The Efficacy of an Internet-based Behavioural Intervention for Physical Activity Promotion among University Students

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Abstract

Despite the numerous health benefits associated with regular physical activity (PA), an obvious decline in PA during the transition from secondary school to university has been reported (Bray & Born, 2004). Most university students have easy access to the Internet and are technologically savvy about computer and Internet use. Using of the Internet to promote PA in university campus settings is promising but the efficacy is unknown. Two randomized controlled trials were conducted in this thesis to examine the efficacy of the Internet for PA promotion among university students in Hong Kong.

In study 1 (Chapter 3), the effectiveness of the Internet-based behavioural intervention for PA promotion among university students was examined. A total of 111 Hong Kong university students were randomly assigned to one of the three groups, namely, Internet-based group (IB), print-based group (PB), and control group (C). Both the IB and PB groups received the same program materials, i.e. the 14-week PA behaviour change program entitled "*Active Living Every Day (ALED)*" (Blair et al., 2001), but through different delivery media (online programme for the IB group and face-to-face class for the PB group). Group C did not receive any intervention program. The assessments of PA level (by International Physical Activity Questionnaire, IPAQ) and stage of change (by Stage of Exercise Change Questionnaire, SECQ) were conducted at baseline, third and sixth month of the intervention. Increased total PA scores ($p < 0.05$) were found in the PB and IB groups at the 3rd and 6th month assessments; there was no difference ($p > 0.05$) in changes of total PA scores between the intervention groups.

An increase in number of participants meeting the ACSM/AHA criteria of sufficient PA was found in the IB group ($Z = 2.646$, $p < 0.05$) at the 3rd month assessment. Improvement in stage of change was only found in the IB group ($Z = 3.288$, $p < 0.05$) at the 3rd month assessment. Improvements in stage of change were found in both the PB group ($Z = 3.026$, $p < 0.05$) and the IB group ($Z = 2.766$, $p < 0.05$) at the 6th month assessment. The results suggested that the Internet-based intervention was as effective as the print-based intervention in PA promotion among university students in Hong Kong.

Whether standard Internet was as effective as the tailored-Internet for PA promotion was inconclusive. In order to test for the efficacy of the standard Internet in relation to the tailored-Internet for PA promotion, the medium of delivery was controlled in study 2 (Chapter 4). This study implemented mixed research methodology by using both quantitative (online questionnaire) and qualitative (face-to-face semi-structured interviews) data collection means. The use of this design allowed the qualitative results to connect and expand on the quantitative findings in order to have a better understanding of the mechanisms by which the intervention programmes worked.

A total of 161 Hong Kong university students were randomly assigned to one of

the three groups, namely, public access Internet group (PAI), stage-targeted Internet group (STI), and control group (C). Participants of the PAI group received a Web page containing links to five publicly available websites relating to PA. Participants of the STI group received the ALED online programme (Blair et al., 2001). Group C did not receive any intervention program. The assessments of PA level (by IPAQ), stage of change (by SECQ) and exercise self-efficacy (by Self-efficacy Questionnaire, SEQ) were conducted at baseline, third and sixth month of the intervention.

Increased total PA scores were only found in the STI group (F [1, 48] = 9.965, $p <$ 0.05) at the 3rd month assessment. There were no significant changes ($p > 0.05$) in the numbers of participants meeting the ACSM/AHA criteria of sufficient PA found in all groups at the 3rd and 6th month assessments. Improvements in stage of change were found in the STI group ($Z = 2.379$, $p < 0.05$) at the 3rd month assessment and in both the PAI group ($Z = 2.351$, $p < 0.05$) and the STI group ($Z = 2.013$, $p < 0.05$) at the 6th month assessment. Decreased mean self-efficacy scores were found in the PAI group at the 3rd (F [1, 50] = 6.130, $p < 0.05$) and 6th month (F [1, 50] = 4.659, $p < 0.05$) assessments respectively.

Three focus group interviews were conducted, a total of 15 participants were interviewed, and qualitative data were collected. The contents of the public access websites could not arouse the PAI group participants' interest to read through the details and hence did not help in increasing their PA levels and stages of exercise change. The ALED course contents facilitated the STI group participants to increase their PA levels by leading them to set their own exercise goals and by emphasizing the importance and health benefits of regular PA. Both the ALED course contents and assessment questionnaires had positive influences on stages of exercise changes of the STI group participants. The participants in the PAI and the STI groups did not perceive any positive influences from the intervention contents on their exercise self-efficacy. In addition, participants in all groups commented that the campus environment and sports facilities were useful in increasing chances of PA participation.

The results suggested that participants in the PAI group did not demonstrate improvement in PA to the same extent as their counterparts in the STI group. The public access websites were not effective for PA promotion among university students. The STI intervention was effective in elevating the PA level of the university students, however, the influence was rather short term, and the effect disappeared at the 6th month assessment.

The findings of current studies can provide evidence-based support for the efficacy of using stage-tailored Internet to promote PA among university students in Hong Kong. Future Internet-based PA research might focus on the long-term PA participation enhancement. Future design of PA promotion websites may not only focus on information dissemination but on experience-sharing and social interaction. This might be crucial for enhancing the rate of retention of participants.

摘 要

定期體力活動（PA）對健康儘管有莫大的裨益，中學生過渡到大學後的PA有明顯下降（Bray & Born, 2004）。大學生很容易接觸互聯網及掌握電腦科技的應用。於大學校園以互聯網推動體力活動是可望的，但其效能並未知曉。這論文以兩次對照隨機試驗（RCT），研究以互聯網推動香港的大學生體力活動的效能。

研究一【第三章】爲探討以互聯網爲主的行爲干預推動大學生體力活動的有效性。111 位香港的大學生隨機被編入以下三組：互聯網爲主組（IB）、印刷品爲主組（PB）及控制組（C）。 IB 及 PB 組均透過不同途徑（互聯網在線課程 - IB；面對面授課 - PB）接受 14 星期的【活躍生活每一天】（ALED）（Blair et al., 2001）的教材知識，而 C 組並沒有接受任何干預。於最初、三個月及六個月評估其體力活動水平（國際體力活動問卷，IPAQ）及階段變化（階段變化問卷，SECQ）。IB 及 PB 組的體力活動於三個月及六個月的評分皆有進步（$p < 0.05$），而其進步於兩組之間並沒有差異（$p > 0.05$）。

IB 組於第三個月達到美國運動醫學會/美國心臟學會的足夠體力活動標準的上升（$Z = 2.646$, $p < 0.05$）成績； IB 組於第三個月的階段變化評估有改善（$Z = 3.288$, $p < 0.05$）；而 PB 組（$Z = 3.026$, $p < 0.05$）及 IB 組（$Z = 2.766$, $p < 0.05$）於第六個月的階段變化中亦有改善。結果顯示互聯網爲主的干預用作推動大學生體力活動與印刷品爲主的干預同樣有效。

現階段，標準的互聯網 (standard Internet) 是否與專用的互聯網 (tailored-Internet) 於推動體力活動方面同樣有效，未能作出結論，爲了驗證標準的互聯網於推動體力活動之效能，研究二【第四章】對發放途徑作出控制。研究二採用量性（在線問卷）與質性（面對面半結構式面談）的混合研究方式作爲數據收集。這設計以質性的結果聯合和擴大量性的數據，從中理解及得出干預活動的機制。

161 位香港的大學生隨機被編入以下三組：公眾接達互聯網組（PAI）、階段目標互聯網組（STI）及控制組（C）。PAI 組接觸五個與體力活動相關公眾可接達的互聯網， STI 組接觸【活躍生活每一天】（ALED）（Blair et al., 2001）的線上課程，而 C 組並沒有接受任何干預。於最初、三個月及六個月評估其體力活動水平（國際體力活動問卷，IPAQ）、階段變化（階段變化問卷，SECQ）及運動自我效能（自我效能問卷，SEQ）。

STI 組的體力活動水平於第三個月的評估有進步（F [1, 48] = 9.965, $p < 0.05$）；所有組別於第三個月及第六個月於美國運動醫學會/美國心臟學會的足夠體力活動標準中顯示沒有差異（$p > 0.05$）； STI 組的階段變化於第三個月的評估

有改善（$Z = 2.379$, $p < 0.05$）；而 PAI 組（$Z = 2.351$, $p < 0.05$）及 STI 組（$Z = 2.013$, $p < 0.05$）都於第六個月的評估有改善； PAI 組的自我效能平均分於第三個月（$F[1, 50] = 6.130$, $p < 0.05$）及第六個月（$F[1, 50] = 4.659$, $p < 0.05$）下降。

透過三次共 15 位參與者的聚焦式面談作爲質性數據收集，公眾接達互聯網的內容未能引發 PAI 組的組員仔細閱覽，而因此沒有提升他們的體力活動水平及階段變化。【活躍生活每一天】（ALED）的課程內容能促使 STI 組的組員提升他們的體力活動水平，以及帶領他們建立運動目標和了解定期運動對健康的重要性。而且，其課程內容及評估問卷都對 STI 組的組員的運動階段變化產生正面影響。PAI 及 STI 組的組員沒感到因干預的內容所引致的運動自我效能有正面的影響。此外，三組的組員都認爲校園環境及設施皆對提升體力活動參與有幫助。

研究二的結果指出，與 STI 組比較， PAI 組未能改善其體力活動水平，顯示公眾接達互聯網未能有效推動大學生的體力活動。而階段目標互聯網的干預可有效短期提升大學生的體力活動水平，但其影響於第六個月消失。

以上兩個研究結果爲以階段目標互聯網推動香港的大學生體力活動的效能提供循證的支持，未來以互聯網爲主的體力活動研究可把重點放於提升長期體力活動參與爲焦點。提升參與者保留率的關鍵點是，未來推動體力活動的互聯網設計不只集中於資訊的發布，而應重視經驗分享及社交互動。

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Publications and Presentations

The findings arose from the thesis have been reported, in part, in the following conference presentations:

Leung, F. L., Wong, H. S. The efficacy of using the Internet in physical activity promotion for university students. Paper presented at the 3rd International Congress on Physical Activity and Public Health, Toronto, Canada, May 5-8, 2010.

Leung, F. L., Wong, H. S. The efficacy of the Internet in physical activity promotion for university students. Oral presented at the 3rd HKASMSS Student Conference on Sport Medicine, Rehabilitation and Exercise Science, Hong Kong, China, June 19, 2010.

Leung, F. L., Wong, H. S., & Huang, Y. J. The efficacy of an Internet-based behavioural intervention for physical activity promotion among university students – a randomized controlled trial. Oral presented at the 2011 Annual Meeting of the International Society for Behavioral Nutrition and Physical Activity, Melbourne, Australia, June 15-18, 2011.

Leung, F. L., Wong, H. S., & Huang, Y. J. Internet-based versus print-based behavioral intervention for physical activity promotion among university students – a randomized controlled trial. Paper presented at the 16th Annual Congress of the European College of Sport Science, Liverpool, United Kingdom, July 6-9, 2011.

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CHAPTER ONE

Introduction

1.1 Background

There is ample evidence that physical activity (PA) is beneficial to health (Hamilton et al., 2007; Healy et al., 2008; Paffenbarger et al., 1986; Physical Activity Guidelines Advisory Committee Report, 2008; U.K. Department of Health, 2004; U.S. Department of Health and Human Services, 2000; Wyrwich & Wolinsky, 2000), conversely, physical inactivity has been shown to be associated with coronary heart disease, type II diabetes and cancer (Blair et al., 1989; Hamilton et al., 2007; Healy et al., 2008; Helmrich et al., 1991; Paffenbarger et al., 1975; Paffenbarger et al., 1986; Wyrwich & Wolinsky, 2000). In addition, regular PA improves concentration and academic performance of children and teenagers (Trost, 2007).

The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) recommended that healthy adults need to accumulate at least 30 minutes of moderate-intensity aerobic PA on five days each week or to accumulate at least 20 minutes of vigorous-intensity aerobic PA on three days each week, combinations of both moderate-intensity and vigorous-intensity aerobic PA can be performed to meet the recommendation (Haskell et al., 2007). The World Health Organization adopted this recommendation (WHO, 2005). The Department of Health (2005) recommended similar

guidelines for the Hong Kong citizens.

Despite its beneficial effects on health, the PA levels of young people have been reported to be below the levels sufficient to gain the health benefits exercise can offer (Cavill et al., 2001). Unsatisfactory PA participation was also found in Hong Kong, according to the survey of Hui and Morrow (2001), 76% of Hong Kong adult were not active enough to obtain health benefits, whereas, 36.1% were sedentary. A citywide PA participation survey (Hui, 2004) found that 31.5% Hong Kong youth were not active enough to obtain health benefits, whereas, 18.3% were sedentary. Another citywide study on the participation patterns of Hong Kong people in PA (LCSD, 2009) reported that more than half (51.4%) of the Hong Kong citizens were inactive. They did not meet the requirements of engaging in moderately or vigorously intense PA three times a week for at least 30 minutes accumulated per day.

PA declines during the transition from secondary schools to universities (Bray & Born, 2004). There is a considerable proportion of university students who do not meet the recommendation criteria for PA (Seo et al., 2007). Interventions that increase PA and improve health awareness and healthy behaviours during college years could have a positive influence on the prevention of acute and chronic health problems in adulthood (U.K. Department of Health, 2004; U.S. Department of Health and Human Services, 2000).

There are six categories of PA interventions (Kahn et al., 2002; Wu et al., 2011), namely, community-wide campaigns, creation or enhancement of access to places for PA, school-based PA interventions, point-of-decision prompts to the use of stairs, social support in a community context and individual PA behaviour change programmes. The community-wide campaigns (Bauman et al., 2003; DeCocker et al., 2007; Reger et al., 2002; Wen et al., 2002) usually involve administrators drawn from multi-disciplines and are targeted at the general public. These campaign messages are transmitted through broad-based, multiple interventions, such as advertisements in the mass media and on transit outlets, press releases, and the organisation of sports fun days and carnivals. The aim of such campaigns is to transmit information on the benefits of regular PA and to change the attitudes and behaviour of the audiences with respect to participation in PA. To be successful, community-wide campaigns require prudent planning, good communications and coordination between the different community sectors, the provision of sufficient resources, regular evaluations and the effective implementation of the interventions.

The creation or enhancement of access to places for PA (Ridgers et al., 2007; Stratton et al., 2005; Verstraete et al., 2006) requires the support of different organisations, commercial agencies and government sectors. With proper planning and sound coordination, access to places for PA for the targeted population can be created and

enhanced. Such interventions include the construction of walking trails, providing access to fitness equipment in community centres or local commercial fitness centres, and redesigning the playground settings to make them colourful and attractive for users. To be successful, such interventions require a sufficient resource allocation, maintaining good communications between the organisations involved, regular evaluations and the effective implementation of the interventions.

The school-based PA interventions (Pate et al., 2005; Sallis et al., 2003; Salmon et al., 2008) require the support of the decision makers and teachers in the schools, and sometimes the support of the parents is also important. These interventions include teacher-led PA education, leaflets combined with a motivational game or quiz, school-based physical education and educational programmes on health, nutrition and diet. To be successful, such interventions require good cooperation between the school management, the teachers, the parents and the students, as well as the allocation of sufficient resources.

Point-of-decision prompts to the use of stairs (Auweele et al., 2005; Boutelle et al., 2004; Eves et al., 2008; Webb et al., 2005) consist of signs or posters placed close to escalators and elevators to encourage people to use the stairs. The messages motivate them to use the stairs, indicating the benefits for their health, weight control and time saving. Appropriate locations for these signs include airports, banks, libraries, office

buildings, train stations, and shopping centres. In some cases they can be supplemented by framed artwork and various types of music (Kerr et al., 2004). These interventions are likely to be effective by drawing the attention of people to the opportunity to be more active and by reminding them of the health benefits of using the stairs.

The social support interventions in a community context (Issacs et al., 2007; Jancy et al., 2008; Martinson et al., 2008) are designed to enhance PA by making use of new social networks or by strengthening pre-existing social networks in community settings, such as the local leisure centres, worksites and community societies. They can include neighbourhood based walking programmes, telephone-based and mail-based PA support programmes, pairing up in a "buddy" system to provide companionship and social support, which can facilitate PA behavioural change.

The individual PA behaviour change programmes (Aittasalo et al., 2006; Chan & Ko, 2006; Marcus et al., 1998a; Marshall et al., 2003a; Prochaska et al., 2008; Spittaels et al., 2007) provide participants with the behavioural management skills needed for the adoption and maintenance of a change in PA behaviour. These interventions aim to help participants to incorporate moderate intensity PA into their daily routines. Usually, the programme contents are developed based on one or two established health behaviour change theories, such as the TTM (Prochaska & DiClemente, 1983), the SCT (Bandura, 1986), and the Health Belief Model (Rosenstock, 1960). The behavioural modification

skills include goal setting and self-monitoring, social support building, self-rewarding, self-talking, problem solving and relapse prevention. The interventions provide counselling to participants through face-to-face consultations, through mailing print materials, using an automated telephone system, and providing computer compact disc programmes and Internet-based programmes. To be successful, such interventions require careful planning, selection of the appropriate behaviour change programmes for the targeted populations, the allocation of sufficient resources, and the availability of well-trained facilitators and staff.

The PA interventions designed for individuals and face-to-face groups have limited population reach and are more expensive comparing with the Internet-based interventions for wide scale PA promotion (Lewis et al., 2010). Internet-based interventions seem to have shown the potential of serving large numbers of the population, and possess the advantages of convenience, flexibility, and more effectiveness and opportunities for interaction. Internet-based interventions not only have greater reach, but also provide tailored information and instantaneous feedback (Fotheringham et al., 2000a). Recently, focus has been put on using Internet as a means to promote health-related behavior change (Steele et al., 2007; Wantland et al., 2004; Vandelanotte et al., 2007).

1.2 Purpose and Significance

It has been suggested that PA declines sharply during the teenage and young adult

years (Caspersen et al., 2000; Stone et al., 1998). Currently, large proportions of university students are spending considerable time in sedentary behaviours, particularly computer and Internet using (Fotheringham et al., 2000b). If a sedentary lifestyle is developed during young adulthood, this may persist throughout the life span. In order to halt the sedentary trend among the university students, effective PA interventions should be implemented.

The appeal of the advanced information technology and the relatively greater cost efficiency of Internet-based interventions (Lewis et al., 2010) facilitated the need to examine the efficacy of using Internet as a mode of delivery for PA promotion. Some studies have examined the efficacy of the Internet in producing PA behavior change. Marshall and colleagues (2003b) reported limited PA change, and only a significant decrease in sitting time observed, in subjects allocated to a PA-based website compared with a group receiving printed information. Napolitano and colleagues (2003) reported increased minutes of PA (at first month assessment) and walking behavior (at third month assessment) for a 12-week Internet-based programme, compared to the control group.

Steele and colleagues (2007) conducted a randomized trial with 192 participants and reported statistically equivalent increases in PA in all groups, including face-to-face, Internet-mediated (with Internet access and face-to-face sessions) and Internet-only groups immediately after a 12-week intervention. Franko and colleagues (2008)

conducted a randomized control trial and 476 full-time undergraduate students were recruited from six universities in the United States. They were randomly assigned to one of the three groups: the two sessions Internet programme group (I), the two sessions Internet programme plus booster group (IB) and the attention placebo control group (C). Similar to Marshell et al. (2003b), no significant changes in PA, and only improved attitude towards exercise were found in the intervention groups.

Carr and colleagues (2008) delivered a randomized controlled trial to examine the effectiveness of an Internet-delivered PA behaviour change programme to promote PA and improve cardiometabolic disease risk factors (CDRF) in sedentary overweight adults. The results found that there was similar improvement in PA participation in all intervention groups compared to baseline in the post intervention assessment, whereas the coronary risk ratio decreased in the overweight participants of the Internet-delivered behaviour change programme group.

Overall, some studies reporting increased in PA participation across time but some studies did not show any positive PA outcomes. The findings on the actual effectiveness of using the Internet for PA promotion remained inconclusive, further studies are needed to examine the efficacy of Internet-based programme for PA promotion.

Sparling (2003) claimed that universities are important settings in which healthy lifestyles can be promoted and nurtured. With the advantage that most university students

have access to the Internet and are familiar with computer use (Madden & Jones, 2002), the Internet has the potential for delivering interactive PA promotion programmes for university students. Furthermore, university-based physical education and university students' PA are under researched (Kahn et al., 2002; Keating et al., 2005). The use of this new technology for PA promotion in university campus settings is promising but the efficacy is unknown. There are few studies if any to test the new information technology for PA promotion in such settings. The purpose of this study was to examine the effectiveness of the Internet in promoting PA among university students. The findings were expected to generate new knowledge in understanding the mode of delivery of PA intervention for PA promotion among university students.

1.3 Operational Definitions

1.3.1 Physical Activity

Physical activity is any bodily movement produced by the contraction of the skeletal muscles that substantially increases energy expenditure above the baseline level. Commonly used categories include occupational, leisure-time or recreational, household, self-care, and transportation or commuting activities (Physical Activity Guidelines Advisory Committee, 2008; Wuest & Bucher, 2005).

1.3.2 Exercise

Exercise is a subcategory of physical activity that is "planned, structured, and

repetitive and purposive in the sense that the improvement or maintenance of one or more components of physical fitness is the objective" (Physical Activity Guidelines Advisory Committee, 2008; Wuest & Bucher, 2005).

1.3.3 Health-enhancing Physical Activity

Health-enhancing physical activity, is activity that produces health benefits (Physical Activity Guidelines Advisory Committee, 2008; Wuest & Bucher, 2005), these activities include brisk walking, rope skipping, dancing, weight lifting and climbing on playground equipment during recess.

1.3.4 Physical Inactivity

Physical inactivity is not achieving the level of physical activity recommendations, that is, 30 minutes of moderate intensity activity on at least five days a week, or 20 minutes of vigorous activity on at least three days a week (Haskell et al., 2007).

1.3.5 Stage of Change

Stage of change reflects the temporal dimension of readiness in which attempts to adopt new behaviour occur (Marshall & Biddle, 2001).

1.3.6 Self-efficacy

Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3).

1.4 Hypotheses

The current studies had a number of hypotheses as follows:

1) Participants in the Internet-based intervention group would demonstrate an improvement in PA to a similar extent as their counterparts in the print-based intervention group.
2) Participants in the Internet-based intervention group would demonstrate an improvement in stage of exercise change to a similar extent as their counterparts in the print-based intervention group.
3) Participants in the stage-targeted Internet intervention group would demonstrate an improvement in PA to a similar extent as their counterparts in the public access Internet intervention group.
4) Participants in the stage-targeted Internet intervention group would demonstrate an improvement in stage of exercise change to a similar extent as their counterparts in the public access Internet intervention group.
5) Participants in the stage-targeted Internet intervention group would demonstrate an improvement in self-efficacy of physical activity participation as their counterparts in the public access Internet intervention group.

1.5 Limitations of the Studies

The current studies had a number of limitations as follows:

1) The results were obtained from the full time undergraduate students of eight

universities in Hong Kong, which meant that the majority of the participants might have had similar socioeconomic backgrounds. The ability to generalize the findings for other groups of youth with more diverse academic requirements and different socioeconomic backgrounds was thus, limited.

2) The study included interviewing for data collection. Interviewer needed to meet the interviewees; therefore, anonymity was not possible during the face-to-face interviews.

1.6 Delimitations of the Studies

The current studies had a number of delimitations as follows:

1) Full-time undergraduate students were selected because they had more time to stay in their university campuses comparing with the part-time students. The university campuses could provide favourite environment and sports facilities and these might support physical activity participation.

2) Participants were selected from the full-time undergraduate students of eight University Grants Committee funded universities in Hong Kong because most of the full time undergraduate students in Hong Kong were studying in these universities.

3) The study adopted interviewing for data collection. It could help the researcher to gain an in-depth understanding of the participants' behaviours, collect information on what had happened, how it had happened, and why it had happened (Amis, 2005).

CHAPTER TWO

Review of Literature

The studies aimed to investigate the efficacy of the Internet in promoting PA among university students. The present chapter intends to review PA of university students. The researcher will then further elaborate the Transtheoretical Model (Prochaska & DiClemente, 1983) and Social Cognitive Theory (Bandura, 1986). Previous work on print-delivered and Internet-based interventions will be critically reviewed. Finally, the benefits and limitations of the Internet-based interventions will be discussed.

2.1 Physical Activity of University Students

During the transition from secondary school to university the PA of students declines (Bray & Born, 2004). A meta-analysis of college students' PA behaviour (Keating et al., 2005) reported that 40% to 50% of college students were physically inactive. In addition, a considerable proportion of university students do not meet the recommendation criteria for PA (Seo et al., 2007).

Many adult behaviours are established during childhood to early adulthood (Bungum & Vincent, 1997). PA patterns during the young adult years may have important influences on habitual PA during adult life and, consequently, long-term health may be affected. It has been reported that 84.7% college seniors who exercised regularly remained physically active 5 to 10 years later, whilst 81.3% of the college seniors who

were physically inactive remained sedentary (Sparling & Snow, 2002). It is evident that the well being of university students will greatly influence the future of our society because those who attend universities may play an important role in establishing social and cultural norms as they have the potential to become decision makers and influential leaders within society (Leslie, et al., 1999a; Leslie, et al., 1999b).

