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Web-based intervention on the promotion of physical activity among Iranian youth using the transtheoretical model

Asiyeh Pirzadeh, Fereshteh Zamani, Mehri Khoshali¹, Roya Kelishadi¹

Abstract:

BACKGROUND: Sedentary habits may increase the noncommunicable disease risk factors, and few teens get enough physical activity. Therefore, the current study aimed to examine the effects of a web-based intervention on the promotion of physical activity among adolescents using the transtheoretical model (TTM).

METHODS AND MATERIALS: A quasi-experimental study was conducted on 278 high school students who were randomly allocated into one of the three groups: two web-based intervention groups. The intervention groups 1 and 2 received education through web (www.salamat.family), but the second group received educational strategies based on TTM. Five questionnaires were applied two times before the intervention and 6 months after the intervention. And, in the control group, the data were collected using stage of exercise behavior change questionnaire and the International Physical Activity Questionnaire. Student's *t*-test and two-way analysis of variance, and McNemar's test were applied to compare before and after the intervention. $P < 0.05$ was considered statistically significant.

RESULTS: The mean differences for TTM constructs related to exercise behaviors (processes of change, self-efficacy, and decisional balance) in intervention groups 1 and 2 were very higher than the control group. Participants in intervention groups 1 and 2 who had low or moderate physical activity before the intervention were placed in high physical activity after it.

CONCLUSION: According to the obtained results, education on PA based on website effective, but if we use education based on TTM, it will be more useful on the behavior.

Keywords:

Behavior change strategies, intervention, physical activity, web

Department of Health Education and Promotion, School of Health, Isfahan University of Medical Sciences, ¹Child Growth and Development Research Center, Research Institute for Primordial Prevention of Non-communicable Disease, Isfahan University of Medical Sciences, Isfahan, Iran

Address for correspondence:

Dr. Roya Kelishadi, Child Growth and Development Research Center, Research Institute for Primordial Prevention of Non-communicable Disease, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: kelishadi@med.mui.ac.ir

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Introduction

Nowadays, with the urbanization expansion, the industrialization of societies and lifestyle changes lead to increasing levels of insufficient physical activity and therefore contribute to the increase in the prevalence of obesity and noncommunicable diseases (NCDs).^[1]

Physical activity is one of the health-promoting behaviors, and sedentary habits can increase the NCD risk factors

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including elevated blood pressure, insulin resistance, and dyslipidemia.^[2,3]

In Iran, the escalating trend of excess weight among children and adolescents and its strong association with lifestyle habits, most notably inadequate physical activity are well documented.^[4] The national prevalence of overweight and obesity in Iranian children and adolescents is reported 5.0%–13.5% and 3.2%–11.9%, respectively.^[5]

Adolescents must do at least 60 min physical activity daily.^[6] However, according to

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reports, few teens reach this level of participation in physical activity.^[7] The results from studies conducted on Iranian adolescents reported a decrease in regular physical activity, most notably in girls.^[1,8]

Different methods have been used to increase the amount of physical activity. Web-based physical activity programs are considered as a promising method for adolescents and young people.^[9] Interventions on using the web to increase physical activity have highlighted the effectiveness of such interventions.^[10] A study conducted on the use of web-based interventions to increase walking in low-mobility individuals demonstrated beneficial effects.^[11] Another study using web-based interventions in adolescent girls showed an increase in physical activity, such as walking, exercise, and exercise among participants.^[12,13]

Websites that provide “tailored” messages and individually adapted feedback about physical activity are more interacting and have higher effectiveness.^[14,15]

Users search and receive tailored education are more interesting and using information against people who get regular information because it is personally relevant.^[14] Computer-based education can engage a large number of people in the training without expensive waste.^[15]

Therefore, we decided to apply one of the most widely used health education models in the field of physical activity that offers training based on how people are placed in different stages of behavior change with various processes. Various studies conducted on the basis of the transtheoretical model (TTM) on physical activity have shown the effectiveness of the mentioned model on behavior change.^[16-21]

Studies applying the TTM as the theoretical framework for hanging behavior have been criticized in that interventions have focused only on stages of change, while they neglected other components including decisional balance, processes of change, and self-efficacy.^[22]

Only few studies have applied TTM and education based on web for school students, and most of them have used traditional education and lectures. Therefore, the aim of the current study was to examine the effects of web-based intervention on the promotion of physical activity among adolescents by applying TTM.

