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Effect of web-based and software-based educational intervention on stages of behavior change of students' physical activity

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Abstract:

INTRODUCTION: The present study aims at designing and evaluating the effect of new educational media-based educational intervention on students' stages of behavior change of physical activity.

SUBJECTS AND METHODS: In the present interventional study, 225 students of medical sciences university were assigned into two experimental and one control groups using proportional stratified random sampling, where web-based and software-based educational interventions were used. Data were collected using International Physical Activity Questionnaire, Marcus's stages of change scales, and a self-made questionnaire including constructs of barriers, benefits, and self-efficacy. Evaluation was conducted through pretest and posttest and immediate and 2 and 6 months of follow-ups after the intervention. Data were analyzed by SPSS software using descriptive statistics and Chi-square, Friedman, one-way ANOVA, and ANOVA with repeated measure.

RESULTS: Based on the results, there was no significant difference between the experimental and control groups before the intervention ($P = 0.37$); however, immediately and 2 and 6 months after the intervention, there was a significant difference between the experimental and control groups in terms of stages of change ($P < 0.001$). Furthermore, in the experimental group, the educational intervention led to improvement of individuals in the stages of change of physical activity. At 6-month follow-up, 75.4% of the software group and 60.6% of the web group achieved the maintenance stage.

CONCLUSION: The results suggest that designing intervention based on people's level of preparation for changing behavior and using new educational methods such as web and software were effective on individuals' progress in different stages of change of physical activity behavior and physical activity rate.

Keywords:

Physical activity, software, stages of change model, web

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Introduction

The absence of regular physical activity is a current concern of the WHO.[1] Despite well-known short-term and long-term benefits of physical activity in the prevention and treatment of a variety of diseases, including cardiovascular disease, hypertension, stroke, diabetes type II, obesity, metabolic syndrome, types of breast cancer, osteoporosis, depression, and anxiety,[2] the rate of people's participation in regular physical activity is decreasing.[3] As mentioned in various studies, the student period is one of the life courses in which the physical activity may decrease.[4,5] According to the findings of experts in Iran, only 10% of students have sufficient physical activity, which seems to be a low figure compared to a country like Australia

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with 52% participation.[6] Dąbrowska-Galas *et al*.'s study indicated that students at medical university are a large group who do not conduct the recommended level of physical activity despite being aware of its benefits.[7] In addition, new statistics on students show that this group is exposed to chronic illnesses, which contradicts past assumptions that students are at the peak of their health.[8] Regular physical activity is a behavior not performed automatically or by habit and requires planning and choosing a proper training method and model. Behavior change patterns can contribute to understand the nature of health behaviors and suggest ways to achieve behavioral change.[9] The transtheoretical model is one of the most widely used models for planning physical activity related to educational interventions.[10] The most important constructs of this model include stages of change, decision-making balance, and self-efficacy. Self-efficacy expresses one's beliefs or judgments to his/her ability to perform regular physical activity. The decision-making balance emphasizes the individual's assessment of the benefits and obstacles of behavior change, which is an important issue for progress in the behavior change process.[11] The stages of change model not only provides a way to conceptualize behavior change but also provides a basis for assessing individuals' preparedness for change in five stages (precontemplation, contemplation, preparation, action, and maintenance) for intervention and planning, and it is based on the assumption that behavior change is a gradual process that is divided into different parts and the people go through these stages for change. Therefore, becoming aware of the situation where the person is in can be helpful in designing appropriate intervention processes with the desired stage.[10] Despite differences in the method and goals and outcomes of each educational intervention, using educational media is common in all of the above, which is an indispensable and inevitable part of the education process without which the transfer of information, attitudes, and skills development and behavioral abilities are impossible.[12] Based on the studies, computer- and internet-based physical activity interventions are the promising and attractive ways to promote physical activity in the community.[13] In addition to providing easy access, it allows for higher quality tutorials and enhances students' control over the content, time, and place of learning and helps them acquire knowledge and skills faster than traditional instructor-centered approaches.[14] The study results of Foster *et al*. in individuals over 16 years[2] and Lu *et al*. among students[15] showed positive evidence to support the effects of distance and web interventions to promote physical activity.

