

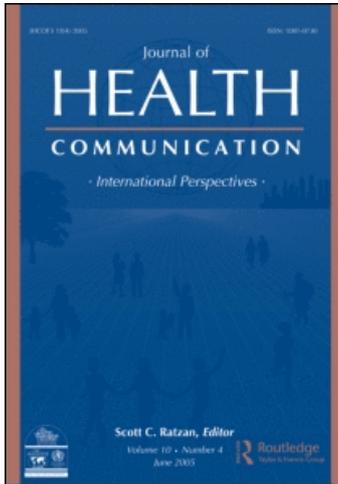
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### The Effect of an Internet-Based, Stage-Matched Message Intervention on Young Taiwanese Women's Physical Activity

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# The Effect of an Internet-Based, Stage-Matched Message Intervention on Young Taiwanese Women's Physical Activity

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*A web-based, stage-matched message intervention was designed in order to see the effect on the physical activity of young Taiwanese women with regard to several variables. The intervention was guided by the Transtheoretical Model (TTM) and was evaluated using a pre-post-test control group design. One hundred thirty female freshmen, enrolled in a nursing class in a university in Taipei, completed the survey at three different points in time. They were assigned to three groups: an experimental group with stage-matched messages on the website, a generic group with non-stage-matched messages on the website, and a control group that was given only lectures but had no access to the website.*

*Results indicated that the subjects in the stage-matched group improved most in terms of stage-of-exercise and amount of physical activity, followed by the generic group at immediate post-test; meanwhile, the control group had a tendency toward downward change. The effect did not persist, however, for the first two groups. A significantly higher level of exercise self-efficacy was found in the stage-matched group than in the other two groups immediately after the intervention. The results suggested that a website conveying theory-based messages can serve as a useful*

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*tool for improving young females' physical activity and exercise self-efficacy. Additionally, we need research that explores different degrees and dimensions of tailoring in order to find the optimal degree of audience segmentation.*

## **Introduction**

### ***Background and Significance***

It has been clearly demonstrated that physical activity can have a positive effect on health. This fact is still ignored in many developed countries, however, and, on average, people tend to be less physically active at younger ages. According to 2006 data provided by the Taiwan Department of Health (2006), heart and cardiovascular diseases, which are sedentary-lifestyle-related and which used to mainly afflict the middle-aged, were among the 10 leading causes of death for young people aged 15 to 24 in Taiwan. This alerted health professionals that more effort needed to be put into promoting physical activities for both adults and youth.

Recent research has indicated that young females are consistently found to be less active than their male counterparts and should be the target group for special interventions (Cavill, Biddle, & Sallis, 2001; Sallis, Prochaska, & Taylor, 2000). This is also the case in Taiwan, where a national study of 1,027 undergraduate students showed that 92.1% of female students failed to exercise regularly (Chung, 2000). Other studies have shown that 55% to 64% of young Taiwanese female college students seldom thought about exercising regularly and were not preparing to start doing so (Huang, Hung, Liu, & Li, 2006; Lin & Lu, 2001). In general, the young women considered schoolwork more important than regular physical activity (Huang, Hung, Liu, & Li, 2005). Thus, Taiwan's youthful female population needs to be encouraged to get more exercise.

On the other hand, although many young Taiwanese women may not exercise regularly, they still have a positive attitude toward regular exercise and likely could be motivated to begin an exercise program through specifically targeted messages (Liu, Huang, Hung, & Li, 2005). These messages should have theory-based contents and appropriate health-education channels.

### ***Designing the Message for Targeted Groups***

Meeting the needs of specific, targeted groups has long been an important principle of health communication. The same principle also is used with other consumer services: it essentially means meeting the needs of the clients in order to get the best results. Researchers already have confirmed the usefulness of this kind of strategy. Marcus, Owen, Forsyth, Cavill, and Fridinger (1998) analyzed 28 mediated intervention studies of physical activity and indicated that tailored messages combined with additional subject contact were the most effective methods to motivate subjects to begin regular exercise programs. Targeting is another approach to designing customized health messages. According to Kreuter and Skinner (2000), targeting involves the development of a single intervention approach for the subgroups of a defined population, one that takes into account characteristics shared by all the subgroup members. This is different from using a tailored message that is directed toward specific individuals.

Both targeted and tailored approaches are guided by sound principles, and studies have demonstrated that both can be more effective than generic interventions, which do not take into consideration the characteristics of those to whom the messages are being sent (Kreuter, Strecher, & Glassman, 1999; Kreuter & Wray, 2003; Rimer & Kreuter, 2006; Skinner, Campbell, Rimer, Curry, & Prochaska, 1999). Designing targeted or tailored messages is easier to do than ever before due to high-speed computers, which facilitate design of appropriate vignettes or stories for people from different sociodemographic backgrounds and with varying psychological profiles. Computer systems also provide interactivity as well as message context to individual users.

