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RESEARCH ARTICLE

Effects of 6 weeks of step aerobics training on pulmonary functions among female students with sedentary lifestyle

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ABSTRACT

Background: Sedentary lifestyle is among the leading cause of cardiovascular and respiratory diseases over the globe. Aerobic conditioning is among the beneficial intervention to improve pulmonary function and manage the complications caused by sedentary life style.

Objective: To determine the effects of step aerobics training on pulmonary function among female students with Sedentary Lifestyle.

Methods: This RCT was conducted in Margalla Institute of Health Sciences from February to July 2019. Non-probability convenient sampling was employed to collect sample of 80 students, randomly allocated into groups (40 per group) by coin toss method. Group A performed step aerobics and Group B performed cycling for 6 weeks. Pulmonary function test (FVC, FEV1, PEF) and 3-minute step test was performed at baseline, after 2, 4and 6 weeks in both groups. Heart rate and oxygen saturation was monitored pre and post exercise.

Results: The mean age of Group A is 22.43±2.49 and Group B is 21.80±2.04. Results showed statistically significant difference in respiratory function between groups. Significant improvement of respiratory function was observed in group A which performed aerobics program as compared to group B. The level of significance was set on $p < 0.05$.

Conclusion: Step aerobics is considered beneficial in improvement of pulmonary functions and is a good alternative for conditioning program for female adults. Cycling also improved pulmonary function but the progress was slow as compared to step aerobics which showed quick impact in improving pulmonary function test.

Clinical Trial Number: NCT04051788

Keywords: Cycling, Pulmonary Function, Sedentary Lifestyle, Step Aerobics.

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Introduction:

A sedentary lifestyle is defined as the lifestyle of an individual living with very little or no physical activity. In daily routine, such a person spending most of his or her time in watching television, playing games on mobile, using internet, reading books, often sitting or lying down while doing these activities. It can lead to many health problems and is potentially very harmful.(1) Over the past hundred years, the manual labor jobs like (farming, manufacturing, building) have been changed into office jobs which is due to globalization and advanced technology. In 1960's physical activity jobs have decreased in number from 50 to 20%, e.g., one in two Americans have jobs which are physically demanding, while in 2011, this ratio lead to one in five.(2) In 1990 to 2016, the ratio of manual labor jobs has decreased to one third. In 2008, the United States American National Health designed a survey in which they found out that 36% of adult were inactive and 59% of adult had no participation in vigorous physical activity which could last up to 10 minutes per week.(3)

The most common effect of sedentary life style is increased BMI and Obesity. The decreased level of physical activity is the most preventable cause of death worldwide.(4) The Center for Disease Control, CDC, has some recommendations to meet the physical

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activity criteria that should be necessary for every individual for being healthy. In this criterion, an individual should spend 150 minutes in moderate and 75 minutes vigorous exercise per week. According to health professionals a person should walk 10,000 steps per day which is about 5 miles, this is said to be an ideal criteria to meet your health benefits and reduce risk factors which are caused due to the inactivity 60 to 85% of population that does not participate in physical activity around the world according to WHO. In global mortality, physical inactivity is the fourth health risk factor. Aerobic exercise and healthy diet can decrease the effects of sedentary lifestyle. If an individual exercises for 30 minutes per day, he can easily overcome the effects of sitting for rest of the day.(5-7) Researches found out that prolonged sedentary time and low level of activity has been associated with high diastolic blood pressure and high-density cholesterol level which indirectly affects the cardiovascular system of an adult and may lead to cardiac issues at a very early age.(8)

Aerobics exercise is defined as physical exertion that depends upon energy generating process. Aerobics defined as something relating to and involving what required free oxygen. During aerobic exercise, maximum use of oxygen can meet the energy demand of the body.(9-10) Activities with light to moderate intensities that adequately meet the demands of aerobic metabolism can be performed for long period of times. We have some common examples of aerobics exercise, for instance walking, swimming, jogging, running and cycling.(9) In a sedentary lifestyle, the person's heart rate beats faster and rapidly with little activity due to decreased level of cardiac endurance, which demands more amount of blood to circulate through the body due to which the heart needs to pump more than normal. A sedentary person's heart rate beats fast with a little exercise, a term named as tachycardia which is more than 100 beats per minute. This is because of weak heart and low level of cardiac endurance due to inactivity. Aerobics conditioning strengthens heart and makes it stronger to pump blood and efficiently circulate it throughout the body.(11)

