Effect of education based on trans-theoretical model on promoting physical activity and increasing physical work capacity

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Abstract

Aims: Increasing physical activity is one of the most effective ways of reducing the risk of some chronic non-contagious diseases. Various methods have been created and validated in order to assess the factors affecting physical activity. The most applied method for this purpose is the Trans-Theoretical Model (TTM). This study was performed with the aim of assessing the effect of an educational program for increasing physical activity and physical capacity by using TTM in one of the governmental centers' employees.

Methods: This quasi-experimental interventional study was performed on employees of a defensive industry in year 2009. 60 male employees aged between 20 – 57 years old were selected by simple random sampling. They were divided into two groups (each containing 30 employees), the experimental and the control group. Questionnaires were completed before and three months after intervention and physical capacity was measured by Ergo-meter bicycle. Educational programs were implied in experimental group. Data was analyzed by SPSS 13.

Results: In stage of change after intervention, the experimental group had a significant positive progress (p =0.001). Mean physical capacity score had significant improvement after finishing educational program, in experimental group (p=0.016). Self–efficacy and total decisional balance and process of change scores were higher after intervention in experimental group (p<0.001).

Conclusion: TTM based educational programs are effective in improving physical capacity and physical activity of governmental center employees.

Keywords: Health Education, Physical Activity, Physical Capacity, Trans Theoretical Model (TTM)

Introduction

One of the consequences of the industrial lifestyle and technological progress in the present century is the mobility shortage and the reduction of the appropriate physical activity in people. Increasing physical activity is one of the most important and effective strategies for reducing the risk of some chronic non-communicable diseases including cardiovascular disease, diabetes, osteoporosis, obesity and some kinds of cancers [1].

Despite the advantages of physical activities, a lot of people do not exercise regularly in many countries including Iran. The investigations conducted in the country have indicated that over 70% of people do not have enough physical activity. Physical activity and exercise is an important health behavior to prevent disease and death, and there is a positive relationship between regular physical activity and the mental and physical promotion [2]. Implementing intervention programs can increase the process of the physical activity. But in this regard, it seems that the effective behavioral interventions are needed for the stability and continuity of the behavior because half of the people who begin the physical activity stop the activity plan in less than six months [3].

The main issue in the physical activity research and programs is the measurement of psycho-social determiners (effective factors) related to the physical activity. These measures can lead to the increase of the active physical behaviors in the behavioral interventions. Aforementioned issue impels the researchers and health care professionals toward the formulation of interventions based on the trans-theoretical models of behavior change to increase the physical activities. Several tools have been made and validated in order to evaluate and measure the effective factors on the physical activity. Norman et al. applied the tools of self-efficacy, social support, balance in decision-making, and change strategies in
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their studies. These tools had been made by American communities and groups and have high rate of reliability and validity. Addressing the physical activity can be promoted in people by passing them from different stages of readiness. The most applied method for this purpose is the trans-theoretical Model (TTM) [4]. The application and the effect of TTM had been reported for the effective planning of the sport intervention in the various studies [5, 6, 7, 8, 9]. This model is derived as the trans-theoretical model from the basic theories of the mental health. "Stages of change" is one dimension of the model which shows the stage of the subject’s readiness for behavior change. "Processes of change" which form another component of the TTM model shows changing of people in each stage of change and includes the behavioral and cognitive strategies that subjects use them for the behavior change. Marcus et al. showed in a research that applying a combination of the stages and processes of change can be a good guide for doing the exercise interventions [10].

Therefore, change processes related to the TTM were selected in order to design interventions in this study while noting that people are at different levels of readiness for addressing physical activity. The present study was performed with the aim of assessing the effect of 12-week training in increasing physical activity and ultimately physical capacity of people with TTM model.

