about the final version (Marin & Marin, 1991). By considering advantages and disadvantages of back translation and committee approaches, it is possible to combine the committee approach with back translation approach in order to enhance linguistically equivalent questionnaires (van de Vijver & Leung, 1997).

## The Cultural Analysis

A study found that when previously developed questionnaires are adapted or translated to other languages, the internal structure of the questionnaire changes and the validity and reliability are lower than the original versions. Thus, once an instrument has been translated, researchers must make sure that the translated version of the questionnaire is fully equivalent to the original version (Marin &

Marin, 1991). That is, researchers should analyze the internal structure (e.g., using factor analysis) and internal consistency (e.g., alpha coefficient) of the questionnaire. Tests of the questionnaire's validity should also be conducted (Marin & Marin, 1991).

After the translation process has been completed, an examination of the psychometric characteristics of questionnaires should be done as a first step (van de Vijver & Leung, 1997). To obtain psychometric characteristics of a target-language questionnaire version, reliability and validity of a target-language version questionnaire should be evaluated (Marin & Marin, 1991). By comparing reliability coefficients between the original-language version and the target-language version, psychometric properties of questionnaires can be determined. Differences in reliability coefficients will show differences between questionnaires or problems of questionnaires such as lack of appropriateness of questionnaires (van de Vijver & Leung, 1997). Second, a factor analysis should be used to detect construct equivalence (van de Vijver & Leung, 1997). It can analyze the internal structure of the target-language version questionnaire as well as its internal consistency to make sure that the target-language version of questionnaire is fully equivalent to the original-language version (Marin & Marin, 1991).

Figures

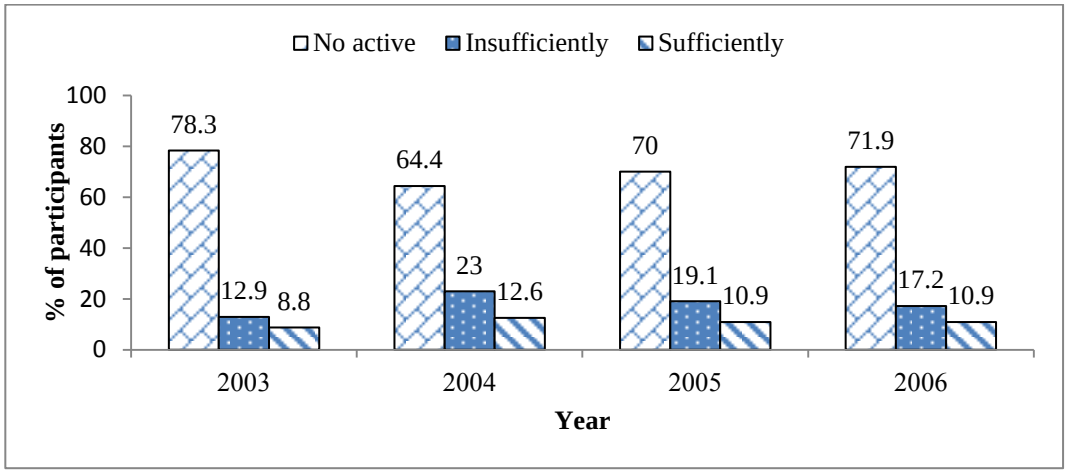


Figure A-1 Trends of Thai people's participation in leisure time physical activity. All the data in this figure were taken from the Asia Pacific Physical Activity Network (Abouzeid, Macniven, & Bauman, 2008).

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# APPENDIX B: QUESTIONNAIRES

**The GSLTPAQ**

Considering a **7-Day period** (a week), how many times on average do **you** do the following kinds of physical activity for **more than 15 minutes** during your **free time** (write on each line the appropriate number)?

| | **Times Per Week** |
|---|---|
| 1.1 STRENUOUS PHYSICAL ACTIVITY<br>(heart beats rapidly, sweating)<br>(e.g., running, jogging, soccer, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, weight training) | _____ |
| 1.2 MODERATE PHYSICAL ACTIVITY<br>(not exhausting, light perspiration)<br>(e.g., fast walking, tennis, easy bicycling, ping pong, volleyball, badminton, easy swimming, dancing) | _____ |
| 1.3 MILD PHYSICAL ACITIVITY<br>(minimal effort, no perspiration)<br>(e.g., easy walking, yoga, bowling, and golf) | _____ |

Considering a **7-Day period** (a week), during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)? (Please mark an answer below)

1. Often 2. Sometimes 3. Never/rarely

This questionnaire was developed by Godin and Shephard (1985).

**The MSEQ**

Performing moderate intensity physical activity (MPA) for 30 to 60 minutes is the equivalent of expenditure 90-180 METs or walking 3,000-6,000 steps. (Please write the appropriate percent of the following confidence).

**Task self-efficacy (T-SE)**

1. How confident are you that you can complete MPA at least 30 min/day for 3 days a week.
   **(no confidence)** 0%.....100% **(complete confidence)**
2. How confident are you that you can follow directions to complete MPA at least 30 min/day for 3 days a week.
   **(no confidence)** 0%.....100% **(complete confidence)**
3. How confident are you that you can perform all activities required for complete MPA at least 30 min/day for 3 days a week.
   **(no confidence)** 0%.....100% **(complete confidence)**

**Coping self-efficacy (C-SE)**

1. How confident are you that you can perform MPA at least 30 min/day for 3 days a week when you feel discomfort when performing PA.
   **(no confidence)** 0%.....100% **(complete confidence)**
2. How confident are you that you can perform MPA at least 30 min/day for 3 days a week when you lack energy
   **(no confidence)** 0%.....100% **(complete confidence)**
3. How confident are you that you can perform MPA at least 30 min/day for 3 days a week when you do not feel well
   **(no confidence)** 0%.....100% **(complete confidence)**

**Scheduling self-efficacy (S-SE)**

1. How confident are you that you could include MPA at least 30 min/day for 3 days a week in your daily routine

   **(no confidence)** 0%.....100% **(complete confidence)**

2. How confident are you that you could consistently perform MPA at least 30 min/day for 3 days a week.

   **(no confidence)** 0%.....100% **(complete confidence)**

3. How confident are you that you could arrange your schedule to include MPA at least 30 min/day for 3 days a week.

   **(no confidence)** 0%.....100% **(complete confidence)**

   This questionnaire has applied from Rodgers and Sullivan (2001), Rodgers, Wilson, Hall, Fraser, and Murray (2008), and Spence et al. (2009).

**The OEQ**

Some people think performing moderate physical activity (MPA) at least 30 min/day for 3 days a week will improve their health, others think it will improve their mood. Do you think the following benefits and values of performing MPA will occur to you? (Please circle the answer that best applied to you).

| | **Belief** | | | | | **Value** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Disagree a lot** | | | | **Agree a lot** | **Very Unimportant** | | | | **Very Important** |
| 1. It would help me spend more time with my friends | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 2. It would help get or keep me in shape | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 3. It would help me control my weight | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 4. It would put me in a better mood | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 5. It would make me better in sports or other activities | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 6. It would be fun | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 7. It would make me look better | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 8. I would make new friends | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 9. I would feel better about myself | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |

This questionnaire has applied from Dishman et al. (2005)

**The SRQ**

***Physical activity goal-setting***

The following questions refer to how you set PA goals and plan physical activities. (Please circle the answer that applied to you).

| **Please indicate the extent to which each of the statements below describes you:** | Does not Describe | | Describes Moderately | | Describes Completely |
|---|---|---|---|---|---|
| 1. I often set PA goals | 1 | 2 | 3 | 4 | 5 |
| 2. I usually have more than one major PA goal | 1 | 2 | 3 | 4 | 5 |
| 3. I usually set dates for achieving my PA goals | 1 | 2 | 3 | 4 | 5 |
| 4. My PA goals help to increase my motivation for doing physical activities | 1 | 2 | 3 | 4 | 5 |
| 5. I tend to break more difficult PA goals down into a series of smaller goals | 1 | 2 | 3 | 4 | 5 |
| 6. I usually keep track of my progress in meeting my PA goals | 1 | 2 | 3 | 4 | 5 |
| 7. I have developed a series of steps for reaching my PA goals | 1 | 2 | 3 | 4 | 5 |
| 8. I usually achieve the PA goals I set for myself. | 1 | 2 | 3 | 4 | 5 |
| 9. If I do not reach a PA goal, I analyze what went wrong | 1 | 2 | 3 | 4 | 5 |
| 10. I tell other people about my PA goal | 1 | 2 | 3 | 4 | 5 |

This questionnaire has applied from Rovniak, Anderson, Winett, and Stephens (2002).