Lee and colleagues (2005) found that among the 247 Hong Kong university student participants in Hong Kong, 31.2% engaged in any form of PA and only 13.8% exercised regularly. A larger scale survey (Abdullah et al., 2005) with 1189 participants found that one-third of the university students in Hong Kong were physically inactive. Tsai and colleagues (2007) conducted a comparative survey with participants of 1336 Hong Kong and 1282 Australian university students. The Hong Kong students were found to be less active, had lower intention to participate in PA, and lower preferences for active recreation.

2.2 University Students and the Internet

The size of the population using the Internet for information, such as health, fitness and PA is growing. The Internet is a popular source of healthcare information (Vance, et al., 2009). Nowadays there are around 1.8 billion Internet users worldwide and more than 764 millions Internet users are located in Asia (Miniwatts International, 2008). According to the survey of Madden (2006), 73% of the USA population has access to the Internet.

The European Commission planned to increase the Internet broadband coverage to 100% by the year 2013 (European Commission, 2010). In Hong Kong, 75.8% of all domestic households had personal computers at home and among those households, 96.8% had their computers connected to the Internet (Census and Statistics Department, 2009).

Currently, university students have become immersed in technology products such as, mobile phone, tablet and portable computer. Large proportions of the students are spending considerable time in sedentary behaviours, particularly computer and Internet usage (Fotheringham et al., 2000b). If sedentary lifestyle is developed during young adulthood, it may persist throughout the life span. In order to reverse the physical inactivity trends among the university students, effective PA interventions should be implemented.

2.3 Theoretical Foundations

2.3.1 Transtheoretical Model (TTM)

Effective health promotion interventions are not created by chance. They are the result of well-conceived planning and are organized around a sound theoretical framework. Among the theories and models used in health promotion, particularly promotion of PA, TTM and social cognitive theory (SCT) have attracted a significant amount of attention from scholars and health educators (Carr, et al., 2008; Dunn, et al., 1997; Dunn, et al., 1999; Marcus et al., 2007; Napolitano et al., 2003; Sciamanna et al.,

2002; Steele et al., 2007; Vandelanotte et al., 2007; Wilcox et al., 2006; Wilcox et al., 2007).

The Transtheoretical Model was first developed by Prochaska and DiClemente (1983) for smoking cessation programmes. The model was then widely applied to promote PA (Bock et al., 2001; Calfas et al., 1996; Carr et al., 2008; Goldstein et al., 1999; Kirk et al., 2001; Marcus et al., 1998a; Marcus et al., 1998b; Marcus et al., 2007; Peterson and Aldana, 1999; Pinto et al., 2001; Sciamanna et al., 2002; Steptoe et al., 1999; Steptoe et al., 2001; Wilcox et al., 2006, Wilcox et al., 2007).

The main constructs of TTM include stages of change, processes of change, self-efficacy and decisional balance. In this review section, those constructs will be consorted with PA behaviour change. The TTM postulates that people differ in their readiness for adopting new behaviours, and that there are five stages of behaviour change (Marshall and Biddle, 2001). They are: (1) pre-contemplation stage, in which one is not participating in any physical activity and has no intention to do so in the future; (2) contemplation stage, in which one is not participating in any physical activity but is intending to start doing so in the next six months; (3) preparation stage, in which one is intending to start participating in regular physical activity in the next six months and is starting to make small changes in activity behaviour; (4) action stage, in which one is meeting defined criteria for physical activity but has done so for less than six months; and

(5) maintenance stage, in which one is meeting defined criteria for physical activity for more than six months. The transition across the stages of change is not believed to be linear, but is considered to be cyclical with the potential of lapse and relapse (Cardinal, 1998).

The TTM integrates stages of change with 10 processes of behaviour change and two behaviour change constructs. The 10 processes of behaviour change are classified as experiential and behavioural processes of change (Prochaska et al., 1992). The experiential processes include consciousness raising, environment re-evaluation, dramatic relief, self-re-evaluation, and social liberation; processes that are most useful during the early stage of progression. The behavioural processes include counter conditioning, helping relationships, reinforcement management, self-liberation and stimulus control; processes most useful in the later stage of progressions. Definitions of the processes of change are listed in Table 1.

Table 1. Processes of change (Prochaska et al., 1992)

Process of Change	Description
Consciousness raising	Increasing awareness about self and potential behaviour change
Environmental re-evaluation	Assessment of how the behaviour change will affect the social environment
Dramatic relief	Reduction of negative emotion caused by problem behaviour through taking action
Self-re-evaluation	Assessing feelings and thoughts of self relative to the behaviour change
Social liberation	Increase in social opportunities relative to the behaviour change
Counter conditioning	Learning healthier behaviours that can substitute for problem behaviours
Helping relationships	Seeking open and trusting support for new behaviours
Reinforcement management	Rewards (from self or others) for making changes
Self-liberation	Belief that change is possible and commitment to act on that belief
Stimulus control	Removal of cues for problem behaviours and addition of prompts for new behaviours

The two behaviour change constructs are self-efficacy and decisional balance. Self-efficacy is associated with the level of self-confidence that a physical activity task can be performed successfully (Bandura, 1997). In a meta-analysis by Marshall and Biddle (2001), self-efficacy was found to increase across the stages of change progression. Self-efficacy has been shown to predict PA behaviour in adults (Kaewthummanukul & Brown, 2006; Sallis et al., 1986; Sallis et al., 1992; Strachan et al., 2005). In addition,

changes in self-efficacy have been shown to mediate the effects of behaviour change interventions on walking (Darker et al., 2010).

According to Janis and Mann (1977), decisional balance refers to the balance between the perceived benefits and costs of PA behaviour change. This construct is believed to be most relevant for progression in the early stage, that is, from pre-contemplation to contemplation or preparation, when the cons outweigh the pros of behaviour change (Prochaska & Marcus, 1994). This finding was consistent with the meta-analysis study of Marshall and Biddle (2001), where highest effect size in decisional balance was found during the shift from pre-contemplation to contemplation. Therefore, increasing the awareness of PA benefits for the pre-contemplators should be carefully arranged during intervention planning.

2.3.2 Social Cognitive Theory (SCT)

The social cognitive theory (Bandura, 1986), originally called social learning theory, posits that an individual's behaviour is uniquely determined by the interaction of environment, behavioural and cognitive factors. The dynamic and reciprocal relationships among person, environment (physical and social), and behaviour itself are important elements of SCT. An alteration in any of the factors will trigger changes for others. Similar to TTM, it was widely applied to promote physical activity (Carr, et al., 2008; Dunn, et al., 1997; Dunn, et al., 1999; Marcus et al., 2007; Napolitano et al., 2003;

Sciamanna et al., 2002; Steele et al., 2007; Wilcox et al., 2006; Wilcox et al., 2007).

The key constructs of SCT include outcome expectations, outcome expectancies, self-control, observational learning, reinforcements and self-efficacy (Baranowaski et al., 1997). Table 2 summarizes these constructs that form the framework for explaining behaviour change.

Table 2. Summary of SCT constructs (Baranowski et al., 1997)

Construct	Definition
Outcome expectations	Anticipated outcomes of a behaviour
Outcome expectancies	Value placed on a particular behavioural outcome
Self-control	Personal regulation of a behaviour
Observational learning	Behavioural acquisition through observing actions and outcomes of others
Reinforcements	Responses to behaviour that increase or decrease likelihood of continuation
Self-efficacy	Confidence in ability to perform a certain behaviour

According to Bandura (2004), SCT provides detailed description on the core determinants, the working mechanism of the determinants, and the paths of health behaviour change. The core determinants include knowledge of health risks and benefits, perceived self-efficacy, outcome expectations, personal goals, perceived facilitators and impediments of behaviour change.

Recognizing the benefits and health risks of health behaviour is a prerequisite to

generate behaviour change. People need to have the relevant knowledge of health risks and benefits of that health practice before adopting a new behaviour. Perceived self-efficacy is the self-confidence that he can exercise control over one's health habits. This determinant affects human motivation to change. With the belief that one can produce desired effects by one's actions, people will have greater motivation to change. Outcome expectations are the expected costs and benefits for adopting of health practices. There are three kinds of outcomes, namely, physical outcomes on the cheerful and disrelish influences of the change, social reactions that caused by the change, and the self-evaluative reactions to the health behaviour.

Personal goals provide guides for health behaviour changes. There are long-term goals and short-term goals. The long-term goals set the direction and plan for the change while the short-term goals provide guides and self-incentives for the health practices. There are different kinds of impediments such as, heavy work load, anxiety, bad weather, and attracted by other inactive recreation activities. Adopting health behaviour would be easier if one's perceived facilitators are more than one's perceived impediments to change. Based on SCT, people work together to share the same goal; individual efficacy can be extended to collective efficacy which might affect policy and health promotion interventions. (Bandura, 2000; Bandura, 2001; Bandura, 2004).

2.4 Individual PA Behaviour Change Interventions

2.4.1 Print-delivered Interventions

Individual PA behaviour change programmes, especially the face-to-face interventions are efficacious and has been recognized as the "gold-standard" for PA promotion (King et al., 1991; King et al., 1995). Face-to-face, print-delivered, theory-based, and stage-targeted interventions (Bock et al., 2001; Koffman et al., 2001; Marcus et al., 1992a; Marcus et al., 1998a; Marcus et al., 1998b; Marshall et al., 2003a; Marshall et al., 2004) have been shown as effective in promoting PA. Print-delivered interventions can use booklets, pamphlets, fly sheets and personal letters to arouse PA behaviour changes. They can be tailored to an individual's stage of change (pre-contemplation, contemplation, preparation, action and maintenance), goals, self-efficacy and interests.

Marcus and colleagues (1992a) conducted a six-week trial in the United States. The study examined the use of the stages of change model in designing an exercise intervention. There were 610 adults aged 18 to 82 years old enrolled in the community-wide programme. The intervention included self-help manuals matched to motivational readiness, and a resource manual describing activity options in the community. The results demonstrated that matching interventions to the individual's motivational readiness for PA adoption could increase PA adoption of participants.

Following this study, a randomized, controlled trial (Marcus et. al., 1998b) was

delivered. This three-month study compared the efficacy of a self-help intervention tailored to the individual's stage of motivational readiness for PA adoption with a standard self-help PA promotion intervention. There were 11 worksites, and 1559 employees participated in the project. The results showed that a motivationally matched printed self-help PA promotion intervention was more effective in promoting PA than the standard self-help materials. The results also demonstrated that progression in motivational readiness for PA adoption was significantly and positively associated with increased self-reported PA.

Another print-based study compared the efficacy of a motivationally matched, individually tailored (IT) intervention with a standard self-help (SS) intervention (Bock et al., 2001; Marcus et. al., 1998a). One hundred and ninety-four adults recruited through newspaper advertisements participated in the project. The participants of the IT group outperformed their counterparts on minutes of PA per week, reaching the current PA recommendation for adults from the Centres for Disease Control and American College of Sports Medicine, and achieving the action stage of motivational readiness for PA adoption. The results revealed that individually tailored, motivationally matched interventions might be an effective approach for enhancing PA participation in the community.

A 12-week educational intervention that aimed to improve lifestyle behaviours in women was conducted by Koffman and colleagues (2001). There were 23,171 women

enrolled into the state-wide programme named "Choose to Move". The participants received manuals with weekly information about how to establish a support system for an active lifestyle and how to deal with cardiovascular disease risk factors. The results indicated that participants who completed the programme significantly increased their levels of PA, decreased their consumption of high-fat foods, and their knowledge and awareness of cardiovascular disease risk factors and symptoms was enhanced.

There were two large-scale trials implemented in Australia. Marshall and colleagues (2003a; 2004) examined the wider effectiveness of mailed stage-targeted print materials delivered to large population samples, including adult residents of a regional city (Marshall et al., 2003a), and participants from adult residents of the State of New South Wales (Marshall et al., 2004). The interventions included a single mailing of a letter and full-colour stage-targeted booklets. After two months, participants in the intervention group of the city-wide programme were significantly more likely to meet the current PA recommendation for adults from the Centres for Disease Control and American College of Sports Medicine than were their counterparts. The results suggested that the stage-targeted print intervention was effective in promoting short-term increases in PA of community residents. However, no significant increase in PA was observed in the state-wide intervention. The results demonstrated that a single mailing of stage-targeted print materials was not effective for promoting PA in the state-wide population.

Trials of these theory-based, stage-targeted, personally tailored and print interventions showed that this medium of delivery has some promise for PA promotion. Further research is necessary on the frequency of contact required and supplementary educational materials needed to produce sustained effects.

Although print-delivered interventions showed some promise on PA promotion, such interventions might have some limitations, including human power, time constraints, postage and printing cost, lack of immediate feedback and interactive activity. Hence, researchers have focused on using the Internet as a means to promote health related behaviour change (Steele et al., 2007; Wantland et al., 2004).

2.4.2 Internet-based Interventions

Nowadays there are nearly 1.8 billion Internet users worldwide and more than a half-billion Internet users in Asia (Miniwatts International, 2008), and many of them are using the Internet for accessing health information (Fox, 2006). Recently, Internet-based interventions have been advocated as a promising mode of delivering health behaviour change, in particular PA interventions (Falk et al., 2008; Fotheringham et al., 2000a; Fotheringham et al., 2000b; Vandelanotte et al., 2007).

Internet-based PA interventions may possess the potential to overcome the limitations of the print-delivered interventions. Some studies have examined using the Internet to produce PA behaviour change for the adults with type II diabetes (Feil et al.,

2000; Glasgow et al., 2003; McKay et al., 2001). McKay and colleagues (2001) conducted an eight-week trial in the United States. Seventy-eight type II diabetic patients participated in the study. They were randomly divided into the Internet information-only comparison group and the Internet Active Lives Intervention group. The intervention group participants received goal-setting and personalized feedback, and strategies to overcome barriers. They could post and receive messages through the on-line "personal coach", and were invited to join the peer group support areas. As a result, there was an overall moderate improvement in PA levels within both groups, but no significant differences in PA improvement between groups. However, there was a significantly larger PA increase in the intervention group compared to the comparison group for participants that used the programme three or more times.

Another randomized controlled trial with diabetes participants evaluated the incremental effects of adding tailored self-management training and peer support to an Internet-based diabetes programme (Feil et. al., 2000; Glasgow et. al., 2003). A total of 320 patients with type II diabetes were randomly assigned into four groups. Group (a) participants could access Internet diabetes information (D-Net website), and received self-management training; group (b) participants could access Internet diabetes information and received peer support; group (c) participants could access Internet diabetes information, and received self-management training and peer support; group (d)

participants could access Internet diabetes information only. The results on PA were quite disappointing; no significant increase in moderate PA, meeting PA guidelines between or within groups was found. The results showed that the intervention components of self-management and peer support did not produce a positive effect on PA behaviour change.

Some studies have focused on weight loss or obesity prevention (Harvey-Berino et al., 2002a; Harvey-Berino et al., 2002b; Harvey-Berino et al., 2004; Tate et al., 2001; Tate et al., 2003; Thompson et al., 2008). Tate and colleagues (2001) recruited 91 healthy, overweight hospital employees through e-mail and hospital intranet. The participants were divided into the Internet education group (IE) and the Internet education plus Internet behaviour therapy group (IBT). The intervention included a self-monitoring webpage for both groups, and weekly behavioural lessons via e-mails for the IBT group only. The results showed significant increases in PA in both groups at the third and sixth month assessments, but no significant differences in PA improvement between groups.

Tate and colleagues (2003) conducted another weight loss study using Internet interventions. Ninety-two overweight adults at risk for diabetes were recruited through newspaper advertisements into the study. The participants were randomized to an Internet weight loss programme (group a) and an Internet weight loss plus e-mail counselling programme (group b). Both groups received face-to-face counselling sessions and the

same self-monitoring Internet programmes. The participants in group b received weekly e-mail behavioural counselling and feedback from a counsellor. The results showed a significant increase in energy expenditure for group b participants at the third month assessment. This demonstrated that adding e-mail counselling to an Internet weight loss program might improve weight loss in adults with diabetes risk.

A pilot study was conducted (Thompson et al., 2008) to evaluate an Internet-based youth obesity prevention programme on fruit, juice, and vegetable (FJV) consumption, PA, FJV self-efficacy, and PA self-efficacy. A total of 80 girls of age 8 to 10 were randomized into the immediate incentive group (immediate) and the delayed incentive group (delayed). The 8-week internet programme promoted FJV, water consumption, and lifestyle PA. The immediate group participants received a weekly incentive of $5 within two business days for completing online activities while the delayed group participants received the incentive at the end of the program. Statistically significant increases were observed in FJV consumption, PA participants, and FJV self-efficiency at both groups. These findings suggested that Internet-based obesity prevention programmes might be an effective way of promoting healthy diet and PA for the youth.

Another pilot study (Harvey-Berino et al., 2002a) examined the feasibility of using Internet support for a weight loss maintenance intervention. Forty-four obese adults were recruited for the study. They were randomly assigned to three groups: the Internet

therapist-led group (I), in-person therapist-led group (TL) and control group (C). The TL group participants communicated with a therapist face-to-face biweekly, while the I group participants contacted their therapist through Internet video sessions. There were no differences between the intervention groups in PA change and weight loss after 22 weeks. Participants lost an average of 1.6kg, decreased calorie and fat intake by an average of 20 calories and 0.33 fat grams per day, and increased calories expended in exercise by 419 Kcals per week. Hence, the Internet might hold promise as a way for maintaining contact with participants to facilitate long-term behaviour change.

The effectiveness of conducting a weight maintenance programme over the Internet was examined again with more subjects (Harvey-Berino et al., 2002b). A total of 122 healthy but overweight adults were randomized into three groups: the frequent in-person support group (FIPS), minimal in-person support group (MIPS) and Internet support (IS) group. There was significant increase in PA across all groups during the 12-month treatment, with the FIPS group maintaining significantly higher than baseline PA level at the eighteenth month assessment. The results suggested that Internet support might be less effective than in-person therapist support for facilitating the long-term maintenance of weight loss.

Harvey-Berino and colleagues (2004) conducted a further investigation on the effect of Internet support on the long-term maintenance of weight loss. A total of 232

overweight and obese adults were randomized into the IS, MIPS and FIPS groups. Compared to the previous study (Harvey-Berino et al., 2002b), telephone calls were included in the FIPS group and the number of e-mail contacts in the IS group was increased in this trial. The results demonstrated that all groups significantly increased reported PA during treatment, but showed no significant difference between groups. Participants of the IS group sustained comparable weight loss compared with participants of the MIPS and FIPS groups. Thus, the Internet could be a feasible medium for long-term maintenance of weight loss intervention.

Some studies have evaluated the efficacy of using the Internet to increase PA participation and to combat physical inactivity (Carr et al., 2008; Hageman et al., 2005; Irvine et al., 2011; Kosma et al., 2005a; Kosma et al., 2005b; Leslie et al., 2005; Marcus et al., 2007; Marshall et al., 2003b; Napolitano et al., 2003; Prochaska et al., 2008; Sciamanna et al., 2002; Spittaels et al., 2007; Steele et al., 2007). A large-scale randomized control trial conducted in Australia aimed to compare a stage-targeted print intervention with an Internet-based program of similar contents (Leslie et al., 2005; Marshall et al., 2003b). A total of 655 university staff participated in the study. They were randomized to either the print group or the website group. The results showed limited PA change, and only a significant decrease in sitting time was observed in participants of the website programme compared with a group receiving printed PA information.

Prochaska and colleagues (2008) also conducted a randomized clinical trial on a worksite sample. The study aimed to compare the efficacy of Motivational Interviewing (MI), online TTM-tailored communications (TTM), and a Health Risk Intervention (HRI) on four targeted health risk factors, namely inactivity, BMI, stress and smoking. A total of 1400 university employees were randomized into the intervention groups. The participants of the HRI only group received an HRI session, the TTM group participants received an HRI session and three TTM online sessions and the MI group participants received an HRI session and three MI in person or telephone sessions. At the 6-month post-treatment assessment, the MI and TTM groups had more participants in the action stage for exercise and effective stress management and their participants had fewer risk behaviors comparing with the HRI only group. The intervention effects were similar in the MI and TTM group. These findings showed that both the MI and online TTM-tailored intervention could produce multiple behavior changes.

Another study targeted at a worksite sample (Irvine et al., 2011) was designed to improve PA of sedentary employees. A total of 221 workers were randomized into the web site group and the control group. The intervention website helped the website group participants to develop personalized PA plan. At 1-month follow-up, the participants of the web site group differed significantly from the control group on 11 outcomes, including, stage of change, self-efficiency and perceived barriers to PA. The findings

supported the efficacy of the intervention web site for increasing PA of sedentary employees.

A large-scale randomized control trial was conducted across several universities (Franko et al., 2008). A total of 476 full-time undergraduate students were recruited from six universities in the United States. They were randomly assigned to one of three groups: the two sessions Internet programme group (I), the two sessions Internet programme plus booster group (IB) and the attention placebo control group (C). The Internet-based programme was a nutrition and physical activity education program designed for university students. Similar to Leslie et al. (2005) and Marshell et al. (2003b), no significant changes in PA, and only improved attitude towards exercise were found in the intervention groups. However, participants in the intervention groups increased their fruit and vegetable intake compared with the C group.

Hageman and colleagues (2005) carried out a study to compare the tailored versus standard Internet-delivered interventions for PA promotion. The participants were 31 older women aged 50 to 69 years, with a mean age of 56. They were randomized into the tailored Internet-delivered group (TI) and the standard Internet-delivered group (SI). The participants of the TI group received computer-tailored newsletters and advice, while the SI group received standard newsletters. Similar to Marshall et al. (2003b) and Leslie et al. (2005), there was no increase either within or between groups for total PA at the third

month assessment.

Another Internet-based study (Napolitano et al., 2003; Sciamanna et al., 2002) was designed to test the efficacy of a 3-month Internet intervention for sedentary adults. A total of 65 participants were randomly divided into the website plus weekly e-mail group (I) and waiting list control group (C). The interventions included accessing a theory-based Internet website and receiving weekly e-mail tip sheets for three months. The results showed that the I group had a significant increase in moderate PA relative to the control group at the first month assessment. The participants of the I group had a significant increase compared with the C group in the number of minutes walking at first month, and maintained a significantly higher walking time at the third month assessment. These findings showed that a PA website and weekly e-mail could have a short-term positive impact on PA promotion.

The study of Kosma and colleagues (2005a; 2005b) also supported the short-term efficacy of the Internet-based PA motivational programme. One hundred and fifty-one sedentary adults with physical disabilities such as spinal cord injury, multiple sclerosis and cerebral palsy participated in the study. The participants were randomly divided into the web-based PA group and the control group. The interventions included a motivational PA website with weekly targeted materials. The participants of the web-based PA group increased their leisure-time PA participation significantly more than the control group at

the one-month post-intervention assessment. However, no differences in leisure-time PA participation between groups were found at the sixth month assessment. Spittaels and colleagues (2007) delivered a randomized control trial in Belgium. A total of 526 adults were recruited through e-mails, posters and newsletters in six worksites. They were randomly assigned to one of the three groups receiving, respectively, online tailored PA advice and stage-based reinforcement e-mails (group a); online tailored PA advice (group b); and online non-tailored standard PA advice (group c). At the sixth month follow-up assessment, total PA, moderate intensity PA and leisure time PA significantly increased in all groups between baseline and follow-up, whereas, no differences in PA participation between study interventions were found. Thus, there was no evidence that an online-tailored PA programme outperformed online standard PA programme.

Similar to Spittaels et al. (2007), Steele and colleagues (2007) reported statistically equivalent increases in PA in all groups, including face-to-face, Internet-mediated (with Internet access and face-to-face sessions) and Internet-only groups immediately after a 12-week intervention. There were 192 inactive adults that participated in this randomized trial.

Marcus and colleagues (2007) conducted a study aiming to compare the effectiveness of Internet-based and print-based PA interventions. A total of 249 participants were randomized to one of the three groups: the motivationally tailored

Internet group (TI), the motivationally tailored print group (TP), and the standard Internet group (SI). Participants in the TI group and TP group received the same intervention content, while the SI group accessed six PA websites available to the public. Similar to Spittael et al. (2007), the times of PA participation significantly increased in all groups between baseline and the sixth month follow-up assessment, but no differences in PA participation between groups were found. The results demonstrated that using tailored Internet, tailored print, and standard Internet as components of a behaviour change intervention increased PA participation similarly.

Carr and colleagues (2008) delivered a randomized controlled trial to examine the effectiveness of an Internet-delivered PA behaviour change programme to promote PA and improve cardiometabolic disease risk factors (CDRF) in sedentary overweight adults. There were 32 adults participating in the study. They were randomly allocated to a 16-week Internet-delivered behaviour change programme (ID), classroom-delivered behaviour change programme (CD), traditional individualized exercise prescription programme (TEP), and control group (C). The results found that there was similar improvement in PA (steps / day) in the three intervention groups compared to baseline in the post-intervention assessment, whereas the coronary risk ratio decreased in the overweight participants of the ID group.