Despite previous training programs implemented in this regard and disturbing statistics of physical activity among students,[1] paying attention to new approaches to explain the physical activity behavior in this significant class of society becomes more evident. It seems necessary to use new educational methods and evaluate their effectiveness on promoting this issue.[3,16] However, there are few studies on designing and evaluating the effectiveness of new media-based interventions on health promotion programs. Therefore, this study was done to compare two media-based interventions in terms of select best media to transfer physical activity information to university students. The study results will help educators to choose the best method and the most appropriate educational media in this target group, considering the factors influencing physical activity and new educational methods.

Subjects and Methods

This is a quasi-experimental study with randomized control group. The study population composed of students of Isfahan University of Medical Sciences who, based on the stages of change model, are at precontemplation, contemplation, and preparation stages. They were willing to participate in the study and had no adverse physical or psychological conditions that would limit participation in the project. The study exclusion criteria included unwillingness to continue participation in each of the stages of study and physical and mental problems during the study. To determine the sample size in each study group with a significance level of 5%, a statistical power of 80%, and a standardized effect size of at least $\Delta = 0.5$, 62 individuals per group were considered, and finally, 75 individuals were considered with a drop probability of 20%. The individuals were selected by stratified random sampling based on volume and allocation in the intervention groups using the Volume 3 randomized block allocation approach with stratified randomization. Each faculty was considered as a class, and according to the number of its students, the sample was randomly selected from the list provided by the researcher, in a systematic way, so that in each faculty, the number of selected students was equal. They were divided into intervention and control groups using systematic random sampling at 3:1 ratio. A four-part questionnaire was used to collect the data. The first part examined the background information (age, gender, marital status, residence, etc.). The second part measured physical activity using the short version of the Persian version of the International Physical Activity Questionnaire, whose validity and reliability have been confirmed in Iran.[17] This questionnaire measures the level of physical activity in the past 7 days, and according to the final score, it is classified into three groups: weak, moderate, and severe.[17] In the third part of the questionnaire, Marcus change stage questionnaire was used to determine the study inclusion criteria. The scale consisted of a five-option question that the individual

chose only one option according to the physical activity conditions and was placed in one of the five stages of prethinking, thinking, readiness, action, and maintenance. The reliability and validity of this tool have been confirmed in other studies in Iran.[18] The fourth part was a self-administered questionnaire consisting of eight questions of perceived benefits (example: having regular physical activity result in better sleep), seven questions of perceived barriers (example: club cost is an important impediment in terms of doing physical activity), and eight questions of self-efficacy (example: I have the ability to engage in regular physical activity even when I am tired). Its validity and reliability were investigated and confirmed. The formal validity was assessed by 12 experts in the field of health promotion, and the necessary corrections were made based on their views. The content validity was assessed using quantitative methods, and content-validity ratio and content-validity index for items were evaluated using the opinions of 15 experts. Reliability of the instrument was assessed using the internal consistency method, in which the Cronbach's alpha for benefits was obtained 0.94, for barriers 0.96, and for self-efficacy 0.96.

The external reliability was assessed using intra-cluster correlation indices. The questionnaire was completed by 30 students at two stages with a 2-week interval, and then, intraclass correlation coefficient index was assessed for each construct that was acceptable (perceived benefits: 0.95, perceived barriers: 0.97, and self-efficacy: 0.97). Questions were answered in a five-point Likert scale, ranging from strongly agree to strongly disagree.