Moreover, the step aerobics mechanics showed different characteristics of movements in middle age groups and older adults and developed improvement in balance and agility. Flexibility can also be achieved by the dynamic movement of step aerobics choreographies. The studies showed beneficial effects and investigations and have evaluated that step aerobics has improved the pulmonary endurance cardio respiratory fitness. Step aerobics, also known as bench aerobics and step training, is a form of aerobic exercise that involves stepping on and off a small platform. Step aerobics is one of several low-impact aerobic exercises. It is similar to climbing stairs, but performed while staying in one place. It is typically performed on medium tempo like 118 to 122 (bpm).(12) Another research was conducted on target matching foot stepping to evaluate the proprioception and function of knee osteoarthritis. It includes functional score, walking velocity and overall knee performance to determine the efficacy of knee osteoarthritis. The exercise was designed to perform in sitting position as knee arthritic patients are not able to tolerate pain in standing position.(13) Another study showed that lower limb ergometric training improves echocardiographic parameters of left ventricle in dilated cardiomyopathy (DMC) patients.(14) Another research was conducted on non-athlete females to evaluate the efficacy of eight weeks of aerobic training programs and compare their effectiveness between resistance, and interval training programs on cardio respiratory measurement in non-athlete females. Their results revealed that interval and aerobic exercise programs could improve cardiopulmonary functions and aerobic training which could be with interval training that can be used to increase VC, IC, PIF, in non-athlete females.(15)

According to the literature, traditional aerobic training programs have great effects on improved pulmonary functions in individuals with sedentary life style but the literature suggested another type of aerobic training named Step Aerobics which is different from a traditional training has less work on pulmonary function but is effective on functional score, and walking velocity.(16) As the step platform is much less expensive and more portable as it can be performed by using a bench or a step, so it would be more feasible for participants to perform anywhere. This study would help physiotherapists to choose aerobics training program which is more feasible and provides equal beneficial outcomes according to literature. So, the main aim of the study is to determine the effects of 6 weeks of step aerobics on pulmonary function on female students with sedentary lifestyles. Sedentary behaviors often correlate with compromised lung function, posing potential risks to respiratory health. By focusing on the impact of step aerobics, a recognized cardiovascular exercise within this specific group aims to discern whether this regimen could serve as an

effective strategy to enhance pulmonary function and mitigate the adverse effects of sedentary living among female students.

Methods:

Randomized control trial was conducted in Margalla Institute of Health Sciences, and the duration of study was from February to July 2019. Sample size was calculated by open epi method, it was 4 on each group through primary outcomes (FEV1).(12,17) It was too low for comparing groups while doing RCT, so a sample of 80 was selected (40/40 each group) while comparing young adults for pulmonary function test. Non probability convenient sampling was employed to collect sample of 80 students then randomly allocated into groups (40 in each group) by coin toss method. Ethical approval was taken from the ethical approval committee of Riphah International University with ref. # Riphah/RCRS/REC/00538 and then this trial was registered on clinical trial.gov (NCT04051788).

Participants were sedentary females of age 15 to 25 years (who had not performed aerobic exercise in the last 3 months). Participants having previously diagnosed with Cardio-respiratory disease or any Musculoskeletal disease that they were unable to perform aerobic exercises, or neuromuscular diseases that made them unable to maintain balance or Disc inflammatory and infectious disease were excluded from the study.

Group A performed step aerobics and Group B performed cycling for 6 weeks. Pulmonary function test forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow (PEF) through digital spirometer (Spirotron– model no.18010500003) and 3-minute step test was performed at baseline, after 2, 4 and 6 weeks in both groups. Heart rate and oxygen saturation was monitored pre and post exercise in both groups through pulse oxymeter (believia –model no: PO10) to evaluate 3-minute step test which shows how quickly the heart returns to normal for both groups. Frequency of intervention was set at 3 sessions per week up to 6 weeks for both groups. Intensity was set on 50 to 75% of HRR (Heart Rate Reserve) for both the groups. For initial 2 weeks, the group A (Step aerobics) participants did 3 minutes of light walk as warm up and then 20 minutes of stepping 120 steps per minute, and 3 minutes of deep breathing exercises post training were followed as a cool down protocol. For initial 2 weeks, group B's (Traditionally aerobic cycling) participants did light repetitions of cycling as warm up protocol and then the intensity was set at a moderate level for 20 minutes. Then deep breathing exercises were followed as cool down protocol for 3 minutes.