### ***The Internet and Health Communication for Young Women***

Research has indicated that Internet-based programs are attractive because of their convenience, availability, anonymity, and interactivity (Doshi, Patrick, Sallis, & Calfas, 2003; Strecher, 2007). The emergence of the Internet has made conveying health messages especially appropriate for young people, as the World Wide Web and E-mail have become one of their major means of communication (U.S. Census Bureau, 2001). Research also has shown that women like to use the Internet to communicate with friends and to seek information (Feil, Glasgow, Boles, & McKay, 2000; Strecher, 2007). In Taiwan, residents aged 16 to 20 ranked highest among all Internet users who said they surfed the Internet to obtain various kinds of information (Taiwan Institute for Information Industry, 2005).

High-speed broadband Internet access is especially useful for individuals who seek information on the Internet. Access to broadband Internet is increasing rapidly in Taiwan, as in other parts of the world: In 2007, 63.36% of all Taiwanese above the age of 12 used broadband, up from 48.10% in 2003. Moreover, in Taiwan females use the Internet almost as frequently as do their male counterparts (Taiwan Network Information Center, 2007). Thus, the Internet has the potential to be an excellent vehicle or medium for the health education of young women in Taiwan.

### ***Transtheoretical Model (TTM)***

The TTM of behavioral change, which takes individual differences into account, has been widely used in current health interventions and has had encouraging results, including in the area of physical activity (Kim, Hwang, & Yoo, 2004; Peterson & Aldana, 1999; Kerr & McKenna, 2000). The TTM incorporates four related concepts considered central to behavioral change: stage of change, self-efficacy, decisional balance, and the process of change. Each stage of change is part of the larger process of change and reflects the temporal dimension in which attempts to change one's behavior occur. The progression through several stages may be linked to differences in self-efficacy and decisional balance as well as to one's capacity to engage in the process of change (Prochaska & Marcus, 1994). Hence, there is a progressive increase in self-efficacy, which moves from the level of precontemplation to that of action (Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Nigg & Courneya, 1998). In other words, in order for one to progress from precontemplation to action, the process of changing must be accelerated, which means that the cons or negative factors must be increasingly outweighed by the pros or positive ones (Prochaska et al., 1994).

The TTM has been applied in many stage-matched health communication studies due to its use of a series of theory-based stages, and has proven to be effective (Prochaska & Velicer, 1997). In general, research on the TTM in the context of promoting physical activity has been supportive of this model (Burbank, Reibe, Padula, & Nigg, 2002; Kerr & McKenna, 2000; Steptoe, Kerry, Rink, & Hilton, 2001; Wallace, Buckworth, Kirby, & Sherman, 2000). Studies using the TTM in the context of encouraging physical activity have dealt primarily with middle-aged and older adults. There have been no published studies evaluating the TTM with an experimental design using young Asian female subjects specifically drawn from the general public. Experimental studies with samples drawn from ethnic groups are needed to confirm these results.

### ***The Present Study***

The present study has both practical and theoretical significance. In Taiwan, every female freshman takes a required course in nursing. Most nursing teachers instruct students in nursing and first aid for sports injuries, and they may also lecture them on the benefits of exercise; thus they are likely to encourage students to engage in physical activity. The purpose of this study was to investigate the effectiveness of a stage-matched website message in improving young women's physical activity level, as opposed to the traditional, unstructured teaching of physical activity in courses such as nursing.

## **Methods**

### ***Subjects***

The researchers performed an impact evaluation of a three-armed, quasiexperimental study. A total of 149 Taiwanese first-year female college students in the College of Liberal Arts, Education, Science and Technology at a national university in Taipei, Taiwan, participated in this study. Students from the Departments of Sports and Physical Education and university sports team members were excluded because extensive physical training already is required of them. Three students (1.3% of the total) were excluded during the baseline survey phase due to ineligibility, and one student (0.7%) refused to participate. The subjects in this research project participated voluntarily. The mean age of the sample was 18 years (*S.D.* = .55, range = 18.25–18.53). Sixty-one percent of the students had parents with a college education or above, and 67% had parents with middle- to high-level professional or managerial positions.

### ***Instrument***

Data were collected with a questionnaire that incorporated the following measures of a subject's attitude toward, and engagement in, physical activity.