In order to examine the feasibility of using Internet technology for translating an

evidence-based lifestyle programme into clinical practice, a before-and-after pilot study (McTigue et al., 2009) was conducted. There were 50 adults with at least one weight-related cardiovascular risk factor participating in the study. The lifestyle interventions included online self-monitoring of physical activity, diet and weight, and automated weekly progress reports. Communication with lifestyle coaches was provided where needed. At the twelve month follow-up assessment, the body weight of the participants decreased 4.79 (SD 8.55) kg and the systolic blood pressure dropped 7.33 (SD 11.36) mm Hg. The findings supported the efficacy of using Internet-based programmes for improving the delivery of preventive medicine counselling in the primary care setting.

Based on the literature review, some studies reporting increased in PA level across time but some studies did not show any positive influence on PA participation. The findings on the actual effectiveness of using the Internet as an alternative mode of PA intervention delivery remain inconclusive, particularly among young adults; further studies are needed to examine the efficacy of Internet-based programme for PA and health promotion. The benefits and limitations of Internet-based interventions are discussed in the following section.

2.5 Benefits and Limitations of Internet-based Interventions

Internet-based interventions seem to have shown the potential of serving large

numbers of the population, and possess the advantages of convenience, flexibility, and more effectiveness and opportunities for interaction. Tailored information and instantaneous feedback can be provided. Not only the feedback, but also the diagnostic tool can be tailored by omitting questions which would be irrelevant for the respondent (Fotheringham et al., 2000a). Internet-based interventions can overcome barriers related to time constraints. Respondents can receive specific information on a particular topic at a specific time. Attractive audio-visual and animated information can also be provided (Tate et al., 2001). Web-based programmes can reinforce social support by providing an electronic platform for group discussion in which the programme recipients can freely communicate and share diverse experiences and ideas. Apart from these communication advantages, web-based programmes can provide long-term cost effectiveness to facilitators in programme implementation and evaluation (Fotheringham et al., 2000a).

However, limitations of Internet-based intervention can also be found. Such interventions, for example, can only reach people who have access to the Internet. Information read from a screen may not be as thoroughly processed as information read as print material, and self-report feedback from participants may not be accurate, and could lead to an incorrect estimation of the health behaviour. Moreover, low engagement and retention rate was also a challenge for Internet-based interventions (Vandelanotte et al., 2007).

2.6 Summary

Marcus and colleagues (2009) claimed that Internet-based PA programmes were as effective as other well-established PA interventions, such as print-based interventions. This review also found that over half of the studies reported increase in PA participation. However, the influences were mostly short term (less than six months). Further, although research on the Internet-based PA interventions is at the early developmental stage, there is still much potential for using the Internet as a mode of delivery for PA promotion. Kreps and Neuhauser (2010) claimed that with the help of powerful new health information technologies, such as online health information websites, electronic health records, tailored health education programs, health decision support programs, and mobile health communication programs (eHealth applications), the quality of health care and promotion of healthy behaviours could be enhanced. These eHealth applications provide convenient access for consumers and providers to relevant information, reduce health care errors, increase collaboration, and facilitate healthy behaviours adoption.

It has been suggested that PA declines sharply during the teenage and young adult years (Caspersen et al., 2000; Stone et al., 1998), obvious PA decline has been found during the transition from secondary school to university (Bray & Born, 2004). Interventions that increase PA and improve health awareness and healthy behaviours during college years could have a positive influence on the prevention of acute and

chronic health problems in adulthood (U.K. Department of Health, 2004; U.S. Department of Health and Human Services, 2000).

The university campuses can provide good opportunities to influence the PA habits of young adults (Leslie et al., 2001). The Internet has the potential for delivering interactive PA promotion programmes for university students. University-based physical education and university students' PA are under-researched (Kahn et al., 2002; Keating et al., 2005). The use of this new technology for PA promotion in university campus settings is promising but the efficacy is unknown. Based on the review of previous studies, it is therefore worthwhile to investigate the efficacy of Internet-based PA promotion interventions among university students. The next chapter describes the first study of the thesis, and the title was "The Efficacy of the Internet for PA Promoting among University Students."

CHAPTER THREE

The Efficacy of the Internet for Physical Activity Promotion among University Students

3.1 Introduction

It is well established that regular PA is beneficial to health (Hamilton et al., 2007; Healy et al., 2008; Paffenbarger et al., 1986; Physical Activity Guidelines Advisory Committee Report, 2008; U.K. Department of Health, 2004; U.S. Department of Health and Human Services, 2000; Wyrwich & Wolinsky, 2000), conversely, physical inactivity has been shown to be associated with coronary heart disease, type II diabetes and cancer (Blair et al., 1989; Hamilton et al., 2007; Healy et al., 2008; Helmrich et al., 1991; Paffenbarger et al., 1975; Paffenbarger et al., 1986; Wyrwich & Wolinsky, 2000). Apart from health promotion and non-communicable disease prevention, regular PA also improves social connections and quality of life, provides community economic benefits by reducing health care costs and assists environmental sustainability by promoting active modes of transport (Toronto Charter for Physical Activity, 2010).

Currently there are around 1.8 billion Internet users worldwide and more than 764 millions Internet users are located in Asia (Miniwatts International, 2008). According to the survey of Madden (2006), 73% of the USA population has access to the Internet. The

European Commission planned to increase the Internet broadband coverage to 100% by the year 2013 (European Commission 2010). In Hong Kong, 75.8% of all domestic households had personal computers at home and among those households, 96.8% had their computers connected to the Internet (Census and Statistics Department, 2009).

The Internet is one of the major sources of health information (Fox, 2006; Leung, 2008; Tu & Cohen, 2008). Internet-based interventions have shown the potential of serving large numbers of the population, and possess the advantages of convenience, flexibility, and more effectiveness and opportunities for interaction. Tailored information and instantaneous feedback can be provided. Internet-based interventions can overcome barriers related to time constraints. Respondents can receive specific information on a particular topic at a specific time. Attractive audio-visual and animated information can also be provided (Tate et al., 2001). In addition, Internet-based interventions may be more anonymous than face-to-face interventions.

With the advantage that most university students have access to the Internet and are familiar with computer use (Madden & Jones, 2002); the Internet has the potential for delivering interactive PA promotion programmes for university students. The university campus can provide good opportunities to influence the PA habits of young adults (Leslie et al., 2001). Furthermore, university-based physical education and university students' PA are under-researched (Kahn et al., 2002; Keating et al., 2005). The use of this new

technology for PA promotion in university campus settings is promising but the efficacy is unknown. There are few studies if any to test the new information technology for PA promotion in such settings. The purpose of this study was to examine the effectiveness of an Internet-based behavioural intervention for PA promotion among university students. The specific research question of the study was "Would participants in the Internet-based intervention group demonstrate an improvement in PA participation to a similar extent as their counterparts in the print-based intervention group?"

3.2 Methods

3.2.1 Selection of Subjects

Participants were recruited from eight UGC-funded universities in Hong Kong. Recruitment strategies include a series of two e-mail messages; and advertisements were posted on the universities' intranet websites, flyers, advertisements in newsletters and in-person information booths. Eligibility criteria included 1) access to Internet; 2) current full-time undergraduate student; 3) absence of any physical conditions that would severely restrict the ability to be physically active; and 4) total PA score less than 3000 MET·minutes per week (at the low or moderate activity category of the guidelines for data processing and analysis of the IPAQ, 2005). The reason for selecting participants at the low and moderate activity categories of the IPAQ guidelines was that they might have more room for improvement in PA participation. This could help to minimize the ceiling

effect from the highly active participants.

Sample size calculations were based on the assumption of 300 MET·min per week total PA scores between group differences (Spittaels et al., 2007) at the 3rd month assessment, assuming a 5% type I error (α) and 80% power. It was estimated that 44 participants per group were needed. With the anticipation of 10% drop out rate, this led to a required number of 48 participants per group. Written consent forms were obtained from all participants. Ethical approval was received from the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong.

3.2.2 Study Design

The study design was a three-arm randomized controlled trial, which consisted of the Internet-based intervention group, the print-based intervention group, and the control group. Participants were stratified by sex and stage of behaviour change (Marshall and Biddle, 2001) and randomly allocated via a computer-generated randomization sequence (GraphPad Software, Inc.) into one of the three groups.

3.2.2.1 Internet-based Intervention (IB) Group. Passwords were provided to participants to log into a commercially available theory-driven Internet-based PA behaviour change programme. The programme was password protected, thus the chance for cross-contamination by other groups was minimized.

This programme has 20 sessions entitled 'Active Living Every Day (ALED) (Blair et

al., 2001). The course material was developed based on the Transtheoretical Model (Prochaska & DiClemente, 1983) and Social Cognitive Theory (Bandura, 1986) and was adapted from the research study Project Active (Dunn et al., 1998; Kohl et al., 1998; Sevick et al., 2000). This programme is suitable for use in Hong Kong, which is a highly westernized society. English is the official language in these universities. The ALED programme focuses on daily life activities, such as walking, jogging and cycling which are common activities found in Hong Kong. Therefore, cultural differences related to adopting this programme to the Hong Kong context should not be a concern.

Participants of the IB group were requested to read the programme materials and complete the activities via Internet in a convenient time and place at a rate of one session per week. A complimentary copy of the ALED workbook (Blair et al., 2001) was provided with the online course. The programme contents, with interactive and animated graphic designs, were designed for learning the behaviour modification skills which included virtual partners' stories, short stage-based quizzes, goal setting, making a step-by-step plan for exercise, benefits of doing regular exercise, overcoming exercise barriers, time management, choosing suitable exercise, rewarding yourself, receiving social supports and relapse prevention. The participants were encouraged to answer the stage of behaviour change questionnaire (Marshall and Biddle, 2001) where needed and formal requests for answering the questionnaire were scheduled at sessions 2, 5, 9, 13 and

17. This allowed matching of motivation-tailored advice and activities with participants' level of readiness to change and PA participation. Apart from these, the section entitled 'My Journal' allowed personal recording of an exercise log and setting of individual exercise goals.

3.2.2.2 Print-based Intervention (PB) Group. Participants received the same information as the Internet group in printed form. They attended a weekly ALED class at a university. The discussion class was instructed by a licensed ALED facilitator (Human Kinetics) ® (Blair et al., 2001). During classes, cognitive and behavioural skills for adopting and maintaining an active lifestyle were discussed. The face-to-face discussion sessions were also complemented by the ALED workbook (Blair et al., 2001). A 14-week ALED intervention programme (Dunn et al., 1997 & Carr et al., 2008) was employed and is listed in Table 3. Participants who missed a scheduled class were provided with course materials and were requested to finish the contents and the journal activities at home.

Table 3. A 14-week ALED intervention programme (Carr et al., 2008; Dunn et al., 1997)

Week	Session (s)
1	Getting started (#1)
2	Ready, Set, Go (#2)
3	Making Plans (#3), Barriers and Benefits (#4)
4	Over, Under, Around, and Through (#5)
5	Let's Burn Some Calories! (#6)
6	Setting Goals (#7), Rewarding Yourself (#11)
7	Enlisting Support (#8), Gaining Confidence (#9)
8	Strengthening the Foundation (#10)
9	Avoiding Pitfalls (#12)
10	Defusing Stress (#13)
11	Step by Step (#14), Managing Time (#15)
12	Exploring New Activities (#16)
13	Becoming a Hunter-Gatherer (#18), Positive Planning (#19)
14	Making Lasting Changes (#17), Onward and Upward (#20)

3.2.2.3 Control (C) Group. Participants received no intervention treatment. They were asked to maintain their present lifestyle for six months.

3.2.3 Questionnaire Design

3.2.3.1 Stage of Change. The Stage of Exercise Change Questionnaire (SECQ) adapted from Marcus and colleagues (1992c) was used. This questionnaire was chosen because it has been widely used (Dunn et al., 1997; Marcus et al., 1992c & Marshall et al., 2003b) and proven to be content valid. Wallace and colleagues (2000) reported internal consistency of 0.71 and a one-week test-retest reliability of 0.81. This questionnaire has been used for studying the exercise behaviour of university students in Hong Kong (Callaghan et al., 2002).

The five-choice item questionnaire matched the five stages of behaviour change (Marshall and Biddle, 2001) and reflected participants' levels of readiness to change. Each participant was asked to select a stage that best described their current PA of moderate physical effort. Regular PA was defined according to the recommendations of the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) (Pate, et al., 1995; Haskell et al., 2007), as five or more times per week of moderate-intensity PA of 30 minutes or more daily. The choices were: (1) pre-contemplation stage, "I do not exercise, and I do not intend to start in the next 6 months."; (2) contemplation stage, "I do not exercise, and I intend to start in the next 6 months."; (3) preparation stage, "I am doing some PA but not regularly."; (4) action stage, "I exercise regularly but I have done so for less than 6 months."; and (5) maintenance stage, "I exercise regularly and I have done so for 6 months or longer."

3.2.3.2 Physical Activity. The International Physical Activity Questionnaire (IPAQ) Short Past 7-day instrument (Craig, et al., 2003) was used. This questionnaire measured the frequency and duration of vigorous PA, moderate PA and walking. The IPAQ has been tested in 12 countries with over 2000 participants (Booth, 2000). Craig and colleagues (2003) reported acceptable criterion validity of 0.3 and a one-week test-retest reliability of 0.8. The IPAQ has been used for an international prevalence study on PA for 20 countries or cities, including Hong Kong (Bauman et al., 2009).

IPAQ evaluates the participants' frequency and duration of vigorous intensity PA, moderate intensity PA, walking and sitting over the previous seven days. According to the guidelines for data processing and analysis of the IPAQ (2005), total PA score is calculated by summing up the time spent in vigorous intensity PA, moderate intensity PA and walking per week weighted for intensity by selected MET (multiples of basal metabolic rate) estimates (Ainsworth et al., 2000). The calculation formula is : total PA score = 3.3 x walking minutes x walking days + 4 x moderate-intensity activity minutes x moderate-intensity days + 8 x vigorous-intensity activity minutes x vigorous-intensity days. The unit of total PA score is MET·minutes per week.

In addition, standard demographic questions such as gender, age, weight and height were asked. The assessment was carried out at baseline, and the third and sixth month after the commencement of the intervention.

3.2.3.3 Meeting the ACSM/AHA Recommendation for PA. A dichotomous variable based on meeting the ACSM/AHA recommendation for PA was created (Haskell et al., 2007), whereby participants who accumulated at least 150 minutes per week moderate-intensity PA or 450 MET·min per week PA score at five separate days, or at least 60 minutes per week vigorous-intensity PA at three separate days were classified as sufficiently active.

3.2.4 Data Collection

The survey instruments were mailed to the participants of the control and print-based intervention groups, while the Internet-based intervention participants completed their questionnaires online.

3.2.5 Pilot Study

A pilot test of the instruments was administered to a convenience sample of 48 full time undergraduate students recruited from one university. The aim of this pilot study was to ensure that the language used and the questions adopted were appropriate. The feedback from this pilot study on ways of improving the instrument was incorporated into the survey. The revised questionnaire was reviewed by experts in this area of research in Hong Kong and it was considered to be content valid. The one-week test-retest reliability of the total PA score was 0.701 and that of the stage of exercise change was 0.895.

3.2.6 Data Analysis

Data were collected from 111 full time undergraduate students. Only participants having responded to the three assessments were included in the analyses. Data extracted from the survey instrument were used as follows: the dependent variables included the total PA score and the stage of exercise change; the independent variables included gender, age, body mass index (BMI, weight/height^2) and the intervention group.

Descriptive statistics for the total PA score, meeting the ACSM/AHA recommendation, stage of change, gender, age and BMI were calculated. One-way

analyses of variance (ANOVAs) were used to test for differences in the baseline characteristics of the participants between the three intervention groups. Repeated measure ANOVAs, with time (baseline, 3rd month & 6th month) as the within-subjects factor and intervention group (print-based, Internet-based and control group) as the between-subjects factor, were used to evaluate the effects of the different interventions on PA. One-way ANOVAs were performed on the PA score mean difference (from baseline to 3rd month and from baseline to 6th month) to examine the intervention effects among groups, and post hoc Tukey tests were conducted when the ANOVA tests revealed significant effects.

Wilcoxon Signed Ranks tests were used to analyse the within-group differences in the categorical data. The primary dependent variable was the stage of exercise change and meeting the ACSM/AHA criteria for sufficient PA. There were three categories in the tests: a positive rank was assigned if the stage moved from a lower category to a higher category, a negative rank was assigned if the stage moved from a higher category to a lower category and a tie was assigned if the stage remained unchanged from the baseline to the 3rd or 6th month assessment. Mann-Whitney tests were used to analyse differences in the stage of exercise change between groups. Chi-square tests were used to analyse differences in the proportion of participants meeting the ACSM/AHA criteria of sufficient PA between the groups. The data were analyzed using the Statistical Package for Social

Science (SPSS) version 12 for Windows software. Statistical significance was set at a level of 0.05.

3.3 Results

3.3.1 Participant Characteristics

The study was conducted from September 2008 to April 2009. A total of 173 full time undergraduate students from six UGC-funded universities responded to the study recruitment. The response rate was 0.3% of the full time undergraduate student population in Hong Kong in 2008 to 2009 (University Grants Committee, 2010). Of these participants, 62 were already very active (total PA score more than 3000 MET·minutes per week) and thus were ineligible for the study. The remaining 111 participants were stratified by sex and by their stage of exercise change (Marshall and Biddle, 2001). They were randomized to one of three groups, namely IB, PB and C group. The number and percentages of students recruited from the different universities in Hong Kong are shown in Table 4. The flow diagram of the randomization is shown in Figure 1.

Table 4. Number of students recruited from different universities in Hong Kong (N = 106)

	Number	Percentage
CUHK	81	76.4%
HKUST	13	12.3%
HKBU	1	0.9%
Poly U	5	4.7%
City U	4	3.8%
HKIED	2	1.9%

Note: the Chinese University of Hong Kong (CUHK), the Hong Kong University of Science and Technology (HKUST), the Hong Kong Baptist University (HKBU), the Hong Kong Polytechnic University (Poly U), the City University of Hong Kong (CityU) and the Hong Kong Institute of Education (HKIED).

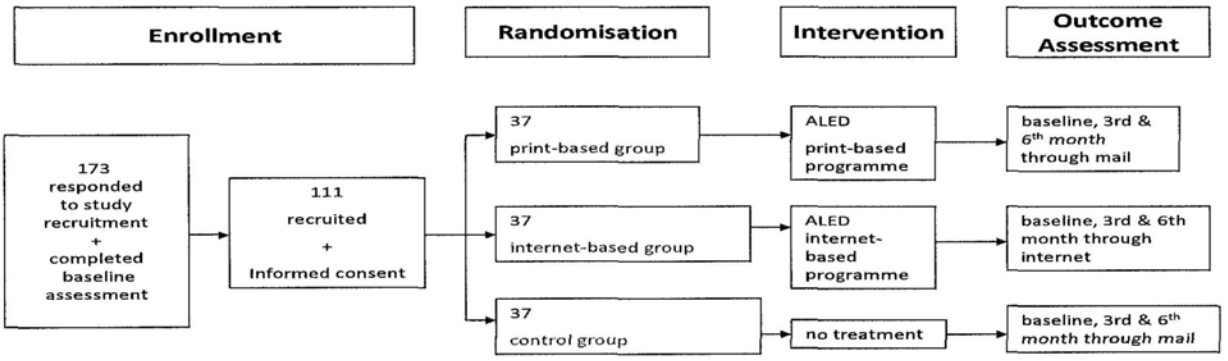


Figure 1. Flow diagram of participants' progress through different phases of the randomized control trial

Of the participants (N = 111) who finished the baseline assessment, 55.9% were female and 44.1% were male. Women were over-represented slightly in the respondent sample, compared with the female full-time undergraduate student population in Hong

Kong (52.5%) in 2008 to 2009 (University Grants Committee, 2010). The age of the participants ranged from 17 to 24 (mean ± standard deviation [SD], 19.17 ± 1.21), and their body mass index (BMI) ranged from 16 to 30.12 kg/m^2 (mean ± SD, 20.27 ± 2.62). There were no significant differences among the three groups with respect to the demographics and baseline variables. Table 5 shows the baseline characteristics of the participants.

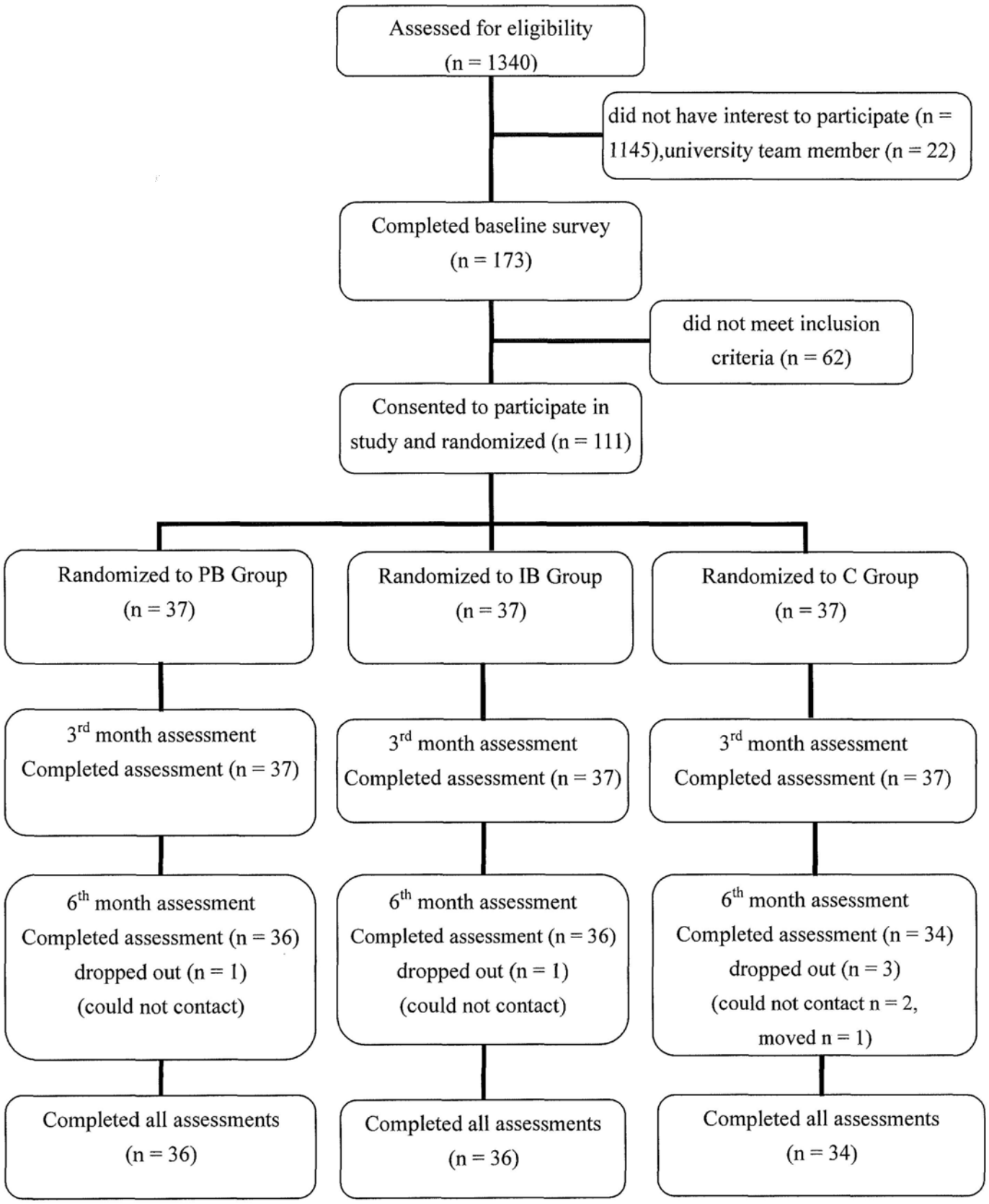
Table 5. Baseline characteristics of total sample and three groups (mean ± SD or %)

	Total sample (n = 111)	PB Group (n = 37)	IB Group (n = 37)	C Group (n = 37)
Demographics				
Gender (% of female)	55.9	56.8	56.8	54.1
Age (year)	19.2 ± 1.2	19.1 ± 1.2	19.2 ± 1.2	19.2 ±1.3
BMI (kg/m^2)	20.3 ± 2.6	20.2 ± 2.8	20.2 ± 2.9	20.4 ± 2.1
Physical Activity				
Total PA Score (MET·min/week)	1314.2 ±672.3	1325.2 ±632.0	1228.0 ±656.4	1389.3 ±733.1
Meeting the PA recommendation (%)	85.6	91.9	78.4	86.5
Stages of change				
Pre-contemplation (%)	2.7	2.7	2.7	2.7
Contemplation (%)	16.2	16.2	16.2	16.2
Preparation (%)	73.9	73.0	73.0	75.7
Action (%)	7.2	8.1	8.1	5.4
Maintenance (%)	0	0	0	0

3.3.2 Changes in Total PA Scores

The follow up assessments were completed for 100% of the participants (N = 111) at the 3rd month and for 95.5% of the participants (N = 106) at the 6th month. There was no significant difference in the dropout rates between the groups. Only those participants who had responded to all three of the assessments were included in the statistical analyses. The flow diagram of the participants is shown in Figure 2.