Data was analyzed on SPSS version 21. Descriptive analysis of variables was done and results were shown in frequency (percentages) and mean and standard deviations. Shapiro-Wilk Test was applied to check the normality of different variables which showed p value < 0.05, so non-parametric test applied. Mann Whitney U Test and Friedman test was used for between the group analyses within group analysis.

Results:

Total 80 female participants were recruited in the study with 40 participants in the group A (Step aerobics) and 40 participants in the group B (Traditionally aerobic cycling).(Figure 1). Demographic data (Homogenous) was collected to avoid confounding impact on the results in which mean and standard deviation of the age, weight and height and frequency (percentages) of the BMI among the groups was reported. (Table 1)

Comparison of Group A (Step aerobics) and Group B (Traditionally aerobic cycling) at baseline, to 6^{th} week of data on pulmonary functions (FEV1, FVC and PEF statistical test results, along with descriptive mean and standard deviations because of continuous data are reported instead of median and interquartile. While applying between group analysis, both groups showed improvement at 4^{th} week and 6^{th} week and were significant ($p<0.05$). Within group analysis for all variables, both groups showed significant improvement ($p<0.05$) except FVC in Group B was not significant ($p>0.05$). (Figure 2) (Table 2)

Results of the data for 2^{nd} week, 4^{th} week, and 6^{th} week are reported on 3 Min Step Test (Pulse Rate, Saturation and time to recover heart rate) statistical test along with descriptive mean and standard deviations for comparison of Group A (Step aerobics) and Group B (traditionally aerobic cycling) at baseline. While applying between group analysis, both groups showed improvement in mean of pulse rate and saturation variables but statistically remained inconclusive as it is significant at baseline ($p<0.05$). But for time to recover heart rate, both groups showed significant improvement at 2^{nd} and 4^{th}week ($p<0.05$). Within group analysis for all variables, both groups showed significant improvement ($p<0.05$) except time to recover heart rate ($p>0.05$). (Table 3)

Fitness level of female students among the groups at baseline, at the end of 2nd week, at the end of 4th week and at the end of 6th week showed improvement in fitness level in both groups when moving to 4th and 6th week. It was derived from 3-minute Step Test on the bases of heart rate. (Figure no 3)