### ***Exercise Stages of Change***

Following Marcus and Simkin (1994), five TTM "stages of change" were specified. Of these, the Precontemplation stage was defined as "has not attempted to exercise within the past 6 months"; the Contemplation stage was defined as "will attempt to exercise within 6 months"; the Preparation stage was defined as "is exercising

occasionally but not regularly”; the Action stage was defined as “has been regularly exercising for less than 6 months”; and the Maintenance stage was defined as “has been regularly exercising for at least 6 months.” In our study the test–retest reliability for this measure (2-week Kappa index) was .88.

#### *Amount of Physical Activity*

The amount of physical activity was measured via metabolic equivalents (METs), estimated in terms of weekly frequency of exercise at different levels of intensity. Participants were asked in the questionnaire to recall the frequency of each kind of exercise, in order to calculate the metabolic equivalents. The test–retest reliability was .80 in our study, and it was consistent for light, moderate, and vigorous activities.

#### *Exercise-Related Self-Efficacy Questionnaire*

A 5-item scale, with measures participants’ confidence in their ability to keep exercising in various situations, was used (Liu & Huang, 1999). Cronbach’s  $\alpha$  for interitem reliability was .90, and for test–retest reliability it was .88.

#### *Decisional Balance (pros and Cons)*

A decisional balance scale (pros and cons; Marcus, Rakowski, & Rossi, 1992) was used. This scale was further modified by Wu and Pender (2002), who applied it to a Taiwanese adolescent sample. The 16-item scale had Cronbach’s  $\alpha = .93$  and  $.84$ , respectively, for the *pros* and *cons* subscales.

#### *Exercise Knowledge*

Eight items were included in this scale. The difficulty level, that is, the percentage of the subjects who answered the item correctly, for all items ranged from .2 to .8, and the Discriminate Index was above .25.

#### *Process Measures*

Website Satisfaction and Website Use Frequency measures were used. The 5-point Likert-type Website Satisfaction Scale employed three levels of satisfaction: General Satisfaction (8 items, Cronbach’s  $\alpha = .91$ ), Structural Satisfaction (6 items, Cronbach’s  $\alpha = .80$ ), and Content Satisfaction (6 items, Cronbach’s  $\alpha = .85$ ). The Website Use Frequency measure, which also employed a 5-point Likert Scale, asked about the frequency of students’ general website use, and also inquired about the frequency of their use of each of seven website strategies. All were one-item questions.

#### *Demographic Data*

Data were gathered on the students’ ages and academic majors and parents’ levels of education and occupations.

#### *Intervention*

The aim of the intervention was to promote physical activity among female college students. All first-year female students who attended a nursing class for 2 hours a week were offered the opportunity to participate ( $n = 149$ ) and 98% ( $n = 146$ ) participated. Students were divided into three groups, with one Nursing teacher in charge of all three, and were subjected to different teaching methods: these were labeled the stage-matched group, the generic group, and the control group. The

stage-matched group members were given messages via the Internet based on their current stage-of-change. In this project, Marcus and Simkin's five stages were condensed into three levels: Level 1 was the Precontemplation stage; Level 2 included the Contemplation and Preparation stages; and Level 3 included the Action and Maintenance stages. The researchers combined the contemplation and preparation stages because of the small sample size available for each stage. Before implementing the program, we conducted statistical analysis with the needs assessment data ( $n = 600$ ) and found that in terms of the process of change variable, the three groups—precontemplation, contemplation and preparation, action and maintenance—were clearly distinguished from each other. The contemplation and preparation groups as well as the action and maintenance groups, however, were not significantly different from each other. Others have used this categorization as well (Noia, Schinke, Prochaska, & Contento, 2006).

The materials were developed based on the process of change described by Prochaska, Redding, and Evers (2003). All three groups received a message about knowledge and skills related to physical activity and health-related fitness, as well as prevention and treatment of sports injuries using different methods. The control group received only a lecture; the stage-matched and generic groups received web-based intervention messages that used a virtual house containing graphics, pictures, and games to illustrate the subjects mentioned above. The latter two groups then self-navigated through the web.

The difference between the stage-matched and generic groups was that in the former, the 10 variables, that is, consciousness raising, dramatic relief, self-reevaluation, environmental reevaluation, self-liberation, helping relationships, counter-conditioning, contingency management, stimulus control, and social liberation, which facilitated the change of stage (Prochaska, Redding, & Evers, 2002), were integrated into the design to foster exercise behavior. For example, there were stage-matched stories for different groups on the billboard in the "living room." There was also a telephone set to hide the "chat-room," to which only the Level-3 group was able to obtain access as a way of getting a "helping relationship." The subjects in the stage-matched and generic groups were assigned names and passwords so that they could log into their own websites. The subjects of the stage-matched group could surf through all the materials suitable to their stage of exercise as well as the non-stage-matched materials. On the generic group's website, the stage-matched parts were not moveable when subjects "hit" the pictures, but they could surf through all the non-stage-matched materials, such as the homepage (living room) and other rooms containing knowledge and skills related to physical activity and health-related fitness, as well as prevention and treatment of sports injuries. The contents of the Exercise-Girl website are described in more detail in the next section.