Figure 2. Flow diagram of the participants



At the 3rd month assessment, the participants in the PB group reported a mean total PA score of 1849.2 ± 1234.3 MET·minutes per week, those in the IB group reported 1689.8 ± 1085.2 MET·minutes per week, and those in the C group reported 1393.5 ± 870.2 MET·minutes per week. Table 6 shows the changes in the total PA scores.

The results indicated that there were statistically significant increases in the PA scores found both in the PB group, $F(1, 35) = 8.364$, $p < 0.05$ and in the IB group, $F(1, 35) = 7.958$, $p < 0.05$. There was a slight fall in the total PA scores in the C group, but this was not statistically significant ($p > 0.05$). In addition, the ANOVA univariate tests found a significant difference in the mean change between the groups ($F [2, 105] = 3.552$, $p < 0.05$). The post hoc Tukey tests showed a statistically significant difference ($p < 0.05$) between the PB group and the C group.

At the 6th month assessment, participants in the PB group reported a mean total PA score of 1880.0 ± 1238.7 MET·minutes per week, those in the IB group reported 1738.2 ± 1287.9 MET·minutes per week, and those in the C group reported 1252.1 ± 728.5 MET·minutes per week. These results highlighted statistically significant increases in PA scores, compared with the baseline assessment, in both the PB group, $F(1, 35) = 7.625$, $p < 0.05$ and the IB group, $F(1, 35) = 6.259$, $p < 0.05$. The decrease in the total PA scores, compared with the baseline assessment, was not statistically significant ($p > 0.05$) in the C group. In addition, the ANOVA univariate tests found significant differences in the

mean change among the groups (F [2, 105] = 4.496, $p < 0.05$). The post hoc Tukey tests showed statistically significant ($p < 0.05$) mean change between the PB group and the C group, and between the IB group and the C group ($p < 0.05$).

Increased total PA scores were found in the PB and IB groups at both the 3rd month and 6th month assessments when compared to the baseline. The ANOVA univariate tests found no significant differences in the changes of PA between the PB group and the IB group at either the 3rd or the 6th month assessments respectively. There was no difference in changes of the total PA scores between these two intervention groups. The total PA scores of their participants increased similarly. In addition, no gender differences ($p > 0.05$) in PA changes were found at either the 3rd month or the 6th month assessments.

Further analysis of the separate PA patterns, including walking (WPA), moderate PA (MPA) and vigorous PA (VPA) of the participants, revealed a statistically significant increase in the WPA scores in the IB group at the 6th month assessment (F [1, 35] = 5.913, $p < 0.05$) whereas a statistically significant decrease in the WPA scores was found in the C group at the 6th month assessment (F [1, 33] = 4.975, $p < 0.05$). There were no statistically significant differences observed either in the MPA or the VPA scores in any of the groups ($p > 0.05$).

Table 6. Mean physical activity (PA) scores (MET·min per week) at baseline, 3rd month and 6th month assessments

	PB Group (n = 36)	IB Group (n = 36)	C Group (n = 34)
Total PA scores (MET·min/week)			
Baseline	1330.8 ± 640.0	1213.2 ± 659.4	1414.9 ± 758.9
3rd month	1849.2 ± 1234.3*	1689.8 ± 1085.2*	1393.5 ± 870.2
Mean Difference	518.4#	476.6	-21.4
6th month	1880.0 ± 1238.7*	1738.2 ± 1287.9*	1252.1 ± 728.5
Mean Difference	549.2#	525.0#	-162.8

Note: *p< 0.05, compared with baseline data within group
#p< 0.05, compared with C group

3.3.3 Changes in Total PA Scores (CUHK Participants Only)

The participants were mainly recruited from the CUHK (76.4%). The data for the CUHK participants were analysed separately, in an attempt to remove variations arising from any university specific influences. At the 3rd month assessment, participants in the PB group reported a mean total PA score of 1800.7 ± 1217.0 MET·minutes per week, those in the IB group reported 1642.1 ± 949.2 MET·minutes per week, and those in the C group reported 1323.1 ± 852.7 MET·minutes per week. Table 7 shows the changes in the total PA scores.

The results indicated that statistically significant increases in the PA scores were found both in the PB group, $F(1, 34) = 7.405$, $p < 0.05$ and in the IB group, $F(1, 24) = 5.177$, $p < 0.05$. There was a slight drop of total PA scores in the C group, but it was not

statistically significant ($p > 0.05$). In addition, the ANOVA univariate tests found no significant difference in the mean change between the groups (F [2, 80] = 2.589, $p > 0.05$).

At the 6th month assessment, participants in the PB group reported a mean total PA score of 1871.6 ± 1255.7 MET·minutes per week, those in the IB group reported 1724.1 ± 1333.0 MET·minutes per week, and those in the C group reported 1223.8 ± 768.0 MET·minutes per week. A statistically significant increase in the PA scores, compared with the baseline assessment, was found in the PB group, F (1, 34) = 7.835, $p < 0.05$. Although the increase in PA was not statistically significant in the IB group, the significance level was close to 0.05 (F [1, 24] = 3.438, $p = 0.076$). The decrease in the total PA score, compared with the baseline assessment, was not statistically significant (F [1, 20] = 0.766, $p > 0.05$) in the C group. In addition, the ANOVA univariate tests found no statistically significant difference in the mean change between the groups (F [2, 80] = 2.895, $p > 0.05$).

An increased total PA score was found in the PB group at both the 3rd month and the 6th month assessments when compared to the baseline, and in the IB group at the 3rd month assessment. The ANOVA univariate tests found no significant difference in the changes in PA between the PB group and the IB group at either the 3rd or the 6th month assessments and there was no difference in changes of total PA scores between the two intervention groups. The total PA scores of their participants increased similarly. The

pattern of PA changes of the CUHK participants was similar to that of the total sample.

Table 7. Mean physical activity (PA) scores (MET·min per week) at baseline, 3rd month and 6th month assessments (CUHK participants only)

	PB Group (n = 36)	IB Group (n = 36)	C Group (n = 34)
Total PA scores (MET·min/week)			
Baseline	1301.8 ± 624.9	1230.77 ± 631.4	1407.6 ± 799.8
3rd month	1800.7 ± 1217.0*	1642.1 ± 949.2*	1323.1 ± 852.7
Mean Difference	498.9	411.4	-84.5
6th month	1871.6 ± 1255.7*	1724.1 ± 1333.0	1223.8 ± 768.0
Mean Difference	569.8	493.3	-183.7

Note: *p< 0.05, compared with baseline data within group

3.3.4 Meeting the ACSM/AHA Criteria of Sufficient PA

At the 3rd month assessment, a statistically significant increase in the number of participants (28 vs 35) meeting the ACSM/AHA criteria of sufficient PA was found in the IB group ($Z = 2.646$, $p < 0.05$). The Chi-square tests showed a statistically significant difference in the number of participants meeting the criteria between the PB and C groups (X^2 [1, N=70] = 4.613, $p < 0.05$), and between the IB and C groups (X^2 [1, N=70] = 6.721, $p < 0.05$). At the 6th month assessment, there were no statistically significant differences ($p > 0.05$) observed either within or between groups. Table 8 shows the changes in the number of participants meeting the ACSM/AHA criteria of sufficient PA.

Table 8. Number of participants meeting the ACSM/AHA criteria of sufficient PA [number (%)]

	PB Group Total n = 36	IB Group Total n = 36	C Group Total n = 34
Baseline	33 (91.7)	28 (77.8)	29 (85.3)
3rd month	34$^{\#}$ (94.4)	35*$^{\#}$ (97.2)	26 (76.5)
6th month	30 (83.3)	30 (83.3)	29 (85.3)

Note: *p< 0.05, compared with baseline data within group

$^{\#}$p< 0.05, compared with control group

3.3.5 Shifting of Stages of Change

At the 3rd month assessment, a slight drop was found in the numbers at the contemplation stage, and slight increases were found in the numbers at the preparation and action stage in the PB and C groups. In the PB group, eight participants had improved, 24 participants remained unchanged and four participants had regressed in their stages of change. The shift was not statistically significant ($Z = 0.882$, $p > 0.05$). Table 9 shows the stages of change.

In the IB group, there was a trend for the participants to shift from the pre-contemplation and contemplation stages to the preparation and action stage; 18 participants had shown improvement, 15 participants remained unchanged and three participants had regressed in their stages of change. A statistically significant improvement ($Z = 3.288$, $p < 0.05$) in their stage of change was found in this group. In the C group, six participants had shown improvement, 25 participants remained unchanged and three participants had regressed in their stages of change. The shift was not

statistically significant ($Z = 1.000, p > 0.05$). In addition, the improvement in the stage of change in the IB group was statistically significant compared with the PB group ($U = 436.5, p < 0.05$), and the C group ($U = 403.5, p < 0.05$).

At the 6th month assessment, statistically significant improvements were found only in the PB group and the IB group, but not in the C group. In the PB group, 19 participants had shown improvement, 14 participants remained unchanged and three participants had regressed in their stages of change. A statistically significant ($Z = 3.026, p < 0.05$) improvement in the stage of change was also found in this group. In the IB group, 17 participants had shown improvement, 16 participants remained unchanged and three participants had regressed in their stages of change. A statistically significant ($Z = 2.766, p < 0.05$) improvement in stage of change was found. For the C group, nine participants had shown improvement, 21 participants remained unchanged and four participants had regressed in their stages of change. The shift was not statistically significant ($Z = 1.255, p > 0.05$).

Table 9. Stages of change at baseline, 3rd and 6th month assessments

Stages of change	Baseline			3rdMonth			6thMonth		
	PB (n=36)	IB (n=36)	C (n=34)	PB (n=36)	IB (n=36) ※ b c	C (n=34)	PB (n=36) *	IB (n=36) #	C (n=34)
Pre-contemplation	1	1	1	1	0	1	0	1	2
Contemplation	5	6	5	3	3	4	6	3	5
Preparation	27	26	26	28	17	25	14	19	19
Action	3	3	2	4	15	4	12	10	6
Maintenance	0	0	0	0	1	0	4	3	2

Note: Wilcoxin Signed Ranks Tests $Z = 3.288^{※}$, $p<0.05$; $Z = 3.046^{*}$, $p<0.05$; $Z = 2.766^{\#}$, $p<0.05$ compared with baseline within groups. Mann-Whitney Tests $U = 436.5^{b}$, $p<0.05$ compared with PB group; $U = 403.5^{c}$, $p<0.05$ compared with C group.

3.3.6 Programme engagement

Programme engagement was tracked using weekly attendance rolls in the PB group which were collected by the course facilitator. The mean number of sessions completed was 7.8, which was equal to 39% programme compliance. The IB group participants reported an average number of 6.9 sessions completed, which was equal to 35% programme compliance.

3.3.7 Summary of Results

Increased total PA scores were found in the PB and IB groups at the 3rd and 6th month assessments across time; there was no difference in changes of total PA scores

between the intervention groups. No gender differences in PA changes were found at the 3rd month or the 6th month assessment.

An increase in number of participants meeting the ACSM/AHA criteria of sufficient PA was found in the IB group at the 3rd month assessment. The proportions of participants meeting the criteria were higher in the intervention groups than in the C group at the 3rd month assessment.

Improvement in stage of change was only found in the IB group at the 3rd month assessment. Improvements in stage of change were found in both the PB and IB groups at the 6th month assessment. The results suggested that the Internet-based intervention was as effective as the print-based intervention in PA promotion among university students in Hong Kong.

3.4 Discussion

The primary goal of the current study was to examine the efficacy of the Internet-based and stage-targeted intervention for PA promotion among university students. The current study used a PA behaviour change programme adapted from previous studies (Dunn et al., 1998; Kohl et al., 1998; Sevick et al., 2000) which has been shown to be effective in providing positive PA influences.

As hypothesized, participants of the IB group demonstrated improvement in PA to a similar extent as their counterparts in the print-based intervention group. This finding was

similar to these derived from previous studies (Carr et al., 2008; Marcus et al., 2007; Steele et al., 2007) and illustrated that Internet-based and stage-targeted interventions were as effective as the print-based and stage-targeted interventions in PA promotion. The reasons for the positive PA outcomes might be due to learning of behavioural modification strategies and skills from the print-based or Internet-based intervention programme. In addition, with the access to sports facilities and safe greenways on campus, a PA programme could be initiated and adopted.

An increase in the WPA scores was found in the IB group participants but a decrease in the WPA scores was found in the C group participants at the 6th month assessment. Increases in the minutes of walking time have also been found in previous studies (Napolitano et al., 2003; Sciamanna et al., 2002). The possible reason for this might be the emphasis of the intervention programme on promoting an active lifestyle, and to the fact that walking is one of the easiest and most frequent of activities in daily life. The decrease in the WPA score in the C group participants might be attributed to the negative effect of the hot and wet weather during the summer months in Hong Kong.

Improvements in stage of exercise change were found in the PB group at the 3rd month assessment and in the IB group at both the 3rd and 6th month assessments. Similar to the previous studies (Marshall et al., 2003b; Napolitano, et al., 2003), these findings confirmed the efficacy of Internet-based PA intervention in improving stage of exercise

change in PA.

Some studies (Marcus et al. 2007; Napolitano et al., 2006) excluded subjects with greater than 90 minutes of moderate intensity PA per week in order to maximize sedentary participants' recruitment. Other studies (Marshall et al., 2003; Spittaels et al., 2007) did not have exclusion criteria on PA level for their participants. However, the high PA cutoff point might result in the enrollment of comparatively less sedentary subjects that might not have much room for PA improvement and thus the intervention effect might be influenced. In an effort to recruit comprehensive subject samples, the current study chose a medium exclusion criterion of more than 3000 MET·min per week, which included subjects classified as low or moderate level of PA (IPAQ guidelines for data processing and analysis, 2005).

Programme engagement rates were collected. The mean number of sessions completed by the PB group was 7.8, which was equal to 39% programme compliance. The IB group participants reported an average number of 6.9 sessions completed, which was equal to 35% programme compliance. The programme engagement rates were similar to previous studies (Carr. et al., 2008; Marshall et al., 2003; Steele et al., 2009). As postulated by Brouwer and colleagues (2011), the programme compliance of the Internet-delivered interventions has been found to be lower than expected. Futhermore, programme participants were inclined to leave the intervention websites before

completing them (Danaher et al., 2005; Eysenbach, 2005; Glasgow et al., 2007)

According to the qualitative system review of Brouwer and colleagues (2011), peer and counsellor support enhanced longer website visits; e-mail or phone contacts of participants and updates of the intervention website related to a higher number of log-ins. In order to maintain the engagement of the participants, innovative and interactive website components such as user communication platforms (live-chat, online discussion groups and blogs) which might increase a sense of community, practical individual tools (training logs, BMI calculators and exercise goals setting record forms) and theoretically-based professional feedback (instantaneous individually tailored feedback reports and professional replies through questions and answers mechanisms) should be provided and emphasized. It will be important for future studies to examine strategies to increase the interactivity of the intervention websites and to improve the engagement rate, especially during the action and maintenance stages of exercise change of the participants.

Although studies on the efficacy of Internet-based PA promotion interventions have produced mixed results (Kroeze et al., 2006; Norman et al., 2007; Vandelanotte et al., 2007), the current study adds strength to those studies with positive outcomes. Its results suggest that the Internet-based intervention was as effective as the print-based intervention in the promotion of PA among university students in Hong Kong.

CHAPTER FOUR

The Efficacy of Publicly Available Websites for PA Promotion among University Students

4.1 Introduction

Substantial evidence demonstrates that regular PA has positive influences on health and well-being (Hamilton et al., 2007; Healy et al., 2008; Paffenbarger et al., 1986; Physical Activity Guidelines Advisory Committee Report, 2008; U.K. Department of Health, 2004; U.S. Department of Health and Human Services, 2000; Wyrwich & Wolinsky, 2000). It helps to delay or prevent the development of ischaemic heart disease, obesity, type II diabetes mellitus, hypertension, cancer, osteoporosis, anxiety and depression. It also helps to maintain bone mass, muscle strength and agility, improve cardiovascular fitness.

Despite the many health benefits associated with regular exercise, PA participation rates decline sharply during the teenage and young adult years (Caspersen et al., 2000; Stone et al., 1998). Furthermore, a decline in PA during the transition from secondary school to university has been reported (Bray & Born, 2004). Keating and colleagues (2005) illustrated that 40% to 50% of university students were physically inactive. Similar university students' PA participation was found in Hong Kong, according to Abdullah and colleagues (2005), one-third of the university students in Hong Kong were

physically inactive. Tsai and colleagues (2007) conducted a comparative survey between Hong Kong and Australian university students. It was reported that the Hong Kong students were found to be less active, had lower intention to participate in PA, and lower preferences for active recreation.

Physical activity patterns during the young adult years may have important influences on habitual PA during adult life and, consequently, long-term health may be affected. It is evident that the well being of university students will greatly influence the future of our society because those who attend universities may play an important role in establishing social and cultural norms as they have the potential to become decision makers and influential leaders within society (Leslie, et al., 1999a; Leslie, et al., 1999b). Hence, there is an intense need for effective interventions that promote PA among university students.

PA interventions designed for individuals and face-to-face groups have limited effect in the population reach and are more expensive compared with Internet-based interventions for wide scale PA promotion (Lewis et al., 2010). Internet-based interventions seem to have shown the potential of serving large numbers of the population, and possess the advantages of convenience, flexibility, and more effectiveness and opportunities for interaction. Barriers related to time and venue constraints can be overcome. Tailored information and instantaneous feedback can be provided. Attractive

audio-visual and animated information can also be provided (Tate et al., 2001). Not only the feedback, but also the diagnostic tool can be tailored by omitting questions which would be irrelevant for the respondent (Fotheringham et al., 2000a).

During the past decade, the focus has shifted to using the Internet as a means of promoting health related behaviour change (Steele et al., 2007; Wantland et al., 2004; Vandelanotte et al., 2007). Previous studies (Carr et al., 2008; Marcus et al., 2007; Steele et al., 2007) have shown that Internet-based interventions are as effective as print-based interventions for PA promotion. Positive PA outcomes were found in both the print-based and the Internet-based groups in study 1.

Some studies have suggested that the effectiveness of the standard Internet is similar to that of the tailored Internet in PA promotion (Hageman et al., 2005; Marcus et al., 2007; McKay et al., 2001; Spittaels et al., 2007). Hageman and colleagues reported no increase in PA in either the standard Internet group or the tailored-Internet group. Some other studies (Marcus et al., 2007; McKay et al., 2001; Spittaels et al., 2007) reported that increases in PA participation were similar in both standard Internet group and tailored-Internet group.

Due to the limited number of studies, the findings concerning whether standard Internet was as effective as the tailored-Internet for PA promotion were inconclusive. In order to test the efficacy of the mode of delivery for PA promotion, the content of the

intervention was controlled in study 1. In order to test the efficacy of the standard Internet against that of the tailored-Internet for PA promotion, the medium of delivery was controlled in study 2.

The application of the standard Internet for promoting PA seems to have some potential, but more research is needed to evaluate its efficacy for increasing the level of PA. There are few studies, if any, that compare the efficacy of the standard Internet with that of tailored-Internet for raising the level of PA among university students. The purpose of the current study was to examine the efficacy in the public access Internet in relation to the tailored-Internet for promoting PA among university students. The specific research question of the study was "Would participants in the public access Internet intervention group demonstrate an improvement in PA participation to a similar extent as their counterparts in the stage-targeted Internet intervention group?"

4.2 Methods

4.2.1 Selection of Subjects

The participants' selection procedures and criteria had been previously described in study 1. Written consent forms were obtained from all participants. Ethical approval was also received from the University Survey and Behavioral Research Ethics Committee.

4.2.2 Study Design

The study design is a three-arm randomized, controlled trial, which included a

stage-targeted Internet intervention group, a public access Internet intervention group, and a control group. Like study 1, participants were stratified by sex and stage of behaviour change (Marshall and Biddle, 2001) and randomly allocated via a computer-generated randomization sequence (GraphPad Software, Inc.) into one of the three groups.

4.2.2.1 Stage-targeted Internet Intervention (STI) Group. Participants received the same ALED online programme (Blair et al., 2001) as the IB group in study 1. Participants were requested to read the programme materials and complete the activities via Internet at their own convenient time and places one session per week for 20 weeks. A complimentary copy of the ALED workbook (Blair et al., 2001) was provided with the online course.

4.2.2.2 Public Access Internet Intervention (PAI) Group. Participants received a web page containing links to five websites relating to PA. These websites are publicly available and were selected by a panel of five experts. The websites were selected based on accuracy of information, inclusion of benefits of regular exercise, tips for overcoming exercised barriers and the reputation of the website organization. The websites selected are listed in Table 10. Participants were requested to log into the websites and read the website contents once a week for 20 weeks.

Table 10. The 5 websites selected for the public access Internet intervention group

Aerobics and Fitness Association of America	http://www.afaa.com/
American Alliance for Health, Physical Education, Recreation and Dance	http://www.aahperd.org/
PE Web	http://www.pe-web.org/
Sport Science	http://www.epsport.idv.tw/
American College of Sports Medicine	http://www.acsm.org/index.htm

4.2.2.3 Control (C) Group. Participants received no intervention treatment. They were asked to maintain their present lifestyle for six months.

4.2.3 Questionnaire Design

4.2.3.1 Stage of Change. The Stage of Exercise Change Questionnaire (SECQ) adapted from Marcus and colleagues (1992c) was used. The details have been reported in study 1.

4.2.3.2 Physical Activity. The International Physical Activity Questionnaire (IPAQ) Short Past 7-day instrument (Craig, et al., 2003) was used. The details had been described in study 1.

4.2.3.3 Meeting the ACSM/AHA Recommendation for PA. As in study 1, a dichotomous variable based on meeting the ACSM/AHA recommendation for PA was created (Haskell et al., 2007). The criteria of sufficient PA had been described in study 1.

4.2.3.4 *Self-efficacy.*

The Self-efficacy Questionnaire (SEQ) adapted from Marcus and colleagues (1992c) was used. Marcus and colleagues (1992c) reported internal consistency of 0.82 and a two-week test-retest reliability of 0.90. This questionnaire has previously been used for studying the exercise behaviour of university students in Hong Kong (Callaghan et al., 2002). There are five statements designed to measure participants' confidence in their ability to participate in moderate regular PA under various conditions, such as feeling tired, bad mood, lack of time, on vacation and adverse weather.

Participants were asked to respond to a 5-point Likert scale from 1, not at all confident, to 5, very confident to each statement, e.g. "I am confident I can participate in regular PA when I am tired."; "I am confident I can participate in regular PA when I am in a bad mood."; and "I am confident I can participate in regular PA when I don't have time." Self-efficacy was scored by calculating the mean score of the five statements for each participant.

In addition, standard demographic questions such as gender, age, weight and height were asked. The assessment was carried out at baseline, and the third and sixth month after the commencement of the intervention.

4.2.4 *Data Collection*

This study implemented mixed research methodology by using both quantitative (online questionnaire) and qualitative (face-to-face semi-structured interviews) data

collection means. Yin (1994) claimed that using more than one method of data collection would elevate the potential for making the findings and conclusion more convincing and accurate. In addition, Freebody (2003) suggested that multi-disciplinary approaches and multi data sources could facilitate triangulation. Blending of quantitative and qualitative research approaches can take advantage of the strengths of one research method to minimize the limitations of the other research method (McDowell & MacLean, 1998). The use of this design allowed the qualitative results to connect and expand on the quantitative findings in order to have a better understanding of the mechanisms by which the intervention programmes worked.

All participants were emailed a web-link to complete the questionnaire through the Internet. Selected participants were invited to attend focus group interviews. The details of the interviews will be delineated in the following session.

4.2.4.1 Focus Group. In order to obtain a more complete picture of the influences of the interventions on the participants, the study adpoted qualitative research technique - interviewing for data collection. Wengraf (2001) delineated interview as an instrument of research in that the researcher uses the process of skilled conversation to collect information from another person or sometimes more with the objectives of developing or testing a model of some aspect of reality. Interviewing is a common and powerful way of exploring the details of a particular aspect or aspects that may not be covered by other

forms of data collection. It can help the researcher to gain an in-depth understanding of the meaning of the participants' behaviours. It is also helpful to collect information on what has happened, how it has happened, and why it has happened (Amis, 2005).

Generally, face-to-face interviews can be divided into three types, namely structured, semi-structured and unstructured interviews, each serving different purposes. Among them, the structured interview is mostly organized in advance and includes detailed content of research questions and procedures. The semi-structured interview contains specific research questions which are prepared by the interviewer to form the conceptual framework of the study. With the use of prompt and probe questioning techniques, the interview can elicit in-depth and broad range information. In addition, with the use of both closed and open-ended questions, the interviewer can lead and control the interviewing process thoroughly. The unstructured interview mainly contains open-ended questions which provide much more flexibility and freedom than the above-mentioned types of interview (Cohen & Manion, 1994).

Apart from these, an interview can be conducted one time, more than one time, individually or in the form of group interviewing. A group interview or "focus group" interview is normally conducted after a major part of the research has been completed, in which one or two interviewers facilitate several interviewees (Madriz, 2000).

Different types of interviewing suit different research topics and purposes. Moreover,

each type of interviewing has its own strengths and weaknesses. Subjectivity and bias are two limiting factors as interviewers could ask leading questions in order to support their viewpoints or hypotheses. Some interview questions may lead the interviewees to respond in a particular way that is anticipated by the interviewers. Sometimes, the participants themselves may want to please the interviewers and provide incorrect data (Gall, Gall & Borg, 2005).