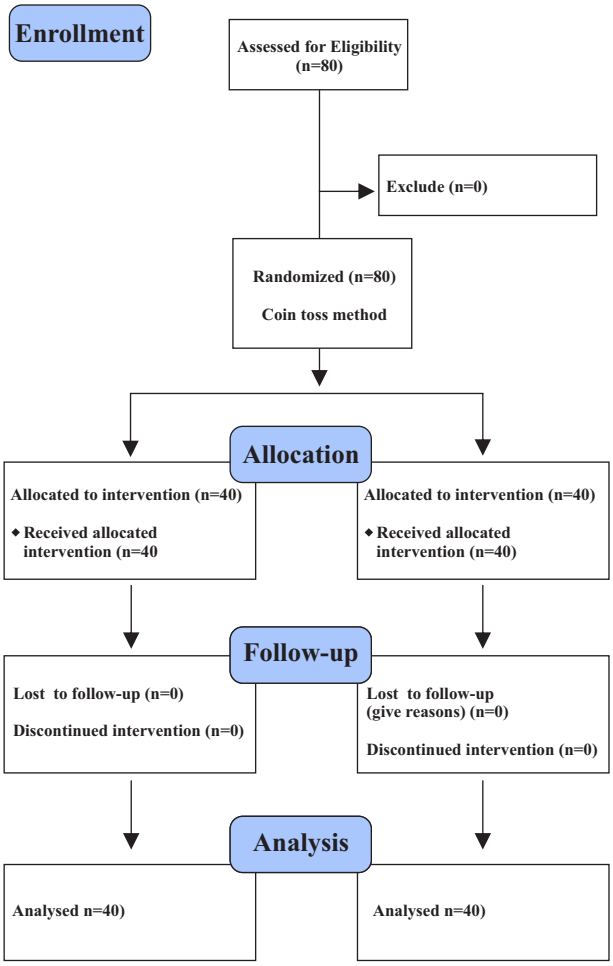

Figure 1: Consort Diagram

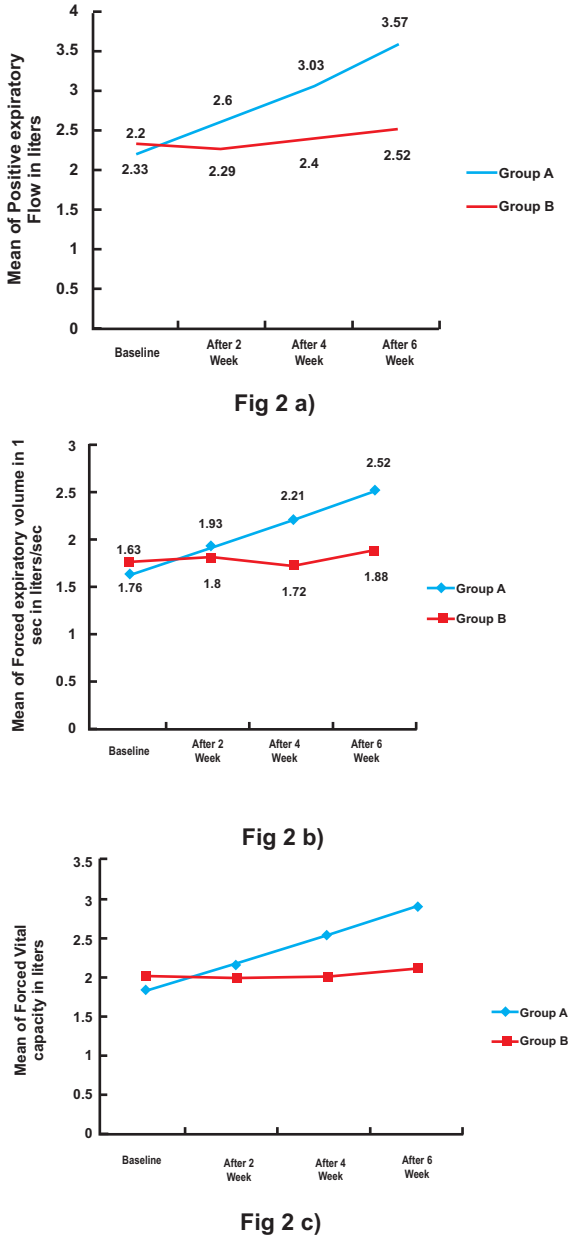

Figure 2: Shows the Mean of PEF (fig 2a), FEV[1] (fig 2b), FVC (fig 2c) among the groups

Table 1: Comparison of Demographics (Age, weight, Height and BMI) among the Groups

Variable		Group A Mean±SD	Group B Mean±SD
Age (years)		22.43±2.49	21.80±2.04
Weight (kg)		58.93±5.94	57.13±6.75
Height (feet. Inches)		5.33±0.18	5.32±0.16
Body Mass Index (kg/meter^2)	Normal	38 (95%)*	38 (95%)*
	Overweight	2 (5%)*	2 (5%)*

SD= Standard Deviation, n= Sample, kg= kilogram, *= Frequency (percentage)