### *Physical Activity Website*

The various scenes on the website took place in the virtual space of a three-floor girl's dormitory named Exercise Girl (or "Exercise House" in Chinese). This design was based on the results of a needs-assessment study, which included a series of six focus groups (Huang, Hung, Liu, & Li, 2005) and a large-scale survey ( $n = 600$ ; Huang, Hung, Liu, & Li, 2006). Six college students were invited to develop the preliminary website contents under the supervision of two health educators. This preliminary website then was modified, based on the results of an end-user pretest (15 female college students) and a review by experts (two professors in sports psychology

and two professors in exercise physiology). In order to prevent intervention contamination, students involved in development and pretesting did not participate in this study. They provided feedback on the contents, adding more illustrative animations for the movement, modifying the fitness level criteria for adolescents, adding more items (e.g., a food-exchange table) using calorie counts, and improving the layout quality. Some modifications were made, such as adding more animation, adding more food items that fit the lifestyle of the youthful females, simplifying the contents regarding physical activity and fitness, and enlarging the font size.

The Exercise Girl website is a virtual dormitory. The contents are displayed in Table 1, and the layout in Figures 1–3. Students in the stage-matched and generic groups were allowed to log onto the living room with predetermined identification numbers and passwords, and then to enter the five virtual rooms: the Limber Room, Cardiovascular Room, Muscle Strength and Endurance Room, Personal Room, and Kitchen. Seven strategies were applied in this website: learning (knowledge), exercise illustration, reference website linkage, learn-by-playing games, celebrity announcements, billboards, and individualized interactive activities. Students could practice stretching and aerobic exercises with illustrated animations and figures with legends, and they could engage in individualized interactive activities, including calorie expenditure/intake calculation and recording.

For the subjects in the stage-matched group there were three ways of delivering stage-matched messages through the system-directed mechanism mentioned in the intervention section. The first was a poster in the living room showing different stories based on the subject's exercise stage when she "hit" the poster. Only the message appropriate to her level of readiness based on the pretest would be shown to her. The second was the Personal Room: subjects on Level 1, Precontemplation, had a question and answer section in order to learn more; girls on Level 2, Contemplation and Preparation, were asked to sign an exercise contract; girls on Level 3, Action and Maintenance, were able to change or add to the room accessories, such as wallpaper, posters of movie stars, bed sheets, sofas, and even dolls, by earning points gained by doing physical activities. The Personal Room on Level 3 was equipped with a telephone for getting a "helping relationship." Through this, the subject could enter the chat room to talk with friends, establish good relationships, and receive helpful advice. Based on the needs assessment, the entire virtual dormitory was painted in soft colors, and the interior design resembled a female college student's room. Five new rooms were opened every 2 weeks, so that students would not get bored.

### ***Intervention Process and Data Collection***

Data were collected at the baseline (September 2004) and immediately postintervention (November 2004). To assess longer-term effects of the program, follow-up data collection was completed 5 months postintervention (April 2005). The nursing teacher who was in charge of the three classes incorporated the intervention components into the nursing curriculum; therefore, all students who were in an intervention class—except for those in the control group—received the computerized program. The system would notify subjects to browse the website in case they had not logged on for more than one week. The nursing teacher also would remind the students. One hundred thirty subjects (88.4% of the eligible) were included in the final analysis, which compared the results among three different groups. Twelve students were lost

**Table 1.** Summary of the “Exercise Girl” website

Variables	Scenario of website	Components	TTM stage-matched messages
<b>Self-efficacy</b>	<b>Doorway</b>	Log in entrance Billboards Learn-by-playing games	
	<b>Living room</b>	Newspaper with celebrity announcement of personal experience with exercise	
<b>Decisional balance</b>	<b>Living room</b>	Handbook on advantages of exercise and sports injuries	
<b>Process of change</b>	<b>Living room</b>	Billboard with stories	Tailored stories Stage 1: consciousness raising, dramatic relief, environment reevaluation, and self-reevaluation Stage 2: social liberation Stage 3: helping relationships, reinforcement management, stimulation control
<b>Knowledge of fitness</b>	<b>Limber Room, Cardiovascular Room, Muscle Strength and Endurance Room</b>	Definition of fitness Exercise training (animation and picture illustration) Self-assessment of knowledge level Reference website linkage	The strength training illustration varies with stages
<b>Knowledge of exercise skill</b>	<b>Kitchen</b>	Food and body weight control (including calculation of body mass index), Easy cookbook, Daily dietary plan Energy consumption table	