The duration of interviewing hinges on the willingness to talk and the value of answering contents of the interviewees (Burns, 1994). As such, interviewers face difficulties in determining how long and how many sessions of interviews are required. In addition, Gillham (2000) remarked that it is time consuming to organize and conduct an interview; the researchers need to make appointments with the interviewees, arrange the interviewing venue, audio-tape, transcribe and analyze the dialogue data collected. Lastly, interviewers need to meet their interviewees during face-to-face interviews and as such, anonymity will not be possible.

Conversely, McMillan and Schumacher (1997) claimed that interview is flexible in data collection as interviewers can clarify and probe into particular points whenever necessary. This increases richness of the data. Moreover, they argue that interview is an effectual method for revealing subjective aspects, such as, values, feelings, experience, perceptions and morals.

According to Burns (1994), the respondents can use their own natural language rather than trying to interpret the specific terms and concepts of the studies. The respondents are no longer the "guinea pigs" of the research since during semi-structured interviews respondents and interviewers have equal status. This was echoed with Fontana and Frey (1994) that in order to learn about people, the interviewers must treat their interviewees as people and they would uncover their lives to them.

The semi-structured interview (Wengraf, 2001) method was used in this study to collect qualitative data toward the programme. The advantages of choosing semi-structured interview for this study were that it enabled the interviewer to experience the participants' lives firsthand, provided suitable attention to common themes, and also supported individual expression (Bogdan & Biklen, 1998). The university students are used to forming groups such as, classes, project groups, sports teams and student organizations, suggestions and opinions are usually formed through discussions (Stage & Manning, 2003). Focus group interviews provide chances for researcher to grasp the beliefs of the participants and find out the details that may be missed in individual interviews (Campbell, 1988). Through group interaction and ideas exchanges, the participants can clarify and modify their ideas, the researchers can capture the details of the participants' experiences and attitudes.

The semi-structured interview is flexible, where "why" and "how" questions are

asked following the specific interview questions (Wengraf, 2001). These open-ended questions helped the interviewer collect unanticipated and relevant data. The specific interview questions were set according to the purpose of study and based on previous literature on evaluation of an Internet-based physical activity intervention, web-based physical activity motivational program, PA promotion on university campus and from critical reviews of theoretical foundations of literature on the Transtheoretical Model (Prochaska & DiClemente, 1983), Social Cognitive Theory (Bandura, 1986) and self-efficacy (Bandura, 1997). These formed the conceptual framework of the study and were helpful in evaluating the efficacy of using the Internet to promote PA for university students.

The interviews were conducted in a semi-structured format where six participants from each group were selected and three focus groups were formed at the end of the intervention. The selections were based on the total activity scores at the 6^{th} month assessment, i.e., two from the low (at or below 25^{th} percentile of all participants), two from medium (at 45^{th} to 55^{th} percentile of all participants) and two from high (at or above 75^{th} percentile of all participants). Selected participants of the same group were interviewed together.

All interview dialogues were audio-taped on two recorders to prevent loss of data caused by machine malfunctioning. All the recorded dialogue data was transcribed and

translated from Cantonese into an English written text directly after each interview where the memory of the interviewer was still fresh. In order to ensure consistency and accuracy of data processing, the entire interview process including venue arrangement, audio-taping, transcription, translation and data analysis was conducted by the researcher. A total of three focus group interviews were conducted in July 2010. Information on exercise history, barriers of accessing the intervention contents, social support from others and detailed opinions toward the program was collected. The specific interview questions were as follows:

1) Did you participate in physical activities recently? How often? What activities? Why?
2) How did you access the intervention contents? Where? When? How often? Why?
3) Is there any change in the frequency of accessing the intervention contents from1December 2009 to 29 May 2010? Why? What can be done to maintain the retention rate?
4) What were the barriers to accessing the intervention contents?
5) How would the intervention affect your stage of exercise change? Why? (3rd month and 6th month after intervention started)
6) How would the intervention affect your belief in your ability to engage in moderate regular physical activities (exercise self-efficacy)? Why? (3rd month

and 6th month after intervention started)

7) How would the intervention affect your PA level? Why? (3rd month and 6th month after intervention started)

8) Do you find the Internet-based programme (or the public access physical activity related websites) user friendly, logical and easily readable? If not, what can be done to improve it?

9) Which programme components (or the public access physical activity related websites) will you rate as most useful? Why?

10) As a whole, do you find the Internet-based programme (or the public access physical activity related websites) useful for increasing physical activity? How? Why?

11) Do you find the campus environment and sports facilities useful for increasing physical activity? How? Why?

12) Do you find the questionnaires useful for increasing physical activity? How? Why?

13) Did you receive any social support for physical activities participation? What? If yes, go to question 14. If no, why?

14) Do you find the social support useful for increasing physical activity? How? Why?

15) If you were provided with an Internet-based programme (or the public access physical activity related websites)? Do you think this programme or websites will help you to increase your physical activity level? Why? (for the Control group only)

16) If you were provided with an Internet-based programme, the public access physical activity related websites, the face to face behaviour change programme or others, which one will you choose to improve your physical activity level? Why?

17) What were your other opinions toward the programme? If any.

(Note: Questions 2 to 10 are for the two intervention groups only.)

4.2.5 Pilot Study

4.2.5.1 Quantitative. A pilot test of the online questionnaire was administered to a convenience sample of 56 full time undergraduate students recruited from one university. The aim of this pilot study was to ensure that the language used and the questions adopted were appropriate. The feedback from this pilot study on ways of improving the instrument was incorporated into the survey. The revised questionnaire was reviewed by experts in this area of research in Hong Kong and it was considered to be content valid. The one-week test-retest reliability of the self-efficacy score was 0.927. The test-retest reliability of the total PA score and the stage of exercise change had been conducted in study 1.

4.2.5.2 ***Qualitative.*** Three pilot focus group interviews were arranged with six full time undergraduate students recruited from one university. The aim was to ensure that the language and the specific interview questions used were appropriate. Feedback on ways of improving the interview process was used to adapt the specific research questions. The revised questions were reviewed by experts in qualitative studies in Hong Kong and the questionnaire was considered to be content valid.

4.2.6 Data Analysis

4.2.6.1 ***Quantitative.*** Data were collected from 161 full time undergraduate students. Only participants having responded to the three assessments were included in the analyses. Data extracted from the survey instrument were used as follows: the dependent variables included the total PA score, the stage of exercise change and the self-efficacy score; the independent variables included gender, age, BMI (weight/height^2) and the intervention group.

Descriptive statistics for the total PA score, the self-efficacy score, gender, age and BMI were calculated. One-way analyses of variance (ANOVAs) were used to test for differences in the baseline characteristics of the participants between the three intervention groups. Repeated measure ANOVAs, with time (baseline, 3rd month & 6th month) as the within-subjects factor and intervention group (public access Internet, stage-targeted Internet and control group) as the between-subjects factor were used to

evaluate the effects of the different interventions on PA and self-efficacy. One-way ANOVAs were performed on the PA score changes and self-efficacy score changes to examine the intervention effects in each of the groups, and post hoc Tukey tests were conducted when the ANOVA tests revealed significant effects.

Wilcoxon Signed Ranks tests were used to analyze the within group differences in the categorical data. The primary dependent variable was the stage of exercise change and meeting the ACSM/AHA criteria for sufficient PA. There were three categories in the tests: a positive rank was assigned if the stage moved from a lower category to a higher category, a negative rank was assigned if the stage moved from a higher category to a lower category and a tie was assigned if the stage remained unchanged from the baseline to the 3rd or 6th month assessment. Mann-Whitney tests were used to analyze differences in the stage of exercise change between the groups. Chi-square tests were used to analyze differences in the proportion of participants meeting the ACSM/AHA criteria of sufficient PA between the groups. The data were analyzed using the Statistical Package for Social Science (SPSS) version 12 for Windows software. Statistical significance was set at a level of 0.05.

4.2.6.2 Qualitative. For the qualitative data analysis, the narrative approach (Bowling, 2009; Thomas & Nelson, 2001) was adopted. This approach emphasizes analysis of the content of the narrative in its original and intact form. Direct quotations,

which describe the details of an incident or experience, including what participants had said, done, thought and felt on that occasion, were used in the analysis. The search for the reasons and details of an incident through a process of interpretation of the participants' lived experience is a substantial part of a narrative inquiry and this approach is best suited to the qualitative data analysis of study 2.

In order to ensure the internal validity of the credibility of the responses, member checks were conducted during which participants were asked to correct inaccuracies in the interview transcripts and analyzed data (Lincoln & Guba, 1985; Merriam, 2009). To confirm the explication of the research process and findings, the researcher invited expert in the field to review the interview data throughout the process of analysis and to confirm the accuracy of the findings. Using interviews as a secondary source of data collection enabled the researcher to extract meaningful data from the interview transcripts and this enriched the explanations and provided detailed descriptions in support of the quantitative results of the study.

4.3 Results

4.3.1 Participant Characteristics

The study was conducted from October 2009 to July 2010. A total of 286 full time undergraduate students from six UGC-funded universities responded to the study recruitment. The response rate was 0.5% of the full time undergraduate student population

in Hong Kong in 2009 to 2010 (University Grants Committee, 2010). Of these participants, 125 were already very active (total PA score more than 3000 MET·minutes per week) and thus were ineligible for the study. The remaining 161 participants were stratified by sex and by their stage of exercise change (Marshall and Biddle, 2001). They were randomized to one of the three groups, namely PAI, STI, and C group. The number and percentages of students recruited from the different universities in Hong Kong is shown in Table 11. The flow diagram of the randomization is shown in Figure 3.

Table 11. Number of students recruited from different universities in Hong Kong (N = 151)

	Number	Percentage
CUHK	138	91.4%
HKU	5	3.3%
HKUST	3	2.0%
HKBU	2	1.3%
Poly U	2	1.3%
City U	1	0.7%

Note: the Chinese University of Hong Kong (CUHK), the Hong Kong University (HKU), the Hong Kong University of Science and Technology (HKUST), the Hong Kong Baptist University (HKBU), the Hong Kong Polytechnic University (Poly U) and the City University of Hong Kong (City U).

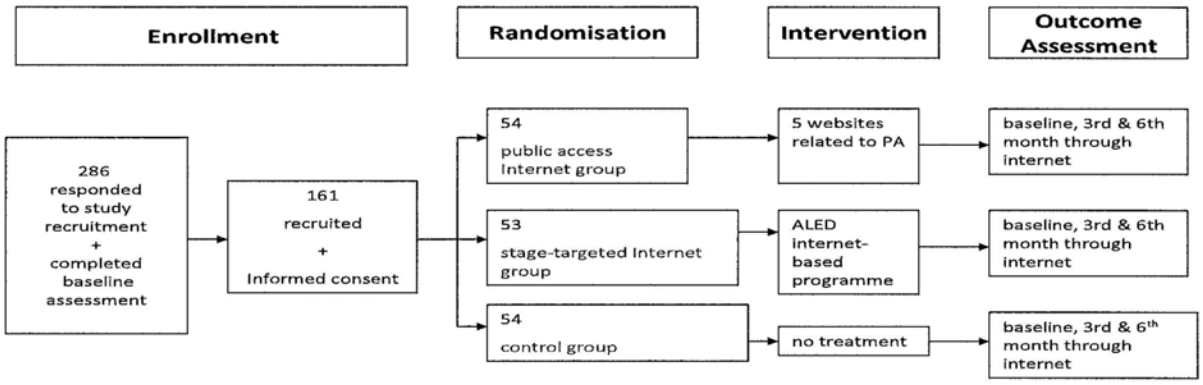


Figure 3. Flow diagram of participants' progress through different phases of the randomized control trial

Three focus group interviews were conducted in July 2010. Six participants from each intervention group were invited to take part and participants from the same group were interviewed together. One participant from the C group was unable to join the group interview due to a personal schedule conflict, so a total of 15 participants were interviewed. Information on PA participation, barriers to accessing the intervention contents and social support, as well as detailed opinions concerning the intervention, was collected. The interview dialogues were audio-taped on two recorders and were transcribed, and translated from Cantonese into an English written transcript. Member checks were conducted and participants were asked to correct inaccuracies in the interview transcripts and the analysed data (Lincoln & Guba, 1985; Merriam, 2009).

Appendices 3-5 contain the interview transcripts.

Of the participants (N = 161) who finished the baseline assessment, 79.5% were female and 20.5% were male. Women were over-represented in the respondent sample, compared with the female full-time undergraduate student population in Hong Kong (52.2%) in 2009 to 2010 (University Grants Committee, 2010). The age of the participants ranged from 17 to 27 (mean $\pm$ SD, 19.14 $\pm$ 1.10), and their BMI ranged from 15.61 to 28.73 kg/m^2 (mean $\pm$ SD, 19.38 $\pm$ 2.15). There were no significant differences among the 3 groups with respect to the demographics and baseline variables. Table 12 shows the baseline characteristics of the participants.

Table 12. Baseline characteristics of total sample and three groups (mean ± SD or %)

	Total sample (n = 161)	PAI Group (n = 54)	STI Group (n = 53)	C Group (n = 54)
Demographics				
Gender (% of female)	79.5	77.8	79.2	81.5
Age (year)	19.1 ± 1.1	19.3 ± 1.5	19.0 ± 0.8	19.1 ± 0.8
BMI (kg/m²)	19.4 ± 2.2	19.3 ± 2.0	19.7 ± 2.2	19.2 ± 2.3
Physical Activity				
Total PA Score (MET·min/week)	902.3 ±572.9	887.3 ±568.6	908.4 ±544.3	911.2 ±613.7
Meeting the PA recommendation (%)	73.9	70.4	81.1	70.4
Stages of change	16.2			
Pre-contemplation (%)	24.2	16.7	15.1	16.7
Contemplation (%)	59.6	24.0	24.5	24.0
Preparation (%)	0	59.3	60.4	59.3
Action (%)	0	0	0	0
Maintenance (%)		0	0	0

4.3.2 Changes in Total PA Scores

The follow up assessments were completed for 100% of the participants (N = 161) at the 3rd month and for 95.0% of the participants (N = 153) at the 6th month. There was no significant difference in the dropout rates between the groups. Only those participants who had responded to all three of the assessments were included in the statistical analyses. The flow diagram of the participants is shown in Figure 4.

Figure 4. Flow diagram of the participants

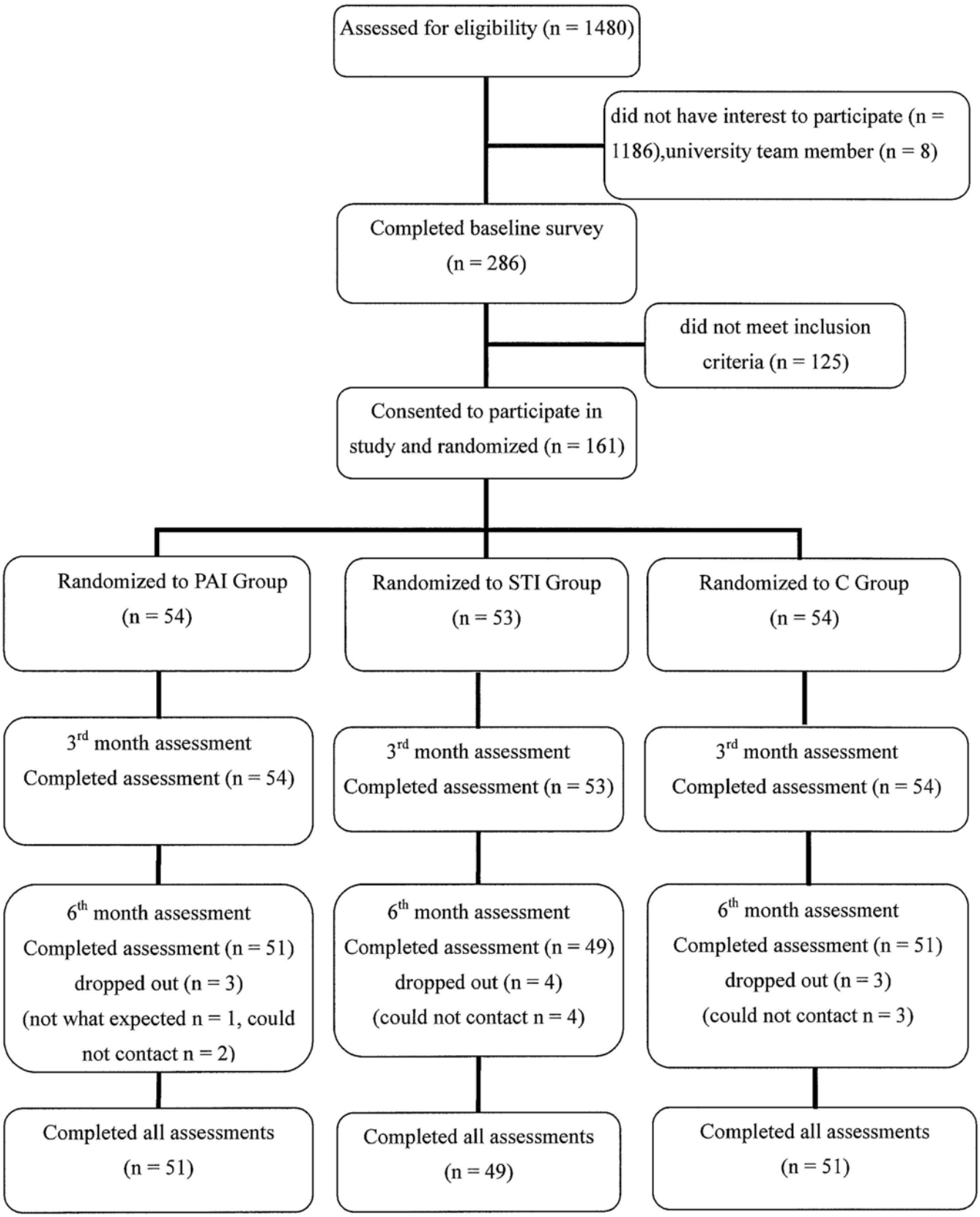


Table 13 shows that at the 3rd month assessment, the participants in the PAI group reported 1029.9 ± 920.6 MET·minutes per week, those in the STI group reported a mean total PA score of 1359.6 ± 918.8 MET·minutes per week, and those in the C group reported 1007.6 ± 936.6 MET·minutes per week. Although increases in the total PA scores were found in all groups, the improvement in the STI group was only found to be statistically significant F (1, 48) = 9.965, $p < 0.05$. The ANOVA univariate tests found no significant difference in the mean change between the groups (F [2, 150] = 1.761, $p > 0.05$). In addition, no gender difference ($p > 0.05$) in PA changes was found at the 3rd month assessment.

Supporting information was identified in the interviews. Participants in the STI group reported that the STI course contents helped them to increase their PA level by guiding them to set their own exercise goals, and by providing information on the importance and benefits of regular PA. Respondent 12 stated,

> *"I participated in more physical activities and tried to set up some goals to meet its requirement."*

Respondent 8 pointed out that,

> *"I was made aware of the importance of physical activities from the online (STI) course."*

Respondent 7 further commented that,

> *"...during the normal school day I gave dealing with my heavy workload a high priority in my school life. But I still placed the workbook in a prominent position to remind me of participating in physical activities."*

Participants of the PAI group reported that the contents of the public access websites

were not interesting and did not motivate them to read through the details, and thus did not help them to increase their PA levels. Respondent 4 commented that,

> *"I also accessed the websites at home, but I don't have any intention to access them again as they are too boring."*

Respondent 3 added that,

> *"When I use the internet, I always check my email, access blogs and read the news. I don't bookmark any websites if they are not so interesting the first time."*

Some participants of the PAI group reported that there was not enough information provided on the websites, as commented by Respondent 5,

> *"One of the websites introduces a lot of ball games. I think the information provided in the websites is too superficial and there is not enough information provided."*

Respondent 5 added that,

> *"I suggest providing information on choosing equipment in the websites. I want to have my own set of equipment if I continue to do physical activities."*

Respondent 2 further commented that,

> *"I want to receive some information which introduces special kinds of sports, including where and how to do such physical activities."*

At 6th month assessment, participants in the PAI group reported 931.0 ± 735.3 MET·minutes per week, those in the STI group reported a mean total PA score of 1084.2 ± 636.9 MET·minutes per week and those in the C group reported 981.2± 714.7 MET·minutes per week. Slight increases in the total PA scores were found in all groups, compared with the baseline assessment. However, these improvements were found to be not statistically significant ($p > 0.05$). The intervention effect was not found in the 6th

month assessment. The ANOVA univariate tests found no significant difference in the mean change between the groups (F [2, 150] = 0.205, $p > 0.05$). In addition, no gender difference ($p > 0.05$) in PA changes was found at the 6th month assessment. Table 13 shows the changes in the total PA scores.

Table 13. Mean physical activity (PA) scores (MET·min per week) at baseline, 3rd month and 6th month assessments

	PAI Group (n=51)	STI Group (n = 49)	C Group (n = 51)
Total PA scores (MET·min/week)			
Baseline	856.4 ± 551.0	915.2 ± 549.5	903.8 ± 626.0
3rd month	1029.9 ± 920.6	1359.6 ± 918.8*	1007.6 ± 936.6
Mean Difference	173.5	444.4	103.8
6th month	931.0 ± 735.3	1084.2 ± 636.9	981.2 ± 714.7
Mean Difference	74.5	169.0	77.4

Note: *p< 0.05, compared with baseline data

Further analysis of the separate PA patterns, including WPA, MPA and VPA of the participants, revealed a trend towards an increase in WPA scores was found in the STI group at the 3rd month assessment and the difference was close to being significant (F [1, 48] = 3.982, $p = 0.052$). In addition, statistically significant increases in the VPA score were found in the STI group (F [1, 48] = 9.221, $p < 0.05$) and in the C group (F [1, 50] = 5.012, $p < 0.05$) at the 3rd month assessment. A trend towards an increase in VPA scores

was found in the PAI group at the 6th month assessment and the difference was close to being significant (F [1, 50] = 3.997, p = 0.051). There were no statistically significant differences ($p > 0.05$) observed in the MPA scores in any of the groups.

4.3.3 Changes in Total PA Scores (CUHK Participants Only)

The participants were mainly recruited from the CUHK (91.4%). The data for the CUHK participants were analysed separately reported in Table 14, in an attempt to remove variations arising from any university specific influences. At the 3rd month assessment, participants in the PAI group reported a mean total PA score of 955.1 ± 843.6 MET·minutes per week, those in the STI group reported 1372.0 ± 936.1 MET·minutes per week, and those in the C group reported 1067.1 ± 973.2 MET·minutes per week. Although increases in the total PA scores were found in all groups, the improvement in the STI group was only found to be statistically significant F (1, 44) = 8.131, $p < 0.05$. In addition, the ANOVA univariate tests found no significant difference in the mean change between the groups (F [2, 137] = 1.886, $p > 0.05$).

At the 6th month assessment, participants in the PAI group reported a mean total PA score of 874.3 ± 686.4 MET·minutes per week, those in the STI group reported 1103.0 ± 645.5 MET·minutes per week, and those in the C group reported 1008.3 ± 732.2 MET·minutes per week. Slight increases in the total PA scores were found in all groups, compared with the baseline assessment. However, these improvements were not

statistically significant ($p > 0.05$). The intervention effect was not found in the 6th month assessment. In addition, the ANOVA univariate tests found no significant difference in the mean change between the groups (F [2, 137] = 0.416, $p > 0.05$). The pattern of PA changes of the CUHK participants was similar to that of the total sample. Table 14 shows the changes in the total PA scores.

Table 14. Mean physical activity (PA) scores (MET·min per week) at baseline, 3rd month and 6th month assessments. (CUHK participants only)

	PAI Group (n = 49)	STI Group (n = 45)	C Group (n = 44)
Total PA scores (MET·min/week)			
Baseline	848.9 ± 556.6	939.4 ± 564.0	986.8 ± 625.6
3rd month	955.1 ± 843.6	1372.0 ± 936.1*	1067.1 ± 973.2
Mean Difference	106.2	432.6	80.4
6th month	874.3 ± 686.4	1103.0 ± 645.5	1008.3 ± 732.2
Mean Difference	25.4	163.6	21.6

Note: *p< 0.05, compared with baseline data within group

4.3.4 Meeting the ACSM/AHA Criteria of Sufficient PA

At the 3rd month assessment, no significant change ($p > 0.05$) in the number of participants meeting the ACSM/AHA criteria of sufficient PA was found in all groups across time. The Chi-square tests showed a statistically significant difference in the number of participants meeting the criteria between the STI and C groups (X^2 [1, N=100]

= 4.830, $p < 0.05$). At the 6th month assessment, there were no statistically significant differences observed either within or between groups ($p > 0.05$). Table 15 shows the changes in the number of participants meeting the ACSM/AHA criteria of sufficient PA.