***Physical Activity Planning and Scheduling***

The following questions refer to how you fit PA into your lifestyle. (Please circle the answer that applied to you).

| **Please indicate the extent to which each of the statements below describes you:** | Does not Describe | | Describes Moderately | | Describes Completely |
|---|---|---|---|---|---|
| 1. I never seem to have enough time to have PA | 1 | 2 | 3 | 4 | 5 |
| 2. *PA is generally not a high priority when I plan my schedule | 1 | 2 | 3 | 4 | 5 |
| 3. *Finding time for PA is difficult for me | 1 | 2 | 3 | 4 | 5 |
| 4. I schedule all events in my life around my PA routine | 1 | 2 | 3 | 4 | 5 |
| 5. I schedule my PA at specific times each week | 1 | 2 | 3 | 4 | 5 |
| 6. I plan my weekly PA schedule | 1 | 2 | 3 | 4 | 5 |
| 7. *When I am very busy, I cut out my PA | 1 | 2 | 3 | 4 | 5 |
| 8. Everything is scheduled around my PA routine—both classes and work. | 1 | 2 | 3 | 4 | 5 |
| 9. I try to have PA at the same time and same day each week to keep a routine going | 1 | 2 | 3 | 4 | 5 |
| 10. I write my planned activity sessions in an appointment book or calendar | 1 | 2 | 3 | 4 | 5 |

This questionnaire has applied from Rovniak, Anderson, Winett, and Stephens (2002).

# APPENDIX C: PHYSICAL ACTIVITY MATERIALS, FEEDBACK & PHYSICAL ACTIVITY OF ROLE MODELS, & GOAL SETTING

## Physical Activity Materials

*Physical Activity Guidelines*

| Type (Mild PA) | Duration | Intensity | Total |
|---|---|---|---|
| Yoga | 30 min | 2.5 METs | 75 MET-minutes |
| Stretching | 30 min | 2.5 METs | 75 MET-minutes |
| Walking (~50 m/min) | 30 min | 2.5 METs | 75 MET-minutes |
| **Type (Moderate PA)** | **Duration** | **Intensity** | **Total** |
| Walk (~100 m/min or 100 steps/min) | 30 min | 3 METs | 90 MET-minutes or 3000 steps |
| Bicycling (leisure) | 30 min | 4 METs | 120 MET-minutes |
| Bicycling (light effort) | 30 min | 6 METs | 180 MET-minutes |
| Bicycling (stationary: 50 watts) | 30 min | 3 METs | 90 MET-minutes |
| Bicycling (stationary: 100 watts, light effort) | 30 min | 5.5 METs | 165 MET-minutes |
| Badminton (social singles and doubles) | 30 min | 4.5 METs | 135 MET-minutes |
| Basketball (shooting) | 30 min | 4.5 METs | 135 MET-minutes |
| Basketball (non-game, general) | 30 min | 6 METs | 180 MET-minutes |
| Bicycling (leisure) | 30 min | 4 METs | 120 MET-minutes |
| Dancing (general) | 30 min | 4.5 METs | 135 MET-minutes |
| Ping Pong | 30 min | 4 METs | 120 MET-minutes |
| Tai Chi | 30 min | 4 METs | 120 MET-minutes |
| Tennis (doubles) | 30 min | 6 METs | 180 MET-minutes |
| Volleyball (general) | 30 min | 3 METs | 90 MET-minutes |
| Weight Lifting (light workout) | 30 min | 3 METs | 90 MET-minutes |
| Weight Lifting (vigorous effort) | 30 min | 6 METs | 180 MET-minutes |

*Physical Activity Guidelines (Cont.)*

| Type (Vigorous PA) | Duration | Intensity | Total |
|---|---|---|---|
| Aerobic (general) | 30 min | 6.5 METs | 195 MET-minutes |
| Basketball (game) | 30 min | 8 METs | 240 MET-minutes |
| Bicycling (320-370 m/min) | 30 min | 8 METs | 240 MET-minutes |
| Bicycling (380-430 m/min) | 30 min | 10 METs | 300 MET-minutes |
| Bicycling (stationary: 150 watts, moderate effort) | 30 min | 7 METs | 210 MET-minutes |
| Bicycling (stationary: 200 watts, moderate effort) | 30 min | 10.5 METs | 315 MET-minutes |
| Jogging (general) | 30 min | 7 METs | 210 MET-minutes |
| Running (130 m/min) | 30 min | 8 METs | 240 MET-minutes |
| Running (160 m/min) | 30 min | 10 METs | 300 MET-minutes |
| Running (180 m/min) | 30 min | 11 METs | 195 MET-minutes |
| Running (200 m/min) | 30 min | 12.5 METs | 375 MET-minutes |
| Running (230 m/min) | 30 min | 14 METs | 420 MET-minutes |
| Running (270 m/min) | 30 min | 16 METs | 480 MET-minutes |
| Swimming (freestyle, slow, light effort) | 30 min | 7 METs | 210 MET-minutes |
| Tennis (singles) | 30 min | 8 METs | 240 MET-minutes |
| Workout Example | Duration | Intensity | Total |
| Walk<br>Bicycling (leisure) | 20 min<br>10 min | 3 METs<br>4 METs | 100 MET-minutes |
| Walk<br>Jogging | 20 min<br>10 min | 3 METs<br>7 METs | 130 MET-minutes |

The METs equivalence of PA in these tables was taken from Ainsworth et al. (2000).

*Information about physical activity*

| Week | Contents |
|---|---|
| 1 | What is physical activity?<br>Physical activity (PA) is defined as any bodily movement produced by skeletal muscle that requires energy expenditure (ACSM, 2010).<br>What is exercise?<br>Exercise is defined as the systematic PA for a specific purpose (Thompson et al., 2003).<br>What is physical fitness?<br>Physical fitness refers to a physiological state of well-being that allows individuals to have a capacity to live or work in daily living or that provides the basis for sport performance (Warburton et al., 2006). Physical fitness includes cardiovascular fitness, muscular strength, muscular endurance, flexibility, and body composition (USDHHS, 2000).<br>What are the health benefits?<br>Increased PA not only increases physical fitness which lead to many health benefits (Prasad & Das, 2009), but also helps improve emotional state and decreases depression and anxiety (Wipfli, Rethorst, & Landers, 2008). Moreover, regular PA offers primary and secondary prevention of several chronic diseases such as coronary heart disease and hypertension (Buchner, 2009). In addition, increased levels of PA and physical fitness have been found to reduce the risk of premature death (Macera, Hootman, & Sniezek, 2003), and in turn decreased physical fitness has been found to increase the risk of premature death (Erikssen, 2001). |

| Weeks | Contents |
|---|---|
| 2 | PA recommendations<br>Moderate-to vigorous- intensity leisure-time PA for about 30 minutes at least 5 times a week is recommended by the national guidelines in Canada, US, UK, Finland as well as other countries (Tremblay et al., 2011).<br>Guidelines (in Canada)<br>1. To achieve health benefits, adults should accumulate at least 150 min of moderate- to vigorous-intensity aerobic PA per week, in bouts of 10 min or more.<br>2. It is also beneficial to add muscle- and bone-strengthening activities that use major muscle groups, at least 2 days per week.<br>3. More PA provides greater health benefits.<br>How?<br>Adults can meet these guidelines through planned exercise sessions, transportation, recreation, sports, or work, volunteer, and community activities. This should be achieved above and beyond the incidental physical activities accumulated in the course of daily living. It is appropriate to start with smaller amounts of PA and gradually increases duration, frequency, and intensity as a stepping stone to meeting the guidelines (Tremblay et al., 2011).<br>Health benefits<br>Following these guidelines can reduce the risk of premature death, coronary heart disease, stroke, hypertension, colon cancer, breast cancer, type 2 diabetes, and osteoporosis, and improve fitness, body composition, and indicators of mental health (Tremblay et al., 2011). |

