Effects of health program aimed at increasing daily living non-exercise physical activity on physical activity and self-efficacy in sedentary college students

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The goal of the present study was to determine if a daily living non-exercise physical activity intervention increases physical activity and self-efficacy in sedentary college students. Daily living non-exercise activities are defined as physical activity not classified as exercise or sports such as household chores and movement/travel. A 10-week health promotion program aimed at increasing daily non-exercise physical activities was implemented in which participants were randomly assigned to either an intervention (n = 23) or control group (n = 19). Participants in the intervention group were provided advice about their daily living non-exercise physical activity during weekly individual counseling sessions. The intervention and control groups also attended two seminars providing health-related information.
A survey was administered for 1 week before the start of the program and after the end of the program to assess levels of physical activity of the two groups using a physical activity monitor. They were also asked to complete a questionnaire regarding general self-efficacy and the SF-36® Health Survey. The intervention group exhibited significant increases in moderate-intensity physical activity and general self-efficacy compared with the controls. Based on their answers to the SF-36® Health Survey, scores for the intervention group for the categories of bodily pain and general health changed positively and significantly; however, these changes in the intervention group were not significantly different from those of control group. Given that the target setting designed to increase daily non-exercise physical activities during the intervention was not very demanding, the repeated attainment of less-demanding targets resulted in enhanced self-efficacy in sedentary students. Conclusions: These results demonstrate that health promotion programs designed to increase daily non-exercise physical activities as the first step in promoting behavioral change are effective in shifting sedentary students from inactive to active lifestyles.

Keywords: daily living non-exercise physical activity, sedentary college students, self-efficacy, tri axial accelerometer

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1. Introduction

A recent investigation revealed that approximately half of Japanese college students failed to meet the recommended level of physical activity as described by either the joint guidelines issued by the Center for

Disease Control and Prevention of the United States and American College of Sports Medicine (ACSM) or the ACSM's own guidelines (Okazaki et al. 2009). Further, annual reports by the Ministry of Education, Culture, Sports, Science & Technology of Japan (2008) indicate marked declines in physical fitness of college students over the last 30 years. Because declines in physical activity and fitness increase the risk of noncommunicable diseases (NCDs) and reduce the quality of life (Brown et al. 2003; Carnethon et al. 2003), countermeasures are urgently required to increase the level of physical activity of college students. The Ministry of Health, Labour and Welfare of Japan (2006) drafted the Exercise and Physical Activity Guide for Health Promotion in 2006, which proposes measures to increase the physical activity level of the population regardless of time or place. Specifically, this guide is characterized by a target of daily living non-exercise physical activity of at least 3 METs. Daily living non-exercise activities are defined as physical activity not classified as exercise or sports such as household chores and movement/travel. Levine et al. (1999) accurately measured non-exercise activity thermogenesis (i.e., daily living non-exercise physical activity), and showed that daily living non-exercise physical activity play a major role in the daily energy expenditure. According to a survey by the Sasagawa Sports Foundation (2010), the main reason for the lack of participation in physical activity among college students is lack of time, which was mentioned by 67.6% of respondents. Other barriers to physical activity are "There are other activities more worthwhile than exercising or sports." (24.5%) and "I don't bother to exercise." (19.6%). Therefore, increasing daily living non-exercise physical activity could be an effective strategy as it requires less time and elicits fewer barriers such as place or fatigue than participating in sports or exercise.

Although many studies have focused on the effect of sports or exercise on health (Anton et al. 2006; Capodaglio et al. 2007; Tully et al. 2005; Woo et al. 2006), we are not aware of any studies on the effects of an intervention aimed at increasing the level of daily living non-exercise physical activity.

A daily living non-exercise physical activity intervention is considered to relate self-efficacy (Raedeke et al. 2010; Tayama et al. 2012). Given that the target setting designed to increase daily living physical activity during the intervention could be not very demanding, the repeated attainment of less-demanding targets may be result in enhanced self-efficacy. Here, we evaluated the effects of a daily living non-exercise physical activity intervention on the level of physical activity and self-efficacy among sedentary college students who did not engage in regular exercise.