(Continued)

**Table 1.** Continued

Variables	Scenario of website	Components	TTM stage-matched messages
<b>Process of change</b>	<b>Personal room</b>	Personal interaction activities: Exercise plan, Calculating energy acquisition and consumption, Calculating calorie consumption, Online diary	Stage 1: knowledge Q&A Stage 2: exercise contract Stage 3: earn exercise points to exchange virtual room accessories
<b>Helping relationships</b>	<b>Chat-room</b>	Internet chatroom	chatroom was accessible only in level 3 of the stage-matched group

Stage 1: precontemplation stage; Stage 2: contemplation and preparation stage; Stage 3: action and maintenance stage.

to follow-up in the post-test and delayed post-test stages, and another four students had missing values for important dependent variables.

### *Statistical Analysis*

Descriptive statistics (frequencies and means) were used to describe demographic characteristics (age, parents' occupation and education level) and amount of physical activity at baseline, immediately post-test, and delayed post-test. An ordinal variable was used for the exercise stage (dependent variable). Chi-square analysis and an *F* test were used to identify baseline differences among the two intervention and



**Figure 1.** Exercise Girl (Exercise House) website.

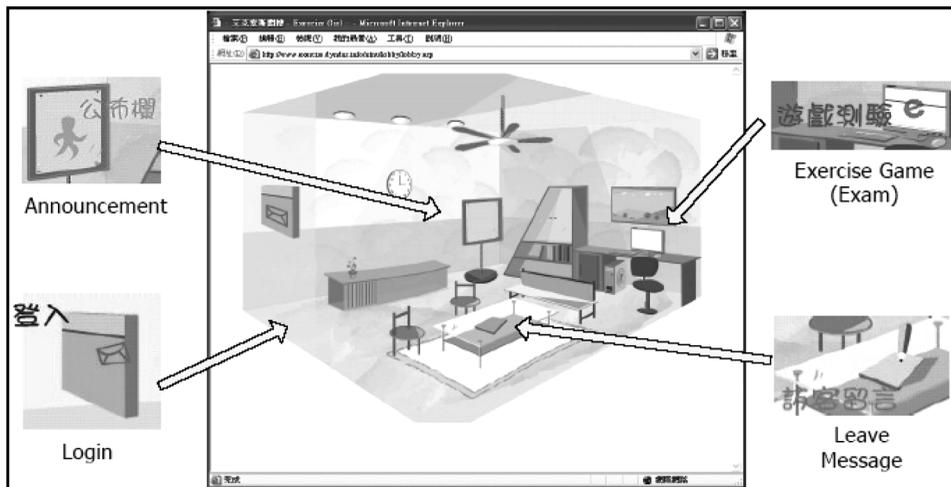


Figure 2. Lobby.

control groups. To identify differences in physical activity level and psychological determinants at immediate and delayed post-test, analysis of covariance (ANCOVA) and repeated measures of ANOVA were used.

## Results

### *Baseline Characteristics of the Respondents*

In total, the researchers analyzed data for 130 students: 45 in the stage-matched group, 42 in the generic group, and 43 in the control group. There was no significant

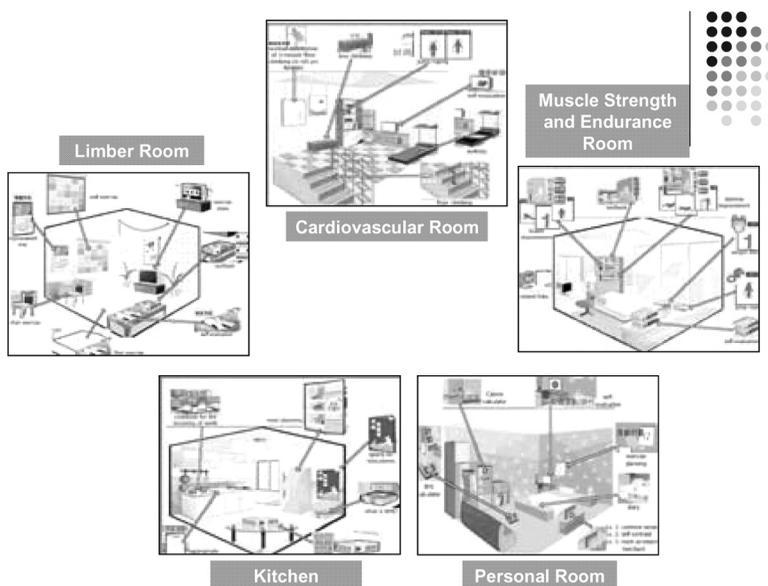


Figure 3. Five physical fitness rooms.

difference with regard to the sociodemographic variables and the amount of physical activity for all the groups at pretest ( $F(2,127) = 2.06, p = 1.32$ ). Also, there were no significant differences, with regard to sociodemographic variables, between those students who remained in the study and those who dropped out. (For parents' education,  $\chi^2(2, N = 130) = 5.32, p = .88$ ; for social status,  $\chi^2(2, N = 130) = 10.74, p = 1.26$ .)