Methods and Materials

Study design and participants

This quasi-experimental study was conducted in 2018 at Isfahan University of Medical Sciences, Iran. The study participants were 278 high school students, who were randomly assigned to one of the three

groups: intervention group 1 ($n = 94$), intervention group 2 ($n = 97$), and control ($n = 87$).

Intervention group 1 received education through web (www.salamat.family), in this web for participants in every stage, health educators had placed tailored education as shown in Table 1.

For participants in precontemplation and contemplation, we used pyramid physical activity with four levels, and described appropriate physical activity in every level using pictures.

Participants in preparation stage received 24-h table of activities and goal setting, as well as commitment to physical activity.

In the action and maintenance stage, we placed types of physical activity, i.e., warm-up exercises, endurance sports, flexibility exercises, balance exercises, strengthening exercises, and isometric exercises with pictures. Moreover, we uploaded the printable pamphlet containing all of contents to the website. Considering the importance of walking, the correct walking method with pictures and how to measure the maximum heart rate and tensile strength before and after running were placed on the website.

For relaxation education, three relaxation techniques such as deep breathing, muscle relaxation, and visualization meditation were uploaded on the website.

Temptation control is a technique for avoiding negative stimuli, and exposing positive stimuli as well as sending daily exercise reminder SMS from project team to participants and planning for mass sports and family and friends sports.

The intervention group 2 received education by the same website, but they had access to untailed education, i.e., only public information about physical activity. In this group, we presented the amount and types of physical activity for children and adolescents, physical activity pyramid, good sleep pattern, strategies for increasing physical activity in children and adolescents, some important points of physical activity on academic achievement and two clips related to aerobic raining and exercise at home.

The control group did not receive the abovementioned education during intervention times, but after the intervention period, both the intervention groups became familiar with the web site in one session.

Instruments

The following questionnaires were applied two times, before the intervention and 6 months after intervention in the intervention and control groups.

Table 1: Stages of change and tailored education in every stage of precontemplation, contemplation, preparation, action, and maintenance

Stage of change	Process of change	Educational strategies
Precontemplation contemplation	Consciousness raising	Disadvantages of inadequate physical activity
	Dramatic relief	Positive effects of physical activity on body, mental and community
	Environmental reevaluation	Appropriate physical activity level
Preparation	Selfreevaluation	Pyramid physical activity
	Selfliberation	24-h table of activities
	Decisionmaking balance	Goal-setting with examples
		Specific goals with examples
Action maintenance	Counterconditioning	Commitment to physical activity
	Stimulus control	Types of physical activity exercises
	Helping relationships	Stimulus messages and photos
	Reinforcement management	Relaxation techniques
		Assess physical activity and self-reward
		Tempting fighting techniques

First Q.: Stage of exercise behavior change questionnaire. It is a 5-item questionnaire developed by Marcus *et al.*^[23] Students were asked to select which items best described their level of PA. Finally, according to their selection, they would be placed in 5 stages (precontemplation, contemplation, preparation, action, and maintenance). The validity and reliability of the questionnaire have been confirmed in Iran.^[24] After placing people in different stages, they receive education based on change processes, decision-making, and self-efficacy, that are very effective in changing their individual behavior.

Second Q.: Processes of change questionnaire includes 40 items about cognitive and behavioral strategies and uses a five-point scale (never, rarely, sometimes, often, and always).^[25]

Third Q.: Decision-making balance questionnaire has 43 items asked by four-scaled criteria. His scale ranged from “I quite disagree” to “I totally agree.” This questionnaire show pros (perceived benefit) and cons (perceived barrier) about PA in participants.^[26]

Fourth Q.: Exercise self-efficacy sale and it consists of 16 items with 4 scales (ranging from “not quite sure” to “I’m quite sure”).^[27]

Fifth Q.: International Physical Activity Questionnaire short form.^[28] Each person selects items that show level of PA in a week (severe, moderate, and walking).

