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A model-based educational intervention to increase physical activity among Iranian adolescents

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Abstract

Objective: To conduct an evaluation of an educational program based on the health promotion model (HPM) and stages of change to improve physical activity (PA) behavior among Iranian adolescents.

Methods: This was a group randomized controlled trial with 165 participants in two groups (intervention/control). Data were collected using self-reported questionnaires based upon HPM constructs (benefits and barriers of action, self-efficacy, activity-related affect, interpersonal influences, and situational influences). The stages of change scale was used to select eligible participants (were placed on precontemplation, contemplation, or preparation stages) and to assess the trend. After collecting baseline data, the intervention was administered to the participants and follow-up data was collected 3 months after intervention.

Results: In all, 88 males and 77 females with a mean age of 13.99±0.4 participated in the study. The differences in all HPM constructs, except activity-related affect and social influences, were significant ($p < 0.01$) between baseline and follow-up measurements. Adolescents in the intervention as compared to the control group were placed in action (70%) or preparation (30%) stages at follow-up. Multiple regression analysis revealed that competing preferences, social norms, role models, ($p < 0.001$), and commitment to action plan can significantly predict PA behavior. The model accounted for 22.5% of the variance in PA.

Conclusions: The results suggest that educational interventions based on stages of change can have important implications for improving PA among adolescents in more constructs of HPM.

J Pediatr (Rio J). 2012;88(5):430-8: Health behavior, physical activity, health education, adolescent.

Introduction

Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths around the world annually.[1] Patterns of activity in adulthood are often established during adolescence,[2] and involvement in regular physical activity (PA) by adolescents provides psychological and physiological benefits for them.[3,4] Studies have shown the adolescents with higher levels of PA have more healthy diets and normal weight.[5,6] In addition, it reduces both the deterioration of mobility-related activities[7] and the development of secondary health problems later in life.[8]

According to the World Health Organization (WHO) recommendation for PA, children and youth aged 5-17 should accumulate at least 60 minutes of moderate- to

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vigorous-intensity PA daily.[9] In Iran, many young people do not meet the current recommendation. For example, data from the CASPIAN Study indicates that only about 25% of Iranian adolescents engage in sufficient moderate-to vigorous-intensity PA per day.[10] Also the prevalence of overweight and obese children has increased considerably in recent decades, affecting about one third of youth.[11] Therefore, effective interventions to increase PA are needed to prevent disease and improve health in adolescents.

Theory-based interventions have been associated with larger and longer-term effects than those without an explicit basis in theory.[12,13] Moreover, applications of theory or model-based interventions present an opportunity to test whether an intervention successfully modifies the hypothesized determinants, and if these changes mediate behavior change effects.[14]

The stages of change construct from the Transtheoretical Model (TTM) allows persons to be assessed for their readiness to change a particular behavior such as PA.[14,15]

Another model to address health behaviors is the health promotion model (HPM). The model formulated by Pender includes three groups of influencing factors: individual characteristics and experiences, behavior-specific cognitions and affect, and immediate behavioral contingencies.[16] The set of behavior-specific variables which develops a core of the intervention can be modified through educational actions. These six variables are: perceived benefits of action, perceived barriers to action, perceived self-efficacy, activity-related affect, interpersonal influences, and situational influences.[17] "Measuring changes in these variables is essential to determine if such changes actually result from the intervention."[18]

Therefore, we hypothesized that designing a health education program based on stage of change (SOG) and HPM might affect the PA behavior among adolescents. The present study introduces the development and preliminary test of an educational intervention that used health behavior theoretical bases to enhance PA in adolescents.

Methods

Overall, 165 adolescents aged 13-15 years old were recruited by a cluster-randomized design from all high schools in Khoramabad city. The size of sample was calculated using Cohen tables for sample size estimation (effect size = 0.3, power = 0.8 and α = 0.05).[19] This grouped controlled educational intervention was conducted from October 2010 to February 2011. We approached four randomized selected high schools in Khoramabad city to solicit their participation in the intervention aimed at enhancing PA. All four high schools agreed to participate in the study. By simple random allocation, two schools were assigned to the control group and the remaining two became the intervention group.