### ***Program Participation and Process Evaluation***

The use frequency of the website was 24.2 minutes per week for subjects in two intervention groups; there was no significant difference between the stage-matched group (Mean = 22.1, *S.D.* = 2.3) and the generic group (Mean = 26.4, *S.D.* = 3.6), ( $F(1,86) = .795, p = .375$ ) with regard to use frequency. Furthermore, there was no significant difference between use frequency and subjects' "stage of exercise" ( $F(2,127) = 1.34, p = .29$ ). Students' feedback was collected through open-ended questionnaires. Students gave their opinions regarding the advantages and disadvantages of the website. The advantages were analyzed in terms of design, content, and the e-learning process. As for design, most students regarded the website as an exciting and creative educational strategy. They considered the alluring animations, clear illustrations, and interesting games to be attractive, helpful, and close to their own lives. Some students also expressed their appreciation of the virtual room, which clearly appealed to young women (girls) and made their web-surfing more "comfortable." The contents of the exercise illustrations and celebrity announcements also were thought to be useful and persuasive. As for the e-learning process, students liked going on this new health education "channel" because it was more convenient and interesting than previous methods and techniques they had used. Students' barriers to website use could be categorized as either personal—such as being busy or forgetful—or impersonal—such as having difficulty going on the website because of inconvenience or software/hardware inadequacies.

## **Impacts**

### ***Stage of Change***

The subjects included in the data analysis were those who had filled out all the questionnaires in the pretest and the immediate and delayed post-tests. About 23% of the total were at the stages of action or maintenance at pretest, that is, they already were regular exercisers. At baseline, the control group had more subjects (41%) at these two stages as compared with the other two groups (stage-matched group = 22%; generic group = 19%), a difference that reached a significant level ( $\chi^2(2, N = 146) = 12.78, p = .02$ ). The stage-matched group made the most significant improvement at both immediate and delayed post-test, followed by the generic group. Friedman's two-factor ordinal ANCOVA was used to explore the changes within groups. Three sequential measures of the stage-matched group showed significant positive change (pretest = 1.77, immediate post-test = 2.00, delayed post-test = 2.23,  $\chi^2(2, N = 45) = 12.78, p = .002$ ). The differences between pretest and immediate post-tests, immediate and delayed post-tests, and pretest and delayed post-tests were significant for this group. The same three sequential measures of the generic group did not yield such significant differences, although there was still an upward trend ( $\chi^2(2, N = 42) = 3.89, p = .14$ ). For the control group, there was a significant negative change

over the course of the same three measures ( $\chi^2 (2, N=43) = 10.84, p = .004$ ), and the post-test results significantly lagged behind those of the pretest. The results are summarized in Table 2.

**Amount of Physical Activity**

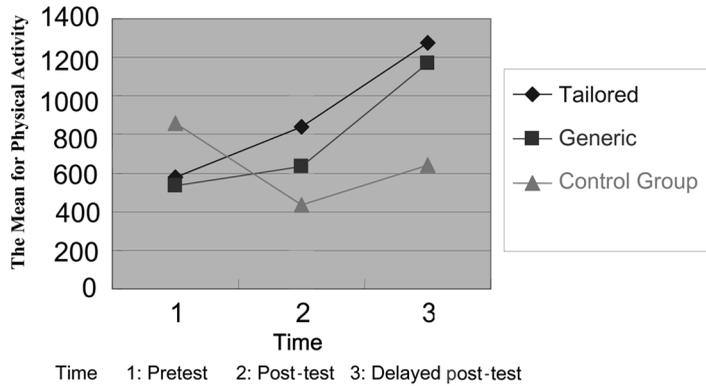
At post-test and delayed post-test, students from the stage-matched and generic groups were more active than they had been at baseline. On the other hand, for those in the control group the amount of physical activity decreased in the post-test but increased again in the delayed post-test, though it was still lower than its pretest level as shown in Figure 4. For all three groups, using ANCOVA and the pretest

**Table 2.** Descriptive data for the physical activity stage of three groups and Friedman two-way analysis of Variance by ranks