<table>
<tr><th>Weeks</th><th>Contents</th></tr>
<tr><td>3</td><td>
Metabolic equivalent<br>
Metabolic equivalent (MET) is the ratio of the PA metabolic rate to the resting metabolic rate. One MET is defined as 1 kcal/kg/hour and is roughly equivalent to the energy cost of sitting quietly (Ainsworth et al., 2000). Performing PA will increase MET. For example, brisk walking (~100 meters/min) on a flat level expends about 3.0 METs. Thus, an individual performing an activity of 3 METs has the energy cost 3 times higher than that at rest. If a person has body weight 50 kilograms walks 30 minutes, she will spend 90 MET minute or 75 kcal (90 x 50 / 60 = 75).<br>
PA intensities and MET<br>
PA intensities are categorised as the following terms.
<table>
<tr><th>Intensity</th><th>METs</th><th>Example</th></tr>
<tr><td>Sedentary<br>Light<br>Moderate<br>Vigorous</td><td>1 to less than 2<br>2 to less than 3<br>3 to less than 6<br>6 or more</td><td>Sitting<br>Walking less than 100 step/minutes<br>Bicycling (leisure)<br>Aerobic dance</td></tr>
</table>
MET and PA goals<br>
Based on the PA recommendation, the PA goal per week should be set in the range of 450 to 750 MET minute per week (3 x 150 = 450 and 5 x 150 = 750) (Haskell et al., 2007).<br>
Health benefits<br>
Time spent in PA is related with health benefits. Spent time in PA more than 150 minutes (450 MET) per week can prevent body weight gain (Lee et al., 2010), reduce risk of cardiovascular disease, type 2 diabetes disease, breast and colon cancer (Brown et a., 2007), and mortality risk (Kokinos et al., 2008).
</td></tr>
</table>

| Weeks | Contents |
|---|---|
| 4 | PA recommendations and walking<br>The minimum PA recommendation (i.e., 30 minutes of moderate intensity on 5 days a week) can be achieved by walking.<br>A minimal stepping rate of 100 steps per minute is equivalent to moderate-intensity walking in adults (Marshall et al., 2009; Tudor-Locke et al., 2005).<br>Thus, to meet the recommendation, a person should walk at least 3,000 steps at a rate of at least 100 steps per minute (Tudor-Locke et al., 2011). Also, three bouts of 1000 steps in 10 minutes each day can be used to meet the recommendation (Marshall et al., 2009).<br>PA recommendations and steps/day<br>A value of ≤5,000 steps/day had been classified as a sedentary lifestyle (Tudor-Lock & Bassett, 2004; Tudor-Lock, Hatano et al., 2008).<br>To meet PA recommendation, a person should accumulate 7,100 to 11,000 steps per day (Tudor-Lock et al., 2011).<br>Health benefits<br>There was report that individuals taking < 5,000 steps/day had a substantially higher prevalence of a number of adverse cardiometabolic risk factors than those taking higher steps/day (Schmidt et al., 2009). Women who took ≥ 7,500 steps/day had a 50% lower prevalence of depression than women taking < 5,000 steps/day (McKercher et al., 2009). In addition, women who took 5,000-7,500 steps/day had a significantly lower BMI than those who took < 5,000 steps/day. Further, women who took 7,500-9,999 steps/day had a significantly lower BMI than those who took 5,000-7,500 steps/day (Krumm et al., 2006). Women who have a normal BMI will have steps/day ranged from 8,000 to 12,000 (Tudor-Lock, Bassett et al., 2008) |

| Weeks | Contents |
|---|---|
| 5 | Exercise dose for physiological benefits<br>Exercise dose for physical benefits can be classified as two levels. Exercise dose for health-related fitness and exercise dose for physical fitness. The purpose of the first exercise dose is to promote and maintain health while the purpose of the second exercise dose is to improve and increase levels of physical fitness and health.<br>Exercise dose for health-related fitness<br>The exercise dose for health-related fitness is minimum recommendation for health benefits (ACSM, 2010). Following this exercise dose can increase health benefits. |

| Purpose | Intensity | Duration | frequency |
|---|---|---|---|
| Aerobic | Moderate 3-6 METs | ≥ 30 minutes | ≥ 5 day/week |
| | High > 6 METs | ≥ 20-25 minutes | ≥ 3 day/week |
| | Mix (both moderate and high) | 20-30 minute | 3-5 day/week |
| Strength | 8-12 reps/set (~60-80% of 1RM) | 2-4 set<br>rest 2-3 minutes/set | 2-3 day/week |
| Muscle endurance | 15-25 reps/set (< 50% of 1RM) | 1-2 set<br>rest 1-2 minute/set | 2-3 day/week |

| Weeks | Contents |
|---|---|
| 6 | Exercise dose for physical fitness<br>The exercise dose for physical fitness is appropriate for those who want to increase their levels of physical fitness (ACSM, 2010). Following this exercise dose will increase more in cardiovascular fitness (Gutin et al., 2002; Kemi et al., 2005). For example, exercise at high intensity (i.e., > 6 METs) can increase $VO_2$max, cardiomyocyte hypertrophy, and cardiomyocyte function higher than exercise at moderate intensity (Kemi et al., 2005). Increase frequency of exercise also increases the reducing in body weight for those who exercise for weight lose (Westcott et al., 2009; Willis et al., 2009). |

| Purpose | Intensity | Duration | Frequency |
|---|---|---|---|
| Cardiovascular fitness | Moderate to high<br>3 to > 6 METs | 20-60 minutes | 3-5 days/week |
| Weight loss | Moderate 3-6 METs | 50-60 minutes | 5 days/week |
| | High > 6 METs | 50-60 minutes | 3 days/week |
| Strength | 8-12 reps/set (~60-80% of 1RM) | 2-4 set<br>rest 2-3 minutes/set | 2-3 days/week |
| Muscle endurance | 15-25 reps/set (< 50% of 1RM) | 2-4 set<br>rest 1-2 minute/set | 2-3 days/week |

| Weeks | Contents |
|---|---|
| 7 | An example of workouts for cardiovascular fitness<br>Type: Aerobic exercise<br>Intensity: 3 to more than 6 METs or 60 to 85% of maximum heart rate<br>Duration: 20 to 60 minutes<br>Frequency: 3-5 days/week<br>Exercise method: Continuous exercise<br>An example:<br>1. Warm up:<br>Walking (~50 m/min) 5 minutes and stretching 5 minutes or<br>Jogging 5 minutes and stretching 5 minutes<br>2. Workout:<br>Aerobic dance 50 minutes or<br>Bicycling (stationary: 150 watts, moderate effort) 30 minutes or<br>Play basketball (game) 30 minutes or<br>Bicycling (300-400 m/min) 30 minutes or<br>Running (130 m/min) 30 minutes or<br>Swimming (freestyle, slow, light effort) 30 minutes or<br>Play tennis (singles) 30 minutes<br>3. Cool down:<br>Walking (~50 m/min) 5 minutes and stretching 5 minutes or<br>Jogging 5 minutes and stretching 5 minutes |