2. Methods

2.1 Subjects and groups

Fifty-nine participants from a group health promotion program conducted at four universities in Miyagi Prefecture were recruited using posters and by announcing the program in class. The participants were randomly assigned to either an intervention or control group. We assessed the level of physical activity using a physical activity monitor for 1 week before the start of the health promotion program. In addition, before the start of the health promotion program, we administered a questionnaire regarding general self-efficacy along with the SF-36® Health Survey. The health promotion program lasted for 10 weeks, and we assessed the level of physical activity and the questionnaire in the same way as before the start of health promotion program. According to the 2007 National Health and Nutrition Survey Japan (2007), mean daily step counts in individuals aged 15-19 years and those aged 20-29 years were 8,556 and 7,605, respectively. Thus, we used a cut-off level of 8,000 steps to delineate active from sedentary participants. Because we intended to study only college students with a low level of physical activity level, nine participants with a daily step count of more than 8,000 were excluded. We also excluded eight other participants who showed marked changes in lifestyle during the health promotion program. Accordingly, 23 subjects in the intervention group and 19 in the control group were included.

2.2 Description of the health promotion program

The members of the intervention group were given individual counseling regarding a daily living non-exercise physical activity program lasting 10 min each week over the 10-week program. They were asked to wear a three-axis physical activity monitor except while sleeping and bathing. Based on the results of monitoring, participants in the intervention group were individually counseled on the number of steps and the duration of various physical activities at 1.1-3, 3-6, and 6+ METs. The fundamental principle of counseling was that the members of the intervention group were responsible for setting their own daily living non-exercise physical activity level target and devising measures to reach this target by themselves. When the subject was counseled to set a goal for the number of steps, the increase in the weekly number was set to around 300 steps, a readily attainable goal. To reinforce the desired behavior of increasing steps in the intervention group, each week members were given three plastic bottles of a catechin-containing tea beverage (Healthya Water, 500 ml/bottle, Kao Corporation, Tokyo, Japan). This beverage was selected to promote health-conscious behavior among members of the intervention group, because students recognize it as a product aimed to support walking through the commercials on prime-time television and the bottle labeled “support in walking", and because many college students regularly carry a bottled beverage. Members of the intervention group attended two 90-minute seminars, held on the fourth and eighth weeks, providing health-related information. The first seminar focused on the role of daily living non-exercise physical activity in preventing NCDs and the relationship between daily living non-exercise physical activity and total daily energy consumption. In the second seminar, participants were advised on the utility of diet in the primary prevention of NCDs and attended a lecture concerning the importance of a regular lifestyle and the effect of catechin on lipid metabolism (Harada et al. 2005; Ota et al 2005). In contrast, members of the control group attended one health seminar after 4 weeks. This seminar was the same as that given to the intervention group.

2.3 Measurements

The levels of physical activity of all participants were determined for 1 week before and after the program. A health-related questionnaire was administered at these times as well. Because accurate measurement of the intensity of daily living non-exercise physical activity is important, we selected a physical activity monitor (Actimarker EW4800P-K, Panasonic Electric Works Co., Ltd., Osaka, Japan) whose accuracy in quantifying daily living non-exercise physical activity had been confirmed (Hara et al. 2006). The physical activity monitor was set at a sampling frequency of 21 Hz and an acceleration detection sensitivity of 0.01 G. The acceleration was converted to METs using data obtained by 1-minute sampling according to the standard deviation of the resultant tri-axial acceleration. Levels of physical activity were evaluated in categories described in the revised exercise prescription guidelines of the American College of Sports Medicine (ACSM) and American Heart Association as follows: low (<3 METs), moderate (≥3 and <6 METs), and vigorous, (≥6 METs) (Haskell et al. 2007).

2.4 General self-efficacy and Health-related Quality of Life Surveys

To measure general self-efficacy of daily living, we used a questionnaire prepared by Sakano et al (Sakano and Tohjoh 1986). General self-efficacy was evaluated according to the total score of a questionnaire consisting of 16 items.

The Health-related Quality of Life (HRQOL) of subjects was assessed using the SF36 survey (Fukuhara et al. 1998). It consists of 36 questions, 35 of which are included on eight multi-item scales as follows: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health.

2.5 Statistical analyses

All data are presented as means and standard deviations. Comparisons between the intervention and control groups before the health promotion program were performed using non-paired t-tests or the Chi-square test as appropriate. Within-group comparisons were made using paired t-tests. The effects of the health promotion program were analyzed by the analysis of covariance (ANCOVA) using baseline values as covariates. Relationships between variables were analyzed using Pearson’s product-moment correlation coefficients. All statistical analyses were performed using SPSS 16.0J for Windows (Japan IBM, Tokyo, Japan). Significance was defined as $p < 0.05$. All participants in the study provided written informed consent. The study was approved by the Ethical Committee of the Japanese Society of Nutrition and Food Science.

