

## The effect of Pilates exercises on general health in women with type 2 diabetes

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**Abstract:** There is a lot of evidence that proves exercise therapy as an effective method to improve general health in patients with type 2 diabetes. One of these methods that has recently drawn exercise experts and physiotherapists' attention toward itself and extensively been expanding is Pilates exercise. The present study was aimed at determining the effect of Pilates exercises on general health in woman patients with type 2 diabetes. **Materials and Method:** In this clinical trial study, 70 women suffering from type 2 diabetes were randomly divided into an experimental group (35 patients) and a control group (35 patients). A demographic information questionnaire and a general health one (GHQ28) were utilized to collect the required data. First, general health in both groups was measured before the intervention. Then, modified Pilates exercises were carried out in the experimental group twice a week over a period of 8 weeks. During the same period, the control group received conventional medications. Afterwards, general health in both groups was measured again. Finally, the collected data were analyzed through SPSS 17.0 software. Data analysis was carried out through Independent and Paired samples t-tests and chi-square test. **Results:** Mean health score in the experimental and the control groups were respectively  $43.07 \pm 11.72$  and  $29.6 \pm 12.43$ . In this regard, Independent samples t-test proved a significant difference ( $p=0.003$ ). There was also a significant mean difference between both groups' health aspects including physical symptoms ( $p=0.01$ ), anxiety ( $p=0.003$ ), social dysfunction ( $p=0.001$ ), and depression ( $p=0.04$ ) before and after the intervention. **Conclusion:** According to the findings of this study, it is concluded that Pilates exercises can be utilized as an effective and safe method to improve general health in patients with type 2 diabetes. The results introduced Pilates exercises as an effective method for patients with type 2 diabetes.

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**Keyword:** Pilates exercises; general health; type 2 diabetes

### Introduction

Type 2 diabetes is a chronic disease is spreading all around the world with an alarming rate. Environmental factors and genetic agents such as inactivity, type of diet, family history, resistance against insulin, and malfunction of beta cells are effective in occurrence of the disease [1]. Increasing prevalence of obesity, changes in life style, and inactivity are considered as the most important factors in appearance of type 2 diabetes and its complications [2]. Diabetes is associated with various complications. Its short-term complications include hypoglycemia and hyperglycemia. Its long-term complications are caused by chronic increase in blood sugar level [3]. Patients with diabetes have different problems accomplishing their everyday activities. In addition to physical difficulties, some studies reported high levels of emotional problems that diabetes patients experience. These problems include depression, anxiety, aggression, and so on [4]. Their social and psychological problems may be due to limitations in their diet and activities, need for

constant and meticulous self-care, and occurrence of serious physical complications like problems of kidney, heart, and brain [5]. Nowadays, knowledge, control of diabetes complications, diet, medication, and physical activities are principles to control diabetes, among which physical activities are associated with low costs and a non-medicine nature [6]. Some scholars believe that regular physical activities play a key role in managing type 2 diabetes; especially in controlling glycaemia, modifying cardiovascular danger factors, increasing sensitivity to insulin, reducing they body fat and blood pressure, and improving anxiety level and general health [7]. On the other hand, some other believe that it cannot be claimed that all types of physical activity decrease anxiety in individuals but it is dependent on the type of physical activity [8]. Research has showed that decrease in anxiety reduces cortisol secretion in responding to stress through affecting hypothalamus-pituitary-adrenal axis. Since cortisol enhances blood sugar production and decreases its consumption in body tissues through affecting kidney, it seems that

such experiments reduce cortisol secretion and control diabetes patients' blood sugar better. Moreover, by intensifying behavioral changes and discontinuation of medical-care diets, excitement stress can influence the level of blood sugar indirectly. In order to reducing excitement problems can provide diabetes patients with better control ability over blood sugar. Besides, by controlling their blood sugar more properly, these patients will become more hopeful and deal more combatively with anxiety and worry caused by physical complications and social problem pertinent to diabetes [9]. Sports and rehabilitation experts have recently introduced Pilates exercise as one of sports methods which is spreading fast [9 & 10]. This exercise was invented in 1880 by Joseph Pilates. It includes a set of specific exercises that engage the body and the brain in a way that affect the body's strength, flexibility, and resistance. Unlike most other exercises that only focus on the individual's physical aspects, Pilates exercises consider not only the individuals' physical dimension but also their mental aspects and they are based on balance between body and mind, which results in the individual's mental and physical health [11]. Health definition regards both aspects together. According to this definition, health means lack of disease and defect in each of these aspects [12]. Joseph Pilates introduced 6 main principles in Pilates exercises: peace, concentration, attention, harmony, movement, and breath [8]. This method is based on exercises that include different standing states (lying, sitting, and standing) and without traveling, jumping, and leaping. Therefore, the advantage of Pilates exercises is that doing these exercises reduces the risk of joint and muscle damages caused by jumping movements and they are possible to perform in any place (home, work place, outdoors, indoors, etc.) and by all individuals like elderly ones [13]. Since sports damages are critically important in diabetes patients, Pilates can be an appropriate exercise for them.