Methods
The present study was a quasi-experimental study which was performed on a headquarters’ employees of one of the governmental centers in 2009. After listing the names of all employees, the number of samples was calculated using the formula of means' comparison. To remove the possible altered variables, subjects were randomly assigned to the experimental and control groups and 60 participants were finally examined (30 subjects in the experimental group and 30 subjects in the control group). The criteria for entering to the study included remaining at least one year to the end of the military service, the required ability for doing the ergometry test (having no cardiovascular problems, arthritis, respiratory problems, etc.), lack of mental disease, disability disease and handicap and ongoing presence and participation in educational programs. Getting satisfaction of the participated employees in the plan, maintaining confidential information, insuring to the studied community regarding the lack of tool use of information and maintaining human dignity were considered as the most primary of the research ethics.

Stages of change in the exercise activities which were the most important applied structure of this model were measured by 5-item Stages of Exercise Change Questionnaire (SECQ) that had been prepared by Marcos et al [10]. The definitions of the aforementioned stages regarding the exercise behavior include five stages as follows:

Pre-thinking or pre-reflective stage (the individual does not exercise and does not have any plan to start it for the next six month), thinking or reflective stage (the individual does not exercise but that he/she is going to start it the next six month), readiness stage (the individual is going to start enough exercising the next month), practice stage (it is less than six months that the individual is exercising sufficiently) and behavior maintenance stage (it is more than six months that the individual is exercising sufficiently).

Enough exercise means any physical or sport activity which has been done at least three times a week about 20 minutes or more, as it causes an increase in the heart or breathing rate or sweating [11].

Questionnaires related to the TTM structure were used in order to evaluate the change processes (cognitive and behavioral) and the balance in decision making [9]. Finally, after the pilot study on 26 subjects from the relevant office employees, the validity of the questions was determined and the final form of questions was defined in each structure. Physical capacity of people was measured by ergoline bicycle, and obtaining the maximum heart rate and the maximum of the work load and the Astrand-Rhyming diagram. Questionnaires related to TTM (stages of change, the balance in decision-making, change processes and self-efficacy in exercising) were completed by the participants before and after the intervention, and the physical capacity of people before and after the intervention (by a device and an individual) were measured.

After doing the pre-test and gathering the basic data, the training group was divided into five groups in accordance with the process of sport activities. Educational methods included lectures, group discussions, training workshops, presenting training booklets and pamphlets regarding the regular physical activity which were done during six sessions of 60 minutes. Training sessions included the following cases:

First and second sessions (joint section): The sessions were held as entitled “What sport brings us”. In these sessions, public training was presented for all subjects (experimental group) especially those in the first stage
(pre-thinking) with the aim of increasing knowledge about the benefits of the exercise activities and risks of the low mobility, increasing individual’s susceptibility to the threats of the disease related to low mobility, creating self-care behaviors associated with physical activity and empowering people for this purpose. In these two sessions, it was tried to increase the individual’s perception about the exercise benefits by encouraging people to think and consider the effect of exercise in the personal life and others. The other objectives of this part of the training was increasing the information level of the individuals and the individual’s understanding of the health concept and its dimensions, and the role of the physical activities in accessing the health and the ways of being physically more active. In the second part of the educational programs, trainings were different with each other in terms of the various stages of the subject’s readiness to address the physical activity. This feature was considered consistent with the main structure of the theory which was concentrated on increasing knowledge and emotional preparation of the subjects for changing and starting exercise in the pre-action stages (pre-thinking, thinking, readiness) and on the required skills to perform and maintain of the regular physical activity in the operating procedures (operation and maintenance).

Third session (the rate of the needed exercise for the physical fitness): In this session, education for the estimation of the needed exercise rate for the physical fitness, physical activity pyramid, enhancement of efficacy and description of a wide range of low-cost or free available options for the physical activity with low, medium and high intensity in accordance the available contents in the booklet were presented.

Fourth session (helping to improve the efficacy of the physical activity levels and increase of people self-efficacy): training of this session was dedicated to the improvement of the physical activity level and the increase of the subject’s efficacy for doing sport activities with the aim of promotion from the lower stages to higher stages (for example, increasing the number of participants from the first and second stages of the physical activity to the fourth stage of the physical activity).