Consenting participants were only included in the study after meeting the following inclusion and exclusion criteria. The inclusion criteria were: they had no limitations or restrictions that would prohibit them from engaging in moderate PA as measured by the Physical Activity Readiness Questionnaire,[20] and they consented to participate in the study. Also a parent or legal guardian of participants signed the informed consent document. The participants should be in the precontemplation, contemplation or in the preparation stages of change. The exclusion criteria were as follows: planning to leave the geographic area, having a friend or relative enrolled in the trial (by asking the participants to answer the question: "Do you have any friend or relatives at 'name of the school'?"), and being on the action or maintenance level of the stages of change. The study was approved by the Institutional Review Board at the Baqiyatallah University of Medical Sciences.

Data were collected within individual school settings. Both intervention and control groups' data were assessed at baseline and at the 5-month follow-up (3 months after the intervention).

Baseline data were collected in October 2010. After this, the intervention schools participated in the educational program, while the control schools continued with their regular school programs. The education program lasted about 2 months (October and November). Subsequent follow-up data collection took place in late February 2011. Data collectors checked for incorrectly completed questionnaires (i.e., pages or items not filled in), and invited participants to correct their mistakes or complete the missing items. At baseline, participants in all conditions completed the following measures. All scales except demographics were completed by participants at follow-up.

Demographic variables include: age, grade, gender, and parents' education and job ascertained by a one-sheet questionnaire.

Stage of changes scale

This was developed by Kearney et al.[21] and has two questions. In the first question, participants were asked whether they believed they did sufficient sports or PA on a two-point scale (yes/no). Those who answered "no" were asked to select one of the three options regarding their intention to engage in sports or PA in the future. Those answering "yes" chose between two options that identify action or maintenance stages.

Children's exercise self-efficacy survey

This was adopted from Garcia et al. study.[22] The adopted scale included eight items with a four-point modified Likert scale. This scale asks participants to evaluate their ability to exercise under different conditions such as fatigue, loneliness, or having other work.

Children's perceived benefits/barriers to exercise questionnaire

The original scale has been developed by Garcia et al.[22] The measure contained a nine-item benefits and 10-item barriers subscales using a four-item Likert-type response format. The modified version of the scale having eight items concerning perceived benefits was used in our study.[23]

Interpersonal variables scale

The interpersonal variables scale consisted of three subscales and was first developed by Garcia et al.[22] and then modified in another study.[23] The exercise models, exercise norms, and social support subscales have 12, four, and 24 items, respectively.

Physical activity enjoyment scale

This scale was developed based on Robbins et al.[24] For this study the measure was used to assess activity-related affect (i.e. affections such as hate, discomfort, enjoyment, etc.). The scale consisted of a four-point Likert scale.

Exercise preference profile

This preference scale was used for measuring immediate competing demands and preferences. It was developed by Pender et al.[25] The scale has nine items and each item contains two choices, A and B, and the participant must choose the one they like best (sedentary or active behaviors).

Situational influences options

This is a self-report questionnaire with 11 items that was developed by Pender et al.[25] The scale asks participants questions such as, "Which places can you go to play or exercise?" For each item there are two options (Yes or No). "Yes" responses receive 1 and "No" receive 0.

Planning for exercise scale

This scale included 11 items that each had three options (never = 1, sometimes = 2, and often = 3). The scale was developed by Pender et al.[25] and is a measure of commitment to a plan of action.

Child/adolescent activity log

This log was used to assess PA. The scale was developed by Garcia et al.[26] and was modified in another related study.[23] The scale has 20 items that requires participants to recall the activities they participated in the previous day, and the number of minutes spent on each activity.

Weekly physical activity scale

This was developed by researchers and was used to measure the time of PA during the preceding week. This scale requests participants to recall the time (number of minutes per day) that they spent on activities such as jogging, cycling, and other exercises on a weekly basis which led to a rapid heartbeat and sweating.

The Farsi versions of all scales, except situational influences, were available. The backward-forward translation technique was used to translate the scale. The scale was then sent to five experts on health education, and test development, and their recommendations were used to modify the scale. Thereafter, it was pilot-tested on 25 adolescents, and their viewpoints and understanding of the items were addressed to assist in developing the final scales. The internal consistency coefficient for all scales ranged from 0.76 to 0.85.