	Frequency/group				Chi-square/ F test
	Stage- matched	Generic	On-campus control	Total	
Pretest	<i>n</i> = 50	<i>n</i> = 48	<i>n</i> = 48	146	
Precontemplation/ Contemplation/ Preparation	39	39	28	106	$\chi^2 = 7.62$ <i>p</i> = .02*
Action/Maintenance	11	9	20	40	
Posttest	<i>n</i> = 48	<i>n</i> = 43	<i>n</i> = 46	137	
Precontemplation/ Contemplation/ Preparation	29	32	37	98	$\chi^2 = 4.47$ <i>p</i> = .11
Action/Maintenance	19	11	9	39	
Delayed posttest	<i>n</i> = 45	<i>n</i> = 42	<i>n</i> = 43	130	
Precontemplation/ Contemplation/ Preparation	23	24	27	74	$\chi^2 = 1.14$ <i>p</i> = .57
Action/Maintenance	22	18	16	56	
Friedman rank test					
a. pretest	1.77	1.88	2.16	1.84	<i>F</i> = .42 n.s.
b. post-test	2.00	1.98	1.75	1.99	<i>F</i> = .97 n.s.
c. delayed post-test	2.23	2.13	2.09	2.17	<i>F</i> = .61 n.s.
$\chi^2$	<b>12.78</b>	<b>3.89</b>	<b>10.84</b>	<b>12.25</b>	
<i>P</i> value	.002*	.14	.004***	.00***	
	c > a, b > a, c > b	n.s.	a > b	a > b, a > c, b > c	

**a: pretest, b: post-test, c: delayed post-test.**

\**p* < .05; \*\**p* < .01; \*\*\**p* < .001.



**Figure 4.** The distribution of physical activities for three groups of female students.

as a covariate, the amount of physical activity as measured at post-test reached a significant level. The effect size was .155, however, which is small according to Cohen (1988). The post-hoc analysis showed that, once again, both the stage-matched and generic groups showed a higher level of physical activity than the control group. Thus it was concluded that students who received web-based messages, whether stage-matched or non-stage-matched, exercised more than those who did not receive them. The repeated ANOVA analysis showed that there was no significant difference among the post-test results of all three groups ( $F(2, 127) = 1.86, p = .30$ ). Further analysis of the between-measures difference for each group, using ANOVA, revealed that for the stage-matched group the immediate post-test results were higher than those for the pretest, and that the delayed post-test results were higher than those for the immediate post-test. The same was true for the generic group. On the other hand, for the control group the pretest results were higher than those for the immediate post-test. These differences all reached a statistical significance level. The results are shown in Table 3.

### *Psychological Determinants*

Table 3 describes the effects of the program on psychological determinants of behavior. Overall, few effects on the determinants of physical activity were found. After the 8-week intervention, a significantly higher level of exercise self-efficacy was found in the stage-matched group than in the generic and control groups. The effect size was .041, which is small according to Cohen (1988). There was no significant difference, however, among groups regarding the results of the delayed post-test.

A “power analysis” summary of the statistical tests performed is included in Table 3. The amount of physical activity and exercise self-efficacy reached powers as high as .99 and .65, respectively. Other values were too small to detect the difference.

### **Discussion**

This group-randomized trial of a web-based, stage-matched, targeted-message-based health communication program was successful in promoting physical activity among

**Table 3.** ANCOVA statistics & repeated measure statistics for physical activity, knowledge, decisional balance and self-efficacy of 3 groups in immediate posttest & pretest

	a. Stage-matched (n = 45)	b. Generic (n = 42)	c. control (n = 43)	ANCOVA F test	Repeated measurement F test
Physical activity					
1. pretest	578.27 (562.42)	840.96 (745.95)	1274.26 (850.21)	F = 11.67 P = .000*** a > c, b > c	F(group) = 1.86 P = .162
2. post-test	540.06 (826.83)	634.84 (575.87)	1172.33 (661.62)	Effect Size = .155	Power = .38
3. delayed post-test	920.10 (1092.88)	442.72 (491.16)	669.17 (672.46)	Power = .99	
	2 > 1, 3 > 2				
Knowledge of fitness					
1. pretest	12.90 (1.33)	12.94 (1.49)	13.00 (1.41)	F = 1.33 P = .27	F (group) = .32 P = .73
2. post-test	12.83 (1.63)	13.23 (1.48)	13.11 (1.72)	Power = .30	Power = .11
3. delayed post-test	13.02 (1.45)	13.09 (1.55)	12.26 (2.02)	F = .47 P = .63	F (group) = .74 P = .48
Benefit of exercise				Power = .19	Power = .01
1. pretest	42.36 (5.47)	42.10 (6.95)	42.04 (6.99)	F = 1.51 P = .23	F (group) = .124 P = .884
2. post-test	40.96 (6.85)	40.22 (8.19)	41.48 (7.06)	Power = .02	Power = .23
3. delayed post-test	41.43 (5.88)	40.47 (5.75)	41.36 (5.52)	F = 5.06 P = .02*	F (group) = .04 P = .97
Barriers to exercise				a > c Effect size = .041	Power = .00
1. pretest	47.45 (9.71)	47.82 (8.57)	48.00 (9.33)	Power = .65	
2. post-test	46.85 (11.09)	45.06 (10.00)	46.72 (9.90)		
3. delayed post-test	45.02 (9.85)	46.53 (10.74)	50.48 (10.28)		
Self-efficacy					
1. pretest	41.76 (12.94)	42.04 (13.71)	46.47 (12.27)		
2. post-test	42.70 (11.29)	40.43 (11.31)	45.46 (9.39)		
3. delayed post-test	43.02 (12.35)	40.55 (11.74)	4189 (11.85)		