Content and media design

The program was named "health to infinity," and based on the fitted model, effective predictors of physical activity behavior and stage, meeting lesson plans, general and specific goals, strategies, and training activities were identified for each session. For the practical part, the desired exercises were first selected; during the sessions attended by physical activity and exercise physiology experts, the exercises were assessed to be appropriate for the target group; and after final modification and confirmation, filming began and more than 120 videos were prepared in this field. The level of exercise was adjusted so that it gradually increased throughout the program from 10 min to ½ h at the end of the program. The written text, related images, appropriate music, and videos were used in this training program. The program was designed for 4–5 weeks. This program was produced as a DVD and the content was used to design the blog. Content design and educational intervention in this study were based on the stages of change model. Based on this model, the time when people are ready for change can be understood and taking it into account, interventions for all individuals and without audience segmentation will not yield the desired results.[10] Thus, at the beginning of the program, according to Marcus questionnaire, the stage in which the individual is placed (prethinking, thinking, and readiness) is determined, and accordingly, each person will receive a training program tailored to it. The importance of self-efficacy and its enhancement through various strategies, including breaking down complex behavior into small, practical and feasible stages, modeling, and self-rewarding, were among other things highlighted in this program.

In terms of understanding, matching, and appropriateness to the target group and the attractiveness and applicability of the content, the prepared program was examined by five health education experts, physiologists, and two computer and programming experts, and their corrective comments were applied. The program was then shown to 15 persons in the target groups (students) and their comments were also applied.

Educational intervention

In this study, there were two intervention groups (one software group and one web group) and one control group that did not receive any intervention. In both intervention groups, in the first in-person session, training was provided regarding the program. In the web group, all students were asked to visit the blog at least once a day in the next month. In addition, SMS and e-mail were used to inform and introduce the blog. During the intervention, the blog was continuously reviewed and weekly educational content was added to it. In the software group, according to the planned program, the educational content was provided to the subjects for 1 month. In both groups, after the program presentation, several activities were planned for the students, which were recorded in a printed booklet. During the course, the participants were able to ask questions from the research team about the program. It was possible to use E-mail to answer questions and problems that students might have. The evaluation was done by pretest and posttest, and follow-up was performed immediately and 2 and 6 months after the intervention.

Statistical analysis

Data were analyzed by SPSS (SPSS Inc., Chicago, Illinois, USA, Ver 20).[16] Numerical variables were reported as mean and standard deviation while non-numerical variables were reported as frequency and percentage. Chi-square and Kruskal–Wallis tests were used to compare the qualitative variables in the study groups, and one-way ANOVA was used to compare the three groups. ANOVA with repeated measure was used to assess the mean of physical activity.

Ethical consideration

This study was approved via the Ethics Committee of Isfahan University of Medical Sciences (approval code:

IR.MUI.REC.1396.3.578). After explaining the goals of the study, participants completed written consent form. The participants were informed about confidentiality of information.

Results

The study participants included 225 students. The mean age of the participants was 23.96 ± 4.94 years, and the minimum and maximum age was 18 and 38 years, respectively. The demographic information of the participants is presented in Table 1. Before the intervention, no significant difference was observed in the intervention and control groups in terms of underlying factors such as age, gender, education, and family economic status ($P > 0.05$).[Table 1]

Chi-square test indicated that the experimental and control groups did not differ significantly before the intervention in terms of stages of change ($P = 0.37$), but this difference was significant immediately and 2 and 6 months after the intervention ($P < 0.001$). Using the Kruskal–Wallis test, the three experimental and control groups were compared in each of the four time periods with a significant difference ($P < 0.001$). The distribution of individuals in the stages of physical activity change was such that immediately after intervention, none of the students were in the precontemplation stage and 47.8% of the students in the software group and 33.3% in the web group had reached the action stage; further, 6 months after the intervention, 75.4% of the students in the software group and 60.6% in the web group were in the maintenance stage [Table 2].

The relationship between the stages of change in physical activity with the constructs of perceived benefits, barriers, and self-efficacy before and after the intervention in the experimental and control groups is presented in Table 3.

