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## Effect of mat Pilates exercises on pulmonary function parameter and quality of life of women with type 2 diabetes mellitus: An experimental trial

**Ganesh BR and Aarzu Bhavanagri (Noorani)**

### Abstract

**Study Design:** An experimental study

**Background:** Diabetes mellitus associated with reduced life expectancy, significant morbidity due to specific diabetes related microvascular complications, increased risk of macrovascular complication and diminished quality of life [1]. These changes also have adverse effect on the lungs of the patients.

**Aims:** To evaluate the effect of Mat Pilates exercise on pulmonary function parameters and quality of life in type 2 diabetes mellitus.

**Method:** 30 females with type 2 diabetes mellitus between the ages 45-65 years were included in the study. Demographic data of each participant was obtained and Mat Pilates exercises were administered for 45 minutes/day for 4 days a week for 2 weeks. Spirometric tests were done pre and post intervention; the spirometric parameters were FEV<sub>1</sub>, FVC and the ratio of FEV<sub>1</sub>/FVC. The change in quality of life was measured pre and post intervention.

**Result:** Statistically there is a significant difference between the pre and post pulmonary performance and quality of life. There was significant statistical difference between pre and post FEV<sub>1</sub> average performance values with p-value is less than 5% significance level (p= <0.05).

**Conclusion:** Present study concludes that Mat Pilates exercises helps in maintaining pulmonary function and quality of life in type 2 diabetes mellitus females.

**Keywords:** Type 2 diabetes mellitus women, mat pilates and pulmonary function.

### 1. Introduction

According to WHO Classification "Diabetes is a condition primarily defined by the level of hyperglycaemia giving rise to risk of microvascular damage. The reduced life expectancy is associated with significant morbidity due to specific diabetes related microvascular complications, increased risk of macrovascular complication and diminished quality of life [1]. The main symptoms of diabetes mellitus are polyuria, polydipsia, weight loss; some of the other symptoms are polyphagia and blurred vision. Long term complications of diabetes mellitus are retinopathy, foot ulcers, cardiovascular complications, pulmonary complications, peripheral neuropathy, sexual dysfunction, autonomic neuropathy. Diabetes is mainly classified into type 1 and type 2, Type 1 diabetes is also known as insulin dependent diabetes or juvenile onset diabetes, it mainly occurs due to cellular-mediated autoimmune destruction of the  $\beta$ -cells of the pancreas. Type 2 diabetes is also known as insulin independent diabetes or adult onset diabetes, this individuals are insulin resistance or has relative insulin deficiency. Usually people with type 2 diabetes mellitus either are obese or develop obesity in later stages [2].

As we all know the principal muscle for breathing is diaphragm, the diaphragm contracts during inspiration and relaxes during expiration [3], Diaphragm moves downwards during inspiration and upward during expiration. This movement of the diaphragm is in co contraction of the abdominal muscles and pelvic floor muscles [4]. As the diaphragm moves upwards the intra abdominal pressure increases due which the pelvic floor muscles contract to protect the organs. Thus the pelvic floor contracts during expiration and relaxes during expiration [5]. This shows that diaphragm with other muscles of respiration alone are not responsible for breathing, it is the co-contraction of the respiratory muscles, diaphragm, the abdominals and pelvic floor muscles [6].

Since the co contraction of these muscles increases the intra abdominal muscles, it also helps in trunk stability [7]. Pilates exercises are based on the principles of centering, contraction, control, precision, breathing, and movement flow. Pilates strengthens the muscle, increases the flexibility, breathing co-ordination [8]. Pilates mainly focuses on the core muscles such as the abdominals, hip extensors, hip flexors, the pelvic floor muscles and the diaphragm which are also the main muscles for stability of spine. Based on this concept that pelvic floor muscles contract during breathing, this study will be carried out and Pilates effect will be seen on the respiratory muscles.

**2. Methods**

Study was approved by institutional review committee and was concluded in conformity with the principles outlined in declaration of Helsinki.

**2.1 Participants**

Participants were recruited from the tertiary care hospital at Belagavi. Thirty participants were included in the study from the tertiary care hospital. The inclusion criteria were: females diagnosed with type 2 diabetes mellitus between the age of 45-65years and the patients who were willing to take part in the study. The exclusion criteria included: musculoskeletal disorders, neurological disorders and acute and chronic cardiovascular disorders. After meeting the inclusion and exclusion criteria patients were recruited in the study.

**2.2 Intervention**

Each patient included in the study received 10 minutes of warm up exercises, followed by 30minutes of mat Pilates

and 5 minutes of cool down period. For all the participants the intervention was given for 45minutes/day for 4 days a week for 2 weeks. The outcome measures were assessed before commencing the treatment and at the end of the study duration. Outcome measures used were pulmonary parameters and RAND Sf -36. Pulmonary parameters were measured by a spirometer (vitalograph COPD6) which included the Forced expiratory volume in the first second, Forced vital capacity and the ratio of the two (FEV<sub>1</sub>/FVC). The RANDSf-36 scale consists of 8 health concepts: physical functioning, bodily pain, role limitation due to physical health problems, role limitations due to personal or emotional problems, emotional well being, social functioning, energy/ fatigue, and general perception. It also provides a single item that provides an indication of perceived change of health.