3. Results

The baseline characteristics of members of the intervention and control groups were similar with respect to gender, age, height, and body weight as determined using the non-paired t-test or Chi-square test (**table 1**). Tables 2 and 3 summarize the effects of intervention on daily living non-exercise physical activity for various outcomes. The before-program characteristics of members of the intervention and control groups were similar with respect to number of daily steps, level of physical activity, general self-efficacy score, and responses to the SF36 using the non-paired t-test. The number of daily steps showed an increase in the intervention group ($t = 8.124$, $p < 0.05$) and increased significantly in the intervention group compared with the control group after program ($F=18.783$, $P<0.05$). Similarly, the duration of activities at ≥3 METs and <6 METs showed an increase in the intervention group ($t = 5.886$, $p < 0.05$) and increased significantly in the intervention group compared with the control group ($F=6.942$, $p<0.05$). Although the duration of activities at less than 3 METs increased in the intervention group ($t = 4.136$, $p < 0.05$), this change was not significantly different in comparison with that of the control group. Similarly, although the duration of activities at ≥6 METs showed an increase in the intervention group ($t = 2.813$, $p < 0.05$), the change was not significantly different from that observed in the control group. The intervention group showed a significant increase in the general self-efficacy score in comparison with the

Table 1 The characteristic of subjects.

	intervention group	control group
Number of subjects	n = 23 11 male and 12 female	n = 19 9 male and 10 female
age (yrs)	19.4 ± 2.5	20.7 ± 3.3
height (cm)	162.8 ± 8.0	164.0 ± 10.2
weight (kg)	64.4 ± 15.0	58.0 ±12.4

Values are expressed as mean ± standard deviation.

Table 2 Effects of a 10-week daily living non-exercise physical activity program on the level of physical activity of sedentary college students.

		Before program	After program	Difference	95% CI
Number of steps (steps / day)	Intervention group	5652 ± 1102	8326 ± 1908 * §	2674 ± 1578	1991 , 3357
	Control group	6154 ± 1280	6423 ± 1917	269 ± 1782	-590 , 1128
Duration of activities at < 3 METs (min)	Intervention group	426.4 ± 108.7	482.2 ± 86.8 *	55.8 ± 64.7	27.8 , 83.8
	Control group	448.9 ± 135.9	455.7 ± 167.8	6.8 ± 137.7	-59.6 , 73.2
Duration of activities at > 3 METs and < 6 METs (min)	Intervention group	39.4 ± 13.2	57.5 ± 16.5 * §	18.1 ± 14.7	11.7 , 24.5
	Control group	43.8 ± 12.0	46.8 ± 15.4	3.0 ± 18.5	-5.9 , 11.9
Duration of activities at > 6 METs (min)	Intervention group	1.0 ± 1.1	2.4 ± 2.9 *	1.4 ± 2.4	0.4 , 2.5
	Control group	0.6 ± 1.2	1.7 ± 2.5	1.1 ± 2.5	-1.3 , 2.2

Values are expressed as mean ± standard deviation.
Intervention group: n=23
Control group: n=19
95% CI: 95% Confidence interval
*: $p < 0.05$, Within-group comparison from pre- to post-program (paired *t*-test)
§ : $p < 0.05$, Comparison of the effects of the program between the intervention and control groups (ANCOVA)

Table 3 Effect of a 10-week non-exercise physical activity intervention program on the general self-efficacy and SF-36 scores of inactive college students.

		Before program	After program
General self-efficacy score	Intervention group	5.2 ± 4.2	6.8 ± 3.3*§
	Control group	5.7 ± 4.1	5.3 ± 3.8
Physical functioning	Intervention group	51.9 ± 6.2	53.0 ± 1.1
	Control group	47.4 ± 16.0	54.4 ± 5.8
Role-physical	Intervention group	47.3 ± 2.2	47.2 ± 2.1
	Control group	45.8 ± 9.5	48.0 ± 9.8
Bodily pain	Intervention group	51.9 ± 1.3	58.5 ± 1.2*
	Control group	47.2 ± 8.9	53.5 ± 9.3
General health	Intervention group	50.7 ± 2.3	54.5 ± 1.8*
	Control group	47.2 ± 7.7	50.8 ± 10.5
Vitality	Intervention group	43.4 ± 2.0	44.4 ± 1.5
	Control group	41.6 ± 8.3	45.9 ± 8.1
Social functioning	Intervention group	47.5 ± 2.1	49.5 ± 1.8
	Control group	44.5 ± 13.9	48.2 ± 10.8
Role-emotional	Intervention group	44.7 ± 2.5	42.5 ± 2.1
	Control group	43.8 ± 11.4	44.7 ± 10.7
Mental health	Intervention group	45.3 ± 2.0	44.8 ± 2.0
	Control group	44.5 ± 10.1	47.0 ± 9.5

Values are expressed as mean ± standard deviation.
Intervention group: n = 23
Control group: n = 19
＊: p < 0.05, Within-group comparison from pre- to post-program (paried t-test)
§: p < 0.05, Comparison of the effects of the program between the intervention and control groups (ANCOVA)

control group (F=5.681, p<0.05). The intervention group demonstrated a significant increase in the SF36 scores for bodily pain and general health, although these changes were not significantly different in comparison with those in the control group.