Statistical methods

Continuous variables were expressed as means ± standard error (SE), and categorical data were presented as number (percentage). The normality of data was assessed graphically and Kolmogorov–Smirnov. Comparisons between means of TTM constructs in participants who moved in a progressive pattern from precontemplation, contemplation or preparation at baseline to action or

maintenance after intervention (group 1) and people who remained in precontemplation, contemplation, or preparation before and after intervention were performed using independent Student’s *t*-test. The Pearson correlation coefficients were used to determine associations between scores of TTM constructs. Two-way analysis of variance (ANOVA) was used to examine the interaction effect of interventional groups and TTM stages on TTM constructs. The multivariate ANOVA (MANOVA) was performed to assess interaction effect of interventional groups and TTM stages on each three TTM constructs. McNemar’s test was applied to compare the physical activity status before and after the intervention. *P* < 0.05 was considered statistically significant, as shown in Flow Diagram 1.

Ethical consideration

Data were collected anonymously, and confidentiality of the students’ information was secured. Participants were informed that they could withdrawal from the study any time. Written informed consent was obtained from parents who agreed to participate before pretest and data collection.

Results

Figure 1 shows comparison of participants’ self-reported stage of change before and after intervention. After intervention, the majority of participants were in groups of action or maintenance. The scores of TTM constructs at baseline are shown in Table 2. The correlation coefficients between the scores of TTM constructs are shown in Table 3. All coefficients were significant and scores of self-efficacy and processes of changes showed the highest correlation.

Table 4 shows mean ± SE for difference of scores before and after intervention for processes of changes, self-efficacy, and decisional balance in exercise

behavior for participants who moved in a progressive pattern from precontemplation, contemplation, or preparation at baseline to action or maintenance after intervention (group 1) and people who remained in precontemplation, contemplation or preparation before and after the intervention (group 2). Mean differences for decisional balance, and self-efficacy in intervention group 1 were higher than those group intervention 2. These differences were significant for decisional balance in both intervention groups 1 and 2. The mean differences for TTM constructs related to exercise behaviors (processes of change, self-efficacy, and decisional balance) in intervention groups 1 and 2 were significantly higher than those in controls. The results of two-way ANOVA showed that interaction effect between these two factors was not significant

for each three TTM constructs $P > 0.05$. Furthermore, it indicated the significant main effect of the interventional group on each three TTM constructs with $F(2230) = 31.51$, $F(2229) = 52.31$, and $F(2235) = 11.79$ for self-efficacy, processes of change, and decisional balance, respectively; the P values were statistically significant for each three ($P < 0.001$). The main effect for stage group was significant for processes of change and decisional balance with $F(1229) = 6.50$; $P = 0.011$ and $F(1235) = 15.29$; $P < 0.001$, respectively. The Tukey *post hoc* multiple comparisons of means for decisional balance changes and self-efficacy changes revealed significant differences

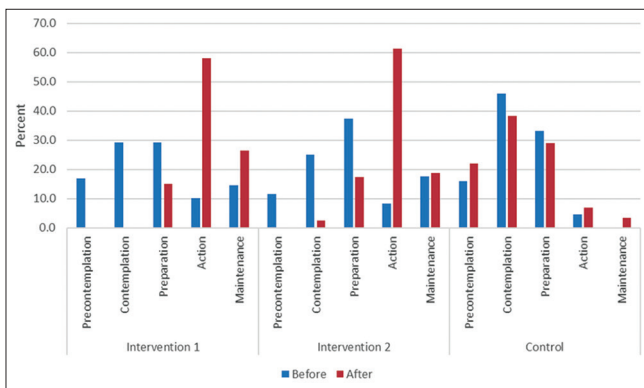


Figure 1: Comparison of participants' self-reported stage of change at before and after intervention

