Comparison of aerobic & Tai Chi exercise on cardiopulmonary endurance levels in smoker university students; A randomized controlled trial

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**Objective:** To compare the two well-known techniques i.e. Aerobic and Tai Chi Exercise on cardiopulmonary endurance levels among the smoker.

**Methodology:** In this Randomized Controlled Trial, a total of 88 male university students aged between 18 to 27 years who were smokers, having mild-severe nicotine level, determined by the nicotine and cotinine urine analysis, were included. People with psychiatric disorders, neurological disorders, malignancies, cardiac diseases, musculoskeletal problems and pulmonary issues were excluded. They were randomly and equally divided into two groups (control and experimental) by toss a coin method. Post treatment assessment were noted using nicotine level test in urine, digital spirometry and shuttle run test for cardio-pulmonary assessment. Data were analyzed using SPSS 21.

**Results:** One participant was dropped out from the experimental group. A non-significant improvement in Mean and median (IQ) was observed between the groups at post treatment, the post-training value of VO2 max, number of shuttles, shuttle distance, shuttle time, forced vital capacity (FVC) and forced expiratory volume.

**Conclusion:** Aerobic exercises and Tai Chi technique both were effective in improving the cardio-respiratory fitness and health status of smokers.

**Keywords:** Aerobic, Tai Chi, smokers, cardio-respiratory fitness.

**INTRODUCTION**

Tobacco smoking is the leading cause of disability and premature mortality worldwide.1 According to WHO, there are around 1300 million smokers in the world, and every day, 100,000 young people under 18 years start smoking.2 In the Framingham study, an increase in coronary risk was observed up to 4 times when smoking and high blood pressure were combined, and 6 times if dyslipidemia and smoking coexisted.3 There have been many advancements to reduce the adverse effects of smoking on the human body4 and field of physiotherapy has also presented some positive outcomes through the utilization of physical activity on a daily basis.5 Moderate to vigorous physical activity for at least 5 minutes, preferably for 30 minutes reduces the intense cravings for a cigarette.6 Supervised physical activity has achieved better results compared to other therapies used to quit smoking.7 Exercise facilitates the management of tobacco induced symptoms including depression, irritability, lack of concentration and cravings to smoke, indicating a possible relapse in smoking.8 A continuous aerobic physical activity for 30 – 90 minutes, 5 days/week is recommended by WHO to develop aerobic capacity.9,10 However, in active smokers, increased arterial stiffness, cholesterol and high blood pressure lead to chronic diseases.11 High intensity aerobic exercises for a duration of 30 minutes can make significant difference in mitigating the risk of such diseases.12 Tai Chi exercises improve the health and well-being of population with cardiovascular diseases, hypertension, and stroke.13 Traditional Chinese exercises are low-risk interventions for improving the quality of life.14,15 Tai Chi stimulates the central nervous system, lowers blood pressure, relieves stress.16 It increases the elimination of toxins from the body, improve blood circulation17 and provide message to the internal organs, thus improve their functionality.18 Minimum level of evidence is available regarding the most effective treatment technique for cardiopulmonary fitness. This study focused on comparison of two techniques i.e. aerobic and Tai Chi exercise in smokers.

**METHODOLOGY**

This Randomized Controlled Trial protocol was approved from Ethical Committee and Review Board of
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Riphah International University (Ref # Riphah/RCRS/REC/00319), Islamabad Pakistan. The informed written consent was taken from all participants. The study setting was conducted at University of Lahore, Islamabad campus. The subjects selected through snowball non-probability sampling technique were randomly and equally divided into two groups (control and experimental) by toss a coin method. A total of 88 respondents were selected using open epi tool software. Male university students aged between 18 to 27 years who were smokers, having mild-severe nicotine level, determined by the nicotine and cotinine urine analysis, were included in study. People with psychiatric disorders, neurological disorders, malignancies, diagnosed cardiac diseases, musculoskeletal problems and pulmonary issues were excluded.

Participants in the control group were asked to perform aerobic exercises on the elliptical trainer at moderate intensity and Heart Rate Reserve (HRR) of 40% to 60%. The training was performed for 45 minutes which was divided into warm up exercises for 10 minutes that included stretching exercises of the upper and lower limb, 25 minutes of elliptical training at moderate intensity and in the end cool down exercises for 10 minutes including breathing, stretching and active exercises. This protocol was followed for 3 times/week for 6 weeks. All the exercises were performed under the supervision in the university lab and adherence to the protocol was assured.

Participants in the experimental (Tai chi) group attended 25 minutes of tai chi class for 6 weeks maintaining moderate intensity with HRR (40% – 60%). Tai chi class was based on meditation, maintenance of coordinated slow and smooth static and dynamic body postures (Fig. 1) and controlled breathing. Before Tai chi class, they were instructed to follow the warm up exercises for 10 minutes that included stretching exercises of the upper and lower limb and after the tai chi session cool down exercises were performed for 10 minutes including breathing, stretching and active exercises. Base line and post treatment assessment were noted using nicotine level test in urine, digital spirometry and shuttle run test for cardio-pulmonary assessment.