| Weeks | Contents |
|---|---|
| 8 | An example of workouts for cardiovascular fitness<br>Type: Aerobic exercise<br>Intensity: 3 to more than 6 METs or 60 to 85% of maximum heart rate.<br>Duration: 20 to 60 minutes<br>Frequency: 3-5 days/week<br>Exercise method: Interval exercise<br>An example:<br>1. Warm up:<br>Walking (~50 m/min) 5 minutes and stretching 5 minutes or<br>Jogging 5 minutes and stretching 5 minutes<br>2. Workout:<br>2.1. Bicycling (stationary: 200 watts, moderate effort) 10 minutes and bicycling (stationary: 50 watts, very light effort) 5 minutes. Repeat 2-3 times, or<br>2.2. Running (160 m/min) 5 minutes and walking (50 m/min) 2 minutes. Repeat 3-5 times, or<br>2.3. Swimming (freestyle, slow, light effort) 5 minutes and rest 2 minutes. Repeat 3-5 times.<br>3. Cool down:<br>Walking (~50 m/min) 5 minutes and stretching 5 minutes or<br>Jogging 5 minutes and stretching 5 minutes |

| Weeks | Contents |
|---|---|
| 9-12 | An example of workouts for cardiovascular fitness<br>Type: Aerobic exercise<br>Intensity: 3 to more than 6 METs or 60 to 85% of maximum heart rate.<br>Duration: 20 to 60 minutes<br>Frequency: 3-5 days/week<br>Exercise method: Cross exercise<br>An example:<br>1. Warm up:<br>Walking (~50 m/min) 5 minutes and stretching 5 minutes or<br>Jogging 5 minutes and stretching 5 minutes<br>2. Workout:<br>2.2.1 Cycling (stationary: 200 watts, moderate effort) for 10 minutes, running (160 m/min) for 10 minutes, and play basketball (game) for 10 minutes, or<br>2.2.2 Walk (~100 m/min) for 10 minutes, jogging 10 minutes, and swimming (freestyle, slow, light effort) for 10 minutes, or<br>2.2.3 Running 1 days a week, cycling 1 days a week, and swimming 1 day a week, or<br>2.2.4 Play badminton 1 day a week, play basketball 1 day a week, and play tennis 1 day a week.<br>3. Cool down:<br>Walking (~50 m/min) 5 minutes and stretching 5 minutes or |

## Feedback and Physical Activity of Role Models

*Feedback*

Feedback on your PA level

In the last week, you participate in PA [*participant's PA level*] minutes which equivalent to [ ] METs, or [ ] steps. Compared to your PA goals in the last week [*participant's goal setting*] minutes which equivalent to [ ] METs, or [ ] steps,

(*For a person who cannot reach her PA goals*) you almost reach your goal! I am confident that you can make it in the next week. I believe in your performance. Please ask me if you do not know how to increase your PA level.

(*For a person who can reach her PA goals*) you are great! You have been classified among the best performers. Well done! Keep going!

PA levels of the group

In the last week, the PA level of the group was [*group's average PA level*] minutes which equivalent to [ ] METs, or [ ] steps.

*PA of role models*

[*Moon*] is fit and healthy girl. In each day, she walks from dormitory to class room. She takes stairs instead of elevators. She knows that walking and taking stairs can improve her muscle strength, help burn calorie (good shape), and save environments. During a class break, she takes a break by walking to outside the room and standing when talking with her friends. When classes finished, she always walk back to the dormitory.

[*Moon*] also participates in PA. She set PA goals and increase its 3 minutes every week. In the last week, her goal was participating in PA for [*30*] minutes a day for 3 days a week. On Monday, she walked at normal speed (~100m/minute) from dormitory to gymnasium which spending 7 minute (~21 METs). She stretched for 3 minutes (~7.5 METs), [*jogged for 10 minutes (~70 METs)*], and then stretched for 3 minutes and walked back to dormitory. Over all, she spent [*30 minutes (~127 METS)*]. On Wednesday, she walked for 7 minutes from dormitory to gymnasium. She stretched for 3 minutes, [*rode a stationary bicycle (at intensity 100 watts) for 10 minutes (~55 METs)],* and then stretched and walked back to dormitory. That day, she spent [*30 minutes (~112 METs)*]. On Friday, she rode a bicycle from dormitory to gymnasium which spent 5 minutes (~20 METs). She stretched for 3 minutes and played [*basketball (shooting and general) for 15 minutes (~90 METs)],* and then stretched and rode a bicycle back to dormitory. She spent [*31 minutes (~145 METs)*]. In total, [*moon*] participated in PA [*91 minutes (~384 METs)*] in the last week.

[*Name of role models* and *physical activities*] will be changed in each week and [*time spent in PA each day*] will be increased 3 minutes every week.

## Goals Setting

1. My averages MPA per day for 3 days in this week equals to

   _____ min/day or equals to _____ steps

2. My PA goals per day for 3 days in the next week are performing MPA

   _____ min/day or equals to _____ steps

   (1 minute of MPA equals to 3 METs and 100 steps)

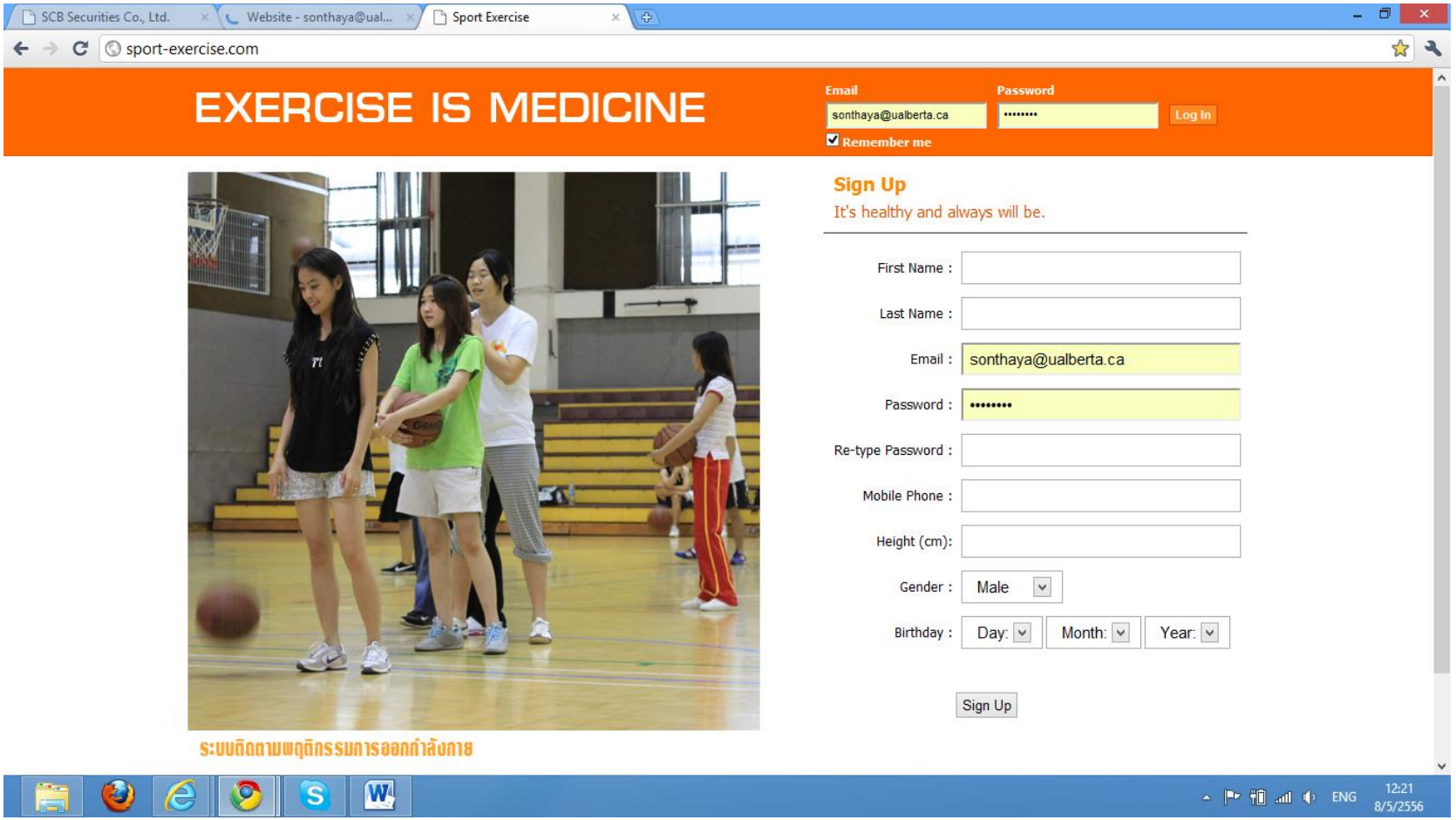
3. How confident are you that you can complete your PA goal setting?