The results of Ferreira's study in the US entitled, "Effects of Pilates-based exercise on life satisfaction, physical self-concept and health status in adult women" showed that Pilates exercises could enhance individuals' general health and physical state [14]. Rodrigues (2010) has investigated the effects of Pilates exercises on mental health in old women and concluded that doing such exercises for a period of 8 weeks could influence mental health and anxiety reduction [10]. However, the results of Segal's (2004) study showed that Pilates exercises would not affect general and physical health in men and women over 18 [15]. In Australia, Kuo (2009) also showed that doing Pilates exercises for ten weeks would not influence physical and mental health in individuals

over sixty [16]. Due to high degree of diabetes prevalence, its chronic nature, lack of sufficient studies on the effects of Pilates exercises on Iranian diabetes patients, and contradictions about needed time to study the effects of Pilates exercises on general health, the researchers decided to investigate the effects of Pilates exercises on general health in women with type 2 diabetes.

### Materials and Method

The present study is a clinical trial one. Subjects were consisted of 70 women suffering from type 2 diabetes who referred to diabetes center of Kashan and met required qualifications to enter the study. Selecting female patients as the subjects was due to the fact that there was a female trainer; moreover, cultural obstacles inholding co-sexual exercise classes caused not to choose male patients. First, 100 patients were selected in a purpose-oriented method, thirty of whom did not have required criteria to enter the study; therefore, they were crossed out of the study. The rest 70 patients were randomly divided into a control group (35 individuals) and an experimental one (35 individuals). The two groups were homogenized in terms of their age and medicine. In order to select the subjects randomly, patients' list was retrieved from the diabetes center and they were divided into two groups through a table of random figures. Criteria to enter the study included feminine, age between 30 and 70, blood sugar diagnosis by an endocrinologist, patient's permission issued by her doctor to do the exercises, lack of structural disorder in spinal column, more than one year experience of type 2 diabetes, lack of psychic diseases, dementia, and mental retardation. Criteria to exit the study included occurrence of any diabetes complication that prevented the patients from doing the exercises, more than 2 sessions of absence from training classes, and the individual's unwillingness to participate in the study. Before the study, study purpose and its phases were explained to the subjects and their consent was the main criterion for them to enter the study. They were also made sure that their personal information would be quite confidential. Questionnaires were filled out through interviewing or self-reporting for patients who were not able to complete the questionnaires. After the study, the results were delivered to the groups. Some months before the study, the researcher had counseled with a sports expert and learned and mastered in techniques of Pilates exercise. First, both groups filled out demographic information form (including age, marriage, occupation, duration of diabetes suffrage) and general health questionnaire GHQ28. Afterwards, the experimental group were provided

with both conventional medications and modified program of Pilates exercises twice a week over 8 weeks. Each session lasted 60 minutes [10]. In the first session, basic principles of Pilates exercises were explained and general information on them was provided to the experimental group. In the beginning of each session, class preliminaries such as checking body state (pelvis and spinal column), controlling breath, and standing posture in Pilates classes were taught. Then, stretching exercises (about 5 minutes), Pilates exercises (about 50 minutes), and cooling down and returning to the initial state (about 5 minutes) were carried out. Number of exercises began with 10 repetitions in first sessions and in last sessions they reached 70-80 repetitions.