We evaluated the relationships between changes in the duration of activities at different MET levels and changes in the number of steps during the health promotion program in the intervention group (**Table 4**). A significant positive correlation was observed between a change in the duration of activities at ≥3 METs and <6 METs and the change in the number of daily steps. Further, a weak positive correlation was noted between a change in the duration of activities at <3 METs and the change in the number of daily steps.

When the intervention and control subjects were combined (**Fig. 1**), a weak positive correlation was observed between the values of baseline and post-study daily number of steps and general self-efficacy score. However, no correlation was detected between the change in number of steps and changes in general self-efficacy score (data not shown, r = 0.11, n.s.).

4. Discussion

We report here a study of college students considered sedentary based on their average daily step count of less than 8,000. Their participation in

Table 4 Correlations between changes in the number of daily steps with changes in the physical activity level during a 10-week non-exercise physical activity interventional program.

Changes after the program			
	< 3METs	3 - 6 METs	> 6 METs
Changes in number of steps	0.50 *	0.83 *	0.26

*: p<0.05

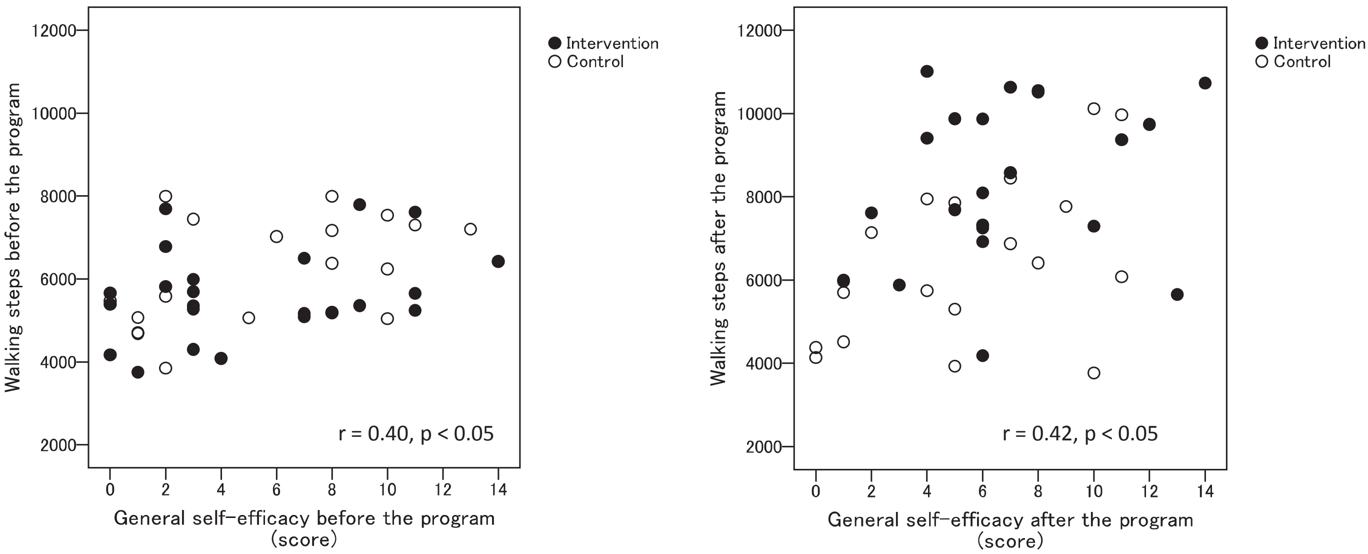

Figure 1 Relationship between general self-efficacy and number of steps.
The left and right graphs show correlations between values assessed before and after the program, respectively.

a very simple and easy to follow health promotion program resulted in increases in the number of steps and the level of moderate-intensity physical activity as well as an improvement in self-efficacy. Baseline value for the mean daily number of steps (5,879 ± 1,198) taken by the participants in this study was markedly lower than that reported for individuals aged 15-19 or 20-29 years by the 2007 National Health and Nutrition Survey in Japan (2007) (8,556 and 7,605 steps, respectively). Thus, we consider the participants to have been predominantly sedentary. Participants in the intervention group were asked to review their daily physical activity patterns using the physical activity monitor and to independently plan to increase their daily living non-exercise level of physical activity. The daily number of steps during the study did not change in the control group. In contrast, the daily number of steps increased by 48% in the intervention group to a level that was 30% higher than that in the control group. This suggests that the current intervention was effective at increasing the daily number of steps.