Table 2: Transtheoretical model constructs scores at baseline

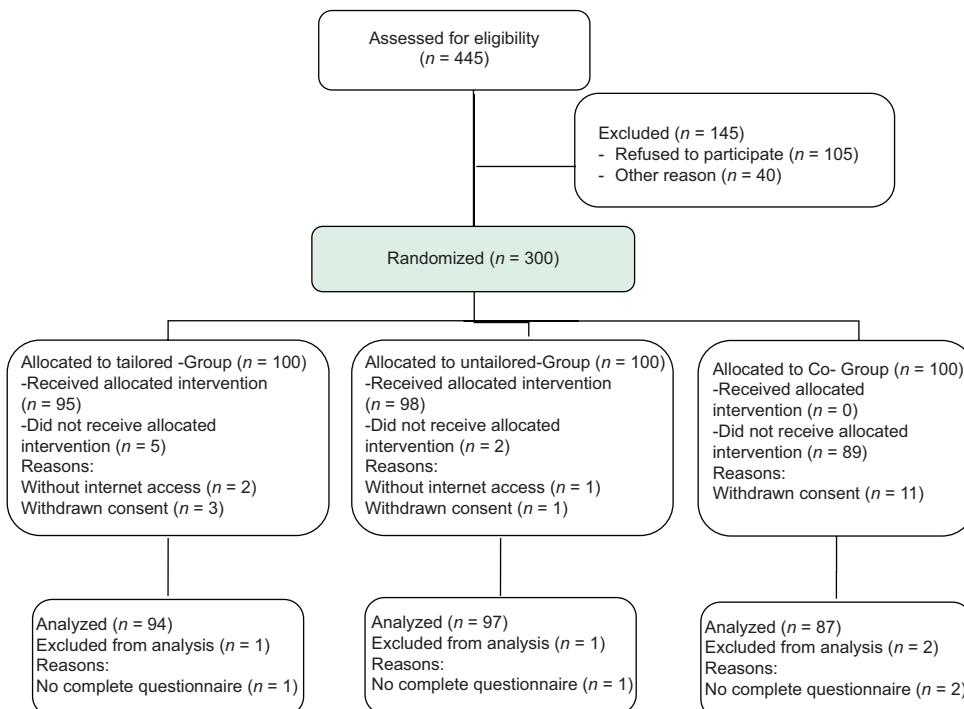
Groups	Mean±SE		
	Decisional balance	Self-efficacy	Processes of changes
Intervention 1 (n=94)	127.82±2.07	47.55±0.92	123.05±1.84
Intervention 2 (n=97)	134.84±2.02	47.53±1.02	130.20±2.51
Control (n=87)	123.63±0.76	56.10±0.59	149.08±1.44
Total (n=278)	128.96±1.05	50.20±0.56	133.73±1.33

SE=Standard error

Table 3: Correlation between transtheoretical model constructs scores at baseline

Variables	Self-efficacy	Processes of changes	Decisional balance
Self-efficacy	1	0.685**	0.152*
Processes of changes		1	0.258**
Decisional balance			1

**, *Correlation are significant at the 0.01 and 0.05 levels, respectively



Flow Diagram 1: Flow diagram of the participants

Table 4: Comparison of mean differences between before and after in groups of stage change and interventional

Groups	Decisional balance, mean±SE		P ₁	Self-efficacy, mean±SE		P ₁	Processes of changes, mean±SE		P ₁
	Group 1	Group 2		Group 1	Group 2		Group 1	Group 2	
Intervention 1	12.74±5.78	29.82±3.35	0.008	13.23±2.20	15.08±1.06	0.045	40.17±4.07	47.38±2.31	0.102
Intervention 2	15.43±3.78	26.61±2.90	0.019	12.37±1.65	14.05±1.35	0.430	28.41±3.69	37.95±3.24	0.055
Control	-1.95±1.04	7.00±5.68	0.157	0.97±0.71	1.22±2.02	0.909	1.28±1.69	7.00±5.51	0.283
P ₂	<0.001			<0.001			<0.001		