Table 15. Number of participants meeting the ACSM/AHA criteria of sufficient PA [number (%)]

	PAI Group Total n = 51	STI Group Total n = 49	C Group Total n = 51
Baseline	35 (68.6)	40 (81.6)	37 (72.5)
3rd month	39 (76.5)	44# (89.8)	37 (72.5)
6th month	35 (68.6)	40 (81.6)	37 (72.5)

Note: #p< 0.05, compared with control group

4.3.5 Shifting of Stages of Change

At the 3rd month assessment, a statistically significant improvement in the stage of change was found only in the STI group, as such, 16 participants had shown improvement, 29 participants remained unchanged and four participants had regressed in their stages of change. The improvement was found to be statistically significant ($Z = 2.379, p < 0.05$).

In the PAI group, 16 participants had shown improvement, 27 participants remained unchanged and eight participants had regressed in their stages of change. The shift was found to be not statistically significant ($Z = 1.369, p > 0.05$). In the C group, 10 participants had shown improvement, 32 participants remained unchanged and nine participants had regressed in their stages of change. The shift was also found to be not

statistically significant ($Z = 0.171$, $p > 0.05$).

Additional information was identified in the interviews. Participants in the STI group believed that there were some factors that had a positive influence on their stages of exercise change. These supporting factors were social support, the STI course contents and the questionnaires which would remind them to participate in PA. Respondent 12, referring to the factor of social support, said

> *"I don't think it (the STI intervention) was very influential on my stage of exercise change. Actually, social support was more influential in my stage of exercise change. The invitation to physical activities from my friends was more important in affecting my participation in physical activities."*

Respondent 9 from the STI group reported that the STI course contents reminded him of the benefits of participating in regular PA,

> *"I think it (the STI course) made me aware of the advantages of doing physical exercise. But if I was too busy, I continued not to do so."*

Respondent 8 added that,

> *"Indeed, I agree that the intervention contents as a reminder affected my motivation to take part in physical activities. The questionnaires also push me to invite my friends to participate in physical activities, because I was made aware of the importance of physical activities from the online course."*

On the other hand, participants of the PAI group claimed that the information from the websites did not help them to improve their stage of exercise change. Respondent 2 commented that,

> *"Indeed, I don't think the intervention contents were very useful for my motivation to have physical activities. My awareness of getting older reminded me to do exercise in my daily life."*

At the 6th month assessment, statistically significant improvements in the stage of change were found in both the STI and PAI groups. In the PAI group, 20 participants had shown improvement, 23 participants remained unchanged and eight participants had regressed in their stages of change. The improvement was found to be statistically significant ($Z = 2.351$, $p < 0.05$). In the STI group, 18 participants had shown improvement, 22 participants remained unchanged and nine participants had regressed in their stages of change. The overall improvement was found to be statistically significant ($Z = 2.013, p < 0.05$).

In the C group, 14 participants had shown improvement, 27 participants remained unchanged and 10 participants had regressed in their stages of change. The shift was found to be not statistically significant ($Z = 0.791, p > 0.05$). Table 16 shows the stages of change at the baseline, and at the 3rd and 6th month assessments.

Table 16. Stages of change at baseline, 3rd month and 6th month assessments

Stages of change	Baseline			3-Month※			6-Month*#		
	PAI (n=51)	STI (n=49)	C (n=51)	PAI (n=51)	STI (n=49) ※	C (n=51)	PAI (n=51) *	STI (n=49) #	C (n=51)
Pre-contemplation	9	6	9	7	6	11	3	3	7
Contemplation	13	13	12	11	7	9	15	13	15
Preparation	29	30	30	29	29	29	28	28	25
Action	0	0	0	4	7	2	4	4	4
Maintenance	0	0	0	0	0	0	1	1	0

Note: Wilcoxin Signed Ranks Tests $Z=2.379^{※}$, $p<0.05$; $Z= 2.351^{*}$, $p<0.05$; $Z=2.013^{\#}$, $p<0.05$; compared with baseline within groups.

4.3.6 Change in Self-efficacy

The scores for the self-efficacy of the participants at the baseline (mean ± SD = 2.71 ± 0.62; skewness, standard error = -0.049, 0.197; kurtosis, standard error = -0.303, 0.392), the 3rd month (mean ± SD = 2.63 ± 0.66; skewness, standard error = 0.193, 0.197; kurtosis, standard error = -0.265, 0.392) and the 6th month (mean ± SD = 2.67 ± 0.68, skewness, standard error = 0.003, 0.197; kurtosis, standard error = -0.416, 0.392) assessments were normally distributed. Since all the skewness and kurtosis scores were within the expected ranges of chance fluctuations in the statistics, which would indicate distributions with no significant skewness and kurtosis problem, their frequency graphs were close to normal curves. Therefore, parametric statistical analysis methods could be

used.

Table 17 shows that at the 3rd month assessment, participants in the PAI group reported a mean self-efficacy score of 2.59 ± 0.66, those in the STI group reported 2.70 ± 0.68, and those in the C group reported 2.60 ± 0.66. An increase in the mean self-efficacy score was found only in the STI group. However, the increment was not statistically significant (F [1, 48] = 0.079, $p > 0.05$). Decreases in the mean self-efficacy scores were found in both the PAI and C groups. The decrement was statistically significant (F [1, 50] = 6.130, $p < 0.05$) in the PAI group but not significant (F [1, 50] = 0.151, $p > 0.05$) in the C group.

At the 6th month assessment, participants in the PAI group reported a mean self-efficacy score of 2.56 ± 0.69. The score was lower than that of the baseline assessment and was statistically significant (F [1, 50] = 4.659, $p < 0.05$). The participants in the STI group reported a mean self-efficacy score of 2.79 ± 0.67. A slight increase in the self-efficacy score was reported compared with the baseline assessment, but the improvement was not statistically significant (F [1, 48] = 1.731, $p > 0.05$). The mean self-efficacy score of the C group was 2.65 ± 0.67. Compared with the baseline assessment, there was a slight increase in the score, but the increment was not statistically significant (F [1, 50] = 0.037, $p > 0.05$). In addition, the ANOVA univariate tests found significant differences in the mean change between the groups (F [2, 150] = 3.477, $p <$

0.05); post hoc Tukey tests showed a statistically significant difference ($p < 0.05$) between the PAI and the STI group. Table 17 shows the changes in the mean self-efficacy scores.

During the interviews, when the participants of the STI and PAI groups were asked "How would the intervention affect your belief in your ability to engage in moderate regular physical activities (exercise self-efficacy)?" all participants replied that the intervention contents did not help to improve their exercise self-efficacy. Respondent 7 from the STI group stated,

> *"I have the habit of doing physical exercise, thus I don't think it (the STI course) had any influence on my confidence in engaging in physical activities."*

Respondent 8 from the same group added that,

> *"I agree. Sometimes workload has a higher priority in my life in comparison to physical activities even after I have read the intervention contents."*

Respondent 4 from the PAI group commented that,

> *"It (the PAI intervention) was not very useful as the information provided is too theoretical without many practical examples, such as the information on safety rules when playing squash."*

Table 17. Mean self-efficacy scores at baseline, 3rd month and 6th month assessments

	PAI Group (n = 51)	STI Group (n = 49)	C Group (n = 51)
Self-efficacy scores			
Baseline			
3rd month	2.82 ± 0.64	2.67 ± 0.63	2.64 ± 0.59
Mean Difference	2.59 ± 0.66*	2.70 ± 0.68	2.60 ± 0.66
	-0.23	0.03	-0.04
6th month			
Mean Difference	2.56 ± 0.69*	2.79 ± 0.66#	2.65 ± 0.67
	-0.26	0.12	0.01

Note: *p< 0.05, compared with baseline data within group
#p< 0.05, compared with PAI group

4.3.7 Programme Engagement

The reported mean number of websites visited was 1.7, which was equal to 33.4% of the websites recommended. The reported mean number of programme sessions completed was 5.9, which was equal to 29% programme compliance.

4.3.8 Summary of Results

Increased total PA scores were only found in the STI group at the 3rd month assessment. No gender differences in PA changes were found either at the 3rd month or the 6th month assessment. There were no significant changes in the number of participants meeting the ACSM/AHA criteria of sufficient PA across time in all groups. Statistically, a significant difference in number of participants meeting the criteria between the STI and the C group was found at the 3rd month assessment.

Improvements in the stage of change were found in the STI group at the 3rd month

assessment and in both the PAI and the STI groups at the 6th month assessment. Decreased mean self-efficacy scores were found in the PAI group at the 3rd and 6th month assessments respectively. There were no statistically significant changes in the mean self-efficacy scores found in the STI and control groups.

Qualitative data were also collected. The contents of the public access websites could not arouse the PAI group participants' interest to read through the details and hence did not help in increasing their PA levels and stages of exercise change. The ALED course contents facilitated the STI group participants to increase their PA levels by leading them to set their own exercise goals and by emphasizing the importance and health benefits of regular PA. Both the ALED course contents and assessment questionnaires had positive influences on stages of exercise changes of the STI group participants. The participants in the PAI and the STI groups did not perceive any positive influences from the intervention contents on their exercise self-efficacy. In addition, participants in all groups commented that the campus environment and sports facilities were useful in increasing chances of PA participation.

The results suggested that participants in the PAI group did not demonstrate improvement in PA to the same extent as their counterparts in the STI group. The public access websites were not effective for PA promotion among university students. The STI intervention was effective in elevating the PA level of the university students, however,

the influence was rather short term, and the effect disappeared at the 6th month assessment.

4.4 Discussion

The primary goal of the current study was to examine the efficacy of the public access Internet as compared with the tailored-Internet for PA promotion among university students. The current study compared public access websites selected by experts with the stage-tailored PA behaviour change programme adapted from previous studies (Dunn et al., 1998; Kohl et al., 1998; Sevick et al., 2000) which had been shown to be effective in having a positive influence on PA behaviour.

Contrary to the hypotheses, improvement in PA participation was only found in the STI group at the 3rd month assessment, and no statistically significant change in total PA scores and stage of exercise change was found in the participants of the PAI group. These findings contrasted with studies that demonstrated similar improvement in PA participation in both the tailored Internet group and in the public access Internet group (Marcus et al., 2007; McKay et al., 2001; Spittaels et al., 2007).

The findings of the current study show that the public access websites were not effective in promoting PA among university students. Their failure to influence PA behaviour might be attributed to the lack of attractive contents in the chosen websites and to the fact that the expectations for the websites were not positive enough; as respondent

4 commented,

> *"...I don't have any intention of accessing them (chosen public access websites) again as they are too boring."*

Respondent 5 of the PAI group added that,

> *"I think the information provided in the websites is too superficial and there is not enough information provided...I suggest providing information on choosing equipment in the websites. I want to have my own set of equipment if I continue to do physical activities."*

Respondent 2 suggested that,

> *"I want to receive some information which introduces special kinds of sports, including where and how to do such physical activities."*

Increases in VPA scores were found in the STI and C group at the 3rd month assessment, a result that is close to being significant ($F [1, 50] = 3.997$, $p = 0.051$) and an increase was also found in the PAI group at the 6th month assessment. During the interviews, most interviewees agreed that the campus environment and availability of sports facilities encouraged their participation in PA. Previous studies (Ridgers et al., 2007; Stratton et al., 2005; Verstraete et al., 2006) reported that enhancing access to places for PA could have a positive influence on PA participation. The possible reasons for the increased VPA scores might be due to the easily accessible sports facilities, such as fitness rooms, swimming pools and multipurpose halls provided on campuses.

Improvements in stage of change were found in the 6th month assessments of both the STI and PAI group respectively. These findings might be attributed to the reduction in academic workload during the time of questionnaire distribution, which was in early June

2010. The university students might have more time to think about doing exercise, and thus were more motivated to exercise, during summer vacation. In addition, weight control for summer clothing and training for physical fitness for tackling future challenges in the next academic year were also reasons for increasing motivation for PA participation. As respondent 3 of the PAI group expressed,

> *"I am aware of controlling my weight in order to wear my summer clothing and I am motivated to exercise during the summer vacation."*

Respondents 6 of the same group reported that,

> *"Now that I am in my second year, I am busy facing many academic problems. That's why I am doing physical fitness exercises in summer so that I can tackle my workload in the next academic year."*

A "gap" usually exists between intention and action for many behaviours (Orbell & Sheeran, 1998), and this might explain why improvements in the stage of change were found in the PAI and STI groups at the 6th month assessment, but no changes in the PA scores were found in the participants of the PAI and STI groups at the same assessment.

Programme engagement rates were collected. The reported mean number of websites visited was 1.7, which was equal to 33.4% of the websites recommended. The reported mean number of programme sessions completed was 5.9, which was equal to 29% programme compliance. The programme engagement rates were similar to previous studies (Carr et al., 2008; Marshall et al., 2003; Steele et al., 2009). As postulated by

Brouwer and colleagues (2011), the programme compliance of the Internet-delivered interventions has been found to be lower than expected.

The stage-tailored Internet programme was targeted at PA initiation and progress. The programme was developed based on the models of TTM (Prochaska & DiClemente, 1983) and SCT (Bandura, 1986) and self-efficacy is a key construct of these two models. This refers to a person's confidence in their own ability to organize and execute the course of action required to perform a particular behaviour (Bandura, 1997). It has been shown to predict PA behaviour in adults (Kaewthummanukul & Brown, 2006; Sallis et al., 1986; Sallis et al., 1992; Strachan et al., 2005). In addition, self-efficacy has been shown to mediate the effects of behaviour change interventions on walking (Darker et al., 2010).

Unexpected decreases of exercise self-efficacy scores were found in the PAI group participants at the 3rd month and 6th month assessments respectively. However, improvement in stage of change was found at the 6th month assessment. These findings were contrary to the findings of Marcus and colleagues (1992b), that exercise self-efficacy increased as the stage of change of an individual moves towards maintenance stage. The meta-analysis study of Marshall and Biddle (2001) also illustrated that within the TTM constructs, self-efficacy increases across the stages of change.

The systematic review of Ashford and colleagues (2010) suggested that feedback on past or others' performances was effective in elevating the self-efficacy for PA but barrier

identification was associated with lower levels of self-efficacy. The possible explanations for the dropping of exercise self-efficacy scores might be attributed to the lack of feedback provided, lack of experience sharing platform and mechanism establishment at the publicly available websites recommended. In addition, lack of behavioural modification skills to cope with exercise barriers, such as lack of time and feeling of being tired due to heavy academic workload, might also be a negative factor of the self-efficacy scores. The possible explanations for the lack of significant effect on the self-efficacy scores in the STI group might be attributed to limited stage-tailored feedback and experience sharing provided from the ALED intervention Internet programme. In addition, as the ALED is a healthy lifestyle promotion programme, exercise self-efficacy may not be as critical as in the structured exercise-based intervention, such as in a traditional exercise prescription programme.

Furthermore, the decline in self-efficacy in the PAI group might also be attributed to the unattractive website contents of the PAI intervention. As reported by the respondents of the PAI group during the focus group interview, the website contents were too boring and theoretical and did not help to improve their exercise self-efficacy. Respondent 4 mentioned that,

> *"...I don't have any intention to access them (chosen public access websites) again as they are too boring."*

Respondent 4 added that,

"They were not very useful as the information provided was too theoretical."

Moreover, results derived from the interviews highlighted the fact that current PA related websites available in Hong Kong are mainly sports oriented; they focus on sports skills and athletes training. For example, the contents of the PE Web (http://www.pe-web.org/) are mainly designed for physical education teaching and emphasize the demonstration of sports skills; the Sport Science Web (http://www.epsport.idv.tw/) focuses on sports science and training theories; and the websites of the sports associations are mainly for sports events and course promotion.

The general public may find it difficult to understand the website contents and to learn the applicable skills for adopting exercise habits. The general public may eventually give up the practice of active lifestyles. Respondent 2 of the PAI group stated,

"The second website is confusing when describing how to write an abstract. It includes so much information and seems irrelevant to its title."

Respondent 5 of the PAI group commented that,

"One of the websites ..., introduces lots of ball games. I think the information provided in the website is too superficial and there is not enough information provided."

In view of the cost and time associated with face-to-face PA promotion intervention, the use of the Internet could be a cost-effective option for PA promotion (Lewis et al., 2010). A well designed, stage-tailored and theory-based Internet programme or website focusing on healthy lifestyle promotion is needed. Practical skills to overcome exercise

barriers and adopt lifelong exercise habits such as step-by-step exercise goal setting, choosing suitable exercises, rewarding the improvements and establishing social support systems should be incorporated into the main contents of the PA promotion website. In addition, tailored feedback and mechanisms for experience sharing should also be provided in the website.

CHAPTER FIVE

Discussion

5.1 Introduction

The purpose of these two studies was to examine the effectiveness of the Internet in promoting PA among university students. In study 1, it was hypothesized that an internet-based PA intervention would be as effective as the print-based PA intervention in PA promotion among university students. The outcome assessments were total PA score and stage of change. In study 2, it was hypothesized that the publicly available PA websites chosen by specialists were as effective as the stage-targeted Internet PA interventions in PA promotion among university students. The outcome assessments were total PA score, stage of change and exercise self-efficacy.

Chapter 5 will present a summary of studies 1 and 2. The summary includes the statement of the problem for the studies, methodology and findings. In addition, implications derived from the research findings are discussed. A number of recommendations for further studies are then suggested. Finally, the overall conclusions of the thesis are presented.

5.2 Summary of the studies

5.2.1 Statement of the problem

Regular PA plays a significant influence on health as well as on quality of life. Despite the wealth of evidence that being physically active is beneficial to health

(Hamilton et al., 2007; Healy et al., 2008; Paffenbarger et al., 1986; Physical Activity Guidelines Advisory Committee Report, 2008; U.K. Department of Health, 2004; U.S. Department of Health and Human Services, 2000; Wyrwich & Wolinsky, 2000), few Hong Kong citizens were found to be active enough to achieve health benefits (Hui, 2004; Hui & Morrow, 2001; LCSD, 2009). Physical inactivity is a major cause of chronic diseases such as coronary heart disease, type II diabetes and cancer (Blair et al., 1989; Hamilton et al., 2007; Healy et al., 2008; Helmrich et al., 1991; Paffenbarger et al., 1975; Paffenbarger et al., 1986; Wyrwich & Wolinsky, 2000). The unfavourable trend toward a sedentary lifestyle has become a worldwide burden and public health concern.

As Sparling (2003) mentioned, universities are important settings in which healthy lifestyles can be promoted and nurtured. Leslie and colleagues (2001) suggested that university campuses can provide good opportunities to influence the PA habits of young adults. With the advantage that most university students have easy access to the Internet and are technologically savvy about computer use, the Internet has the potential for delivering PA promotion intervention to university students.

Given the cost and time associated with face-to-face PA intervention, the use of the Internet may be a cost-effective channel for wide-scale PA promotion (Lewis et al., 2010). The use of this new technology for PA promotion in university campus settings is promising but the efficacy is unknown. It is worthwhile to investigate the effectiveness of

using the Internet to promote PA among university students.

5.2.2 Methodology

5.2.2.1 Study 1.

The Efficacy of the Internet for PA promotion among University Students

The target population for the present study represented the full-time undergraduate students studying in universities in Hong Kong in 2008. The participants in the study included 111 university students from six UGC-funded universities.

The participants were stratified by sex and stage of exercise change and randomized to one of the three groups, namely IB, PB and C group. Apart from demographic data, the questionnaire collected data on stage of exercise change and PA level. The baseline assessment was conducted in November 2008; the response rate was 100% (N=111). The 3rd month assessment was conducted in February 2009; the response rate was 100% (N=111). The 6th month assessment was conducted in May 2009, the response rate was 95.5% (N=106).

5.2.2.2 Study 2.

The Efficacy of Publicly Available Websites for PA promotion among University Students

This study implemented mixed research methodology by using both quantitative (on-line questionnaires) and qualitative (face-to-face group interviews) data collection

methods. The target population for study 2 represented all full-time undergraduate students studying in universities in Hong Kong in 2009. The sample in this study included 161 university students from six UGC-funded universities. The participants were stratified by sex and stage of exercise change and randomized to one of the three groups, namely STI, PAI and C group.

The baseline assessment was conducted in December 2009; the response rate was 100% (N=161). The 3rd month assessment was conducted in March 2010; the response rate was 100% (N=161). The 6th month assessment was conducted in June 2010; the response rate was 95.0% (N=153).

Three focus group interviews were conducted in July 2010. The interviews were conducted in a semi-structured format where six participants from each group were selected. The selections were based on the total activity scores at the 6th month assessment, i.e., two from the low (at or below 25th percentile of all participants), two from medium (at 45th to 55th percentile of all participants) and two from high (at or above 75th percentile of all participants). Participants from the same group were interviewed together. One participant from the C group was absent in the C group interview due to a personal schedule conflict. A total of 15 participants were interviewed. Information on PA participation, barriers to accessing the intervention contents, social support and detailed opinions toward the intervention was collected. The interview dialogues were audio-taped

on two recorders and were transcribed and translated from Cantonese into an English written transcript. Member checks, which ensure the internal validity of credibility, were conducted and participants were asked to correct inaccuracies in the interview transcripts and analysed data (Lincoln & Guba, 1985; Merriam, 2009).

Descriptive statistics for total PA, gender, age, BMI and self-efficacy score (study 2 only) were calculated. One-way analyses of variance (ANOVAs) were used to test for differences in baseline characteristics of participants between groups. Repeated measure ANOVAs, with time (baseline, 3rd month & 6th month) as the within-subjects factor and intervention group as the between-subjects factor, were used to evaluate the effects of different interventions on PA and self-efficacy score (study 2 only). Wilcoxon Signed Ranks tests were used to analyse the within-groups differences in categorical data. Mann-Whitney tests were used to analyse differences in stage of exercise change between groups. Chi-square tests were used to analyse differences in proportion of participants meeting the ACSM/AHA criteria of sufficient PA between groups. SPSS version 12 for Windows was used for data analysis. Statistical significance was set at a level of 0.05.

5.2.3 Findings

5.2.3.1 Study 1. Increased total PA scores were found in the PB and IB groups at the 3rd and 6th month assessments respectively; the PA scores increased similarly in the two intervention groups. An increase in number of participants meeting the ACSM/AHA

criteria of sufficient PA was found in the IB group at the 3rd month assessment. The proportions of participants meeting the criteria were higher in the intervention groups than in the C group at the 3rd month assessment.

Improvement in stage of change was only found in the IB group at the 3rd month assessment. Improvements in stage of change were found in both the PB and IB groups at the 6th month assessment. The results suggested that the Internet-based intervention was as effective as the print-based intervention in PA promotion among university students.

5.2.3.2 Study 2. Increased total PA scores were only found in the STI group at the 3rd month assessment. There were no significant changes in the numbers of participants meeting the ACSM/AHA criteria of sufficient PA across time in all groups. Statistically, a significant difference in number of participants meeting the criteria between the STI and the C group was found at the 3rd month assessment.

Improvements in stage of change were found in the STI group at the 3rd month assessment and in both the PAI and the STI groups at the 6th month assessment. Decreased mean self-efficacy scores were found in the PAI group at the 3rd and 6th month assessments. There were no statistically significant changes in the mean self-efficacy scores found in the STI and control groups.

Qualitative data were also collected. The contents of the public access websites could not arouse the PAI group participants' interest to read through the details and hence

did not help in increasing their PA levels and stages of exercise change. The ALED course contents facilitated the STI group participants to increase their PA levels by leading them to set their own exercise goals and by emphasizing the importance and health benefits of regular PA. Both the ALED course contents and assessment questionnaires had positive influences on stages of exercise changes of the STI group participants. The participants in the PAI and the STI groups did not perceive any positive influences from the intervention contents on their exercise self-efficacy. In addition, participants in all groups commented that the campus environment and sports facilities were useful in increasing chances of PA participation.

The results suggested that participants in the PAI group did not demonstrate improvement in PA to the same extent as their counterparts in the STI group. The public access websites were not effective for PA promotion university students. The STI intervention was effective in elevating the PA level of the university students, however, the influence was rather short term, and the effect disappeared at the 6th month assessment. The major implications derived from the findings of studies 1 and 2 are further elaborated in the following section.

5.3 Discussion

The IB group of study 1 reported positive changes on total PA scores at both the 3rd and 6th month assessments. The STI group of study 2 reported positive changes on total

PA scores at the 3rd month assessment only; the positive influence on PA disappeared at the 6th month assessment. The results of the current studies showed that the intervention effects were short to medium term, from three to six months. Congruent with the review findings of Marcus and colleagues (2009), Vandelanotte and colleagues (2007), the intervention effects of the Internet-based PA interventions were mostly short lived (less than six months).

Although the same ALED online programme was used in the IB group in study 1 and for the STI group in study 2, the intervention effects on PA were longer in the IB group. An increase in PA scores was found in the IB group in study 1, but not in the STI group in study 2 at the 6th month assessment. The time of the 6th month assessment in study 1 was in May which was still during term time and the time of the 6th month assessment in study 2 was in June which was at the start of summer break. As suggested by Leslie and colleagues (2001), the university campuses could provide good opportunities to influence the PA habits of young adults. The lack of positive PA influences found in the STI group at the 6th month assessment might be attributed to leaving campuses during term break and to reduced intervention programme use.

