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*Corresponding author: Raymond Kim Wai Sum, Department of Sports Science and Physical Education, The Chinese University of Hong Kong, G09, Shatin, NT, Hong Kong
E-mail: kwsun@cuhk.edu.hk

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INFORMATION & COMMUNICATIONS TECHNOLOGY IN EDUCATION | RESEARCH ARTICLE

Efficacy of using Internet-based interventions for physical activity promotion in a Hong Kong Secondary School: An action research approach

Raymond Kim Wai Sum^{1*} and Elean Fung Lin Leung²

Abstract: The purpose of this study was to examine the effectiveness of an Internet-based behavioral intervention for physical activity (PA) promotion among secondary school students. It was hypothesized that the Internet-based PA promotion program could increase the PA levels of secondary school students. The action research approach together with qualitative focus group interview was used. A total of 127 Form 4 (Grade 10) students from a Hong Kong Secondary School were recruited in the study. They were group-randomized by class and placed into two groups—the Internet-based group (IB) and the control group (C). Participants of the IB group received the online behavior change program entitled “let’s exercise and be active daily” (LEAD) for PA promotion among secondary school students. The international physical activity questionnaire short last 7-day instrument was used to assess the PA levels of the participants. The stage of exercise change questionnaire was used to assess the stages of behavioral changes of the participants. The assessments were conducted at baseline and post intervention both after 1st cycle and 2nd cycle. The narrative approach of data analysis was selected in the focus group interview after two cycles of data collection. There was a trend for the participants of the IB group to participate in more PA at the 1st cycle and 2nd cycle assessments,

ABOUT THE AUTHORS

Raymond Kim Wai Sum is an assistant professor in Department of Sports Science and Physical Education of the Chinese University of Hong Kong. His research interests focus on physical literacy of different population, professionalization of PE teachers, and elite athletes’ career development.

Elean Fung Lin Leung is Director of Physical Education Unit of the Chinese University of Hong Kong. Her major research project is looking at efficacy of Internet-based behavioral intervention for physical activity promotion among students.

PUBLIC INTEREST STATEMENT

The study aimed to tackle the problem of insufficient physical activity levels of Hong Kong Secondary School students by integrating daily life activities (such as walking, biking, and taking the stairs) into their daily lives through an Internet-delivered program—“let’s exercise and be active daily (LEAD).” With the advantage that most teenagers are familiar with computer use, it is expected that such an innovative project will have impact on the methods of PA and health promotion used in the community. Secondary school students ($N = 127$) were recruited in the study. They were group-randomized by class and placed into two groups—the Internet-based group (IB) and the control group (C). Participants of the IB group received the online behavior change program. There was a trend for the IB group participants to participate in more PA, but no statistically significant differences within the IB group or between the study groups were observed.

but no statistically significant differences within the IB group or between the study groups were observed. Limitations and suggestions were made in the reflection of the overall study.

Subjects: Health Promotion; Physical Activity and Health; Secondary Physical Education

Keywords: Internet-based interventions; physical activity promotion; Hong Kong Secondary School; action research

1. Introduction

The health benefits of engaging in a physically active lifestyle through the participation of regular physical activity have been well established (Physical Activity Guidelines Advisory Committee, 2008; U.K. Department of Health, 2004; U.S. Department of Health & Human Services, 2010). Such health benefits include reduced risk of cardiovascular diseases, hypertension, stroke, improved immunity, cardiovascular fitness, muscle strength, and musculoskeletal growth. The Department of Health and Human Services of United States recommended that active adolescents need to accumulate at least 60 min of moderate-to-vigorous intensity physical activity (PA) every day, where at least three days in a week involve vigorous intensity PA (Physical Activity Guidelines Advisory Committee, 2008).