   (no confidence) 0%.....100% (complete confidence)

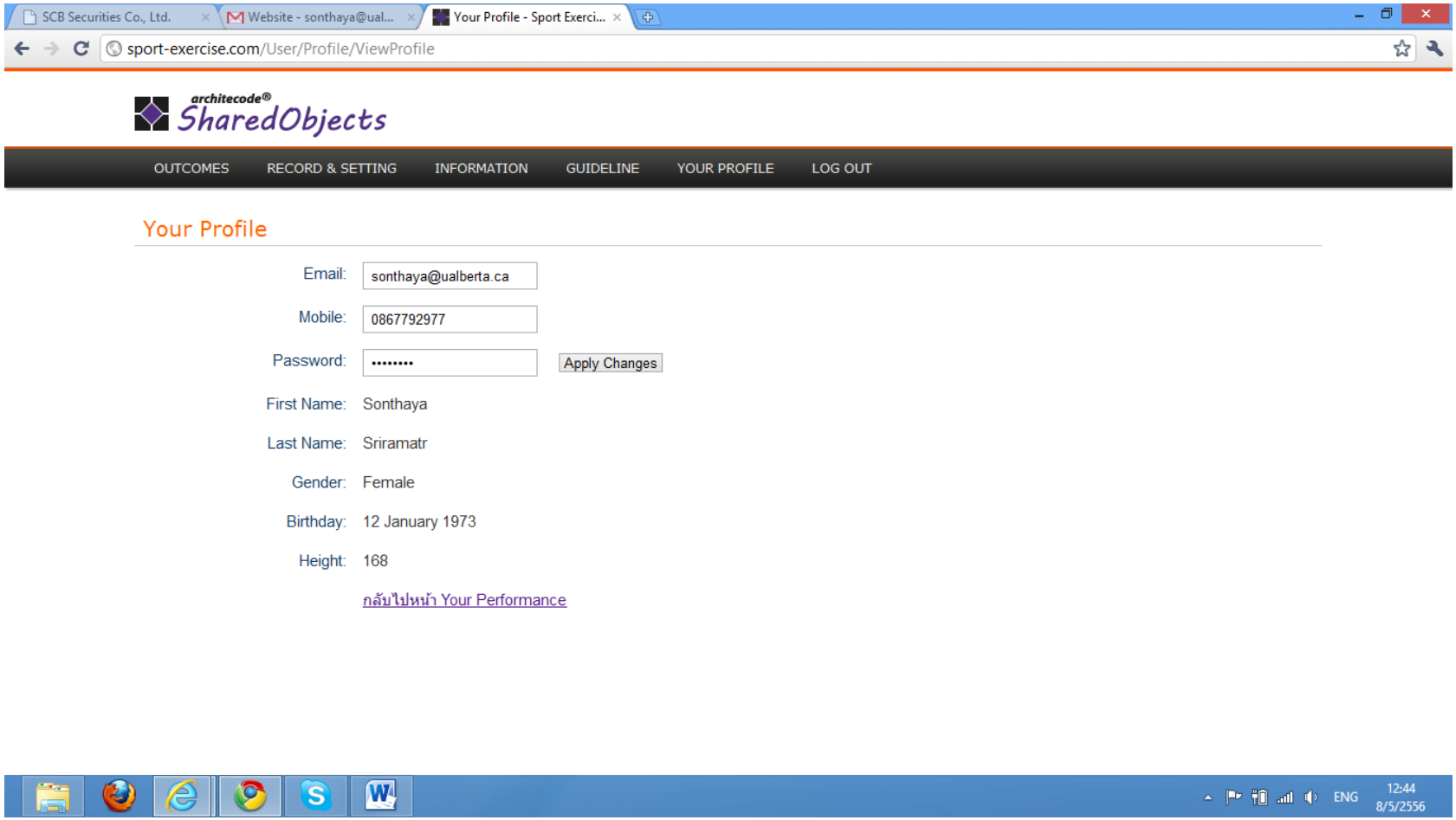
4. Do you expect that completing your PA goal will improve your physical fitness?

   (no expectation) 0%.....100% (complete expectation)