Fifth session (preparing subjects for the sport activities): In this session by understanding of the subjects and environmental barriers for doing the physical activities (via speeches along with the show, questions and answers, practical training of the exercise movements, performance of the Consulting, presence of an aerobic training CD, and presence of a time classification table) and the benefits of the physical activities, short-term goal setting (free time for climbing) and long-term (30 minutes walking five times a week), time management for setting an activity in the schedule (walking on the treadmill while watching TV), the detail of creating walking plans and self-freedom strategies (choice option of the new solutions) were taught by using the change process of TTM.

Sixth session (preserving, maintaining and continuing sport activities): In this session, for preserving, maintaining and continuing sport activities, the needed trainings were done on processes in helping relationships, mutual deserve-making (replacing unhealthy behaviors with healthy behaviors such as relaxation training vs. stress), the strengthening management, the stimulus control (extracting stimulus of unhealthy habit driving and adding healthy choices more quickly, in other words changing the environment in order to create facilities for the healthy behaviors) and the social freedom (knowledge of the good health norms developed by the society) which are a part of the TTM change process and also the focus on problems.

For statistical analysis, T-test, ANOVA and Tukey key test were used in order to measure the behavior change process, self-efficacy, balance and equilibrium in decision making in the experimental and control groups before and after training. Man-Whitney test and Friedman test were used to measure the change processes in the experimental and control groups before and after the training, and T-test was used to measure the index of physical capacity in the experimental and control groups before and after training.

**Results**

The age range of the participants was from 20 to 57 years old with the mean of 39.8 years old. Before the intervention, there was no statistically significant difference among the age, body mass index, educational level, marital status, vehicle possession, smoking of the participants in both experimental and control groups(p>0.05).

More research employees were at the readiness stage, totally 74.9% of subjects were at the pre-action stage (pre-reflective, reflective, readiness) and 25.1% of subjects were at the action stages (action and maintenance) that there was no statistically significant difference between the stages of the sport activities in both experimental and control groups before training. After the implementation of the educational program, more subjects of the experimental group (83.4%) were
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in the readiness and action stages compared with the control group while 6.7% of the experimental group were at the pre-reflective and reflective stages. This proportion was 33.3% in the control group which this difference was statistically significant (Table 1). The other results in relation to change processes showed that there was a positive and significant progress in the trained group after the intervention (df=1, $X^2=16$, $p<0.0005$) while there was no progress in the control group (df=1, $X^2=2.25$, $p=0.134$).

### Table 1 - The statistical indicators of the change processes regarding the performing of the sporting activities in the intervention and control groups before and after training

<table>
<thead>
<tr>
<th>Stage</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-reflective</td>
<td>2</td>
<td>6.7</td>
<td>3</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Reflective</td>
<td>8</td>
<td>26.7</td>
<td>6</td>
<td>20</td>
<td>2</td>
<td>6.7</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Readiness</td>
<td>14</td>
<td>46.6</td>
<td>12</td>
<td>40</td>
<td>17</td>
<td>56.7</td>
<td>14</td>
<td>46.6</td>
</tr>
<tr>
<td>Practice</td>
<td>3</td>
<td>10</td>
<td>4</td>
<td>13.3</td>
<td>6</td>
<td>20</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Maintenance</td>
<td>3</td>
<td>10</td>
<td>5</td>
<td>16.7</td>
<td>5</td>
<td>16.7</td>
<td>5</td>
<td>16.7</td>
</tr>
</tbody>
</table>

Average: 29.3 before, 31.8 three months after intervention. There was no significant difference about the behavior change processes between the experimental and control groups before the intervention ($p>0.05$). There was also no significant difference about the structures of self-efficacy and balance and equilibrium in decision making and the processes of the exercise changes in the experimental and control groups before the intervention ($p>0.05$).

The mean of the whole process of the experimental group before training was 57.1 which this rate had increased to 59.8 three months after completing the course and re-examination, so this increase was statistically significant (Table 2).