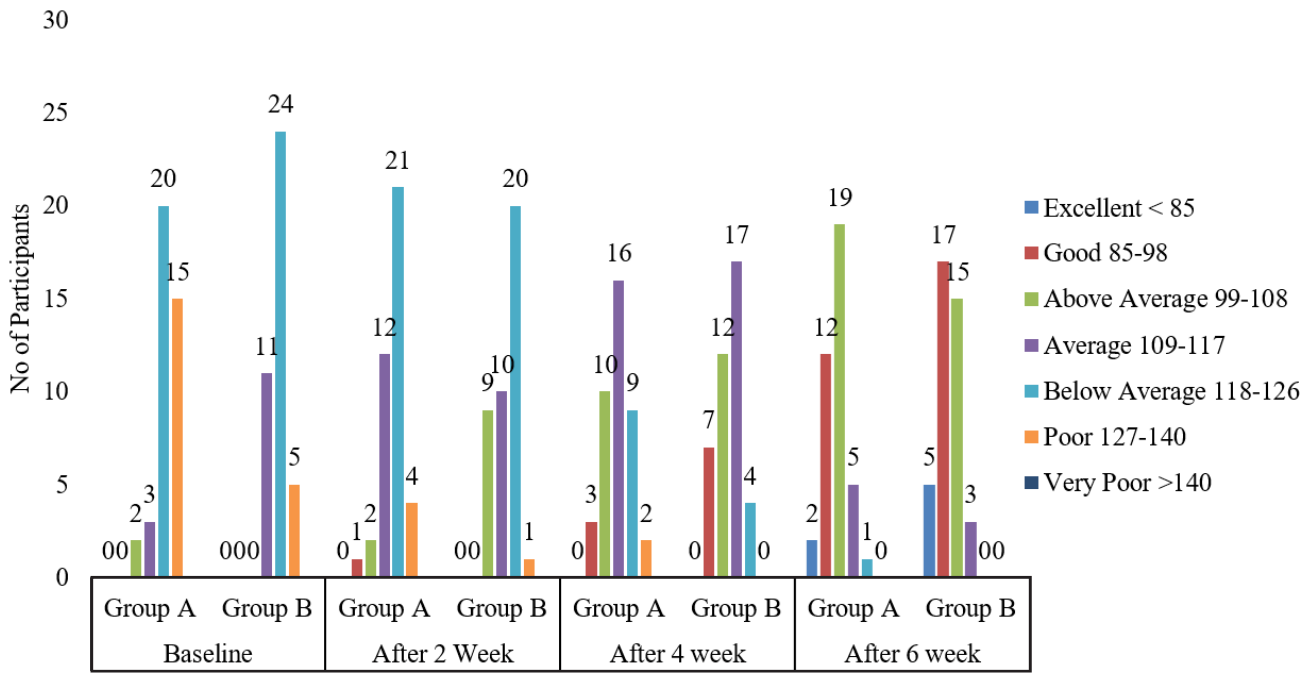

Figure 3 Shows the Frequency of fitness level of female students among the groups

Table 2: Comparison of groups for pulmonary function

Variable		Group A Mean±SD	Group B Mean±SD	Between group P value
FVC in Liters	Baseline	1.87±0.30	2.01±0.42	0.056
	After 2 week	2.17±0.39	2.01±0.36	0.400
	After 4 week	2.55±0.50	2.02±0.35	0.000*
	After 6 week	2.91±0.48	2.13±0.41	0.000*
Within group p value		0.000*	0.194	
FEV1 in liter/sec	Baseline	1.63±0.26	1.76±0.35	0.039*
	After 2 week	1.93±0.31	1.80±0.33	0.063
	After 4 week	2.20±0.36	1.72±0.34	0.000*
	After 6 week	2.52±0.43	1.88±0.43	0.000*
Within group p value		0.000*	0.047*	
PEF in liters	Baseline	2.20±0.49	2.33±0.68	0.519
	After 2 week	2.60±0.64	2.29±0.58	0.013*
	After 4 week	3.03±0.75	2.40±0.64	0.000*
	After 6 week	3.57±0.84	2.52±0.65	0.000*
Within group p value		0.000*	0.018*	

***= statistically significant 0.000=<0.001**

Table 3: Comparison of groups for 3 minute step test

Variable		Group A	Group B	Between group
3 Min Step Test		Mean±SD	Mean±SD	P value
Pulse rate in beat/min at the end of Test	Baseline	124.07±7.19	120.77±4.92	0.021*
	After 2 week	118.50±7.61	115.42±7.20	0.026*
	After 4 week	111.85±8.99	106.42±9.28	0.023*
	After 6 week	95.30±9.21	100.12±9.02	0.024*
Within group p value		0.000*	0.000*	
Saturation in % at the end of Test	Baseline	96.30±0.65	96.75±0.54	0.002*
	After 2 week	97.22±0.77	96.85±7.20	0.014*
	After 4 week	97.22±0.42	97.10±0.50	0.261
	After 6 week	97.30±0.56	97.20±0.40	0.524
Within group p value		0.000*	0.000*	
Time to recover heart rate in seconds	Baseline	214.00±2.83	210.20±2.68	0.302
	After 2 week	182.45±2.75	151.00±5.23	0.017*
	After 4 week	157.45±1.63	139.95±2.47	0.014*
	After 6 week	133.25±2.89	141.65±2.19	0.082
Within group p value		0.112	0.145	