However, the level of PA participation among children has continued to decrease coupled with the increase in average screen-time (watching TV, playing video games, and recreational use of computer and mobile devices) (National Center for Health Statistics, 2012). Unsurprisingly, the PA levels among youths did not meet the recommended standards (Cavill, Biddle, & Sallis, 2001). Research in Hong Kong has shown that 76% of adults and 31.5% of youths (Hui, 2004) were not active enough to obtain health benefits. Another citywide study on the participation patterns of Hong Kong people in PA (Leisure & Cultural Services Department, 2012) reported that 57.9% of Hong Kong adolescents were physically inactive.

At present, school-study demands and screen-time continue to be regarded as the major obstacles and significant predictors for PA withdrawal. While there is evidence to support apparent observations of grades being a more significant predictor for female students (Leggett, Irwin, Griffith, Xue, & Fradette, 2012), a decline in PA participation remains prevalent for both genders (Mak & Day, 2010; Shin & So, 2012). In contrast, regular PA involvement has often been reported to coexist with positive youth development and growth: physiologically, academically, and socially (Fox, Barr-Anderson, Neumark-Sztainer, & Wall, 2010; Trudeau & Shephard, 2008).

Among the known barriers being a negative predictor of PA participation in high school, perceived “lack of learning”—in the sense of lack of relatedness to the student—has been shown to be a major reason for female students to be reluctant to participate in PA (Kimball, Jenkins, & Wallhead, 2009). It has been suggested that students possessing higher positive self-perceived physical fitness, or actual physical fitness, have also been shown to be a good predictor for compliancy in PA participation (Jaakkola & Washington, 2011). Thus, physical educators should ensure that students are able to establish a degree of competence, as well as fostering the mentality of enjoyment rather than from a health perspective, such as “getting fit” or “not getting fat,” in order to allow students to participate and appreciate physical activities.

Alternatively, it may be easier to encourage students who have minimum interest in sports-related physical activities, to accumulate non-exercise physical activity such as active commuting and climbing stairs (Mak, Ho, Lo, McManus, & Lam, 2011). PA withdrawal as a result of loss of interest among young people is commonly attributed to the lack of success and/or enjoyment during participation, as well as having negative experiences such as being punished with physical activity as a form of behavioral management (Rosenthal, Pagnano-Richardson, & Burak, 2010), or being brought up in families that are academically oriented, the latter being prevalent in Asian countries like China (Cui, Hardy, Dibley, & Bauman, 2011) and Taiwan (Tsai, Park, Liu, & Lau, 2012). Indeed, a study has

estimated that children between 10 and 16 years of age spend more than 10 hours a day sedentary (Strauss, Rodzilsky, Burack, & Colin, 2001).

In addition, it has been proposed that most young children generally possess positive attitudes toward PE and hence exhibit minimal resistance toward PA participation (Trudeau & Shephard, 2005). However, various factors such as gradual maturity, decreased leisure time, and increased social responsibilities (e.g. study load, work demands, military service, marriage, and family issues) are likely to generate ambivalence toward PA participation. Further, the benefits of “health” are not always immediately noticeable. This would eventually result in the gradual withdrawal from sports, or PA (Enoksen, 2011). There is also evidence suggesting that effective pedagogical practices of a high school PE curriculum—one that is deemed to be engaging and inclusive—are positively correlated with a higher probability of students to continue PA participation when they are in tertiary education (Kimball et al., 2009).

Therefore, in order to nip the issues of physical inactivity and sedentary behaviors in the bud, the most effective strategy is perhaps to educate and initiate interventions before such unwanted habits are developed. Indeed, school physical education programs represent an important avenue for encouraging young people to develop lifelong exercise habits (Sallis, Carlson, & Mignano, 2012). According to the findings of Trudeau and Shephard (2005), a quality school PE program can influence significantly the overall amount of PA of school-age children. This can be done by encouraging participation in extra-curricular sports activities (Eccles & Templeton, 2002) and active commuting to school (Davison, Werder, & Lawson, 2008) (such as reducing the dependency on motor vehicles which can contribute to increased physical activity: Global Advocacy Council for Physical Activity, 2010), and providing adequate supervision to students commuting within the neighborhood, thereby fostering a physically active lifestyle.