In a meta-analysis of the effects of health promotion programs (Bravata et al. 2007), Bravata et al. reported that the number of steps taken by participants in intervention groups increased by 2,491 (95% confidence interval: 1,098-3,885) compared with those in the control groups. Improvements in response to intervention were also observed for numerous risk factors for NCDs. The increase in daily step counts in the current intervention fell to within the 95% confidence interval range reported by Bravata et al. (2007). Thus, a health promotion program aimed at increasing daily living non-exercise physical activity level may be effective in preventing NCDs.

Participants' responses suggested that members of the intervention group often used their commuting time to increase levels of daily living non-exercise physical activity. Walking to school corresponds to a moderate intensity level of approximately 3 METs. Because a 10-minute walk is equivalent to approximately 1,000 steps, the 18-minute increase in the duration of activities at 3-6 METs observed in the intervention group should correspond to an approximately 1,800-step increase. Therefore, nearly 70% of the observed increase in steps in the intervention group can be explained by increased activities at the moderate intensity level. Indeed, a strong correlation (r=0.83) was observed between changes in the number of steps and the change in the duration of activities at an intensity of 3-6 METs. Similarly, a positive albeit more modest correlation was observed between a change in the number of steps and a change in the duration of low intensity (<3 METs) physical activity (r=0.50). Two reasons may explain the moderate correlation between an increase in the number of steps and the increase in the duration of low-intensity activities. First, the physical activity monitor used in this study only recognizes four or more consecutive steps as walking (Hara et al. 2006). Second, non-exercise physical activities, such as household chores that are performed at less than 3 METs, do not necessarily involve walking.

General self-efficacy was weakly associated with the number of steps at baseline and post-intervention. This suggests that daily living non-exercise physical activity, mainly walking, appears to be related in part to general self-efficacy for sedentary college students. The participants began to positively evaluate physical activities using physical activity monitor and began to make modifications in their daily life to increase the amount of physical activity. Due to the participants' developed expectations, prospects, and individual strategies, an enhancement of self-efficacy is believed to contribute to an increase in physical activity level.

Morimoto et al. (2006) indicated that a greater amount of physical activity was associated with better HRQL, and Puig-Ribera et al. (2005) reported that workplace walking increased with wellbeing among sedentary participants. Furthermore, Izawa et al. (2004) reported that exercise maintenance may be related to improvement of HRQL. In the present study, intervention group had significant improvements in the SF36 scores for bodily pain and general health after health program. The results of SF36 may be relevant to a task of reaching the steps goal repeatedly. Participants in the intervention group were instructed to increase to around 300 steps a week. The increase of around 300 steps a week may be a reasonable goal setting to achieve repeatedly among sedentary participants. In addition, corresponding to low to moderate exercise intensity, daily life non exercise physical activity would hardly cause an acute physical pain. This may be also one of the factors for sedentary participants to maintain health behavior.

There are several inherent limitations to the present study. Firstly, the present study emphasizes the need for large sample study to lead to more accurate results. In addition, because participation was restricted to sedentary college students (< 8,000 steps/day), the same interventional program may not produce similar effects when applied to healthier or more active college students. Future studies should widen the range of subjects participating and evaluate differences in the effects of the program according to age. Because the college term lasts 15 weeks, extending the 10-week health promotion program used here to a 15-week intervention should not be difficult. However, applying this strategy to working or elderly people may be more problematic, as participants are likely to feel that the burden of a weekly commitment is excessive. Assuming that the efficacy of a health promotion intervention is dependent on its frequency and duration, it would be desirable to evaluate the threshold frequency and duration necessary to produce a health-promoting effect.

5. Conclusion

Here, we studied college students considered sedentary based on their average daily step count of less than 8,000. Participants in our 10-week program received a weekly intervention in the form of guidance concerning their daily life non-exercise activities. This guidance resulted in increases in the number of steps and the level of moderate-intensity physical activity as well as an improvement in self-efficacy. These results suggest that a health promotion program designed to increase daily living non-exercise physical activity level could be effective as a first step in prompting sedentary college students to practice health-promoting behaviors that lead to a more active campus life.

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