According to the literature, Pilates exercises were carried out in two phases. In the first four weeks, exercises were done on mats and in the last four weeks they were accomplished in standing posture [17]. Every session, in addition to doing the previous exercises, new ones were added. This issue; on one hand, motivated the subjects and on the other hand keeps the addition principle in the exercises [18]. The researcher showed each exercise and then to get sure about learning explained, performed, and repeated it with help of one of the patients. Finally patients' performance was supervised by the researcher and they were provided with necessary guidance. In addition, all of the exercises were taught slowly and in a controlled way in order to facilitate learning process. Exercises began from a low stage and moved through higher levels as the subjects were progressing. Exercises began in lying posture, moved to sitting state, and ended in standing position. Progress rate was left up to the subjects so that they were asked to continue the exercises until they felt comfortable and not hurt. Moreover, a break of about 30 seconds was provided between every two exercises. Whenever the subjects lost their control or were not able to perform the technique correctly, they were asked to return the last stage and begin anew. Considering this issue helped to pay attention to individual differences between the subjects and prevent their frustration. They were required to bring with them some simple carbohydrates such as chocolate or fruit in order to eat in case their blood sugar dropped. They were also asked to have a complete breakfast in the morning before their class. The control group; however, did not do any Pilates exercises. They just received the conventional medications. In order to prevent the sample from decreasing during the exercises and also to motivate the subjects, exercises were carried out in groups and no charges were received from the patients. In the end of the last session of Pilates exercises, the general health questionnaire was filled out by both

groups once more. This questionnaire was developed by Goldberg [19] and standardized by Homman [20]. It is utilized for non-psychotic mental disorders and also for minor mental disorders in health populations. This questionnaire has four subscales which are respectively physical symptoms, anxiety, social dysfunction, and depression. Each of these scales includes 7 questions. Its scoring is based on Likert scale from 0 (more than ever) to 3 (worse than ever). Score 23 and more means lack of mental health and scores under 23 shows mental health [21]. In a study, Taghavi measured the questionnaire's reliability for use in Iran in 3 ways of re-measuring, bi-sectioning, and Chronbach's alpha and reported them as 0.70, 0.93, and 0.90, respectively. Therefore, it is qualified to be utilized in psychiatric studies and clinical research [22]. Finally, collected data were analyzed through Independent and Paired samples t-tests and chi-square test using SPSS 16.0 software.

### Results

The results of the study showed that 31.7% and 34.4% of the patients aged 41-50 in the experimental and control groups, respectively. And, 34.3% of the experimental group and 40% of the control group were married. The results showed that there was not a significant difference between the two groups regarding their demographic information (See Table 1). As table above shows, the experimental group's physical symptoms before the intervention was  $12.43 \pm 2.11$  that reached  $4.34 \pm 1.81$  after the study, which proved a significant difference ( $P=0.001$ ) while in the control group these physical symptoms did not have a significant difference before and after the experiment ( $P=0.23$ ) (See Table 2).

As Table 3 shows the mean difference of physical symptoms in diabetes patients before and after the study in the experimental and control groups were respectively  $8.09 \pm 0.30$  and  $0.26 \pm 0.4$ . Independent samples t-test proved a significant difference between the two groups ( $P=0.01$ ). According to Table 2, it can be concluded that the general health mean score in the experimental group was  $43.07 \pm 11.72$  and in the control group was  $29.6 \pm 12.43$ . In this regard, Independent samples t-test also showed a significant difference ( $P=0.003$ ).

### Discussion

The results of the present study showed that after intervention there was a significant difference between the experimental and the control groups' general health. Rodrigues (2010) conducted a study entitled, "Pilates method in personal autonomy, static balance and quality of life of elderly females" in Brazil. In this study, there were 53 old women who

Table 1. Demographic Information of Diabetes Women of both Groups Participating in the Study

Groups Demographic Information		Experimental Number (%)	Control Number (%)	Statistics Test p-value
Age	30-40	9(25.7)	8(22.9)	P = 0.2
	41-50	13(37.1)	12(34.3)	
	51-60	9(25.7)	9(25.7)	
	61-70	4(11.4)	6(17.1)	
Marriage	Single	8(22.9)	4(11.4)	P = 0.14
	Married	12(34.3)	14(40)	
	Widow	8(22.9)	12(34.3)	
	Divorced	7(20)	5(14.3)	
Occupation	Jobless	9(25.7)	7(20)	P=0.3
	Housekeeper	8(22.9)	5(14.3)	
	Self-employed	7(20)	7(20)	
	Office Worker	5(14.3)	8(22.9)	
	Retired	6(17.1)	8(22.9)	
Diabetes Suffrage Duration	1-5	9(25.7)	11(31.4)	P = 0.28
	6-10	13(37.1)	14(40)	
	Over 10	13(37.1)	10(28.5)	

Table 2. Comparing Mean Scores of General Health Dimensions before and after the Study in both Groups

