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Immediate Effect of Single Bout of Intermittent Aerobic Exercise Session at High and Low Intensity on ABI In Sedentary Young Adults.

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Abstract

Background: Low values of Ankle – Brachial Index (ABI) are noted in asymptomatic population. Aerobic exercise training increases ABI; however their immediate effect on ABIis unknown.

Purpose: Toanalyze immediate effect of single bout of intermittent aerobic exercise at high and low intensity on ABI in healthy sedentary young adults.

Participants: 30 sedentary young adults (6 males, 24 females), aged 18 - 25 years were included.

Methods: Participants were selected according to inclusion, exclusion criteria. Written consent was obtained after explaining procedure. $VO_{2max}$was calculated considering Cooper's 12 min walk/run test distance. After 1 week, participants were randomly divided into Group A and B. Participants in group A walked on treadmill at high intensity(85% of VO_{2max}), then after 1 week at low intensity (50% of VO_{2max}). Participants in group B walked on treadmill at low intensity, then after 1 week at high intensity. Exercise session included treadmill walking for 30 min, 2 min active recovery (20% of VO_{2max}) after every 10 min. ABI was noted before and immediately after each exercise session.

Analysis: Mean, standard deviation, percentage for descriptive data of patients; Wilcoxon signed rank test for comparison of change in ABIpre, post exercises session; Mann – Whitney test for comparison of difference of ABI post high and low intensity exercise.

Results: MeanABIpre-exercise was 0.992.Mean ABI post high and low intensity exercise was 0.9957, 0.9937respectively. ABI increased immediately after exercises irrespective of intensity. Mean of difference of ABI immediately after high and low intensity exercise was 0.0037, 0.0017respectively. ABI increased more after high intensity exercise session. Results were statistically insignificant, p – value 0.5000.

Conclusion:ABI increases immediately after single bout of intermittent aerobic exercises in healthy sedentary young adults irrespective of exercise intensity.ABI increase is more after high intensity exercises. Findings are statistically insignificant.

Keywords: Inactivity, Asymptomatic, VO_{2max}

Background

In the present pandemic situation there is increased evidence of sedentary behavior (SB) in the individuals of all the age groups. SBs are defined as a class of waking behaviors, performed when in a sitting or reclining position, and associated with low levels of energy expenditure(1,2). SBs increase the risk of various cardiovascular diseases (3,4), heart failure(5), peripheral vascular diseases, stroke, certain cancers, osteoporosis, obesity, type 2 diabetes, and hypertension leading to morbidity(3,6)and mortality(7–10).

The prevalence of peripheral vascular diseases is increasing among young adults(11). Peripheral arterial diseases (PAD) increase the risk of cardiovascular mortality 4-6 times over healthy individuals(12). PAD are the diseases which cause disturbances of structure or function of the circulatory systems leading to insufficient circulation to the extremities and can result in significant physical impairments and subsequent loss of function of either the upper or lower extremities(13). Common among PAD are Atherosclerosis (evident in patients above 40 years), ThromboangitisObliterans (TAO) (evident in young population)and Raynaud's disease (common in females). Intermittent claudication is the classical early symptom when peripheral arteries are affected(12,14–17). Patients with intermittent claudication have moderate to severe impairment of waling ability which leads to functional disability limiting patients from performing personal, social or regular activities of daily living that involve walking short distances(17). These effects may have a detrimental influence on the perceived quality of life and psychology of these patients(17).

Low values of Ankle –Brachial Index (ABI) are associated with increased risk of PAD. Low values of ABI are reported in asymptomatic population as well(11). Physical activity such as a walking is found to increases the value of ABI by causing increased production of Nitric Oxide in the plasma thus improving PAD(18).The conclusions of various studies showed that the value of ABI increases with walking exercise in turn reducing the risk of PAD(18–22). The magnitude of the responses to the training across the studies has varied may be due to differences in the intensities, duration and frequency of the exercise prescription and the methods of measuring exercise capacity. The exercise type used in these studies was cycle ergometer and treadmill walking.

Various studies are conducted to find out the effect of exercise training on ABI in healthy individuals, patients having PAD, athletes and aged population. However the immediate effect of intermittent aerobic exercises on ABI in healthy sedentary young adults is not yet studied. Hence the purpose of the present study was to analyze the immediate effect of intermittent aerobic exercises at different intensities on ABI in healthy sedentary young adults.

Materials and Methodology

Study design : The present study was conducted on sedentary college going students. 30 participants were selected using convenient sampling technique. The healthy, sedentary college going students,6 males and 24 females, aged between 18 - 25 years were included. The students with known cases of cardiovascular and respiratory diseases, altered resting ABI were excluded from the study.