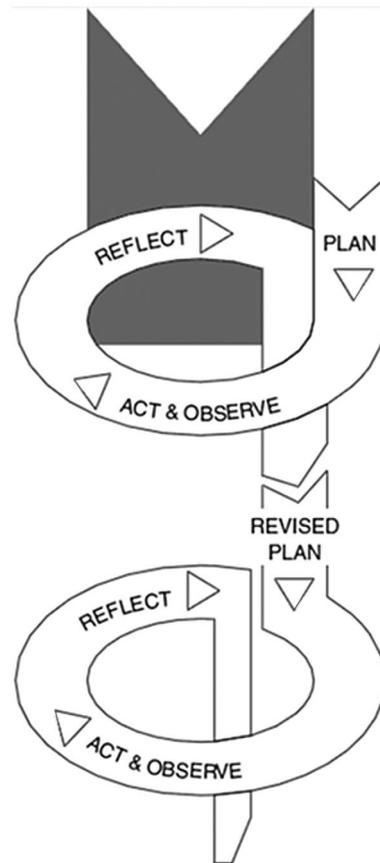
Various strategies have been recommended for exercise promotion. Internet-based interventions have shown the potential of serving large numbers of the population, and possess the advantages of convenience, flexibility, and more effectiveness and opportunities for interaction (Tate, Wing, & Winnett, 2001). Recently, focus has been put on using the Internet as a means to promote health-related behavioral change (Steele, Mummery, & Dwyer, 2007; Vandelanotte, Spathonis, Eakin, & Owen, 2007; Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004). However, the efficacy of using Internet-based interventions for PA promotion in the secondary school sector is unknown.

The current study aimed to tackle the problem of insufficient PA levels of secondary school students by integrating daily life activities (such as walking, biking and, taking the stairs) into their daily lives through an Internet-delivered program. With the advantage that most teenagers are familiar with computer use, it is expected that such an innovative project will have significant impact on the methods of PA and health promotion used in the Hong Kong community. Therefore, the purpose of this study was to examine the effectiveness of an Internet-based behavioral intervention for PA promotion among secondary school students. It was hypothesized that the Internet-based PA promotion program could increase the PA levels of secondary school students.

2. Methodology

This study used the action research approach together with qualitative focus group interview (Krueger, 1994) to examine the efficacy of using Internet-based interventions for physical activity promotion in a Hong Kong Secondary School. The action research approach was chosen because it can help action researchers develop skills (observe, reflect, plan, implement, and assess) which can in turn help PE teachers in the targeted secondary school to handle their issues/problems in a more scientific way. Similar to other action researchers, the researchers of this study have followed the process of action research which is to identify the problem, action planning, implementation, and assessment (Mertler, 2012). Thus, action researchers of this study supported PE teachers in going through every step of the action research process. Since this study is focused on solving school learning and teaching problems and improving practice, the action researchers of this study therefore used the action research spiral (Kemmis & McTaggart, 2000) to undergo the research process as shown in Figure 1.

Figure 1. Kemmis and McTaggart's (2000) action research spiral.



2.1. Setting

The study site was a grammar school situated in Hong Kong. In this school, physical education was a compulsory subject and sports-related activities played a significant role in the extra-curricular program. Physical education lessons were taught to boys and girls separately. This study involved only Form 4 (Grade 10) boys and girls. A PE teacher who taught at the school wished to solve his long existing concerns on the physical activity levels of his students through different means. The action researchers and the PE teacher held a discussion and thereafter proposed to examine Internet-based behavioral interventions for PA promotion among Form 4 (Grade 10) students in the targeted secondary school.