As has been mentioned previously (Leslie et al., 2005; Marcus et al., 2009; Vandelanotte et al., 2007), low engagement and retention rate was a challenge for Internet-based interventions; the short-term intervention effects might be attributed to the

decline in accessing the targeted websites as the intervention progressed. Respondent 11 of the STI group recalled,

> *"My motivation was higher initially when I received the intervention contents; nevertheless, I didn't access the contents during mid-term. Even though you requested that I finish the questionnaires, my intention to access the contents decreased from where it was at the beginning of the research."*

Respondent 7 from the same group added that,

> *"I accessed the online course regularly in order to learn some information from the contents. If there was nothing new, I did not access the online course again."*

The initial higher accessing rate of intervention websites might be due to commitment to the project and curiosity because of the novelty of the Internet-based course contents.

Future studies should also evaluate the influence of booster interventions such as short message service (SMS) and electronic mail on the retention rate of internet-based PA interventions. As suggested by participants during the focus group interviews, reminder electronic mails could help to prompt them to access the Internet-based programme. Respondent 7 from the STI group stated,

> *"...it is recommended that mass mails (electronic mails) be sent to all candidates so as to stimulate their motivation (to log into the Internet-based programme) and to remind them of their participation in physical activities."*

Unintentional PA prompts in the study procedures were found. It was possible that answering the 3rd and 6th month questionnaires during the study period might lead to an

increase in motivation of PA participation. As reported by respondent 8 of the STI group,

> *"The questionnaires were designed to ask details, which motivated me to reflect upon my physical activity participation."*

Respondent 3 from the PAI group mentioned that,

> *"Yes, I think so (the questionnaires were useful for increasing PA). I was asked to write down my weight and my physical habits at different stages which inspired me to reflect on how often I spent time participating in physical activities."*

During the interviews, most interviewees agreed that the campus environment and sports facilities facilitated their PA participation. The reasons might be due to the easily accessible sports facilities, such as swimming pools, fitness rooms and multipurpose halls provided on campuses. As respondent 8 of the STI group elaborated,

> *"I think the sports facilities on campus are convenient for increasing the level of physical activity. I invited my friends to participate in physical activities when I lived on campus."*

University campuses also provide a unique setting for walking. Previous studies (Cervero & Duncan, 2003; Hoehner et al., 2005; Sisson et al., 2008) have demonstrated that planning and layout in the building environment is critical for influencing pedestrian activity, especially transportation-related PA. Walking for transportation is affected by factors such as, perceived safety, accessibility of social destinations, street networks and connectivity (Cervero & Duncan, 2003; Frumkin et al., 2004).

Most university campuses are pedestrian-oriented with aesthetic and shaded footpaths, thus transportation-related walking to classes and social destinations can be facilitated and encouraged. Respondent 13 of the control group recalled,

"Walking is better as I don't need to wait for a school bus. This also enables me to become healthy and to remain fresh after lectures. I really enjoy walking in the campus."

Respondent 11 of the STI group mentioned that,

"Some locations (on campus) are better for walking as the school buses don't go into that area."

The findings from the two studies supported the efficacy of stage-targeted Internet intervention in PA promotion among university students in Hong Kong. In view of the limited supply of lifestyle activity focus and lack of well designed Internet programmes in Hong Kong, research efforts should be dedicated to the design of PA promotion websites in Hong Kong. Further recommendations for future studies, and consideration of limitations and strengths, will be elaborated in the following sections.

A higher rate of use of the intervention websites was associated with higher PA participation (Lewis et al., 2008; Tate et al., 2003). This positive correlation was also found in study 1, as the participants who completed more sessions showed a greater increase in PA ($r = 0.302$, $p < 0.01$). However, a similar correlation was not found in study 2. Indeed, the amount of adequate programme engagement is often undefined (Danaher & Seeley, 2009; Norman et al., 2007). Some studies have found that only a small proportion of participants visited the intervention programme more than once (Brouwer et al., 2010, Verheijden et al., 2007). An increase in familiarity with the characteristics of Internet interventions might help to explain the variance in the effects of different interventions and be used to manipulate the dose response.

5.4 Limitations and strengths

There were some limitations in the current studies. First, the current studies collected self-reported data, which could create a response bias. Some studies assessed objective PA outcomes by using pedometers (Carr et al., 2008) and accelerometers (Hurling et al., 2007). The use of these devices is not only useful for collecting objective data but might also help to remind and motivate participants to exercise.

According to Lenhart and colleagues (2003), the Internet is progressively serving people with lower educational attainment. The general public needs health information to guide them to make health-related decisions. When they experience health problems or symptoms, people may use the Internet as their primary resource, rather than consulting health specialists, in order to obtain health-related information (Hesse et al., 2005). However, the samples recruited in the current studies could not address this trend of Internet use, as all participants were university students. The ability to generalize the findings to people with more diverse academic levels is thus limited.

Third, as the current studies assessed participants at the baseline, 3rd month, and 6th month of the intervention, only medium-term efficacy (three to six months) could be evaluated; the long term effect (more than six months after intervention) of the Internet interventions was unknown. Fourth, the participants were mainly recruited from a university which had required PE courses provided. These PE courses aimed to promote

active participation in regular PA which may result in an unintentional PA enhancement factor in the study procedures. Fifth, participants could take part in the studies voluntarily, which might cause a self-selection bias. Sixth, study 1 provided face-to-face sessions and study 2 included focus group interviews for qualitative data collection. Both the facilitator and interviewer needed to meet the participants during sessions and interviews, which made anonymity impossible.

Despite the limitations, some strengths could be observed in the current studies. First, these were randomized controlled trials which, when handled appropriately, are the gold standard of intervention research. Second, direct comparisons of specific intervention elements were conducted, such as an Internet-based with print-based delivery mode in study 1, and a stage-targeted Internet programme with public access websites in study 2; this help to identify effective factors for future Internet PA promotion interventions.

Third, the current studies examined the efficacy of the Internet in PA promotion among university students, which bridges the gap of few true experimental trials using the Internet to promote PA among university students in Hong Kong. Fourth, study 2 implemented mixed research methodologies by using both quantitative and qualitative data collection. The qualitative data collected in the face-to-face interviews could facilitate the explanation of behaviour changes and thus, enhance the understanding of the specific elements of the Internet-based PA intervention design.

Fifth, with comparatively good computer skills and easy access to the Internet, the university students were already skillful and felt comfortable with on-line surveys (Shih & Fan, 2010), which facilitated the conducting of the 3rd and 6th month on-line assessments. Lastly, the quantitative data collected from the on-line questionnaires were integrated automatically into an Excel file and transported directly into the SPSS data file for further analysis. This not only reduced the time for data processing, but also increased the accuracy of data entry.

Since the outbreak of SARS in 2003, it is obvious that public health awareness has been increased and the value of an active life style has become a major concern for the Hong Kong Special Administrative Region Government and citizens. Promotion of regular PA becomes an important agenda for public health. In view of the cost and time associated with face-to-face PA promotion intervention, the use of the Internet could be a cost-effective option for PA promotion (Lewis et al., 2010). Recommendations for further studies are made in the following section.

5.5 Recommendations for Research and Practice

Based on the current findings, one recommendation for PA and health practice is that a theoretically based, stage-targeted Internet intervention can provide a positive influence on PA participation among university students. Second, the use of stage-targeted print-based and stage-targeted Internet interventions increased PA participation. Third, the

current studies cannot confirm the long-term efficacy of the Internet-based PA intervention on PA promotion. Lastly, the public access websites were not effective in PA promotion among university students.

It is recommended that future Internet-based PA research might include the following:

1. Incorporate long-term PA outcomes assessment at least 6 months after the end of the intervention in order to test the long-term efficacy of the Internet intervention.
2. Use objective PA outcomes measuring devices, such as pedometers and accelerometers for PA assessment.
3. Use uniform PA outcomes measures that facilitate comparison among studies.
4. Incorporate objective tracking systems to record website usage in order to collect objective data on website exposure.
5. Explore the efficacy of booster interventions such as SMS, electronic mail or a web user group that may facilitate long-term effectiveness.
6. Evaluate the influence of processes of change on Internet-based PA intervention.
7. Explore the efficacy of an Internet-based programme on other health-related behaviour change interventions such as smoking cessation, binge drinking elimination, drug abuse prevention and seat belt use.
8. Examine intervention elements such as daily PA tips and questioning mechanism that

can increase website use and intervention programme exposure, resulting in elevation of the engagement and retention of participants.

9. Examine the factors that may facilitate group communication on the web such as live-chat and online groups which may enhance sense of community and social support.
10. Compare the cost-effectiveness between the Internet-based interventions and the traditional methods such as print-based interventions, in order to verify the enhanced value of this delivery method of PA promotion.
11. Develop evidence-based Internet interventions for wide-scale dissemination.

5.6 Conclusion

Although the results of the efficacy of Internet-based PA promotion interventions have been mixed (Kroeze et al., 2006; Norman et al., 2007; Vandelanotte et al., 2007), the current studies add strength to those studies with positive outcomes. Apparently, the current studies are based on the use of an inactive behaviour (Internet using) to promote an active lifestyle. The crucial issue is how to use the advantages of the advanced technology to evoke positive behavioural changes. Innovative and interactive Internet technologies hold promising potential for PA promotion. By using the Internet, a large population can be reached without physical space limit. Through the use of interactive web components such as blogs, live-chats and online discussion groups, not only can

individual needs be addressed, but target audiences can be connected through electronic social networking. As internet access expands and the technical components of this technology improve, Internet-based PA interventions will become increasingly important in public health promotion.

Research on Internet-based PA interventions is still at an early stage of development. Despite a few studies suggesting the efficacy of the Internet for promoting PA participation, much remains to be explored on specific intervention elements that can optimize the effectiveness of using this information technology to promote PA. Future designs of PA promotion websites may not only focus on information dissemination but on experience-sharing and social interaction. This might be crucial for enhancing the rate of engagement and retention of participants.

An in-depth understanding of the efficacy of the Internet PA interventions associated with the campus environment can help university policy makers, health promoters and researchers to provide staff and students with regular opportunities for PA. Researchers should examine populations other than university students in order to gain further insights into other population samples. In addition to future research agendas, the findings of current studies can provide evidence-based support for university faculty and staff in planning for PA promotion on campus.

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Appendix 1

Questionnaire of study 1.

Research Project on Physical Activity Promotion for College Students

Date:

Part I - Demographic Data

1. Name: _____
2. University Name: _____
3. Department/ Program: _____
4. Year: _____
5. Contact telephone number: _____
6. E-mail address: _____
7. Postal address:

   _____

   _____
8. Sex: _____
9. Age: _____
10. Height: _____ cm
11. Weight: _____ kg

Part II – Stages of Exercise Behavior (please put a ✓ into one box)

Have you been participating in physical activities of moderate physical effort such as jogging, ball games, cycling, dancing and similar activities?

☐ No, I do not exercise, and I do not intend to start in the next 6 months.

☐ No, I do not exercise, but I intend to start in the next 6 months.

☐ Yes, I'm doing some physical activities but not regularly (regular exercise = 5 or more times per week for 30 minutes or more daily).

☐ Yes, I exercise regularly but I have done so for less than 6 months.

☐ Yes, I exercise regularly and I have done so for 6 months or longer.

Part III – Physical Activity Data

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix 2

Questionnaire of study 2.

Research Project on Physical Activity Promotion for College Students

Date:

Part I - Demographic Data

1. Name: _____
2. University Name: _____
3. Department/ Program: _____
4. Year: _____
5. Contact telephone number: _____
6. E-mail address: _____
7. Postal address:

   _____

   _____
8. Sex: _____
9. Age: _____
10. Height: _____ cm
11. Weight: _____ kg

Part II – Stages of Exercise Behavior (please put a ✓ into one box)

Have you been participating in physical activities of moderate physical effort such as jogging, ball games, cycling, dancing and similar activities?

☐ No, I do not exercise, and I do not intend to start in the next 6 months.

☐ No, I do not exercise, but I intend to start in the next 6 months.

☐ Yes, I'm doing some physical activities but not regularly (regular exercise = 5 or more times per week for 30 minutes or more daily).

☐ Yes, I exercise regularly but I have done so for less than 6 months.

☐ Yes, I exercise regularly and I have done so for 6 months or longer.

Part III – Physical Activity Data

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Part IV – Self-efficacy

Directions: Listed below are 5 statements designed to assess your *belief* in your ability to engage in *moderate regular physical activity* under various circumstances or conditions. Please evaluate each statement as it applies to you and your situation.
Please CIRCLE your response to each statement.

1 I am confident I can participate in regular physical activity when I am tired.

Not at all Confident	Not Confident	Uncertain	Confident	Very Confident
1	2	3	4	5

2 I am confident I can participate in regular physical activity when I am in a bad mood.

Not at all Confident	Not Confident	Uncertain	Confident	Very Confident
1	2	3	4	5

3 I am confident I can participate in regular physical activity when I don't have time.

Not at all Confident	Not Confident	Uncertain	Confident	Very Confident
1	2	3	4	5

4 I am confident I can participate in regular physical activity when I am on vacation.

Not at all Confident	Not Confident	Uncertain	Confident	Very Confident
1	2	3	4	5

5 I am confident I can participate in regular physical activity when it is raining, cold or very hot.

Not at all Confident	Not Confident	Uncertain	Confident	Very Confident
1	2	3	4	5

This is the end of the questionnaire, thank you for your participation.

Appendix 3

Narrative Notes on an Interview Transcript

(Group 1 Public Access Internet)

Interview 1: 3/7/2010 (2:00pm – 3:00pm)

I: Interviewer

R: Respondent

Document	*Narrative Notes*	*Remarks*
I: Are you busy in the summer holidays? Are you going to participate in physical activities or take any courses in physical activities? How often? What activities? R1: I have taken a swimming course by the Leisure and Cultural Services Department for twice each week. ***I: How long do you spend in each lesson? What is the level of the course?*** R1: Each improvement course is around 1 hour. ***I: Apart from swimming, do you participate in other physical activities?*** R1: Cycling. ***I: How often? Where?*** R1: I ride at least 2-3 hours once each week **along** Tolo Harbor. ***I: Do you have any friends with you when you are cycling? (Do you have any friends to go cycling with you?)*** R1: Yes, I always ride the bicycle with my classmates. ***I: Actually, there is a beautiful scene of Tolo Harbor for cycling. Sometimes I enjoy running there. How about the other classmates?*** R2: I also went cycling yesterday, but I have physical activities irregularly and only want to have fun and gather with my friends. ***I: How long do you exercise with your friends?*** R2: I rode for 2 hours yesterday. ***I: Do you regularly have such sports gatherings?*** R2: I also have such gatherings irregularly.	Supportive factors of physical activity (PA): have fun and social support.	

Cycling is not the only activity in our gatherings. ***I: I know sometimes your meetings are not only for cycling or something else. So, what are the examples?*** R2: For indoor activities, sometimes I play table tennis. ***I: You play table tennis? Where?*** R2: errr.. I sometimes reserve gymnasiums from Leisure and Cultural Services Department for social gatherings. ***I: So, that means the gatherings are usually for social reunion and having fun with your friends in the summer holidays. How about the others?*** R3: I rarely exercise this year. Basically, I usually played badminton once or twice a week when I was a secondary student. We were not the members of school teams, but senior form students who mainly occupied the playground for ball games. I regularly did physical activities. I mean I had more time to do physical activities before entering university. I went running near Shing Mun River at least once a month for about 0.5-1 hour. The time I spent depended on my physical state and mood. My recent physical activity was running along Shing Mun River one or two weeks ago. But I do not have so much time, especially when I have my nursing internship with full of work to do in an office. Sometimes I intended to go running after finishing my work and having my meal each week. I guessed I could do it. Nevertheless, I was tired because of the fatigue and working overtime until 9pm in the day with a lot of work to do in the next day, thus, I did not want to do physical activities. As time passed, for example, when I stayed in hall, I wanted to play with my friends instead of doing physical activities, thus my physical activeness became lower and lower. ***I: How about the other classmates?*** R4: I play squash approximately once or twice a week with my friends in squash courts from Leisure and Cultural Services Department, but the fee is so expensive. ***I: So, why did you choose to play squash even when it charged so high for the reservation of squash courts?***	PA barrier: not enough time, heavy academic workload at university, internship during summer term, worked overtime until 9pm. Sedentary lifestyle and culture in university hostels.	

R4: Because I have already learnt squash in the last semester and feel interested in it. I decided to take some courses from the Leisure and Cultural Services Department, but they were too full and did not have any advanced courses for squash. All of them were beginner courses.	The positive influence on PA promotion of the required physical education (PE) course in university.	
I: That means when you do exercise, you want to have some technical improvements and take some courses to facilitate your improvement and your physical activeness. Does anyone want to share her opinions?		
R5: I haven't started to do such physical activities yet as I have already finished my summer course and I am taking a rest for a long time. I am going to play badminton with my brother, but he hasn't reserved a place in the gymnasium yet. If the reservation is successful, we will play together.		
I: Yes, so why do you choose playing badminton?		
R5: We have such implements at home and both of us know how to play badminton.	Supportive factors of PA: know the sports skills and accessible sports venue.	
I: Both of you know how to play it and there is a gymnasium near your home.		
R6: Let me share my experience. After finishing my examination, I have taken a summer course for 2 to 3 weeks. I still went running after having dinner because I didn't have anything to do at that time and it is costless to go running. When we have a run, we can chat with friends. In addition, the costs of rackets and shuttlecocks are cheap and they are easily available.	Supportive factors of PA: costless, social support.	
R3: We also borrow sporting equipment at school. Playing badminton can involve many friends to participate. Sometimes we reserve a badminton court at school or from the Leisure and Cultural Services Department. As the area of the court is large, it allows 4-6 people to participate in playing badminton. If there are 4 people, we can play doubles. If there are more than 4 people, we can rotate so that everyone can have a chance to play. I don't know whether it can be classified as a kind of physical activity, but when we were lacked rackets during our secondary school life, we created a pair of paper rackets which were made with the cover of an A4-sized paper box. These hand-made rackets prevailed		

among our school for over 2 years, allowing us to play badminton at most places as long as the place was large to play badminton, such as the volleyball court and basketball court. Thus it was convenient in that we didn't need to reserve any badminton courts for playing badminton. ***I: Yes, it sounds funny, convenient and costless. That's a great idea as we are the group of public access websites with 5 linkages for students to access. Did you access the intervention contents?*** R4: Yes, I accessed the websites, but I forgot the name of one of the websites which included lots of articles. For example, there is an article showing how to enhance your interest in physical activities. One of the methods it said is to go exercising with one of your friends so that both of you can push yourselves to participate in physical activities. ***I: You mean it is better to go exercising with your friends during the process. How about the others?*** R5: One of the websites, PE Web, introduces a lot of ball games. I think the information provided in the website is too superficial and there is not enough information provided. It looks like our handout during the examination and it contains too little information. If I am interested in any ball games, I will access it again. ***I: You mean there is not enough information provided in the websites and you don't want to access them again. How about the others?*** R6: The first website I accessed was written in English, whose complicated front page confused me. ***I: You mean some websites are not so user-friendly. We will discuss this part later.*** R1: I accessed Sport Science, but I did not read the content. ***I: Why?*** R1: As I had learnt the information from the website from my major subject, I did not read the articles from it. And I feel more comfortable to access the website in English. As my major subject is in English, I feel more familiar to read materials in English. ***I: Where did you access the intervention contents? When? How often?***	The websites provided information on how to enhance interest in PA, basic knowledge on ball games.	

R3: Actually, I didn't know what the websites were after receiving their link. But as long as I was asked to finish the questionnaires, it was so boring that I just accessed one of the websites. I remembered that I accessed the first website from the list. Finally, I did not access the websites again. If I turn on my computer, I access blogs, Facebook, and read the news online instead of a website about physical activities. It is reasonable that you won't access the website again if you found it was not so interesting and useful in the beginning. ***I: Apart from you who think the content of the suggested websites are too boring; can anyone else share your reasons?*** R4: I also accessed the websites at home, but I don't have any intention to access them again as they are too boring ***I: So, most of you accessed the websites at home. Did anyone access them at the university? (wait for a while) Nobody accessed the websites at the university. Why didn't you access the websites again? Why didn't you access the websites regularly?*** R3: First, I forgot to do it. Second, I will not access a website again if I find it is boring and useless at the first time. When I use the internet, I always check my email, access blogs and read the news. I don't bookmark any websites if they are not so interesting the first time. ***I: Well, so all of you have the same reasons for not bookmarking the websites.*** R1: Yes. When I accessed them at the first time, I scanned all the information provided. I guessed the intervention contents of the websites would not change a lot. ***I: Starting from 1 December 2009 to 29 May 2010, we divided the participants into several groups. The two surveys were in March and May this year. Is there any change in the frequency of accessing the intervention contents from 1 December 2009 to 29 May 2010? Why? How would the intervention affect your stage of exercise change and motivate you to engage in physical activities? Why?*** R2: Indeed, I don't think the intervention contents were very useful to my motivation of	Distractions of accessing the targeted websites: blogs, Facebook, and online news. Reason for not bookmarked the websites: I found it was boring and useless at the first time. The websites contents maintained more or less the same, thus participant had no intention to visit them again.	

having physical activities. My awareness of getting older reminded me to do exercise in my daily life. ***I: So, why do you realize the necessary of participation in physical activities?*** R2: I realize that because my hall life was crazy. I ate a lot and always had social gatherings with people in the same hostel, making me unhealthy. ***I: You mean you do not have so much exercise when you lived on campus, that's why you want to participate in physical activities. How about the others?*** R3: Yes, I think so. After entering university, my weight is increasing so fast, especially when I stay in hall as I do nothing but eating and sleeping. Even when there are gymnasiums in the campus, I didn't remember their opening hours or have physical activities there. But when I stay on campus, my unhealthy hall life reminds me to exercise. I am aware of controlling my weight for summer clothing and I have the motivation to exercise in summer vacation. R6: I agree with you. Now that I am in my second year, I am busy facing my academic problems. That's why I am training my physical fitness in summer to tackle my heavy workload in the next academic year. ***I: In summary, weight control and awareness of having a healthy life are the reasons why you want to participate in physical activities. It is quite good to have an intention to get healthy for the preparation of future challenges. As you mentioned, the intervention contents of the websites were so boring that you did not access the websites again. So could you give some suggestions to the websites in order to attract people's attention?*** R5: I suggest providing information on choosing equipment in the websites. I want to have my own set of equipment if I continue to do physical activities. R2: I want to receive some information which introduces special kinds of sports, including where and how to do such physical activities. ***I: As you mentioned your internet habit, apart from accessing Facebook and blogs, what were the other barriers that prevent you***	The websites contents did not help to increase stage of exercise change. Reasons for increasing motivation in PA participation: 1. awareness of the needs of having a healthy lifestyle 2. weight control for summer clothing and slim figure 3. training physical fitness in summer for tackling the heavy workload in the next academic year. 4. more time for exercise during summer vacation Suggestions for websites development: 1. providing information on choosing sports equipment 2. providing information on special sports	No statistically significant improvement in stage of exercise change at 3rd month assessment, had improvement at 6th month assessment.

from accessing the intervention contents? R4: I think a busy schedule is one of the barriers that prevent me from accessing the intervention contents. R3: I have an idea on such issue. I think probably because of the language used in the websites. I feel more comfortable to read the information written in Chinese instead of English because I don't know some of the professional terms about physical activities. Thus I prefer to access the websites written in Chinese. ***I: You mentioned that the intervention contents didn't motivate you to participate in physical activities. Then, how would the intervention affect your confidence to engage in moderate physical activities (exercise self-efficacy)?*** R4: They were not very useful as the information provided was too theoretical without many practical examples, such as the explanation of safety of squash playing. ***I: Did anyone have their confidence increased while accessing the websites?*** R1: No. ***I: How would the intervention affect your PA level? Why?*** R6: No. ***I: That's mean you think that due to the reasons you have mentioned affect your PA level.*** R5: Yes. ***I: As you mentioned the design of the front page is so complicated. Do you find the Internet-based programme (or the public access physical activity related websites) user friendly, logical and easily readable? If not, what can be done to improve it?*** R2: The second website (American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD)) is so confusing to show how to write an abstract. It includes so much information and seems irrelevant to its title. ***I: What you mean is that the website is so complicated. So what is your suggestion for its improvement?*** R5: I remember the font size of one of the websites is too small and the categories are not so systematic. I prefer PE web more,	Barrier of PA: busy schedule. The websites contents did not help to improve the exercise self-efficacy. Possible reasons: 1. boring contents 2. websites contents too theoretical without many practical examples The websites contents did not help to increase PA level. Suggestions for websites improvement: 1. suitable font size	Statistically significant decreased in exercise self-efficacy score were found at the 3rd and 6th month assessments. Possible reasons: 1. the websites contents did not help 2. no time, busy schedule & heavy academic work load 3. felt tire, overtime internship No statistically significant change in PA was found at the 3rd and 6th month assessments.