### Table 2 - The statistical indicators of the change process regarding the performing of the sporting activities in the intervention and control groups before and after training

<table>
<thead>
<tr>
<th>Stage</th>
<th>Index</th>
<th>Before the intervention</th>
<th>After intervention</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive level</td>
<td>Awareness raising (consciousness raising)</td>
<td>2.97 0.93 3.00 0.91 0.33 -1.000</td>
<td>3.60 2.02 3.60 1.90 0.001 -3.525</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dramatic relief</td>
<td>10.60 2.04 10.73 1.91 0.10 -1.682</td>
<td>6.30 2.02 6.60 1.90 0.001 -3.525</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental re-assessment</td>
<td>4.13 0.97 4.40 0.56 0.03 -2.838</td>
<td>3.43 1.40 4.87 1.46 0.001 -6.573</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social Freedom</td>
<td>6.67 1.02 6.67 0.88 0.01 0.000</td>
<td>2.40 1.07 2.57 0.97 0.23 -2.408</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self reappraisal</td>
<td>13.13 1.94 13.17 1.84 0.33 -1.000</td>
<td>3.80 0.89 3.83 0.83 0.33 -1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>37.5 4.35 37.97 3.84 0.032 -2.249</td>
<td>20.1 1.02 21.83 3.26 0.001 -8.697</td>
<td></td>
</tr>
</tbody>
</table>

Total process: 57.1 before, 6.4 59.8 5.2 0.001 -7.143

In the experimental group, the rate of self-efficacy, balance and equilibrium in decision making and the subjects’ change processes increased significantly after training (Table 3). There was no significant difference
in the mean of balance and equilibrium in decision making in the control group before and after training, but there was a significant difference in the rate of efficacy and the change process of the subjects after three months (Table 4).

### Table 4 - Statistical indicators of self-efficacy, balance and equilibrium in decision-making and change process in the control group before and after training

<table>
<thead>
<tr>
<th>Stage Process</th>
<th>Before intervention Mean</th>
<th>Before intervention SD</th>
<th>After intervention Mean</th>
<th>After intervention SD</th>
<th>p value</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance and equilibrium in decision-making</td>
<td>74.2</td>
<td>7.2</td>
<td>74</td>
<td>7.1</td>
<td>0.257</td>
<td>3.113</td>
</tr>
<tr>
<td>Process of change</td>
<td>57.0</td>
<td>12.2</td>
<td>55.8</td>
<td>11.8</td>
<td>0.003</td>
<td>3.303</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>28.1</td>
<td>9.8</td>
<td>27.2</td>
<td>10</td>
<td>0.0001</td>
<td>-7</td>
</tr>
</tbody>
</table>

The mean rate of the physical capacity increased significantly in the experimental group after completing the educational course. But the rate was reduced in the control group after three months which was not statistically significant (Table 5).

### Table 5- Indicator of physical power in the intervention and control groups before and after training (VO2Max)

<table>
<thead>
<tr>
<th>Stage Group</th>
<th>Before intervention Mean</th>
<th>Before intervention SD</th>
<th>After intervention Mean</th>
<th>After intervention SD</th>
<th>p Paired value</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>13.4</td>
<td>2.6</td>
<td>15</td>
<td>2.4</td>
<td>0.016</td>
<td>-2.481</td>
</tr>
<tr>
<td>Control</td>
<td>14.5</td>
<td>2.2</td>
<td>14.2</td>
<td>2.3</td>
<td>0.593</td>
<td>0.538</td>
</tr>
</tbody>
</table>

**Discussion**

In this study, the physical exercise stage had a statistically significant relationship with the whole TTM processes i.e. behavioral and cognitive processes, self-efficacy and, and balance and equilibrium in doing sport activities. And this rate was more in the self-efficacy and behavioral process which this result was consistent with the TTM theory. According to this theory, people who are at the higher stages of exercise activities have more self-efficacy and the cognitive processes are also used more for the motion in the higher stages of exercise activities [12]. Accordingly, providing educational programs to enhance the subjects’ self-efficacy regarding sport activities as well as providing more educational programs in order to increase behavioral processes in the subjects was considered.