2.2. Gathering preliminary information

In order to have a clearer understanding of the targeted secondary school, with the assistance of this PE teacher, two preliminary meetings were conducted to collect information on Form 4 (Grade 10) students' PA background, PA levels, stage of change, awareness of health benefits of regular PA participation, as well as specific motivators and barriers experienced. A total of 20 students, 10 boys, and 10 girls, were randomly chosen by the participating PE teacher at the school to attend the interviews. The students were divided into two groups and each interview group had ten students. For data analysis purposes, the interviews were photographed and voice-recorded in order to capture the general atmosphere and participants' responses. After two focus group interviews, the preliminary results showed that these two groups of students are relatively inactive and have insufficient PA levels by integrating daily life activities, such as walking, biking, and taking the stairs. In addition, their awareness and motivation of regular PA participation was low.

2.3. First cycle

2.3.1. Participants

The approval for the use on human subjects was obtained from the University Survey and Behavioural Research Ethics Committee at the Faculty of Education, the Chinese University of Hong Kong. A total of 135 Form 4 (Grade 10) students from a Hong Kong Secondary School were invited to participate in the current research project. After obtaining the parental consent, 127 students were recruited. They were group-randomized by class and placed into two groups, i.e. the Internet-based group (IB) and the control group (C). Participants of the IB group received the online behavior change program entitled “let’s exercise and be active daily” (LEAD) which was designed by the Department of Sports Science and Physical Education of the Chinese University of Hong Kong for PA promotion among secondary school students. The online program was based on the Transtheoretical Model (Prochaska & DiClemente, 1983) and Social Cognitive Theory (Bandura, 1986), and was designed with a step-by-step exercise plan, which emphasized the benefits of doing regular exercise, overcoming exercise barriers, choosing suitable exercise, rewarding oneself, receiving social support and exercise guidelines. The IB group was provided a password to access the online course materials. They were instructed to visit the 9-station program for one month, at the frequency of 2 stations a week and about 30 minutes per station, at their convenient time and venue. Participants of group C did not receive any intervention treatment. They were requested to maintain their present lifestyle for three months.

2.3.2. Program activities

In order to monitor the process of the implementation and help the participants obtain benefits from the PA program, two workshops were organized for students before and during the execution of the online program. In addition, the action researchers explained the details of the course materials and obtained feedback from the participating students.

2.3.3. Data collection

The international physical activity questionnaire (IPAQ) short Last 7-day instrument (Craig et al., 2003) was used to assess the PA levels of the participants. The stage of exercise change questionnaire (SECQ) (Marcus, Selby, Niaura, & Rossi, 1992) was used to assess the stages of behavioral changes of the participants. The assessments were conducted at baseline, and post intervention (four weeks after baseline).

2.4. Second cycle

In order to assess the effects of intervention and the effectiveness of the proposed change, critical reflection among the action researchers was an integral feature of this action research study. As a result of critical reflection by the research team, some improvements arose and a further cycle of action research was suggested to solve the identified problems. Therefore, evaluation interviews were conducted to collect information and feedback from the Form 4 students and the participating PE teacher for modification and improvement of the intervention adopted in the 1st cycle. According to the computer tracking system, it was found that only 23% ($n = 15$) of the IB group students had visited the LEAD website. The students reported that the website contents did not motivate them to read through its details. In order to encourage the participants of the IB group to visit the LEAD website and read its contents in the 2nd cycle, some incentives were provided. These included recognition of website visiting and PA participation time as nine hours of “other learning experience” recorded upon providing a PA participation log, and an LEAD Award Certificate to be issued to the participants who had finished visiting all the nine stations of the LEAD website. In addition, a written examination on the website contents was conducted at the end of the 2nd cycle of the intervention. The examination was counted for 20% of the final examination grade for the physical education subject.

The same questionnaire for PA and stage of change data collection used in the 1st cycle was used in the 2nd cycle. The assessments were conducted at baseline, and post intervention (four weeks after baseline). A total of two face-to-face interviews were conducted to collect information and feedback from the participants at the end of the 2nd cycle of the intervention. A total of 12 students

were chosen, 6 from the IB group and 6 from the C group. The participants were selected based on their PA scores at the 2nd cycle assessment, four from low level (at or below 25 percentiles), four from medium level (from 45 to 55 percentiles), and four from high level (at or above 75 percentiles). Participants of the same group were interviewed together.