whose layout and design are simple and readable. ***I: As a whole, which programme components will you rate as most useful? Why?*** R6: I prefer the second website (American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD)), which seems to be an official website whereas PE Web is so simple but readable. R1: I prefer PE Web as the language used in a website is very important and it should be readable and thus motivates me to read its information. R4: I think so. It is very difficult to teach the technical skills by words. Video tapes from the PE Web provide a good demonstration on how to do such physical activities. These motivate me to keep on doing physical activities. R2: I also prefer to read a website in Chinese. ***I: Why do you prefer accessing Chinese websites?*** R3: Websites in Chinese is more readable and it is easier to grasp all the information directly compared with those in English. Additionally, video tapes provided in PE Web enable me to get accustomed to sports. ***I: Do you find the campus environment and sports facilities useful for increasing physical activity? How? Why?*** R4: I agree that it increases my level of physical activity because of the mountain paths in CU. Sometimes I just have a walk. Having more opportunity to walk from NA college to MTR station for more than 10 minutes occasionally after entering CU, I am aware that my leg muscles are getting more powerful this year. But I seldom use sports facilities in the campus because there are not enough facilities in gymnasiums. For instance, there is only one treadmill in N.A. gymnasium causing inconvenience to exercise with my friends as we want to have a run together in the gymnasium. R3: I also think that even I like running, it is very toilsome and easily causes knee injury to run along the mountain paths in the campus. Actually, I like to use the treadmill, the rowing machine and the cycling machine due	2. user friendly systematic category 3. simple and readable layout 4. Chinese language is more preferable 5. providing video tapes of sports skills demonstration Campus environment facilitates PA.	

to their user friendliness. But I have the same experience that there are not enough sports facilitates in the gymnasium, thus when I wanted to use the treadmill and the rowing machine, I needed to wait. I noticed that the gymnasium users are always male with the knowledge of using sports facilitates. When I go to the gymnasium, I feel embarrassed to use sports facilitates individually and get on the school bus with the smell of sweat after physical activities. R4: I do enjoy the squash courts in the campus, but it is too full at night. ***I: Have you ever reserved squash courts successfully?*** R4: I don't know whether I can reserve the courts due to my busy schedule.	Barriers of PA: not enough fitness equipment, sometimes needed to wait, smell of sweat after exercise might cause embarrassment.	
R6: I agree that there are increasing chances to walk in the campus because of the campus environment. Even when I have my lessons in New Asia College, I am used to having a walk instead of taking a school bus. Nevertheless, I seldom use sports facilitates in the campus as I don't live on campus. ***I: Why don't you take a school bus?*** R6: Because there are so many people waiting for the bus, which takes a lot of time to wait if you miss the bus schedule. And I don't like to take a bus. ***I: Do you enjoy having a walk in the campus?*** R6: Yes, but except in summer. What's more, parts of the campus are under construction, causing me not to walk in the campus now.	Campus environment facilitates walking. Campus construction sites inhibited walking	
I: Do you find the questionnaires useful for increasing physical activity? How? Why? R2: Yes, sure. It can be regarded as a reminder telling you to do physical activities through the internet. R3: Yes, I think so. I was asked to write down my weight and my physical activity habit on different stages inspiring me to have a reflection on how often I spent time on participating in physical activities. R2: I don't think the questionnaires have so much influence in increasing my physical activity if you are busy preparing for your examination at that time. It depends on how much time you have. ***I: We had a recent survey done in May, when***	The questionnaires were useful for increasing PA.	

all examinations were over. Did you find the questionnaires useful at that time? R2: Yes, sure. The questionnaires reminded me to do physical activity with friends. ***I: As you mentioned before, social support can encourage you to do more physical activity and reduce the embarrassment of using gymnasiums. Apart from these, did you receive any social support for physical activities participation?*** R5: Social support can bolster up my courage to use gymnasiums but not in helping you in physical activities. It sounds so strange that your friends help you in physical activities. It is more interesting to do physical activities with my friends. ***I: If you were provided with an Internet-based programme, publicly accessible physical activity related websites, a face to face behavioral modification programme or others, which one will you choose to improve your physical activity level? Why?*** R6: I prefer the face to face behavioral modification programme because my physical activity participation can be supervised if I determine to participate in it. I have higher motivation for physical activity if I am asked to report my progress on it. R3: I think so. Such programme checks my progress and provides motivation for my physical activity. I will feel embarrassed when I do not keep on my physical activity participation. Making new friends for participation in physical activities is also the advantage of such programme. R1: Yes. We share the information of physical activity sites for getting more reference and choices on the selection of suitable sites for physical activity. ***I: How about accessing an Internet-based programme?*** R2: It can't provide a mutual mentoring for us as we can't know the progress of the others. Thus, I also prefer to have a face to face programme. R5: I think so. It exerts pressure upon and checks your physical activity habit by asking you to come back and report your progress. If you use an Internet-based programme, you	Social support facilitated PA. Advantages of face to face behavioral modification programme. Limitation of Internet-based programme.	

may forget it during your peak period. ***I: But do you think it is time consuming with the face to face behavioral modification programme?*** R6: If I stay on campus, I don't think it is time consuming. But if not, it is really time consuming. R3: I agree with you that we can get some information and do physical activities with friends and classmates in a face to face programme. Certainly, it is time consuming and meaningless if we only report our physical activity progress without doing anything in such programme. ***I: Thank you for your participation in this research. What are your other opinions towards the programme?*** R1: Actually, I want to share that the results of questionnaires would be different in cases when the questionnaires are printed or browsed on the internet. I was less concentrated when I did the online version as I was browsing other websites while doing questionnaires. R5: I finished the online version faster than the printed version as I did not want to spend so much time to pay attention to the questions. ***I: I have finished all the questions that I need to ask. Thank you very much and you can ask any questions you like.***		

Appendix 4

Narrative Notes on an Interview Transcript

(Group 2 Stage-targeted Internet)

Interview 2: 3/7/2010 (3:30pm – 4:30pm)

I: Interviewer

R: Respondent

Document	*Narrative Notes*	*Remarks*
I: This group is about internet course. If you don't want to answer the questions, you can keep silent or leave the room. Have you participated in physical activities recently? How often? What activities? Why? R7: I went swimming and played basketball near my home for 3 hours. R8: I went cycling near my home with my friends and classmates for 2 to 3 hours. We have our own bicycles. R9: I learnt to ride a bicycle yesterday. ***I: It is harder to learn cycling as it causes tense muscles and painstaking attention. How long have you learnt cycling?*** R9: It was the first time for me to learn cycling. Besides cycling, I seldom participate in physical activities. ***I: Why do you want to ride a bicycle?*** R9: I was invited by my classmates in secondary school to learn cycling together in summer. ***I: Who taught you cycling?*** R9: My classmates. R10: I just read a book and prepared for public examinations in summer instead of participating in physical activities. R11: Sometimes I go swimming, cycling and running with my friends. As long as I wake up around 8, I go running individually near my home biweekly. ***I: How did you access the intervention contents? Where? When? How often? Why?*** R7: I accessed the intervention contents at home for about 30 minutes occasionally. R9: I accessed the websites on campus occasionally.	Social supports. Personal preference: reading books instead of doing exercise.	

I: How many online sessions did you access? R9: I accessed only 10 online sessions, but I read nearly 20 courses printed in the book. ***I: Have you ever done the activities online or in the workbook?*** R9: Seldom. R8: Actually, I am not very accustomed to reading the information on screen as I am distracted by the other websites. Thus, I read the hardcopies instead of browsing the online information on campus for 15-20 minutes occasionally. R11: I seldom access the online course, but sometimes I read the books. ***I: That sounds so surprised that we planned to give out the books as workbooks instead of a reference for the courses. So, is there any change in the frequency of accessing the intervention contents from 1 December 2009 to 29 May 2010? Why?*** R8: The frequency of accessing the intervention contents increased when you distributed the resources to me initially, but after a period of time the frequency dipped. When you informed me to finish the questionnaires, my motivation of accessing the contents mounted again. . R11: My motivation was higher initially when I received the intervention contents; nevertheless, I didn't access the contents during mid-term. Even though you informed me to finish the questionnaires, my intention to access the contents was not as higher as that in the beginning of the research. ***I: Could you explain the reasons why there is such situation?*** R7: I accessed the online course regularly in order to learn some of the information from the contents. If there was nothing new, I didn't access the online course again. R8: I think it was fresh to me as I was not used to doing physical exercise. Therefore, I didn't have any concept and knowledge about the professional terms in such aspect. It was better to have some external force such as the reminder about submitting the questionnaires to urge me to read the intervention contents. ***I: Apart from sending questionnaires, what can be done to maintain the retention rate?*** R7: If, in general, the intention to access the intervention contents is lower according to this	Distractions of Internet-based intervention. Change in the frequency of accessing the stage-targeted Internet programme. Participant did not access the programme again because there was nothing new. Questionnaires could help to remind participants to access the programme.	

research, it is recommended that mass mail are sent to all candidates so as to stimulate their motivation and remind them of their participation in physical activity. ***I: What were the barriers that prevent the access of the intervention contents?*** R7: Studying in CU is very busy and the busy schedule is the main barrier that prevents the access of the intervention contents as it makes me feel painstaking to arrange for more participation in physical activity. Additionally, I couldn't make use of sports facilitates due to the arrangement of the lessons. R11: I think the priority of college users is also a barrier that prevents physical activity. I am a student of New Asia College, but I was not allowed to use sports facilitates such as rowing machines in other colleges because I am not one of their students. What's more, I find it very inconvenient to bring sportswear to university. ***I: How would the intervention affect your stage of exercise change? Why?*** R12: I don't think it was very influential to my stage of exercise change. Actually, social support was more influential in my stage of exercise change. The invitation for physical activities from my friends was more important in affecting my participation in physical activities. R8: Indeed, I agree that the intervention contents as a reminder affected my motivation to take part in physical activities. The questionnaires also push me to invite my friends to participate in physical activities, because I was aware of the importance of physical activities from the online course. R9: I think it made me aware of the advantages of doing physical exercise. But if I was too busy, I continued not to do so. R10: I think social support has more effects to my engagement in physical activity. ***I: How would the intervention affect your belief in your ability to engage in moderate regular physical activities (exercise self-efficacy)? Why?*** R7: I have the habit of doing physical exercise, thus I don't think it had any influence on my confidence in engaging in physical activities. R8: I agree. Sometimes workload has a higher priority in my life in comparison to physical activities even after I have read the intervention	Reminder e-mails could prompt participants to access the programme. Busy schedule in university is one of the barriers of PA. Bringing sportswear was inconvenient and thus became a barrier of PA. Influential factors of stage of exercise change: 1. friends invitations (social support) 2. intervention contents (benefits of regular PA) 3. questionnaires could remind PA participation The intervention contents did not have any influence on the exercise self-efficacy of the participants.	Statistically significant increased in stage of exercise change at the 3rd and 6th month assessments of the STI group. . There was no statistically significant change in the exercise self-efficacy

contents. R9: I agree with you. ***I: How would the intervention affect your PA level? Why?*** R7: There was no change during the normal school day as I also gave dealing with my heavy workload as a high priority in my school life. But I still placed the workbook in a prominent position to remind me of participating in physical activities. I bookmarked the website in my computer. R12: I participated in more physical activities and tried to set up some goals to meet its requirement. ***I: How much of the online courses did you browse?*** R8: About 50%. R10: Only 3 to 4 sessions. R7 and R9: 10 sessions. ***I: Do you find the Internet-based programme user friendly, logical and easily readable? If not, what can be done to improve it?*** R7: I prefer reading a book to accessing the online programme due to my learning habit. Thus, for me, a book is easily readable. I only scanned online information briefly. R11: I think so. I felt very tired to keep my concentration while browsing online information. Nevertheless, I enjoyed reading books as the printing quality was high and there were a lot of attractive pictures. R7: I suggest putting more information in the book instead of the Internet-based programme so that people could get information from books and use the online programme as a brief reference. ***I: Which programme components will you rate as most useful? Why?*** R7: I prefer the training log as a reminder to record my performance, which encourages my improvement. R12: I also agree with the advantages of training log for recording and reminding me to improve. R9: The case studies and real examples provided in the book are convenient to encourage my participation in physical activities. R10: I plan to keep fit, thus the contents of weight control are useful. But the lack of social support for physical activities and laziness are	The workbook can remind participant to participate in PA. The intervention contents increase my PA level: 1. goal setting 2. meeting the requirements of PA guidelines 3. knowing of the importance of regular PA Limitations of online information: 1. participant preferred reading a book 2. participant scanned online information briefly Most useful programme components: 1. training log 2. case studies and real examples 3. contents of weight control Barriers of PA: 1. lack of social support 2. laziness	score of the participants in the STI group. Statistically significant increased in PA level at the 3rd month assessment of the participants in the STI group.

two factors that I can't follow the suggestions. ***I: Do you find the campus environment and sports facilities useful for increasing the level of physical activity? How? Why?*** R7: Yes, sure. If I only get 1 hour left before having the lessons, I will play ball games in campus. But it is unreasonable for the swimming pool to charge admission fees. ***I: So, you think you have paid for the tutorial fees but it sounds unreasonable to spend money while using the swimming pool. How much is the fee for using the swimming pool?*** R7: $4.5. I don't live near university and sometimes want to go swimming in the campus instead of that of the Leisure and Cultural Services Department. I expect the admission fees will be lowered or even become free for university students. R8: I think the sports facilities in the campus are convenient for increasing the level of physical activity. I invited my friends for physical activities when I lived on campus. ***I: Do you think that you do more physical exercise in the campus due to its environment? For example there are so many paths in CU, so do you increase your physical activity level while travelling inside the campus?*** R10: Yes, sure. I walked a lot after entering university. I didn't walk so much in my secondary school. When I want to have a meal, I still have to walk far to get to the canteen. ***I: You mean, the location between each venue is far away, causing you to walk more in the campus. Do you enjoy having a walk in CU on normal days?*** R11: Yes, sure. I prefer walking to taking school buses. R7: Yes, you got it. R11: Yep. Some locations are better for walking as the school buses don't go into that area. ***I: Do you find the questionnaires useful for increasing your physical activity level? How? Why?*** R9: The questionnaires were useful for me in reflecting upon the contents of the courses. R8: The questionnaires were designed to ask details, which motivated me to reflect upon my physical activity participation. R12: I regarded the questionnaires as reminders which motivated me for further physical activity	Campus environment and sports facilities facilitate PA participation: 1. participated in PA with friends when lived on campus (social supports) 2. assessable to sports facilities Questionnaires were useful for increasing physical activity level. (motivation and reminding functions)	

participation. R10: For me, although the questionnaires reminded me to be aware of my physical activity level, I still made no change in my habit of physical activity participation. R11: Yes, I think so. I also reflected upon my physical activity level when I finished the questionnaires. ***I: Do you find social support useful in increasing your physical activity level? How? Why?*** R7: I think even if nobody asks me to do physical exercise, I still do it by myself. But as for playing ball games, it is better to go with my friends and family. R8: I seldom exercise with my family members. Usually, I participate in physical activities with my friends instead of doing them individually. ***I: Previously, some classmates claimed that they prefer to go to gymnasiums with their friends. Do you have such kind of idea?*** R7: I prefer to go there individually. R8: I have been to gymnasiums with my friends so far. R7: Going to gymnasiums with friends causes disturbance and makes me distracted in that period. For example, I need to concentrate on reckoning the time. ***I: You mentioned your friends accompanied you to participate in physical activities. So, are they your classmates?*** R8: I go to the gymnasium with my hall mates. R11: Usually, I play ball games with my classmates during PE lessons. After that, I go to the gymnasium with them. ***I: if you were provided with an Internet-based programme, the public access physical activity related websites or the face to face behavioral change programme etc, which one will you choose to improve your physical activity level? Why?*** R7: I prefer to have an online course based on the contents. Watching TV matching is also a good way to improve my physical activity level as well as my technical skill as I go for physical activity after watching TV matching. R8: I prefer to have an online programme as I can choose the parts I am interested in. R10: I prefer to have the face to face behavioral change programme as it brings me higher	Social supports. Preference of intervention to improve PA: 1. online course 2. watching TV matching 3. face to face behavioral change programme	

motivation through the mentoring process by an instructor. R12: Yes, I think so. It is reliable and safer to receive the suggestions from the programme instructors instead of public access physical activity related websites. R9: I prefer to online courses as it provides systematic programme and its suggestions are more reliable. ***I: What were your other opinions toward the programme, if any?*** R11: No. ***I: Do you want to share anything else or give more detail for the above sharing?*** R7: I would like to add more details on the usage of the gymnasium. I want to know more about how to use the fitness equipment appropriately because the PE courses from the university only teaches superficial stuff. I am highly motivated to do weight lifting activities, but my friends don't have such intention. ***I: I have finished all the questions that I need to ask. Thank you very much and you can ask any questions you like.***		

Appendix 5

Narrative Notes on an Interview Transcript

(Group 3 Control)

Interview 3: 3/7/2010 (5:00pm – 6:00pm)

I: Interviewer

R: Respondent

Document	*Narrative Notes*	*Remarks*
I: If you don't want to answer the questions, you can keep silent or leave the room. Do you participate in physical activities recently? How often? What activities? Why? R13: I play basketball, go cycling and swimming for 3 hours each time in turn each week. Apart from cycling, I play the other two sports at some place from the Leisure and Cultural Services Department near where I live. R14: After finishing my semester, I start going hiking closed to my home and sometimes go hiking in Sai Kung with my friends for two days a month. R15: I went swimming one and a half months ago. I plan to go swimming in summer around for 1 to 2 hours each week in a swimming pool managed by the Leisure and Cultural Services Department. ***I: Do you think the admission fee is expensive although the facility is user friendly?*** R15: I think its admission fee and opening hours are acceptable. R16: I seldom exercise on normal school days, but I plan to go swimming this summer. ***I: What were the barriers that prevent you from participating in physical activities?*** R17: I was busy and not interested in exercising. ***I: Did your friends invite you to do physical activities together?*** R17: I will not participate in outdoor activities to avoid being exposed to the sun, that's why I will only participate in ice skating. ***I: Why do you participate in these physical activities?*** R13: I think swimming and cycling at night are	PA barrier: busy.	

good for cooling off my body in the summer. I want to develop a balance for my interests in physical activity. ***I: What physical activities do you do in winter?*** R13: I play ball games in winter. R14: I go hiking to enjoy the fresh air and natural environment in the countryside as it is very hot in summer. ***I: Do you find the campus environment and sports facilities useful for increasing your physical activity level? How? Why?*** R16: I think the sports facilities in the campus are very boring. I prefer to play table tennis and bowling, which are more entertaining and more effective in releasing pressure while avoiding doing strenuous exercise. R13: There are only a few sports facilitates in my college. Without peer involvement in playing basketball, it discourages me from participating in physical activities. The ground of the basketball court in Lingnan Stadium is also too smooth for playing basketball. ***I: If it is improved, will you increase your participation?*** R13: Yes. R15: I think the difficulty to involve friends to do sports and the inconvenient location of sports facilitates in the campus are two barriers which hinder my physical activity participation. I agree that having lessons in physical education is good for us to be healthy. ***I: Which courses did you take?*** R15: Badminton and tennis. ***I: How about walking in campus? Do you think that you have more chance to have a walk in university?*** R14: Yep. I prefer to walk in the campus as some facilities are not near the school bus stop. But there are so many construction projects, which makes me not uninterested in walking in the campus. ***I: If it was not too hot, what would you prefer, taking a school bus or walking?*** R17: I prefer taking a school bus because I don't want to walk on a path with many mosquitoes. I admit that it is good to have physical education lessons without it being counted in my GPA. R16: If it is not so hot, I prefer walking instead of taking a bus. R13: I think so. Walking is better as I don't need	Required PE course enhanced sports participation. Campus environment facilitates walking. Construction sites on campus inhibit walking.	

to wait for a school bus. This also enables me to become healthy and fresh after lectures. I really enjoy walking in the campus. ***I: After discussing the campus and your physical activities, do you find the questionnaires useful in increasing your physical activity level? How? Why?*** R14: I don't think so. I do physical activities according to my habit, not because of the questionnaires. R13: Yep. I don't have any changes in my physical activity level even after I received the questionnaires. ***I: Do you regard the questionnaires as a reminder to make you alert to have physical activities?*** R15: I am afraid that I don't have such an idea as I answered the questionnaires in accordance to my habit in reality. R15: There would be some changes if the questionnaires asked us to write down our scores on reflecting the motivation for physical activities. However, after finishing the questionnaires, I don't think I have changed my habit for physical activities because of the questionnaires. ***I: You mean, your motivation would be higher if the questionnaires asked you to give a score to yourself. That's a good idea that at least you can evaluate your progress. So, did you receive any social support for physical activities participation? What are they?*** R16: I will go for a swim if my sister accompanies me as she can teach me swimming in Lek Yuen. R15: My family always asks me to do sports when I have nothing to do. I was encouraged by them to do more sports regularly in F.5, such as swimming and running. But it was not long lasting when my habit changed after entering university. Actually, I don't like hot weather as it causes me to sweat a lot. Feeling thirsty while running also makes me feel very toilsome. R13: I am used to playing ball games, such as playing basketball, as well as swimming with my siblings and my friends, and even people I met in the basketball court since it is very boring to do sports individually. I agree that social support motivates me to exercise. R17: I don't have such an idea. Initially, my	Walking enabled participant to become healthy and fresh after lectures. Questionnaires did not help in PA participation. Social supports from sibling. Social supports from other family members. Social supports from siblings, friends and people met in the basketball court.	

friends invited me to participate in sports, but after I usually rejected their invitations, they didn't ask me anymore as they know that I don't like physical activities. Thus, social support doesn't affect me in terms of physical activity participation. R14: It's difficult to invite my friends, including my classmates in both secondary school and university, to go hiking. Thus, I go hiking in the summer as all of us have free time during their summer holidays. ***I: If you were provided with an Internet-based programme or the public access physical activity related websites, do you think this programme or websites will help you to increase your physical activity level? Why?*** R16: The information provided in the online programme is very general and we have read it before. The motivation and determination to do sports is more important than accessing the online programme. ***I: Do you think it is helpful in enhancing your physical activity level if the online programme provides some techniques and knowledge for overcoming your barriers of doing physical activities, such as accessing the sports facilitates or helping you set up your plan?*** R16: I think it will be useful if it provides some technical information. R13: Ah. I agree that it will be helpful for my physical activity level. For example, it provides some technical information, such as how to have a firm grip on a tennis racket. From my experience doing too much physical exercise caused my knee injury. Thus, the online programme could also access my physical activity level and remind me to prevent from being hurt in sports and recovery easily after injury. ***I: That mean you expect the online programme provides specific safety rules or guidelines of sports.*** R15: The online programme for increasing physical activity level is not as important as social support to me. Even when it provides some information about sports, I still need to get accommodated with my friends to exercise together. R14: I think the determination and motivation to do sports are more important in increasing my	The participants believed that social supports were more important than information on PA.	

physical activity level although the online programme enriches my knowledge in sports. R17: The online programme is more useful to me in my first year as I was having my physical activity course, but it is not useful for me after finishing the course. ***I: What you mean is that the online programme is useful when it is related to your examination and courses?*** R17: Yes. ***I: If you were provided with an Internet-based programme, the publicly accessible physical activity related websites or a face to face behavioral modification programme or others, which one would you choose to improve your physical activity level? Why?*** R13: I would rather have an Internet-based programme and publicly accessible physical activity related websites which gives me more flexibility and information. A face to face behavioral modification programme for self-learning and self-reflection on sports is not useful. I can find the information which I am interested in instead of having such courses. R15: I had an experience of having a Tai Chi course when I was in secondary school. I found that the information provided by my teacher was not so relevant and useful. Thus, I would rather have a practical physical education course because I want to have a personal coach to provide me with professional knowledge and express clear concepts to me. ***I: What you mean is that you prefer to choose another alternative other than the three options provided.*** R15: Yep. R16: I am finding a fitness course to help me apply for the job in the Immigration Department or the Police Force so that I can deal with the physical challenges. ***I: You mean you attend physical fitness courses in order to help yourself deal with the physical challenges. So, how about the others?*** R16: I would rather have a face to face training course or have a physical plan set up with my friends. It is more interesting to exercise with my friends. It can motivate me to do sports, give me clearer direction to my physical activity participation and lessen my weaknesses. ***I: So you have the same option with him as***	The participants believed that self determination and motivation were more important than sports knowledge from online programme. The participants believed that Internet-based programme provided flexibility in choosing targeted information, thus more time could be allocated on interested materials.	

both of you would rather have a physical training course, but you would like to train your physical fitness for your future challenges. Actually, there are some courses to prepare for the physical tests of disciplined services in summer. You can find this information from the counter. So what about the others? R17: I would like to attend some short term fitness courses for personal training purposes of keeping fit and a good body shape. It is not too toilsome to exercise in gymnasium. ***I: You mean you want to train specific muscles or your body shape, such as code muscle. I think a Yoga Pilates course is suitable for you if you want to shape your body. We have Yoga courses in CU, but there are no courses about Yoga Pilates.*** R16: The course is very attractive for girls. ***I: Such Yoga Pilates courses are not only beneficial for girls, but also for people who participate regular in physical activities. Having a strong core muscle is good for body shaping, preventing you from being injured in physical activities and increasing your efficiency on doing other kinds of exercise. Back to our question, what were your other opinions towards the programme?*** R13: As I mentioned before, an assessment on our physical activity level should be added in the programme to motivate us to do sports and encourage me to set up a planning for my participation in sports. ***I: I have finished all the questions that I need to ask. Thank you very much and you can ask any questions you like.***	Participant suggested adding assessment on PA level in the questionnaires.	There was no statistically significant change in PA level, stage of exercise change and exercise self-efficacy score at the 3rd and 6th month assessments of the control group.