group: a. stage-matched, b. Generic, c. Control.

Test: 1 = pretest, 2 = post-test, 3 = delayed post-test.

\*p &lt; .05; \*\*p &lt; .01; \*\*\*p &lt; .001.

female college freshmen. The researchers have therefore concluded that this approach should become more widely used in university-level health education, specifically for the purpose of promoting physical activity for young women. Findings are particularly relevant to the case of Taiwan, where increasing the level of females' and children's daily physical activity is one of the major goals of public and school health education. This study suggests that the Internet can be an effective tool for improving or at least maintaining the physical activity level of young females.

### ***Strong Points and Possible Limitations of This Research Project***

This is the first reported study using the Internet as an exercise-promoting tool for young Asian women outside the United States from where e-health is initiated, and overall the program was very appealing to the subjects. Other unique aspects of the study included a user-involved design process, the assessment of psychological changes, and the potential physical-activity mediators that were used to determine "stage of exercise." The results of this study show the importance of the initial theoretical constructs and the need for theory-based interventions to increase or maintain the level of subjects' physical activity and suggest the need for continually modifying and updating such theoretical constructs.

The results indicated that the project was effective in enhancing subjects' exercise self-efficacy at immediate post-test, although these effects did not persist at delayed post-test. A booster may have been needed to maintain the initial level of these positive effects. The process evaluation indicated that the involvement of the target group in the website design process was one of the reasons for the initial effectiveness of this program.

There might be two reasons for no significant differences between the stage-matched and generic groups: (1) The materials were not sufficiently tailored to meet individuals' needs as they were targeted only toward different stages. Thus some information that could have been especially important to particular individuals was not sufficiently emphasized. (2) The subjects in the stage-matched group did not surf through all the websites as they were supposed to do. It is impossible to verify this eventuality, as website browsing was not monitored.

Other limitations included possible measurement error from self-reports, relatively small sample size, imperfect randomization, and soft/hardware problems. Students self-reported physical activity; they were asked to recall and categorize their types of physical activity as vigorous, moderate, or mild, based on given criteria. This method was vulnerable to memory bias, desirability bias, and difficulties with comprehension; however, the instruments had acceptable validity and reliability. Second, the subjects were not randomized at the individualized level but self-selected into class time slots. Baseline data indicated there was no difference in their family backgrounds and degree of physical activity across groups; however, it is possible that the intervention and control group classes differed in unknown ways. Third, the statistical analysis may have been insensitive to changes in behavioral determinants and to intergroup differences in terms of psychological variables, since there were only around 50 subjects in each group. This may explain the small effect size. Finally, the students might have been unable to gain access to the Internet because of equipment deficiencies and difficulties in logging on, and this would have affected implementation integrity and had an impact on intervention results.

### **Implications for Future Study**

Future studies can incorporate some modifications: Enlarging the sample size, adding booster sections, and, as suggested by the Socioecological Model (Sallis & Owen, 2002), adding more environmental factors to the model could increase understanding of the applicability of this research in the real world.

Most importantly, our results showed no significant differences, with regard to physical activity, between the stage-matched and generic groups. The implication for future Internet-based communications may be that individually tailored messages could be more effective than group-targeted ones. It seems likely that, with targeting, some important information that is unique to each individual may not be addressed. On the other hand, we do not know whether tailoring the messages actually would be more effective in promoting a specific behavior such as physical activity. A tailored message could be developed and tested for the same target groups, in order to find out the effectiveness of tailored versus targeted messages. Designing and developing tailored materials is expensive, due to the algorithms and the number of messages that need to be created; therefore, we need research that explores different degrees and dimensions of tailoring in order to find the optimal degree of audience segmentation—with regard to both cost effectiveness and the effective promotion of physical activity, or of any other health-enhancing behavior.

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