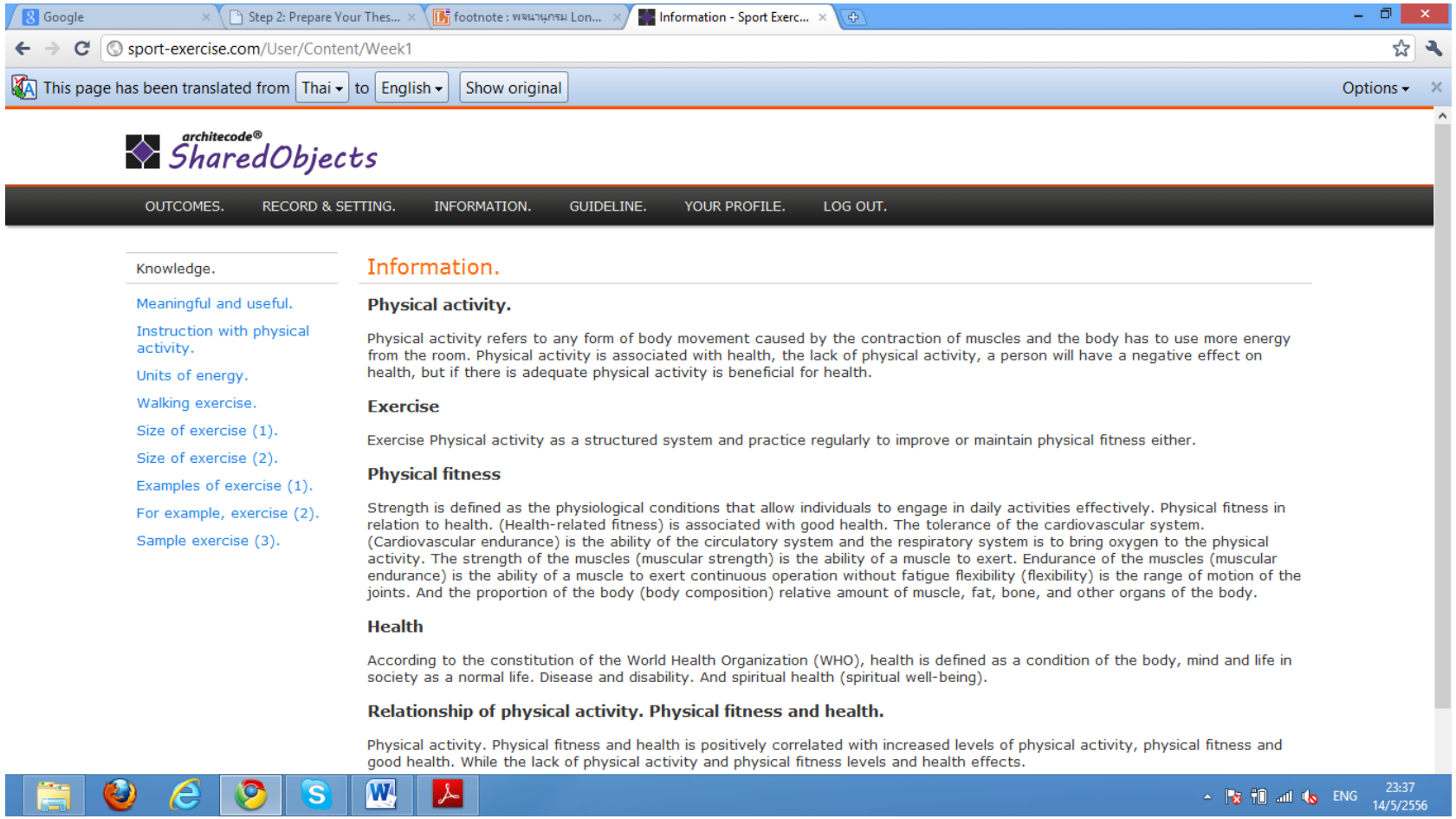
## APPENDIX D: A COPY OF WEBSITE



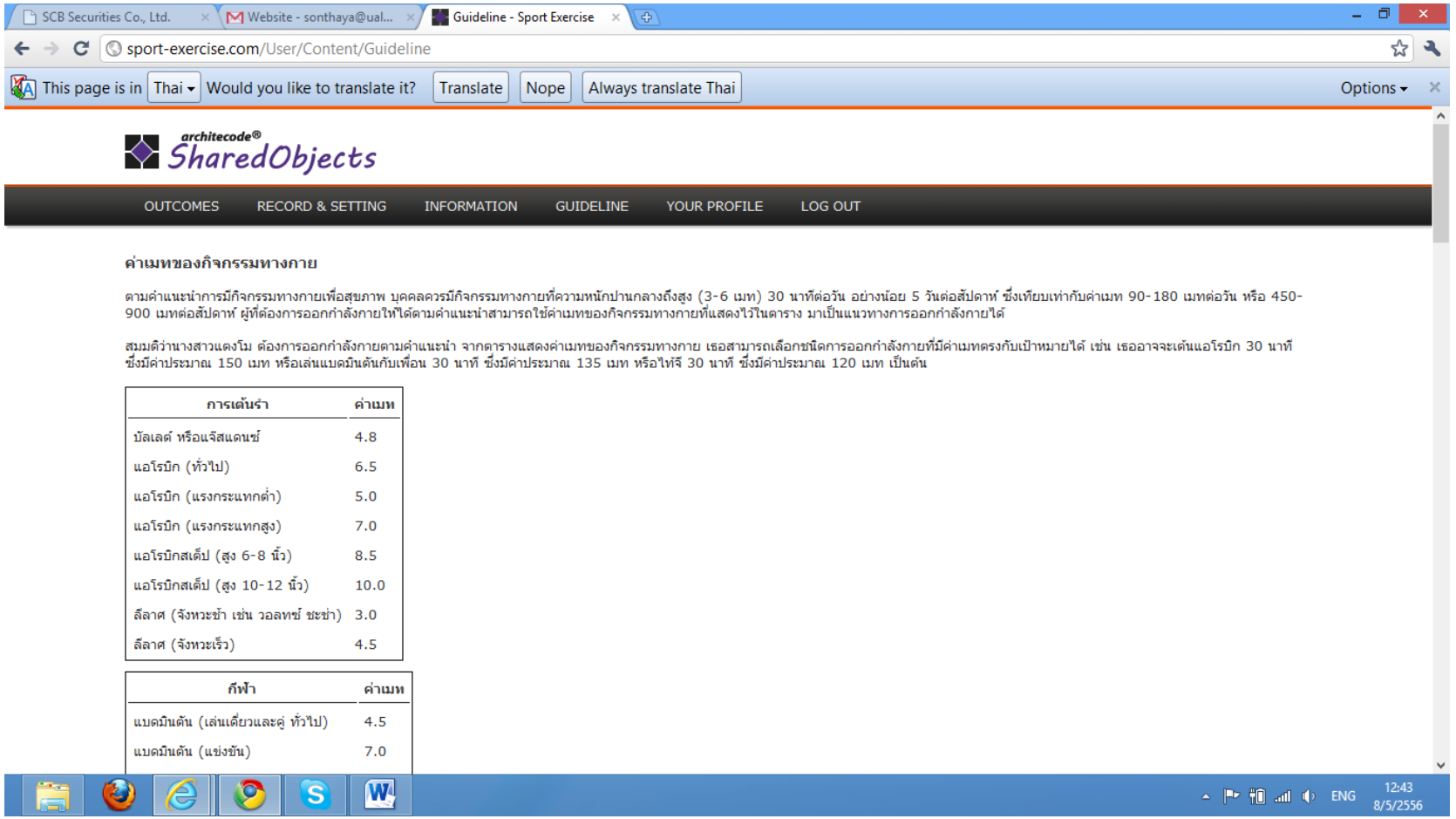

Website home page



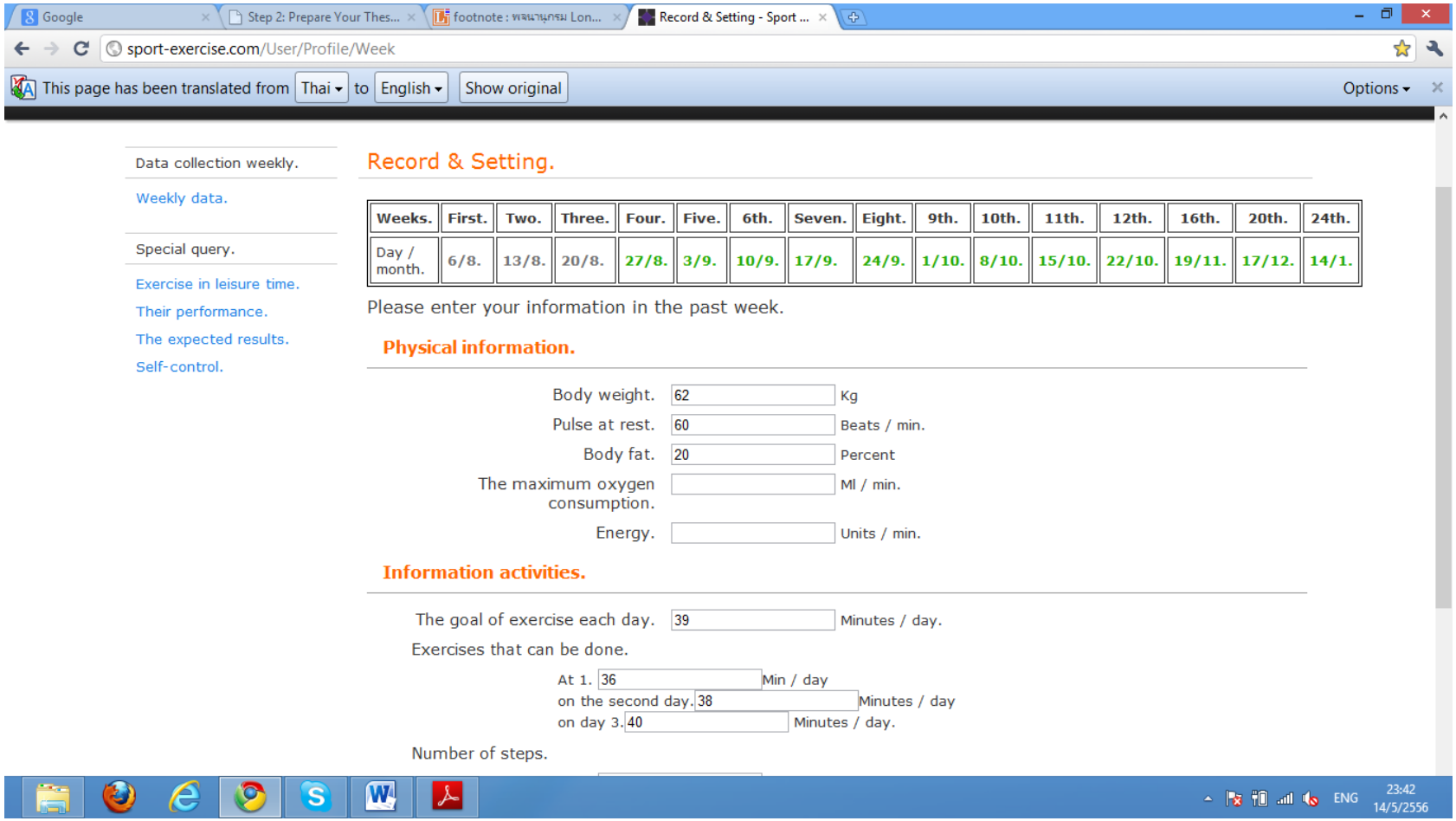

Participant's profile page



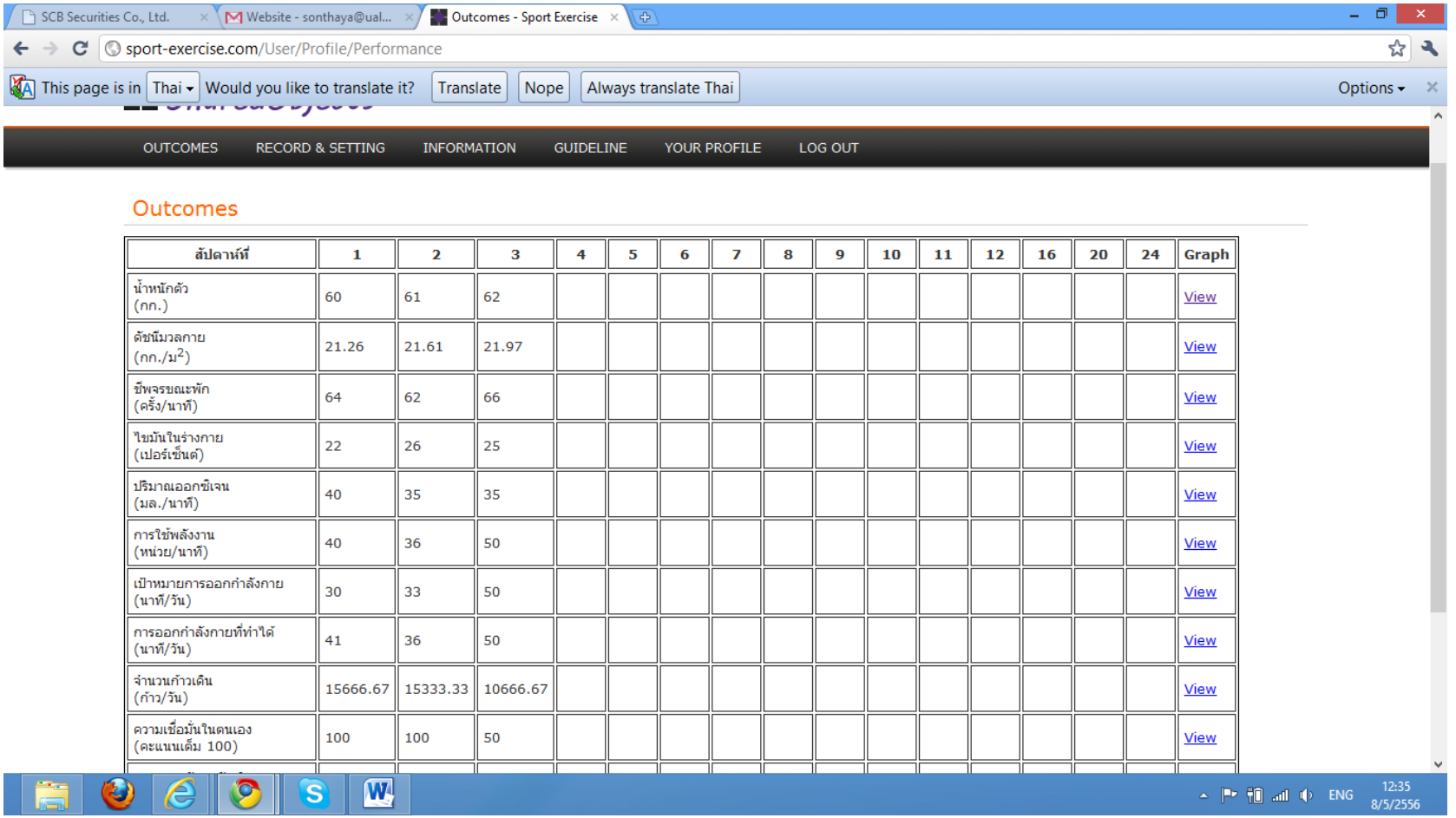

Physical Activity information page




Physical activity guideline page

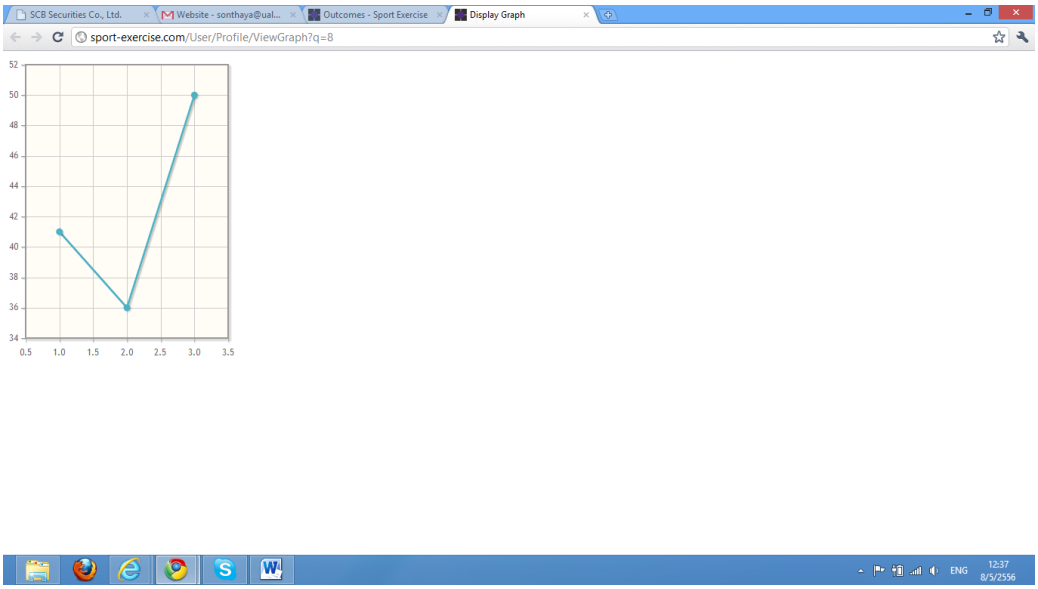



Physical activity recording & setting Page




| สัปดาห์ที่ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 16 | 20 | 24 | Graph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| น้ำหนักตัว (กก.) | 60 | 61 | 62 | | | | | | | | | | | | | View |
| ดัชนีมวลกาย (กก./ม$^2$) | 21.26 | 21.61 | 21.97 | | | | | | | | | | | | | View |
| ชีพจรขณะพัก (ครั้ง/นาที) | 64 | 62 | 66 | | | | | | | | | | | | | View |
| ไขมันในร่างกาย (เปอร์เซ็นต์) | 22 | 26 | 25 | | | | | | | | | | | | | View |
| ปริมาณออกซิเจน (มล./นาที) | 40 | 35 | 35 | | | | | | | | | | | | | View |
| การใช้พลังงาน (หน่วย/นาที) | 40 | 36 | 50 | | | | | | | | | | | | | View |
| เป้าหมายการออกกำลังกาย (นาที/วัน) | 30 | 33 | 50 | | | | | | | | | | | | | View |
| การออกกำลังกายที่ทำได้ (นาที/วัน) | 41 | 36 | 50 | | | | | | | | | | | | | View |
| จำนวนก้าวเดิน (ก้าว/วัน) | 15666.67 | 15333.33 | 10666.67 | | | | | | | | | | | | | View |
| ความเชื่อมั่นในตนเอง (คะแนนเต็ม 100) | 100 | 100 | 50 | | | | | | | | | | | | | View |

