

# Physical activity stage-matched intervention: Promoting metabolic control in type 2 diabetes

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## ABSTRACT

**Background:** Regular physical activity has an important role in reducing cardiovascular risk factors and improving metabolic control in patients with type 2 diabetes. This study aims to investigate the effect of physical activity stage-matched intervention on metabolic control in type 2 diabetes patients.

**Materials and Methods:** An 8-week physical activity program conducted with 50 type 2 diabetes females who were physically inactive and in precontemplation, contemplation, and preparation stages of change. Participants were divided into intervention and control groups (each group,  $n = 25$ ). Data were collected by physical activity stage of change questionnaire and metabolic factors were measured by laboratory tests before initiation program. Subsequently, stage-matched physical activity program was conducted for the interventional group. Control group received routine education from the diabetes center. After 8 weeks, physical activity questionnaire filled out by participants and metabolic factors were evaluated by a laboratory test. **Results:** Findings showed patients in the intervention group and compared with control group significantly moved through stages of change after physical activity program ( $P$ -value  $< 0.05$ ). Evaluation of physical activity after educational program demonstrated that the intervention group adopted regular physical activity more than the control group and also the difference between groups was significant ( $P$ -value  $< 0.05$ ). Our findings indicate a significant relationship between physical activity level and moving in stages of change in the intervention group ( $P$ -value  $< 0.05$ ). Comparison of metabolism factors after physical activity program showed significant decrease in glycosylated hemoglobin in the intervention group than the control group ( $P$ -value  $< 0.05$ ). However, significant differences between groups were not observed in other metabolism factors. **Conclusion:** Designing and implementing physical activity stage-matched intervention can improve metabolic control and management of type 2 diabetes.

**Key words:** Metabolic control, physical activity, stage of change, type 2 diabetes

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## INTRODUCTION

Regular physical activity is an important strategy to improve glycemic control and reduce cardiovascular risk factors in people with type 2 diabetes.<sup>[1,2]</sup> Systematic reviews found that aerobic exercise such as walking, jogging, and gardening reduced the hemoglobin A1c value by about 0.6%.<sup>[3]</sup>

Many studies showed that diabetes mellitus is a major risk factor for cardiovascular disease (CVD). Mortality associated with CVD in people with type 2 diabetes is significantly higher than in nondiabetes people. Dyslipidemia in diabetes mellitus

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can include all the types of dyslipidemia identified in the general population. These metabolic factors are high plasma triglyceride, low high-density lipoprotein (HDL)-cholesterol, and increase in small dense low-density lipoprotein (LDL)-cholesterol particles.<sup>[4,5]</sup>

Physical activity interventions for people with type 2 diabetes have frequently been based on the transtheoretical model (TTM). The model proposes that exercise behavior change is a dynamic process, in which individuals progress or relapse between five main stages.<sup>[6]</sup>

The five stages of motivational readiness to change are precontemplation, contemplation, preparation, action, and maintenance. For example, a person who is not even thinking about increasing his physical activity is considered to be in the precontemplation stage. If the person is thinking about becoming more active but has not taken any actual steps toward that goal is considered to be in the contemplation stage. In preparation, the person is engaging in some physical activity, but not yet meeting the national guidelines of physical activity.<sup>[7,8]</sup>

Other clients may be exercising regularly (action) and can be considered in maintenance once regularly active for at least 6 months. It is important to note that this model is considered cyclical as people tend to move back and forth through these stages of change.<sup>[9]</sup>

## MATERIALS AND METHODS

We conducted an 8-week physical activity program with 50 type 2 diabetes female patients and referred to diabetes research center in Hamadan. Patients who were physically inactive and in precontemplation, contemplation, and preparation stages were selected and divided into intervention and control groups (25 participants in each group). Data were collected using physical activity stage of change questionnaire and measuring of the metabolic factors including HbA1C, HDL, LDL, total cholesterol, and triglycerides (TGs) by laboratory tests. After need assessment from participants and determination of physical activity stage of change, stage-matched physical activity program was conducted for interventional group but control group were not educated about regular physical activity.

The questionnaire included two parts: First part assessed demographic variables of patients such as age, weight, height, marital status, job, education, and membership in a sport club. Second part was Marcus' algorithm (with Yes/No answers) physical activity stage of change.<sup>[10]</sup>

Physical activity program were conducted in two steps for patients. First, patients were educated about physical activity by attending three-session educational programs. We applied several methods in these sessions such as lecturing, question and answer meetings, group discussion, and providing pamphlet and handout educational booklets. Sessions related to 'benefits of regular physical activity', 'importance of

planning in physical activity', and introduction to amplifiers of regular physical activity. After educational session, physical activity compact disks were given to participants. Second, stage-matched physical activity program was planned for 8 weeks (three sessions per week) in the women's sport garden. Effectiveness of educational intervention was evaluated using international physical activity questionnaire (IPAQ), physical activity stage of change algorithm, and laboratory tests of metabolic factors after 3-month follow-up. Finally, data were entered into SPSS software version 16 and analyzed using one-sample *t*-test, Chi-square, Fisher's exact test, Mann-Whitney, Wilcoxon, Kruskal-Wallis, and Friedman tests.

## RESULTS

The age range of the participants was 35–60 years with a mean age of 50.7 years. Measurements of body mass index (BMI) showed that 16% of participants had standard BMI, 2% were underweight, and 82% had nonstandard BMI (overweight and obese).

Investigation of physical activity stage of change in both groups before intervention showed that 14 patients (28%) were in the precontemplation, 21 (42%) in the contemplation, and 15 (30%) in the preparation stages of change. No significant differences were found between the groups before educational intervention (*P*-value > 0.05). Our findings showed no significant differences in metabolic factors between both the intervention and the control groups before education.