2.5. Data analysis

2.5.1. Quantitative

Data were collected from 127 Form 4 secondary school students. Only participants who had responded to the baseline, 1st cycle and 2nd cycle assessments were included in the analyses. Data collected from the survey instrument were used. The dependent variables included the total PA score and the stage of exercise change. The independent variables included age, gender, body mass index (BMI, weight/height²), and the intervention group.

Descriptive statistics for the total PA score, stage of change, age, gender, and BMI were calculated. *T*-tests were used to test for differences in the baseline characteristics of the participants between the IB and C groups. Repeated measure ANOVAs, with time (baseline, 1st cycle and 2nd cycle assessments) as the within-subjects factor and intervention group (IB and C groups) as the between-subjects factor, were used to evaluate the effects of the LEAD website on PA participation. In addition, owing to the skewed nature of the PA variable, the total PA scores were log transformed before analyses.

Wilcoxon Signed Rank tests were used to analyze the within-group differences of the stage of exercise change. The data were analyzed using the Statistical Package for Social Science (SPSS) version 18 for Windows software. Statistical significance was set at a level of 0.05.

2.5.2. Qualitative

The narrative approach (Thomas & Nelson, 2001) of data analysis was selected. The original contents of the narrative were analyzed and direct quotations, which included the details of incidents or experiences of the participants, were used in the analysis.

3. Results

3.1. Participant characteristics

The group of 127 Form 4 students was randomized into 2 groups, namely IB and C groups. The flow diagram of the randomization is shown in Figure 2.

Of the participants ($N = 127$) who completed the baseline assessment, 37.0% were female and 63.0% were male. The age of the participants ranged from 15 to 20 (mean \pm standard deviation [SD], 15.8 ± 1.0) and their BMI ranged from 12.3 to 35.7 kg/m² (mean \pm SD, 21.0 ± 4.3). There were no significant differences between the two groups with respect to the demographics and baseline variables. Table 1 shows the baseline characteristics of the participants.

3.2. Changes in total PA scores

The post-intervention assessments were completed for 96.9% of the participants ($N = 123$) at the 1st cycle assessment and for 94.5% of the participants ($N = 120$) at the 2nd cycle assessment. There was no significant difference in the dropout rates between the two groups. Only those participants who had responded to all three of the assessments were included in the statistical analyses.

At the 1st cycle assessment, the participants in the IB group reported a mean total PA score of $2,908.2 \pm 3,198.0$ MET minutes per week and those in the C group reported $1,798.9 \pm 2,656.3$ MET minutes per week. Table 2 shows the changes in the total PA scores. Increase in total PA scores (mean difference 329.3 MET minutes per week) was found in the IB group, but this was not

Figure 2. Flow diagram of participants' progress through different phases of the group randomized trial.

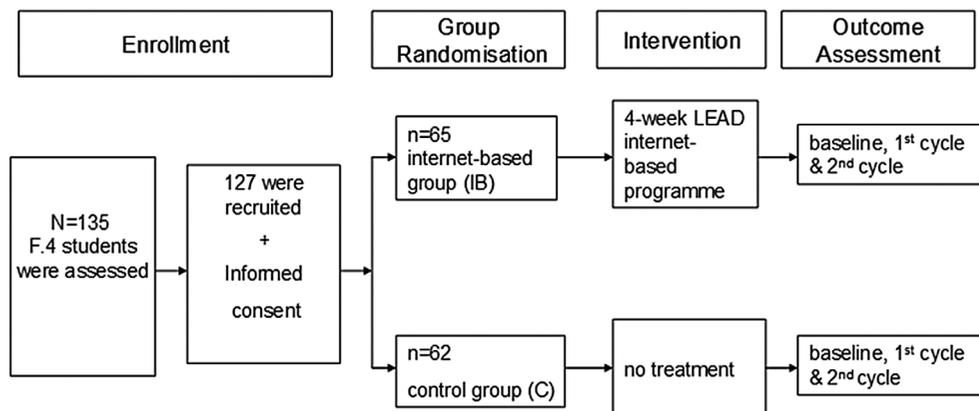


Table 1. Baseline characteristics of total sample and two groups (mean ± SD or %)