**Statistical Analysis:** Data were analyzed using SPSS version 21. Normality test showed that data was dispersed and was not equally distributed, so non-parametric tests were applied. Base line and post treatment values of variables between groups were determined by Independent T test and Mann-Whitney U-Test. p < 0.05 was considered significant.

**RESULTS**
There were total 88 participants with 44 participants in each group.

![Fig. 1: Slow, fast and transitional stances used in Tai chi class.](image)

### Table 1: Pre-Post between groups comparison using Independent T test.

<table>
<thead>
<tr>
<th>Test Variable</th>
<th>Experimental (n = 43) Mean ± SD</th>
<th>Control (n = 44) Mean ± SD</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO2 max</td>
<td>Pre 28.67 ± 4.66</td>
<td>28.57 ± 4.54</td>
<td>0.920</td>
</tr>
<tr>
<td></td>
<td>Post 41.66 ± 6.83</td>
<td>41.66 ± 6.05</td>
<td>0.817</td>
</tr>
<tr>
<td>Number of shuttles</td>
<td>Pre 18.47 ± 5.89</td>
<td>18.55 ± 5.51</td>
<td>0.948</td>
</tr>
<tr>
<td></td>
<td>Post 35.30 ± 9.81</td>
<td>36.09 ± 8.72</td>
<td>0.693</td>
</tr>
<tr>
<td>Shuttle distance (meters)</td>
<td>Pre 368.37 ± 117.29</td>
<td>370.46 ± 110.60</td>
<td>0.932</td>
</tr>
<tr>
<td></td>
<td>Post 706.05 ± 196.23</td>
<td>721.82 ± 174.51</td>
<td>0.693</td>
</tr>
<tr>
<td>Shuttle time (minutes)</td>
<td>Pre 2.43 ± 0.75</td>
<td>2.42 ± 0.79</td>
<td>0.941</td>
</tr>
<tr>
<td></td>
<td>Post 4.40 ± 0.98</td>
<td>4.69 ± 0.91</td>
<td>0.160</td>
</tr>
</tbody>
</table>
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Table 2: Pre-Post between groups comparison using Mann-Whitney U-Test.

<table>
<thead>
<tr>
<th>Test Variable</th>
<th>Experimental (n = 43) Median (IQ)</th>
<th>Control (n = 44) Median (IQ)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC in liters</td>
<td>Pre 3.14 (0.50)</td>
<td>Post 3.39 (0.57)</td>
<td>0.905</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post 3.41 (0.48)</td>
<td>0.452</td>
</tr>
<tr>
<td>FEV1 in liters/sec</td>
<td>Pre 1.08 (0.72)</td>
<td>Post 1.60 (1.09)</td>
<td>0.838</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post 1.60 (1.19)</td>
<td>0.909</td>
</tr>
<tr>
<td>PEF in liters</td>
<td>Pre 1.42 (1.79)</td>
<td>Post 1.88 (1.50)</td>
<td>0.541</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post 2.09 (1.24)</td>
<td>0.300</td>
</tr>
</tbody>
</table>

One participant was dropped out from the experimental group. A non-significant improvement in Mean ± SD and median (IQ) was observed between the groups at post treatment (Table 1). Post-training value of VO2 max, number of shuttles, shuttle distance, shuttle time, forced vital capacity (FVC) and forced expiratory volume are shown in Table 2.

DISCUSSION
After the six weeks intervention, both groups reflected improvement in cardiopulmonary endurance level. The Vo2 max, the mean values of both groups were improved moderately at each week, however, this change was non-significant (p > 0.05). It provided realistic basis to consider that both interventional techniques have influential contribution to enhance the cardiopulmonary endurance level. Wang et al assessed the effectiveness of Tai-chi exercises on functional status and exercise capacity of the patients with chronic heart failure in which two sessions of Tai-chi exercise of one hour each week for 24 weeks were given to the patients. The participants showed remarkable difference after 24 weeks with an increase distance of 6 minutes, decreased serum B type natriuretic peptide level and peak oxygen intake level as compare to other group.20

Another study concluded that moderate Tai-chi exercises for 20 minutes can improve the life style, behavior and body functioning.21 Our findings are similar previous literature and it is validated that Tai-chi can improve the cardiovascular fitness. The current research validates that physical activities including elliptical exercises enhanced the aerobic endurance. With the implementation of aerobic exercises, the researchers have assessed the Vo2 max level and have concluded that different protocols including intensity, frequency and duration of physical activities can influence aerobic power.22,23

With more intensity, frequency and duration, the effect would be larger and even with minimal duration, intensity and with consistent frequency; the impact can be observed.5,12 As the treatment duration was shorter, it has shown the minimal effect on cardiopulmonary endurance, results can be altered with continuous training.

CONCLUSION
It is concluded that aerobic exercises and Tai Chi technique both are effective in improving the cardio-respiratory fitness and health status of smokers.

REFERENCES