After determining the stages of change in the education group by self-reported questionnaires, participants were divided into groups of from six to nine according to their stage of change. The methods used to incorporate education were: lecture, focus group discussion, slide presentation, colloquy, video presentation, role playing, and demonstration.

All intervention-adolescents participated in 10 interactive sessions (1-1.5 hours each) over 2 months. Interactive sessions were identical in content at all training sites for the intervention group. Sessions were held in small groups led by a researcher.

Education was based on the SOG and the HPM. It attempted to seek the viewpoints of participants about personal and environmental obstacles toward PA by performing interpersonal consulting or group discussions. The education program is described in Table 1.

In addition, a 2-hour family workshop was scheduled shortly after randomization was conducted to provide a general introduction to the program goals, and featured tips on how parents could provide support to their children. Families who did not attend were mailed copies.

After each session the content of educational material was provided to participants as either a pamphlet or hand-out, and they were asked to review it at home. Also, adolescents were asked to keep a self-monitoring diary as part of their homework in which they documented, in detail, their daily physical activities.

In order to reinforce social support and role modeling, an exercise program included two football and footrace competitions was held, and participants and their parents were invited to be present at those events.

Data were analyzed using the SPSS software for Windows, version 17 (SPSS Inc., Chicago, IL). Paired *t* test was used to assess pre- and post-differences in participant outcomes. Independent *t* test was used to evaluate differences between the intervention and control groups.

Categorical variables were assessed using either the chi-square test or Fisher's exact test, depending upon expected cell frequencies. One-way ANOVA's compared mean scores between the intervention and control groups, and between males and females. The Pearson correlation test was used to assess relationships between the constructs of HPM and PA. Moreover, a linear multiple regression was performed to address how variables predict PA. In the regression model, the time of weekly PA was considered as a dependent variable. In all analysis, statistical significance was set at a two-tailed p-value (p = 0.05).

Results

The sample consisted of 88 males and 77 females. Ages ranged from 13 to 15 years with a mean age of 13.99 years (SD = 0.475). Of the participants, 10 persons (6%) were in the precontemplation stage and 50 (30%) were in the contemplation stages at baseline. Most adolescents were

Table 1 - The curriculum of physical activity course based on interventional health promotion model constructs and used educational methods

Session topic and description	Educational method	Target variables
Introduction The importance, goal and objectives of program - Time frame and the tasks of participants - Provide statistics about inactivity	L, S	PBOA, II
What is PA? Definition of PA in viewpoints of participants - Defining the true and standard concept of PA	L, FGD, C	ARA, CPA
Types of PA What types of PAs or sports were known by participants? - Presenting the different kinds of personal and grouped PA and sports	L, S, V	ARA,SI
Benefits of PA The positive effects of PA on different systems of body (circulation, musculoskeletal, etc.) and prevention of disease - The positive effects of PA on mood, morale, mental health, etc. - Social and developmental benefits	RP, FGD, C	PBOA, II
Barriers to PA What barriers of PA existed among participants? - How to overcome the barriers	RP, FGD, C	PBTA, II
Increase ability to do PA Breakdown the stages of several PAs to small doable stages - Introducing some role models - Reducing stress related to new PA behaviors - Encouragement to doing PA	V, S, RP, D	PS
Communicating for PA How to get permission and support from parents and family members to participate in PA - How to attract support from peers to participate in PA	L, S, RP, D	II
Place and time for PA Introducing the clubs and stadiums that provide free or low cost services - Providing recommendations about the best times for PA and available time for sports	V, C, S	SI, CDP
Planning for PA Developing an action plan including goal setting and time management for PA - Encouraging participants to develop personal action plans	D, L, C	CPA, CDP
Problem solving skills for PA Identifying present problems associated with PA - Finding potential solutions for problem solving - Prioritizing the potential solutions - Selecting and application of better solutions (along with some examples)	RP, C, FGD	CDP, PBTA, PS

ARA = activity-related affect; C = colloquy; CDP = competing demands and preferences; CPA = commitment to a plan of action; D = demonstration; FGD = focus group discussion; II = interpersonal influences; L = lecture; PA = physical activity; PBOA = perceived benefits of action; PBTA = perceived barriers to action; PS = perceived self-efficacy; RP = role playing; S = slide; SI = situational influences; V = video.

placed in the preparation stage of change (n = 105, 63.6%) before intervention (Table 2).