In this study, the progress in the change processes was considered as one criterion of the intervention success. The statistical results of Man-Whitney test showed that there was no significant difference in the pre-test of the change processes of the exercise activities in both experimental and control groups before training. But after implementing the educational program, the experimental group showed a progress in the change processes and a promotion of the physical activities compared to the control group that it indicated the effect of the educational intervention. Therefore, increasing the number of participants of the experimental group in the readiness and action stages at the end of the common educational program could be related to the used educational strategies in the aforementioned stage. Molaison and Yadrick studied 216 dialysis patients about using the fluids with the TTM application and evaluating its effect after three months and found that the readiness for change and the knowledge of the proper weight maintenance in the experimental group were improved (compared with the control group of 100 patients) which it was consistent with the results of this research. And based on the structure of change processes, this point showed that the educational programs could improve the individuals’ progress during the stages of behavior change [13]. Based on the studies accomplished using the TTM model, when the non-active person in doing exercise moves from the pre-operative stages to the operative and behavioral maintenance stages, the rate of his self-efficacy will be increased [10].

The present study showed a significant relationship between self-efficacy and 5 stages of the behavior change. Based on the obtained results, it was observed that the rate of all these structures had been increased along with the individuals’ progress during five stages of behavior change from the pre-reflective stage to the maintenance stage, so that the highest mean of the self-efficacy was in the maintenance stage and the lowest one was in the pre-reflective stage. These results were consistent with the studies of Dumith [14], Tung [15], Lee [16] and Wakui [17]. Karimzadeh Shirazi et al., in their study which was conducted on promoting the physical activity of Shiraz elderly women for preventing the osteoporosis, found that the mean of the subjects’ self-efficacy for doing the sport activities in the higher stages of change (action) was higher than the mean of the subjects self-efficacy in the lower stages (pre-practice) [9] which was similar to the findings of this study. One reason of the higher self-efficacy of subjects in the action and maintenance stages compared to the pre-action stages was that subjects in the pre-action stages did not still have the experience of being active in terms of exercise and did not believe to its relationship with more efficiency in the life. The subjects who were
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looking for the information about the sports also had more confidence to participate in sport programs regularly.

Kim in his study which was conducted in 2006 in South Korea for the determination of exercise behavior on 1335 adults reported that the self-efficacy was significantly higher in individuals who were at the action and maintenance stages of the physical activities than those who were at the pre-reflective, reflective, and readiness stages [18] that it was consistent with the findings of this study. These results were also similar to the findings of Prapavessis et al. in New Zealand in 2004 [19]. The results of this study about the self-efficacy of the sport activity showed that the subjects’ self-efficacy increased significantly for doing sport activities after the educational intervention and also the subjects’ self-efficacy increased with improving the stage of their change. Of course it is not clear whether the increase of the self-efficacy is an effect of doing exercise or a cause for doing that? According to the findings of Bandura, the self-efficacy is the most powerful structure in the prediction of behavior change in the person [20]. In this regard, he states that since one of the most powerful tools to increase the self-efficacy is the domination on doing behaviors, therefore there is the possibility that changes of the self-efficacy will occur following the successful and active participation of individuals in sport. However, the analytical findings raise this point that the self-efficacy may play an agent role for the behavior change because people who usually show the highest behavior change had initially a higher level of self-efficacy for doing behavior [21].