**3. Result**

The mean values indicate the improvement in performance of respondent after the treatment since post mean value is greater than the pre mean value and also the standard deviation shows the consistency with post treatment value which is less than the pre treatment value. The correlation value also indicated significant association between the two variables since the test has revealed a strong relationship having 62% movement in the same direction was at 5% significance level (i.e.  $p < 0.05$ ). The recorded mean difference value (-6.77) is negative that shows the augmentation in post treatment performance value which was the standard desired or expected outcome of the study. The pulmonary function scores of all the 30 participants are presented in table 4.1.

Table 1

Particular	Mean		Standard Deviation		r – value	p-value	Mean Difference	t-value	p-value
	Pre	Post	Pre	Post					
FEV1	47.26	57.56	16.76	20.61	0.467	0.008*	-10.30	-2.906	0.007*
FVC	47.90	52.03	16.72	17.95	0.698	0.000*	-4.13	-1.673	0.105
FEV1/FVC	75.23	80.96	23.32	21.89	0.567	0.001*	-5.73	-1.490	0.147

\* $p < 0.05$  statistical significance value

The mean values indicate the improvement in performance of respondent after the treatment since post mean value is greater than the pre mean value and also the standard deviation shows the consistency with post treatment value which is less than the pre treatment value. The correlation value indicated insignificant association between the two variables since the test has revealed a weak relationship having 17% movement in the same direction with at 5% significance level (i.e.  $0.326 < 0.05$ ). The recorded mean difference value (-13.11) is negative that shows the augmentation in post treatment performance

value which was the standard desired or expected outcome of the study. To test the hypotheses, Pre and Post performance analysis was performed to document if there are any statistically significant changes in the respondents after treatment using “paired sample t-test” at 95% confidence interval or 5% of significance level and also descriptive statistics analysis has been performed to ascertain the mean difference. The result is shown in the following table 4.2.

Table 2

Particular	Mean		Standard deviation		r – value	p-value	Mean Difference	t-value	p-value
	Pre	Post	Pre	Post					
Rand sf-36 AVG	56.19	69.30	14.54	10.33	0.17	0.326	-13.11	-4.43	0.000*

\* $p < 0.05$  statistical significance value

**4. Discussion**

The complications in Diabetes are mainly due to macroangiopathic and microangiopathic changes that take place during diabetes, which leads to retinopathy,

neuropathy, nephropathy, coronary artery disease and lung impairment. Y.Hsin-Chieh *et al* in their study found that the histopathological findings seen the lungs of diabetic patients revealed microangiopathic changes such as the fibrosis and

basal lamina thickening that can lead to a restrictive lung defects [9]. There were many investigations done which state that hyperglycemia was associated to poor skeletal muscle strength due to increased protein catabolism, for this reason respiratory muscle endurance also decreased in diabetes mellitus [10]. Keerthi *et al* observed that there is a decrease in total lung capacity might be due to an altered collagen matrix in the lung [11]. There was a study conducted by Mahmaud M EL.Habashy *et al* where they studied the impact of diabetes mellitus and its control over the lung and cardiopulmonary exercise tests and they found that there was a decrease in PFT and  $VO_2$  max when compared to non diabetics [12].

In this study we found that there was improvement in forced expiratory capacity in one second ( $FEV_1$ ) and there was no change in the  $FEV_1/FVC$  ratio, there were very few studies done to know the pulmonary function improvement in diabetes mellitus patients. Janaina *et al* reviewed articles about the effect of lung function and functional capacity in obese people and they observed that Pilates promotes the strengthening of the abdominal muscles and that improves the diaphragmatic function it may result in positive outcomes in respiratory function, thereby improving functional capacity [13]. Maria Tinico Fernandez *et al* conducted a study on 45 university students who did not participate in any physical activities and that Pilates does improve the cardio respiratory parameters [14].

In this study we found that the quality of life of the women has improved, D.J Wexler *et al* found there is decrease in quality of life of patients with type 2 diabetes mellitus patients association with pulmonary complications [15]. M. torabian *et al* conducted a study to know the effect of Pilates on general health of types 2 diabetes mellitus women and found that Pilates does improve the general health in the women [16]. HulyaYucel *et al* investigated effects of Pilates-based mat exercise on Glycemic control, anxiety, depression, and quality of life women with type 2 diabetes and found that Pilates would improve the quality of life of women and they suggested that it should be a part of the treatment [17]. The limitation of this study was the duration of the exercise which was 2 week, the long term effect could not be seen and also the blood glucose level was not taken into consideration in the study.

## 6. Conclusion

Present study concluded that there was improvement in  $FEV_1$  but the  $FEV_1/FEV$  ratio was not statistically significant, we can also conclude that Pilates can be used to maintain the pulmonary function and improve Quality of life of type 2 diabetes mellitus women.

## 7. Acknowledgements

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## 8. Declaration of Conflicting Interest

The authors declare no conflict of interest with respect to the authorship and/or publication of this article.

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