After the physical activity program, the mean of metabolism factors had decreased in the intervention group. Therefore, the reduction in glycosilated hemoglobin, HDL, LDL, and cholesterol was significant compared with that before the educational program (*P*-value < 0.05). However, significant decrease in TG levels was not found [Table 1]. Comparison of metabolism factors after physical activity program showed significant decrease in glycosilated hemoglobin in the intervention group than in the control group (*P*-value < 0.05). However, significant differences between groups were not observed in other metabolism factors.

The finding of physical activity stage of change showed patients in the intervention group significantly moved through stages of change in physical activity after educational program (*P*-value <0.05) than those in the control group.

**Table 1: Comparison of metabolic factors before and after educational intervention in intervention group**

Wilcoxon Asymp. Sig. (2-tailed)	Z	After education		Before education		Group Metabolic factor
		St.dev	Mean	St.dev	Mean	
0.211	-1.251	92.28	193	120.35	179	TG
0.021	-2.316	48.91	193	44.13	176	Cholesterol
0.001	-3.218	2.75	41.64	5.26	38.12	HDL
0.04	-1.475	51.91	113	35.94	102	LDL
0.019	-2.355	1.3	8.16	0.8	7.5	HbA1C

Before implementing the educational program all patients were physically inactive. Evaluation of physical activity after educational program in the control group showed that 22 (88%) patients had low-intensity physical activity and 3 patients (12%) had moderate-intensity physical activity, whereas in the intervention group, 11 (44%) patients had low-intensity physical activity, 10 patients (40%) had moderate-intensity physical activity, and 4 patients (16%) had vigorous physical activity. Hence the difference between the groups in regular physical activity was statistically significant ( $P$ -value  $<0.05$ ).

Findings indicate a significant relationship between physical activity intensity and moving in stage of change ( $P$ -value  $< 0.05$ ). Findings showed that patients with low-intensity physical activity (physical inactivity) were in the early stages of change and those with moderate intensity or vigorous physical activity were in the final stages [Table 2].

### DISCUSSION

Considering the importance of BMI in diabetes management and its role in the development of CVD risk factors, majority of these patients had nonnormal BMI and 82% of them were overweight and obese. Maori *et al.* reported abnormal BMI (overweight and obese) in diabetes patients in a population study.<sup>[3]</sup> Our findings are consistent with their study.

After 3 months, metabolic control improved in the intervention group than in the control group [Table 1]. Sigal *et al.* did not find significant differences in levels of TG, cholesterol, HDL, and LDL after 22 weeks' physical activity intervention. Only significant decrease in glycosylated hemoglobin has been reported.<sup>[11]</sup> This may be due to other factors that affect blood lipids, such as nutrition and eating habits. Long-term physical activity program should be followed to reduce blood lipid profile; however, the decrease in lipid profile was not significant.

Kevin and Hughes investigated the impact of educational program in preparation for changes in diabetes patients and have reported significant reduction in glycosylated hemoglobin.<sup>[12]</sup> Allen,<sup>[13]</sup> Kim,<sup>[14]</sup> and Kirk,<sup>[1]</sup> in similar studies, report significant reduction in glycosylated hemoglobin after 3–6 months of physical activity program. The results of the present study are consistent with their studies.

**Table 2: Relationship between stage of change and physical activity level after educational program in intervention group**

High	Moderate	Low	Physical activity Stage of change
0	0	7	Precontemplation
0	0	2	Contemplation
0	3	2	Preparation
4	7	0	Action
4	10	11	Total

Fisher's Exact Test: Exact Sig. (2-tailed) = 0.000.

According to the TTM, participation in educational interventions can improve health status and behavior. When a person is changing, he/she passes through a series of steps that can be progressive, backward, or rotative.

After 3 months of educational intervention, 4% of the patients in control group entered action stage and 44% in intervention group entered action stage. Findorff *et al.* studied 272 women during 28 weeks and 1 year follow-up training program based on stages of change model and showed positive impact of educational program in transition participants from early to late stages of change. After 1 year follow up, 83% in the intervention group and 17% in the control group were in action and maintenance stages.<sup>[15]</sup> In addition, our findings are consistent with the Shirazi *et al.* study of Iranian women with osteoporosis.<sup>[10]</sup> In our study, transition of patients in early stage to late stage could be related to educational strategies used. Stage of change is based on the hypothesis that educational programs can improve people through stage of change.<sup>[16]</sup>

Regular physical activity is strongly associated with metabolic control improvement, reduction in CVD risk factors, and increasing quality of life in type 2 diabetes patients. In addition, to maintain and improve general health, diabetes patients must participate in moderate-intensity physical activity for five sessions per week for at least 30 minutes. However, 80% of type 2 diabetes patients are not physically active and the rate of relapse is higher than in normal population. Although, diabetes patients have reported that they received less support, education, and encouragement than others.<sup>[1]</sup>

According to our findings, educational program show a great impact on physical activity level in the intervention group, that is, 56% have at least moderate-intensity physical activity. Several studies have confirmed our findings. Kirk *et al.* studies on inactive diabetes patients showed significant differences in physical activity between intervention and control groups.<sup>[7]</sup> Allen *et al.* reported significant increase in physical activity level after 8 weeks of physical activity program based on the theory of self-efficacy.

According to the TTM, adoption of healthy behavior increased with progress in stage of change. Findings of our study indicate a positive relationship between physical activity level and stage of change. These findings are consistent with the Kim *et al.*<sup>[14]</sup> and Kirk *et al.*<sup>[1]</sup> studies on physical activity promotion and progression in stages of change.

### CONCLUSION

Design and implementation of physical activity intervention can promote metabolic control in diabetes patients and help them cope with diabetes.

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