*= statistically significant 0.000=<0.001

Discussion:

Healthy lifestyle and physical fitness have a great interrelation. The more the person is strong, not only is he more physically active but also has great impact on psychological and mental health issues. Also, it may help to reduce the mortality and morbidity rate. In our research, we evaluated the effectiveness of pulmonary functions in young female students with step aerobics program which was an experimental group. 40 students were allocated in experimental and control each which received cycling. On analysis, we got more significant results in aerobic as compared to control group. Many previous researches have been carried out with different population and objectives.

In a previous study, there were healthy young medical students, aged 17 to 20 years. The exercise plan was 16 weeks of training program. Pulmonary function test was recorded before the training program and at the end of the training pre and post reading. The paired t test ($p<0.05$) was considered significant to analyze the data. At the end of training, there were significant findings in the improvement of pulmonary function tests ($p<0.05$). The study showed significant difference between aerobic training and pulmonary function. If compared with our study we did on young female students aged 18 to 30 years, we have 4 levels of assessment, and have significant findings in improvement of pulmonary function testing after 6^{th} week of training in experimental group which received aerobic. According to Wilcoxon signed rank test and Freidman test, the p value for aerobic is ($p<0.05$) The other control group received cycling which also shows improvement but less significant as compared to the aerobic group.(17)

In one of the studies, the young females were engaged in aerobics swimming in order to increase their vital capacity and total lung capacity over the duration of one year training. They suggested that larger lung volumes may be due to the swimming training but the mechanism has been unclear in physical inactivity which may influence the effect of FEV1 and FVC,

although the relationship has been found strong between FVC and FEV1 post training.(18)

Another study was conducted on individuals who were 24 to 46, 44 to 46 and 64 to 66 years of age. They were healthy men and their hemoglobin level was more than 10gms/100ml. Pulmonary parameters were measured on spirometer which includes FVC, FEV1, FEV1/FVC%, PEF 50%, RR. The results significantly increased.(19)

A study on healthy adults was conducted to find out the effects of aerobic program on pulmonary function. 65 healthy adults participated with age range from 20 to 35 years. Spirometer was used as an outcome tool. The results showed that pulmonary function improved after the training program.(20)

Another research was conducted on elderly women to evaluate the effects of step aerobics. It is said to be the most famous and traditional program in females. It is designed as a single bench and the person has to move up and down repetitively with rhythm. The body composition showed positive effects in young and older adults. Lower body strength has been improved by the repetitive actions of stepping up and down. It can also improve upper extremity strength as the arms move in a dynamic pattern.(12)

In this study, we have some limitations of temperature as the humidity level was not the same for every student in which she performed the exercises. It's hard for them to cope up with the training program in initial 2-3 sessions.

The study suggests that the aerobics exercise plan should be designed in such a way that would be convenient for the individual to cope up with the exercise in sedentary lifestyle and the person should benefit from the program. Similar warm up and cool down protocol can be planned throughout the 6 weeks as were followed for initial 2 weeks to meet the actual intensity criteria. It is suggested to design RPM (Repetitions Per Minute) in cycling. The data suggests that longer duration and increased level of intensity is recommended to get more significant results in sedentary people. Those with physical issues and with compromised physical mobility are also recommended to do cycling or step aerobics in sitting position which may benefit in improving their pulmonary function.

Conclusion:

This study reveals that step aerobics is considered to be beneficial in the improvement of pulmonary functions and could be a good alternative for conditioning program for female adults. Cycling also improved pulmonary function but the progress was slow and steady as compared to step aerobics which showed quick impact in the improvement of pulmonary function test.

Disclaimer: Article is part of thesis project (Masters in Physical Therapy Cardiopulmonary Physical therapy) which was done in Riphah International University Fall Batch 2018.

Conflict of interest: None to declare.

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Waqqar S: Data acquisition, data analysis, and drafting of manuscript
Waseem M: Data acquisition, data analysis, and drafting of manuscript
Manzoor I: Data acquisition, data analysis, and drafting of manuscript
Fatima A: Data acquisition, data analysis, and drafting of manuscript