	Total sample (n = 127)	IB Group (n = 65)	C Group (n = 62)
<i>Demographics</i>			
Gender (% of female)	37.0	35.4	38.7
Age (year)	15.8 ± 1.0	15.8 ± 0.9	15.8 ± 1.0
BMI (kg/m ²)	21.0 ± 4.3	21.1 ± 4.1	20.8 ± 4.6
<i>Physical activity</i>			
Total PA score	2,245.7	2,578.9	1,896.2
(MET min/week)	±2,727.9	±2,842.9	±2,578.5
<i>Stages of change</i>			
Pre-contemplation (%)	13.4	12.3	14.5
Contemplation (%)	15.0	10.8	19.4
Preparation (%)	43.3	44.6	41.9
Action (%)	7.9	10.8	4.8
Maintenance (%)	20.5	21.5	19.4

Table 2. Mean physical activity (PA) scores (MET min per week) at baseline, 1st cycle and 2nd cycle assessments

	IB Group (n = 63)	C Group (n = 57)
Total PA scores (MET min/week)		
Baseline	2,578.9 ± 2,842.9	1,896.2 ± 2,578.5
1st cycle assessment	2,908.2 ± 3,198.0	1,798.9 ± 2,656.3
Mean difference	329.3	-97.3
2nd cycle assessment	2,762.5 ± 2,814.5	1,817.0 ± 2,474.1
Mean difference	183.6	-79.0

Note: Data are presented as raw means (±SD), analysis was conducted on log transformed data.

statistically significant ($p > 0.05$). There was a slight fall in the total PA scores (mean difference -97.3 MET minutes per week) in the C group, but this was also not statistically significant ($p > 0.05$).

At the 2nd cycle assessment, participants in the IB group reported a mean total PA score of 2,762.5 ± 2,814.5 MET minutes per week and those in the C group reported 1,817.0 ± 2,474.1 MET minutes per week. The increase in total PA scores (mean difference 183.6 MET minutes per

Table 3. Stages of change at baseline, 1st cycle and 2nd cycle assessments

Stages of change	Baseline		1st cycle		2nd cycle	
	IB (n = 63)	C (n = 59)	IB (n = 63)	C (n = 59)	IB (n = 63)	C (n = 59)
Pre-contemplation	7	8	6	4	7	7
Contemplation	6	11	11	13	10	16
Preparation	29	26	26	22	25	14
Action	7	2	4	7	8	7
Maintenance	14	12	16	13	8	15

week), compared with the baseline assessment in the IB group, was not statistically significant ($p > 0.05$). The decrease in the total PA scores (mean difference -79.0 MET minutes per week), compared with the baseline assessment, was also not statistically significant ($p > 0.05$).

3.3. Shifting of stages of change

At the first cycle assessment, it was found in the IB group that 13 participants had improved, 35 participants remained unchanged, and 15 participants had regressed in their stages of change. The shift was not statistically significant ($p > 0.05$). Table 3 shows the stages of change. In the C group, 20 participants had shown improvement, 25 participants remained unchanged, and 14 participants had regressed in their stages of change. The shift was not statistically significant ($p > 0.05$).

At the second cycle assessment, no statistically significant changes ($p > 0.05$) were found in the IB and C groups. In the IB group, 13 participants had shown improvement, 38 participants remained unchanged, and 12 participants had regressed in their stages of change. In the C group, 18 participants had shown improvement, 28 participants remained unchanged, and 13 participants had regressed in their stages of change.