Results showed that the constructs such as barriers of PA, commitment to action plan, competing demand and preferences, and role models' component of interpersonal influences had a correlation at $p < 0.01$ to PA. The benefits of PA, social support component of interpersonal influences, and situational influences at $p < 0.05$ were correlated to time of weekly PA. The direction of the above correlations, except barriers of PA and competing demands, were positive (data not shown).

Multiple regression analysis revealed that competing demands and preferences, social norms, role models ($p < 0.001$), and commitment to action plan ($p < 0.05$) can predict the time of weekly PA among participants. The R^2 value of the regression model indicated a 22.5% variance in PA (Table 3). The ANOVA table showed the regression model predicts the outcome variable significantly ($p < 0.001$).

Three months after the intervention, a majority of individuals reported being in the action stage (44.4%), while there was no one in the precontemplation or contemplation stages among people in the intervention group. The number of people in the control group across the SOG did not significantly change at follow-up, compared to baseline, and only four persons (4.7%) moved to the action stage.

Table 2 - Demographic characteristics of intervention and control groups

Variables	Intervention (n = 80) n (%)	Control (n = 85) n (%)
Gender		
Male	43 (53.8)	45 (52.9)
Female	37 (46.3)	40 (47.1)
Age		
13	8 (10)	11 (13)
14	62 (77.5)	66 (77.5)
15	10 (12.5)	8 (9.5)
Father's education		
Uneducated	5 (6)	8 (9.5)
Primary school (grades 1-5)	11 (14)	9 (10.5)
High school (grades 6-8)	16 (20)	19 (22)
High school (grades 9-12)	25 (31)	22 (26)
Higher education	23 (29)	27 (32)
Father's job		
Self-employed	22 (27.5)	19 (22.5)
Employee	29 (36)	35 (41)
Worker	15 (19)	22 (26)
Employer	6 (7.5)	4 (4.5)
Other	8 (10)	5 (6)
Mother's education		
Uneducated	7 (9)	6 (7)
Primary school (grades 1-5)	13 (16)	19 (22.5)
High school (grades 6-8)	16 (20)	12 (14)
High school (grades 9-12)	29 (36)	37 (43.5)
Higher education	15 (19)	11(13)
Mother's job		
Housekeeper	71 (88.5)	78 (92)
Employed	8 (10)	5 (6)
Other	1 (1.5)	2 (2)
Stage of change		
Precontemplation	4 (5)	6 (7.1)
Contemplation	23 (28.8)	27 (54)
Preparation	53 (50.5)	52 (49.5)

All comparisons are non-significant at $p < 0.05$.

The time of weekly PA increased from 131.93±38.68 to 264.62±72.61 among participants of the intervention group (thought to be considerable), while the mean changes of PA in the control group was not significant. There was a significant difference between girls and boys in terms of weekly PA ($p < 0.001$), in both the intervention and control groups (either in baseline or follow-up). Also, as could be seen in the last table, a comparable number of boys and girls was in preparation stage at baseline (30 vs. 23), but the number of girls that were found to be in preparation stage showed a considerable difference to the boys at follow-up (16 vs. 8) among the participants of the intervention group. Other changes are presented in Table 4.

Discussion

This educational intervention found that education has a noticeable impact on enhancing most HPM constructs and SOG as related to PA both in girls and boys.

In recent years, several studies have reported that model- or theory-based interventions can be effective in promoting proper PA among adolescents. In a theory-based study, the difference in time of daily moderate-to-vigorous physical activities (MVPA) among the intervention group, as compared to the control group, increased from 18 min at post-test to 33 min at the 3 month follow-up.[27] In our study this time was approximately 19 min daily between baseline to the 5 month follow-up.