Outcomes page




An example of graph (e.g., time spent in PA in the 1st to 3rd week)

## APPENDIX E: LETTER OF INFORMED CONSENT

**Letter of Informed Consent (U of A version)**

**Study title:** An **i**nternet-based intervention for promoting and maintaining physical activity in Thai university-aged females: a randomized controlled trial

**Researcher**
Name: Sonthaya Sriramatr
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Phone Number: (081) 649-5623
Email Address: sonthaya@ualberta.ca

**Supervisor**
Name Dr. Tanya Berry
Address: E4-88 Van Vliet Centre, Faculty of Physical Education and Recreation
University of Alberta, Edmonton, AB, T6G 2H9
Phone Number: (780) 492 3280
Email address: tanya.berry@ualberta.ca

**Participant**
Name: .....
Phone Number: .....
Email Address: .....

I, participant, have read and understand the information letter for the study entitled an internet-based intervention for promoting and maintaining physical activity in Thai university-aged females, and am giving my informed consent to participate in this study. I understand that:

- The purpose of this study is to evaluate the efficacy of a SCT-based internet intervention designed to promote and maintain PA in university-aged females in Thailand
- I am agreeing to participate in completing this study.
- I will gain no privileges for participating in the study or suffer no penalties for not participating.
- My participation in this research is voluntary. I understand that I can fully withdraw from the study and have all collected data withdraw from the database up to the February 1, 2013.
- I can ask questions and refuse to answer questions at any time without consequences.
- I am aware that my name and other identifying information will be changed in an attempt to protect my identity. My information will only be seen by researcher and his supervisor.
- I am aware that this research will be used in a doctor's dissertation, and may be used in other publications, presentations, and future research.

I agree to participate in the study based on these terms.

..... ..... .....
Print Name Sign Name Date

**หนังสือให้ความยินยอมเข้าร่วมในโครงการวิจัย** (SWU version)

วันที่ ……..……

ข้าพเจ้า……อายุ……ปี อยู่บ้านเลขที่…..…..
ถนน…….....หมู่ที่…….แขวง/ตำบล……....เขต/อำเภอ…..…….....
จังหวัด……..โทรศัพท์.....

**ขอทำหนังสือนี้ให้ไว้ต่อหัวหน้าโครงการวิจัยเพื่อเป็นหลักฐานแสดงว่า**

ข้อ 1 . ข้าพเจ้า ได้รับทราบโครงการวิจัยของ ผู้ช่วยศาสตราจารย์สนธยา สีละมาด (หัวหน้าโครงการวิจัยและคณะฯ)

เรื่อง AN INTERNET-BASED INTERVENTION FOR PROMOTING AND MAINTAINING PHYSICAL ACTIVITY IN THAI UNIVERSITY-AGED FEMALES

**ข้อ 2. ข้าพเจ้า ยินยอมเข้าร่วมโครงการวิจัยนี้ ด้วยความสมัครใจ โดยมิได้มีการบังคับขู่เข็ญ หลอกลวงแต่ประการใด และจะให้ความร่วมมือในการวิจัยทุกประการ**

ข้อ 3. ข้าพเจ้า ได้รับการอธิบายจากผู้วิจัยเกี่ยวกับวัตถุประสงค์ของการวิจัย วิธีการวิจัย ประสิทธิภาพ ความปลอดภัย อาการหรืออันตรายที่อาจเกิดขึ้น รวมทั้งแนวทางป้องกัน และแก้ไข หากเกิดอันตราย ค่าตอบแทนที่จะได้รับ ค่าใช้จ่ายที่ข้าพเจ้าจะต้องรับผิดชอบจ่ายเอง โดยได้อ่านข้อความที่มีรายละเอียดอยู่ในเอกสารชี้แจงผู้เข้าร่วมโครงการวิจัยโดยตลอด อีกทั้งยังได้รับคำอธิบายและตอบข้อสงสัยจากหัวหน้าโครงการวิจัยเป็นที่เรียบร้อยแล้ว และตกลงรับผิดชอบตามคำรับรองในข้อ 5 ทุกประการ

ข้อ 4. ข้าพเจ้า ได้รับการรับรองจากผู้วิจัยว่าจะเก็บข้อมูลส่วนตัวของข้าพเจ้าเป็นความลับ จะเปิดเผยเฉพาะผลสรุปการวิจัยเท่านั้น

ข้อ 5. ข้าพเจ้า ได้รับทราบจากผู้วิจัยแล้วว่า หากมีอันตรายใด ๆ **อันเกิดขึ้นจากการวิจัยดังกล่าว** ข้าพเจ้า จะได้รับการรักษาพยาบาลจากคณะผู้วิจัย โดยไม่คิดค่าใช้จ่ายและจะได้รับค่าชดเชยรายได้ที่สูญเสียไปในระหว่างการรักษาพยาบาลดังกล่าว ตลอดจนมีสิทธิ์ได้รับค่าทดแทนความพิการที่อาจเกิดขึ้นจากการวิจัยตามสมควร

ข้อ 6. ข้าพเจ้า ได้รับทราบแล้วว่าข้าพเจ้ามีสิทธิ์จะบอกเลิกการร่วมโครงการวิจัยนี้ และการบอกเลิกการร่วมโครงการวิจัยจะไม่มีผลกระทบต่อการดูแลรักษาโรคที่ข้าพเจ้าจะพึงได้รับต่อไป

ข้อ 7. หากข้าพเจ้ามีข้อข้องใจเกี่ยวกับขั้นตอนของการวิจัย หรือหากเกิดผลข้างเคียงที่ไม่พึงประสงค์จากการวิจัย สามารถติดต่อกับ ผู้ช่วยศาสตราจารย์สนธยา สีละมาด ภาควิชาวิทยาศาสตร์การกีฬา หรือโทรศัพท์ 086 7792977

ข้อ 8. หากข้าพเจ้า ได้รับการปฏิบัติไม่ตรงตามที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย ข้าพเจ้าจะสามารถติดต่อกับประธานคณะกรรมการจริยธรรมสำหรับการพิจารณาโครงการวิจัยที่ทำในมนุษย์หรือผู้แทน ได้ที่ฝ่ายวิจัย คณะแพทยศาสตร์ มหาวิทยาลัยศรีนครินทรวิโรฒ โทรศัพท์ 0-3739-5085-6 ต่อ 60428-9 หรือประธานคณะกรรมการจริยธรรมสำหรับการ

พิจารณาโครงการวิจัยที่ทำในมนุษย์หรือผู้แทน ของมหาวิทยาลัยอัลเบอร์ต้า โทรศัพท์ 780-492-2615

ข้าพเจ้าได้อ่านและเข้าใจข้อความตามหนังสือนี้โดยตลอดแล้ว เห็นว่าถูกต้องตามเจตนาของข้าพเจ้า จึงได้ลงลายมือชื่อไว้เป็นสำคัญพร้อมกับหัวหน้าโครงการวิจัยและต่อหน้าพยาน

ลงชื่อ ……... ลงชื่อ ……

(……....) (ผู้ช่วยศาสตราจารย์ สนธยา สีละมาด)

ผู้ยินยอม / ผู้แทนโดยชอบธรรม ผู้ให้ข้อมูลและขอความยินยอม/หัวหน้าโครงการวิจัย

ลงชื่อ ……พยาน ลงชื่อ ……พยาน

(…… ) (…… )

ในกรณีที่ผู้เข้าร่วมการวิจัย อ่านหนังสือไม่ออก ผู้ที่อ่านข้อความทั้งหมดแทนผู้เข้าร่วมการวิจัยคือ

.....

จึงได้ลงลายมือชื่อไว้เป็นพยาน

ลงชื่อ ……พยาน

(……)