4. Discussion

The primary goal of the current study was to solve the long existing problem of insufficient PA levels of secondary school students by promoting activities in their daily lives through the Internet-based LEAD program. There was a trend for the participants of the IB group to participate in more PA at the 1st cycle and 2nd cycle assessments, but no statistically significant differences within the IB group or between the study groups were observed. Contrary to the hypotheses, the Internet-based PA promotion program did not elevate the PA levels of the secondary school students. The finding was different from those derived from previous studies (Carr et al., 2008; Irvine, Philips, Seeley, Duncan, & Moore, 2011; Leung, Wong, & Huang, 2011).

In addition, no statistically significant changes in the stage of change of the IB group participants at the 1st cycle and 2nd cycle assessments were observed. The lack of intervention effects may partly be explained by the lack of program contents engagement. Computer tracking showed that only 23% ($n = 15$) of the IB group participants at the 1st cycle intervention and 23 (35.4%) of the IB group participants at the 2nd cycle intervention had visited the website. The program engagement was lower than previous studies (Leung et al., 2011; Marshall, Leslie, Bauman, Marcus, & Owen, 2003).

Supporting information was identified in the interviews. Some participants of the IB group reported that they did not continue to visit the website because they already had some basic knowledge of physical education. Respondent 1 commented,

These are common sense, they are not useful. We already have some basic ideas for physical education and that is enough.

Respondent 2 added that,

I already have my own exercise plan.

Respondent 3 further commented that,

I don't need to learn how to make an exercise plan and follow it. I want to do exercise freely. Just do what I want and maybe with my friends.

The participants of the current study may have joined the program through the encouragement of their parents and physical education teachers. The limited interest in accessing the LEAD website may have been due to non-self-selected motive compared with self-motivated participants who joined their program on their own initiative at the project recruitment.

Respondent 4 commented that,

We had the chance but we didn't use it.

Respondent 5 added that,

The benefits of sports do not attract me; we already know that and most sports share the same advantage.

Low engagement and retention rate was a challenge for Internet-based intervention (Marcus, Ciccolo, & Sciamanna, 2009; Vandelanotte et al., 2007), and providing peer and counselor support may enhance website access. Providing a suitable dose of face-to-face counseling and setting up of an exercise buddy system may have positive influences on the number of log-ins. In addition, as suggested by one of the participants, providing an interactive user communication platform may increase a sense of belonging to the group and improve program engagement and retention.

Respondent 6 suggested that,

A discussion platform will attract me to enter the website.

5. Reflection on the overall study

There were some limitations to the current study. First, self-reported PA data were collected and response bias might occur. Second, participants were recruited from one secondary school and the ability to generalize the findings is thus limited. Third, the study only examined short-term effects. Long-term effects of the intervention were left unknown. Despite the limitations, the strengths of the current study included the use of mixed research methodologies: both quantitative and qualitative data were collected. The qualitative data collected from interviews enhance understanding of behavior changes and the mechanism of the Internet-based PA promotion intervention. In addition, the current study examined the effectiveness of the Internet-based intervention, which bridged the gap between the few experimental trials using the Internet for PA promotion among secondary students.

The findings of the study showed that the Internet-based LEAD program was not effective in elevating the PA levels of the secondary school students. However, the study illustrated some of the challenges of using the Internet as a mode of delivery of PA promotion. In order to have more understanding on the potential of using this new technology for PA promotion, future studies should be focused on how people respond to Internet-based programs, and strategies to increase the interactivity of the Internet contents.

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Author details

Raymond Kim Wai Sum¹

E-mail: kwsum@cuhk.edu.hk

Elean Fung Lin Leung²

E-mail: elean@cuhk.edu.hk

¹ Department of Sports Science and Physical Education, The Chinese University of Hong Kong, G09, Shatin, NT, Hong Kong.

² Physical Education Unit, The Chinese University of Hong Kong, Shatin, NT, Hong Kong.

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