Using the health promotion model for PA has a practical benefit, because the model has been practiced in other studies that have found significant results in its application for PA.[16,17,22,23,26] But more studies in this regard have focused on predicting the power of the model and its application in the form of an intervention. For example, in a study it is revealed that social support, modeling, self-efficacy, and perceived benefits and barriers to performing PA directly and indirectly influence the behavior of PA in Taiwanese adolescents.[16] The hypothesized model, that was a revised version of the model, explained 25% of the variance in PA. This was about 30% in another study.[17] In our study, the variance of PA explained by the model was approximately 22.5% and therefore consistent with other research.

In a similar study, inclusion of only the adolescents from the preparation stage was reported as a limitation.[28] Moreover, not all constructs of the HPM were measured, and the intervention was performed only with girls. We attempted to overcome such limitations in our study.

Many studies have shown that using the SOG for staging participants can improve interventions.[28-30] The findings of this study support the SOG's application in this population, as most constructs of the HPM to PA differed across stages before and after intervention, and changes were in the direction predicted by theory. However, there was no significant change observed for activity-related affect, or for the components of interpersonal influences.

Pender et al., in the manual of the HPM, suggest that helping to plan enjoyable activities can be used for intervention toward improving the activity-related affect.[29] Guided by this recommendation, we assisted in planning two sport competitions selected by most of participants.

Table 3 - Multivariate regression analyses of weekly physical activity behavior against health promotion model constructs

HPM constructs	B	Beta	95%CI	
			Lower	Upper
Benefits of PA	0.574	0.055	-0.608	1.757
Barriers of PA	-0.777	-0.088	-1.841	0.288
Self-efficacy	0.221	0.027	-0.724	1.166
Commitment to action plan	1.865*	0.133	0.224	3.505
Competing demands and preferences	-6.609†	-0.248	-9.723	-3.494
Activity-related affect	-0.695	-0.044	-2.582	1.191
Social norms	-4.806†	-0.183	-7.727	-1.886
Role models	2.116†	0.206	0.908	3.323
Social support	0.333	0.050	-0.506	1.172
Situational influences	0.567	0.048	-0.820	1.954
R = 0.474	$R^2 = 0.225$	Adjusted $R^2 = 0.200$	F change = 8.966	Sig. ANOVA < 0.001

B = standardized regression coefficients; Beta = unstandardized regression coefficients; 95%CI = 95% confidence interval; HPM = health promotion model; PA = physical activity; Sig. = Significance level.
* $p < 0.05$.
† $p < 0.001$.

Also, we attempted to help adolescents identify enjoyable activities they might consider when goal setting for PA. But perhaps these measurements have not been enough, or else other issues should be addressed in order to sufficiently improve the construct. In *Interventions to address interpersonal influences*, Pender also recommends that solutions for social norms, social support and role models are: "Encourage family and friends to increase expectations of activity, help clients use social support by asking family and friends to be active with him/her or provide support to do so," and to "plan increased interaction with persons who are physically active."[25] To address these recommendations, we administered activities such as describing the importance, benefits, and overcoming the barriers of PA for peers and families, as well as proper communications for generating social support. However, it seems that interventions focusing on influencing interpersonal relations need more time, and also need to be modified, to meet special cultural and individual characteristics of people. This finding is consistent to Taymoori et al.[28]

Another finding of our study was that different levels of PA, competing preferences, activity-related affect, role models, and situational influences between boys and girls was observed. This is not surprising, for other studies have found gender differences that may be affecting time spent on PA,[5] demands and preferences,[31] affects and emotions,[32] and modeling for PA.[33] But a point related to differences concerning situational influences between males and females is that in Iran, as a developing country, there are culture-based differences (such as unequal options for girls compared to boys) that may be impacting upon PA between the two sexes.