Group 1: People who remained in precontemplation, contemplation or preparation before and after intervention, Group 2: Participants who moved in a progressive pattern from precontemplation, contemplation or preparation at baseline to action or maintenance after intervention, P₁ was based on independent Student's t-test and P₂ was obtained using two-way ANOVA. ANOVA=Analysis of variance, SE=Standard error

in mean between intervention groups 1 and 2 and the control group, but not between intervention group 1 and intervention group 2. Moreover, there were statistically significant differences in mean between the intervention group 1 and intervention group 2, as well as intervention groups 1 and 2 and the control group. The interaction between interventional group and stage group on TTM constructs was not significant based on MANOVA test (Wilk's $\lambda = 0.994$, $F(6448) = 0.23$, $P = 0.966$). However, the main effects of interventional group and stage groups on TTM constructs were significant with Wilk's $\lambda = 0.633$, $P < 0.001$ and 0.938 ; $P = 0.002$, respectively. Table 4 shows the distribution frequency (%) physical activity before and after intervention. Based on McNemar's test, distribution frequency of physical activity before and after intervention was significantly different ($P < 0.05$), participants in intervention groups 1 and 2 who had low or moderate physical activity before intervention, were placed in high physical activity after it [Table 5].

Discussion

The primary aim of the current study was to determine the effectiveness of a web-based intervention on the promotion of physical activity in Iranian youth by applying TTM.

Regarding the postintervention, participants showed significant progress during stages of change and changes were greater in the group who was trained by TTM. A large number of people after intervention were placed in three stages (preparation, action, and maintenance). Changes in the process of moving towards higher change stages have been seen in other studies that have been carried out using the TTM.^[21,29]

The percentage of students with low, moderate, and severe levels of physical activity in the two intervention groups has increased significantly after the intervention. This indicates the impact of Web education on the physical activity of adolescents. With respect to the intervention group findings, similar increases in total physical activity have been found in previous web-based studies.^[30,31] For example, in the study of Asghari *et al.*, all the three severe, moderate, and low physical activity

Table 5: Distribution frequency (%) physical activity before and after intervention

Before	After	Low or moderate (%)	High (%)	P
	High	3 (15.8)	16 (84.2)	
Intervention 2	Low or moderate	2 (5)	38 (95)	<0.001
	High	0 (0)	27 (100)	
Control	Low or moderate	68 (82.9)	14 (17.1)	0.004
	High	2 (66.7)	1 (33.3)	

categories have increased in the intervention group at the time of intervention.^[32] Furthermore, Hargreaves *et al.*'s study showed improvements in step counts and physical and psychological health after 12 weeks in intervention groups by a web-based intervention to encourage walking.^[33]

In education based on model, in the intervention group that received tailored education, there were significant changes in the two decision-making balance and self-efficacy structures, while in those who received only general education, only the decision-making structures focusing on increasing pros and reduction of cons have changed significantly.

Decision-making balance is an important aspect, and the balance between the pros and cons could make the individuals to have physical activities. The reason for changing this structure in the group that received the general education was that it provided some of the lessons on the advantages of physical activity and the disadvantages of not do it. Regarding the role of decision-making balance in the adoption of physical activity behavior in other studies,^[34,35] it is also recommended that special attention be paid to this structure in related education.

In our study, to improve self-efficacy, we used goal-setting strategies and planning for doing exercise, breaking PA in smaller steps and using verbal and nonverbal enhancement to achieve the goals. These strategies may have resulted in successfully increasing self-efficacy in students. This is in agreement with other studies.^[19,36-38]

The present study has the unique combination of intervention methods including TTM which was linked to the web site and tailored messages.

The intervention group received a web-based intervention equipped with tailored message for people in every stage that is similar to Kim and Kang study that applied interactive features, personalized goal setting, activity planning, and personalized information.^[31]

Conclusion

According to the obtained results, education on PA based on website can be effective, but if we use education based on the TTM by applying some constructs such as self-efficacy, it will be more useful on the behavior. The limitations of this study included the fact that it was not possible to control all factors affecting the PA among students, especially economic, cultural, and familial factors. We also needed more time to measure the sustainability of physical activity. Therefore, the evaluation of PA level after 6 months may have undermined the intervention effects in terms of changes in PA behavior over the 6-month period.

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Conflicts of interest

There are no conflicts of interest.

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