Chi-square test indicated that there was no significant difference in terms of stages of change between the experimental group with the software and the experimental group with the web before the intervention ($P = 0.528$). However, immediately after the intervention ($P = 0.048$), and 2 months later ($P = 0.017$), there was a significant difference between the two groups, which was no longer significant 6 months after the intervention ($P = 0.257$). Using generalized estimating equations statistical method, the changes of different stages of change in different time periods of web and software groups were separately compared with control group, indicating a significant difference between software and web groups, and showed that individuals in software group had a better advancement at different stages of change than the web group ($B = 0.26$ standard deviation [SD] =0.115, $P = 0.025$). The comparison of software and control groups ($P < 0.001$, $B = 1.72$, SD = 0.119) and comparison of web and control groups also showed a significant difference ($P < 0.001$, $B = 1.46$, SD = 0.131), indicating the effectivity of both types of intervention in this study.

The results of this study indicated that 97% and 97.1% of the students had poor physical activity in the web and software groups before the intervention, which decreased to 48.5% and 27.5% immediately after the intervention, respectively. According to the results fully presented in Table 4, 6 months after

Table 1: Frequency distribution of demographic characteristics in the groups

Demographic variables	Software, *n* (%)	Web, *n* (%)	Control, *n* (%)	Total, *n* (%)	*P**
Gender					
Male	37 (53.6)	41 (62.1)	37 (52.1)	115 (55.8)	0.451
Female	32 (46.4)	25 (37.9)	34 (47.9)	91 (44.2)	
Marital status					
Married	26 (38.2)	26 (40)	31 (43.7)	83 (40.7)	0.802
Single	42 (61.8)	39 (60)	40 (56.3)	121 (59.3)	
Residence					
Student's dormitory	38 (55.1)	29 (43.9)	30 (42.9)	97 (47.3)	0.546
Student house	9 (13)	8 (12.1)	9 (12.9)	26 (12.7)	
With family	22 (31.9)	29 (43.9)	31 (44.3)	82 (40)	
Education					
Bachelor's degree	34 (49.3)	30 (45.5)	35 (49.3)	99 (48.1)	0.93
Master student	14 (20.3)	14 (21.2)	17 (23.9)	45 (21.8)	
Ph.D. student	21 (30.4)	22 (33.3)	19 (26.8)	62 (30.1)	
Economic situation					
Very well	1 (1.6)	4 (6.2)	1 (1.4)	6 (3)	0.517
Good	18 (28.6)	19 (29.2)	15 (21.1)	52 (26.1)	
Medium	40 (63.5)	38 (58.2)	51 (71.8)	129 (64.8)	
Weak	4 (6.3)	4 (6.2)	4 (5.6)	12 (6)	

*χ^2

Table 2: Frequency distribution of students according stages of change in the groups

Time	Stages of change	Software, *n* (%)	Web, *n* (%)	Control, *n* (%)	*P**
Before education	PC	31 (44.9)	36 (54.5)	44 (62)	0.37
	C	22 (31.9)	18 (27.3)	17 (23.9)	
	PREP	16 (23.2)	12 (18.2)	10 (14.1)	
Immediately after the intervention	PC	0	0	41 (58.6)	<0.001
	C	8 (11.6)	18 (27.3)	17 (24.3)	
	PREP	28 (40.6)	26 (39.7)	12 (17.1)	
	A	33 (47.8)	22 (33.3)	0	
	M	0	0	0	
2 months after intervention	PC	0	0	38 (54.3)	<0.001
	C	5 (7.2)	10 (15.2)	19 (27.1)	
	PREP	2 (2.9)	9 (13.6)	10 (14.3)	
	A	62 (89.9)	47 (71.2)	3 (4.3)	
	M	0	0	0	
6 months after intervention	PC	0	0	35 (50)	<0.001
	C	4 (5.8)	7 (10.6)	19 (27.1)	
	PREP	5 (7.2)	10 (15.2)	10 (14.3)	
	A	8 (11.6)	9 (13.6)	4 (5.7)	
	M	52 (75.4)	40 (60.6)	2 (2.9)	
*P***		<0.001	<0.001	<0.001	