The associations between the constructs of the HPM toward PA, and also the predictive power of the regression model, that have reported in similar studies[16,17] identifies

Table 4 - Changes of health promotion model constructs and stage of change in terms of gender for intervention and control groups

	Baseline					Follow-up				
	Intervention		Control		*t* test/X^2	Intervention		Control		*t* test/X^2
Variables	Male	Female	Male	Female	p	Male	Female	Male	Female	p
HPM constructs										
Mean ± SD										
Benefits of PA	22.62±3.44	22.83±4.04	21.95±3.21	22.36±3.86	0.687‡	25.95±4.58	25.70±4.51	21.73±3.12	22.06±3.64	0.000
Barriers of PA	29.02±4.27	30.72±4.47	28.89±4.38	30.65±4.57	0.778‡	23.65±5.36	23.16±4.00	29.04±4.47	30.75±4.33	0.000
Self-efficacy	18.55±4.89	18.16±4.60	18.63±4.35	18.03±4.73	0.486‡	21.81±4.85†	18.70±4.30	18.23±4.06	17.85±4.38	0.000
Commitment to action plan	19.48±2.90	19.94±2.62	19.87±2.56	19.83±2.23	0.723‡	23.69±3.44†	21.27±4.01	19.45±2.48	19.73±2.12	0.005
Competing preferences	4.16±1.42*	4.91±1.40	3.96±1.35*	4.85±1.48	0.308‡	2.55±2.34*	3.72±2.14	3.68±1.14*	4.98±1.56	0.000
Activity-related affect	16.25±2.30*	14.94±2.46	16.12±2.34*	14.65±2.18	0.523‡	16.69±2.15*	15.32±2.32	15.98±2.45*	14.36±2.29	0.094
Social norms	7.93±1.50	8.29±1.45	7.35±1.62	8.31±1.64	0.487‡	8.37±1.58	8.24±2.21	7.48±1.49	8.33±1.52	0.124
Role models	22.58±3.98*	20.89±3.38	22.63±3.71*	21.03±3.45	0.204‡	22.74±4.19	23.05±2.78	22.36±3.31	20.93±3.63	0.085
Social support	39.69±5.77	38.86±5.89	40.21±6.21	37.12±5.18	0.195‡	40.83±5.95	38.56±5.35	40.32±6.04	36.91±5.12	0.067
Situational influences	5.35±1.85*	4.25±1.36	5.24±1.68*	4.21±1.48	0.832‡	6.58±1.44*	5.02±1.23	5.32±1.53*	4.18±1.25	0.000
SOG										
n (%)										
Precontemplation	1 (2.3)	3 (8.1)	3 (6.7)	3 (7.5)	0.749§	0 (0)	0 (0)	3 (4.4)	3 (7.5)	0.000
Contemplation	12 (27.9)	11 (29.7)	13 (28.9)	14 (35.0)	0.749§	0 (0)	0 (0)	12 (26.7)	16 (40.0)	0.000
Preparation	30 (69.8)	23 (62.2)	29 (64.4)	23 (57.5)	0.749§	8 (18.6)	16 (43.2)	28 (62.2)	20 (50.0)	0.000
Action	0 (0)	0 (0)	0 (0)	0 (0)	0.749§	35 (81.4)	21 (56.8)	3 (6.7)	1 (2.5)	0.000
Weekly PA										
Mean ± SD	147.44± 35.61†	113.91± 34.84	152.63± 38.52†	108.35± 29.93	0.238‡	294.41± 64.29†	230.00± 66.74	161.63± 39.33†	116.35± 27.93	0.000

HPM = health promotion model; PA = physical activity; SD = standard deviation; SOG = stage of change.
* p-value is significant at 0.01.
† p-value is significant at 0.001 between genders in each group (intervention/control).
‡ *t* test.
§ X^2.

the benefit of the HPM application for predicting the variables related to PA.

Our study has some limitations that should be considered when interpreting the findings. First, the present study had a 5-month follow-up. If we could monitor the changes for a longer duration results might be different, and we could then assess the number of adolescents who enter in the maintenance stage. With regard to this fact, that the goal of any health education program is the maintenance of healthy behaviors, other research can address the long-term follow-up.

And secondly, we used self-report questionnaires for assessing the variables of the study. Although these instruments may include recall and bias, experts believe that applying these instruments can result in acceptably valid data for PA.[34]

This study provided an opportunity to test a variety of mediators of physical behavior activity and showed that variables such as competing preferences, social norms, and role models can predict the PA behavior among adolescents. The results of this study support the belief that PA, and many variables of the HPM model related to PA, can be improved in adolescents by virtue of participant staging based upon readiness to change and a structured educational program.

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