Groups General Health Dimensions	Experimental Mean±SD		Paired t-test p-value	Control Mean±SD		Paired t-test p-value
	Before	After		Before	After	
	Physical Symptoms	43.12±2.11		4.34±1.81	P=0.001	
Anxiety	10.97±2.05	5.89±2.20	P=0.04	10.63±3.29	10.71±2.57	P=0.11
Social Dysfunction	13.03±2.32	6.17±2.16	P=0.02	12.37±3.51	11.54±2.86	P=0.50
Depression	11.09±2.65	6.37±2.01	P=0.01	11.46±2.91	11.29±2.97	P=0.47
Total Score of General Health	47.25±9.14	22.77±8.18	P=0.002	46.62±12.88	45.48±11.1	P=0.24

Table 3: Comparing the mean differences of general health dimensions in diabetic patients at start and the end of the study

Groups General Health Dimensions	Experimental Mean±SD	Control Mean±SD	Statistics Test p-value
Physical Symptoms	8.09±0.30	0.26±0.4	P=0.01
Anxiety	5.08±0.1	-0.08±0.72	P=0.003
Social Dysfunction	6.86±0.1	0.69±0.65	P=0.001
Depression	4.27±0.63	0.17±0.3	P=0.04
Total Score of General Health	22.77±8.18	29.6±12.43	P=0.003

\*The mean differences defined by the mean scores of public health dimensions at the end of the study minus the mean scores of public health dimensions at the start of study.

did Pilates exercises twice a week over a period of 8 weeks. Each session was 60 minutes. Finally, it was concluded that Pilates exercises in the mentioned period had a good effect on elderly patients' mental health and life quality [10]. Ferreira (2011) investigated, "Effects of Pilates-based exercise on life satisfaction, physical self-concept and health status in adult women". The results of this study indicated that Pilates exercises in the experimental group enhanced general health and physical state after 3 months of exercise [14]. These studies are in agreement with the present one.

Vieira (2013) conducted a research entitled, "the effect of Pilates exercises on the healthy individuals'

life quality" in Brazil. The results of this study showed that Pilates exercises could improve physical state, general health, mental health, and finally life quality after 3 months [23]. This study is also in line with the current one. The results of Segal's (2004) study; however, showed that Pilates exercises would not influence over 18-year-old men and women's physical state and general health during a period of 6 months and one hour a week. Criteria such as intensity of the exercises, subjects' age, and number of sessions can be among the reasons for such differences. In the study conducted by Segal *et al*, sessions were held one a week and subjects were middle-aged women who did not attend the classes

regularly and also there was no control group [15]. Therefore, this study is not in agreement with this one. Kuo (2009) in Australia showed that doing Pilates exercises over 10 weeks, twice a week, in 20-minute sessions did not influence physical and mental health in over 60-year-old individuals [16]. The reasons for this contradiction seem to be the fact that elderly people's body is weaker than youths', it responds to exercises later, and it needs more time to reach appropriate results.

Physical symptoms are the most important dimensions in general health that improved through Pilates exercises. Studies show that deep and diaphragmatic breathing increases level of energy consumption during exercising because not only active muscles are involved but also breathing muscles are engaged and they consume more energy. On the other hand, deep and diaphragmatic breathing causes better and more oxygen supply to active muscles [25]. Moreover, studies show that through deep breathing and more oxygen supply to the body, level of sensitivity to insulin in individuals rises and there is no need for extra insulin secretion [26]. Depression and anxiety are among dimensions of general health, which have reduced in these patients through Pilates exercises. Studies show that deep and diaphragmatic breathing in Pilates exercises controls emotional stress whereby sympathetic nerve activity reduces, which is effective in improving most symptoms pertinent to health and reducing anxiety [27]. Social dysfunction is another dimension of general health, which improves in the studied diabetes patients through Pilates exercises. Studies show that because of group exercises, participation in Pilates classes results in better social interaction, satisfaction, and individuals' responses. This can be due to the interaction between the patient, the therapist, and other patients during exercises [28].

### Conclusion

The results of the study showed that doing Pilates exercises by type 2 diabetes patients can enhance their general health. Therefore, it is recommended that these exercises should be utilized as a complementary medicine in order to improve the patients' health state.

### Suggestions

Since there is no a large body of research on the effects of the above-mentioned exercises on type 2 diabetes patients' general health and due to the results of the present study, it can be concluded that Pilates exercises have a positive effect on type 2 diabetes female patients' general health. However, to prove this important point, more research with larger study samples needs to be conducted.

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