*χ^2, **Kruskal–Wallis. PC=Precontemplation, C=Contemplation, PREP=Preparation, A=Action, M=Maintenance

Table 3: Mean score of perceived benefits, barriers and self-efficacy constructs in different stages of physical activity behavior change

Constructs	Stages of change, mean±SD					*P*
	PC	C	PREP	A	M	
Perceived barriers						
Before education	34.27±2.18	33.52±3.29	33.65±2.9	-	-	0.17
Immediately after the intervention	41.85±17.25	33±24.55	14.96±10.26	8.54±1.59	-	<0.001
6 months after intervention	34.42±0.5	31.93±7.42	21.12±11.1	12.25±5.44	11.35±4.92	
Perceived benefits						
Before education	35.16±4.11	36.84±3.68	35.63±3.67	-	-	0.03
Immediately after the intervention	37.19±3	38.86±1.53	39.12±1.86	39.69±0.76	-	<0.001
6 months after intervention	33.67±3.38	36±2.67	37.8±2.34	39.8±0.4	42.4±11.37	
Self-efficacy						
Before education	9.90±2.17	9.77±1.74	10.18±2.05	-	-	0.6
Immediately after the intervention	10.82±2.25	26.18±12.54	32.81±10.53	38.43±1.91	-	<0.001
6 months after intervention	13.22±1.35	20.46±10.13	27.32±10.94	35.38±6.25	37.25±3.51	

*One-way ANOVA. PC=Precontemplation, C=Contemplation, PREP=Preparation, A=Action, M=Maintenance, SD=Standard deviation

intervention in the web and software groups, 48.5% and 46.4% of the students had moderate physical activity and 36.4% and 47.8% had intense physical activity, respectively. Friedman test showed that the intensity of physical activity was not significantly different before intervention ($P = 0.574$) between experimental and control groups, but immediately and 2 and 6 months after intervention, physical activity score in the intervention groups was significantly different compared to before intervention ($P < 0.001$). The ANOVA with repeated measure showed that there was a significant interactive effect between educational intervention and time, and also, there was a significant difference in the intensity of physical activity in the experimental and control groups before, immediately after, and 2 and 6 months after intervention ($P < 0.001$).

Discussion

Based on the results of this study, web-based and software-based interventions were effective on individuals' progress in various stages of behavior change of physical activity. The present study focused on individuals who based on the pattern of stages of change were at the stages of precontemplation, contemplation, and preparation. According to Procheska and Declamante, people in the precontemplation stage were not doing enough physical activity and were not going to do it for the next 6 months. At the preparation stage, although they do not intend to do so until next month, they assess the benefits and barriers of behavior change and consider the change as feasible, yet valuable, and possibly get prepared for change.[19] Based on the

Table 4: Frequency distribution of physical activity intensity of students in the groups

Physical activity	Groups									*P**
	Software			Web			Control			
	Weak, *n* (%)	Medium, *n* (%)	Intense, *n* (%)	Weak, *n* (%)	Medium, *n* (%)	Intense, *n* (%)	Weak, *n* (%)	Medium, *n* (%)	Intense, *n* (%)	
Before education	67 (97.1)	2 (2.9)	0	64 (97)	2 (3)	0	69 (98.6)	1 (1.4)	0	0.574
Immediately after the intervention	19 (27.5)	42 (60.9)	8 (11.6)	32 (48.5)	13 (19.7)	21 (31.8)	69 (98.6)	1 (1.4)	0	<0.001
2 months after intervention	6 (8.7)	12 (17.4)	51 (56.7)	15 (22.7)	14 (21.2)	37 (56.1)	62 (89.9)	5 (7.2)	2 (2.9)	<0.001
6 months after intervention	4 (5.8)	32 (46.4)	33 (47.8)	10 (15.2)	32 (48.5)	24 (36.4)	61 (88.4)	6 (8.7)	2 (2.9)	<0.001
*P***		<0.001			<0.001			<0.001		