Based on the processes of change, providing appropriate information for people (giving knowledge) in the pre-reflective stage is an effective solution to help them to enter to the reflective stage, because individuals who are at the pre-reflective stage do not often notice that the lack of exercise activities is the result of low mobility. Therefore, doing intervention in the pre-reflective stage, giving knowledge to people in this area and making them interested to the exercise activities are as the most important point for guiding people to the higher stages. Prapavessis et al. who conducted a study on the exercise behavior of the New Zealand adolescents by the TTM model in 2004 reported that there was a significant effect on the process of knowledge-raising in entering people from the initial stages of the exercise behavior change to the higher stages i.e., action and the maintenance of the desired behavior [19] which it was consistent with the results of this study. Other studies also show a positive relationship between the knowledge and stages of change [9, 13, 22, 23]. The interesting point in the structure of processes of change is that interventions can be consistent with the levels of individuals’ readiness for changing their behavior. Researches have shown that many consistent interventions with people were more effective compared with the public interventions and had been achieved to the change of behavior more rapidly [24]. Programs of knowledge-raising such as doing lectures on the benefits of exercise activities for people in the reflective and readiness stages were very helpful and can also stimulate them to enter to the action process [25].

Regarding the processes associated with the physical activities, it was considered that the experimental group had significantly used the environmental or behavioral processes more than control groups after the intervention. The increase of using the processes of change in those who were at the pre-reflective stage might be a useful tool for improving their process of change. Plotnikoff et al. also reported the similar results in this regard [8]. According to the results of similar studies, the role of environmental or behavioral processes from processes of change for the prediction of passing people during the process of change was more significant from the cognitive or experimental processes [8, 9, 10]. In this regard, in the studies of Prapavessis, two behavior processes "confrontation conditioning" and "self-freedom" were the predictor of the exercise behavior changes [19].

Based on the results obtained in the basic assessment, low levels of the physical activities were evident in both groups. But the performance of the experimental group increased significantly after 12 weeks of educational program. Increasing the number of participants in the action stages could directly indicate the high adherence of subjects in the prescribed training and exercise. This fact could also effect on the previous development of subjects in the stages of change which happened following the common curriculum. Woods et al. in their study on sedentary adults in 2002 evaluated the effect of the educational program based on the TTM by self-learning method and reported improving the processes of change and stages of change in the experimental group and concluded that sending training messages entitled "Life with mobility" and presenting the educational programs based on self-learning in sedentary adults were a cheap, suitable and effective method in helping them to progress towards higher stages of the physical activities based on this theory. They also found that helping people to pass from one stage only can double the chance of their success for providing the behavior change in the near future [26]. The mentioned findings
were consistent with the results of this study. The results of this study indicated that the available processes of change in the TTM model caused the improvement of the sport activities and the increase of physical capacity and self-efficacy in subjects. It seemed that training based on the TTM model could cause an increase in such skills including the promotion of the physical activities in the same age range. The participation of the employees in the various stages of research could also cause the health promotion of the employees in the workplace. Providing sport activities at home or at work is very practical and desirable for many people because they can do exercise any time or in any opportunity and without a compliance for observing the classic sport program and make aligned their goals with their programs and conditions. This issue can have more importance in the developing countries with the weak support resources, limited social networks and the high cost for paying to the sports. It is recommended that the behavior models and theories will be used in designing researches about the behavior change in the area of health and also the application of the other models of the educational curriculum such as the behavioral intention models, Beznov and precede-proceed model (the software agents and social networks are involved in preventing and promoting behaviors of the health) will be also investigated, so more studies are needed in this regard. And during applying the models of behavior change, it should also be considered that which components and structures of the model have the priority regarding to the issue and target population. This study is a unique research because in addition to the interventions and process measurements and process of model changes, the physical capacity of the subjects was controlled before and after the intervention by the ergoline bicycle as the quantity. Therefore, this measurement can be an effective intervention technique for promoting and maintaining the sport activities as well as a progress criterion. This study had some limitations such as research in the military situation and special conditions of such areas and the employees’ business and lack of female participated employees in this study. It is recommended that these points will be considered in the further studies.

Conclusion
Exercise educational programs based on the TTM can increase the passing of subjects from the initial stages of exercise behavior change to the higher stages. Thus, to continue and maintain the health behavior in the long run, the intervention (e.g., this method) may be necessary for the development of the sport activities.

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