*Friedman, **Repeated measures

results of this study, in experimental groups, educational intervention led to improvement in stages of physical activity and decreased the number of precontemplation and contemplation stages. Since interventions based on the structure of stages of change, reduction of the number of inactive stages (precontemplation, contemplation, and preparation), and increase of the number of people in the action and maintenance stages show the effectiveness of the program, these results indicate a positive effect of this interventions in passing through the early stages of changing and adopting and maintaining physical activity behaviors in the experimental group. Such that in both experimental groups, immediately after the intervention, none of the subjects were in the precontemplation stages and the number of contemplation stages was reduced, and 47.8% of the software group and 33.3% of the web group entered the action stage. However, there were no controls in this group. This result is consistent with the findings of the study by Skaal and Pengpid[20] and Tuah *et al*.[21]

After the intervention in the software group, 46.4% had moderate activity and 47.8% had intense physical activity, and after the intervention in the web group, 48.5% had moderate activity and 36.4% had intense activity. Increased physical activity after intervention in web and software groups in this study confirms the progress of individuals in the action stage and the effectiveness of web-based and software-based interventions on promoting students' physical activity. These results are consistent with the study results of Foster *et al*.[2] and Bell *et al*.[22] In Carroll *et al*.'s study, although an increase was observed in physical activity after the intervention, this difference was not statistically significant.[23]

One of the important structures of the transtheoretical model discussed in this study is decision-making balance that focuses on the importance of positive and negative consequences of behavior change. It is assumed that a person will not change his/her behavior as long as he/she does not understand the benefits of change to assess its disadvantages. Generally, as the stages of change progress, perceived benefits of behavior increase and its barriers decrease, making perceived barriers more important in the precontemplation stage, while perceived benefits are more important in the action and maintenance stages.[24] The mean score of perceived benefits in the intervention groups increased during the process of stages of change and the perceived barriers score decreased, which is reasonable in the context of this model. Content design proportionate to the stages of change focusing on the benefits of physical activity addressed in various studies, including health and fitness,[25] socialization, self-positive feelings,[26] and presenting strategies for overcoming barriers to doing physical activity based on past studies, including cost, working conditions, poor weather, inadequate facilities, time constraints, lack of proper schedule, fatigue from physical activity,[27] and homework,[26] were the factors contributing to the increase of perceived benefits and decrease of perceived barriers in intervention groups which are consistent with the results of similar research.[28,29]

The maintenance stage is the longer period, maintaining the desired behavior change (more than 6 months) and adopting a new lifestyle where there is always a likelihood of a return to the past;[30] therefore, careful planning to maintain the behavior at this stage has become a challenge and requires maintaining high self-efficacy. The results of the present study indicated that self-efficacy in the experimental groups after the intervention increased during the stages of change from precontemplation to action and maintenance, such that it was higher in action and maintenance stages compared to the stages before action. This finding is consistent with the results of Lari *et al*.[29] and Mahdizadeh *et al*.[31] Keeping behavior in the 6-month follow-up of the majority of students confirms the success of this program. In the study conducted by Maher *et al*.,[32] the level of physical activity increased significantly after the intervention, but after 3 months, it was insignificant, which is consistent with our studyThe study also showed that those in the

software group performed better on physical activity than that in the web group. The reason can be easier and faster access to the training program in this group than in the group that needed the Internet to get the program. No study was found that compared these two methods of intervention. Therefore, no comprehensive and reliable comparison is possible between our study results and previous studies in this regard.

Limitation

This is a single-center study that has done only among students of Isfahan University of Medical Sciences. The results may not be generalizable to all university students.

Conclusion

The results of the present study support the positive effect of educational interventions in the framework of the stages of change model and using new educational media on the development of individuals in different stages of behavior change and increasing regular physical activity. Therefore, educational interventions are suggested to promote students' physical activity.

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Conflicts of interest

There are no conflicts of interest.

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