Equipment's and Materials :

1. Measuring tape
2. Sphygmomanometer
3. Treadmill

Outcome Measure :

1. **SIT Q**(23)**:**

   The SIT-Q is a written **questionnaire,** designed **for population cohort studies. It** measure habitual sedentary behaviours in occupation, transportation, household and leisure-time domains. The questioned asked are about the usual amount of time spent in sitting or lying down in past 12 months. The questionnaire is divided into 7 sections as follows;

   Section 1 : Sleeping and Napping

   Section 2: Meals

   Section 3: Transportation

   Section 4: Work, Study and Volunteering

   Section 5: Child care and elder care

   Section 6: Light leisure and Relaxing

   Section 7: Final Questions (which included other daily pursuits done sitting or lying down that were not covered in previous questions, on either weekdays or weekends and time spent in filling the SIT - Q).

   Time spent in each sedentary behaviour is converted to minutes. Sedentary behaviour is assessed separately for weekdays and weekends within each domain except work, study and volunteering. Sedentary behaviour during work, study and volunteering is reported based on weeks per year, days per week and hours per day

2. **Physical Activity Readiness Questionnaire + (PAR Q+)**(24,25)**:-**

   This questionnaire is used as a pre-participation screening tool for physical activity, in adults with or without known disease who are willing to do exercises. It contains 7 simple question which determine whether individuals are able to become more physically active or engage in a fitness related activities.If any individual responds positively to 1 or more questions on the PAR Q +, he or she is advised to consult a physician for physical activity participation

clearance. It is highly reliable, sensitive and specific tool of measuring physical activity readiness.

3. **Maximal oxygen uptake (VO_{2max}) :-**

It represents the maximal rate at which oxygen can be transported, consumed and utilized during whole body exercise(26) . Itis related to cardio-respiratory fitness. There are several metabolic equations available for the indirect estimation of VO_{2max} during walking, running, and stepping as well as for leg and arm ergometer(27). In the present study the VO_{2max} was calculated according to the distance covered in Cooper's 12 min walk run test using following formula

$$\mathbf{VO_{2max} = (22.351 \times Distance\ in\ km) - 11.288}$$

It is represented in ml/kg/min.

4. **Ankle Brachial Index (ABI)**(28,29)**:-**

Ankle – brachial Index (ABI) is the most frequently performed test using Doppler ultrasound or by palpatory method. In this a BP cuff is used to occlude the flow temporarily and then deflated as the examiner listens or palpates for return of flow this is performed on the upper extremity at brachial artery and on the lower extremity at the posterialtibial and dorsalispedis arteries. The ABI is a ratio of the lower extremity pressure divided by the upper extremity pressure. ABI values with corresponding indications:-

ABI ranges	Possible Indications
> 1.2	Falsely elevated, arterial disease, diabetes
1.19 – 0.95	Normal
0.94 – 0.75	Mild arterial disease with intermittent claudication
0.74 – 0.50	Moderate arterial disease with rest pain
< 0.50	Severe arterial disease

Methodology : 30 healthy sedentary college going students, within age group of 18 – 25 years, were selected out of which 6 were males and 24 were females. Each participant signed a consent form and PARQ + after understanding the study procedure in detail. Each participant was made to perform Cooper's 12 min walk/run test. According to the distance covered in 12 minutes, his or her VO_{2max} was calculated according to the formula. Then for 85% of the VO_{2max} for high intensity, 50 % of VO_{2max} for low intensity and 20% of VO_{2max} for active recovery phase was calculated. According to the respective VO_{2max}, their speed was calculated by the formula,

$$\mathbf{Speed = VO_{2max} - 3.5/0.1}$$

Then after a gap of one week, all the participants were randomly divided in to two groups **Group A** and **Group B**. The participants in Group A were first made to walk /run on treadmill at high intensity and then after a gap of 1 week at low intensity.The participants in group B were first made to walk /run on treadmill then at low intensity and then after a gap of 1 week at high intensity.

Pre - exercises ABI of each participant was calculated and noted in each group.

The Intermittent aerobic exercise protocol consisted walking or running on treadmill at the calculated speed for 30 min in 3 sets. Each set consisted of 10 min of walking or running followed by 2 min of active recovery followed by respective cool-down period at the end of 30 min.

Immediately after the Intermittent aerobic exercise protocol ABI of each participant was calculated and noted in each group.

Data Analysis: The statistical analysis was done using R software. Mean, standard deviation and percentage were used for analysis of descriptive data of participants. Wilcoxon signed rank test was used for comparison of change in ABI value pre and post exercises session. Mann – Whitney test was used for comparison of difference of ABI value post high and Low intensity exercise session.

Results

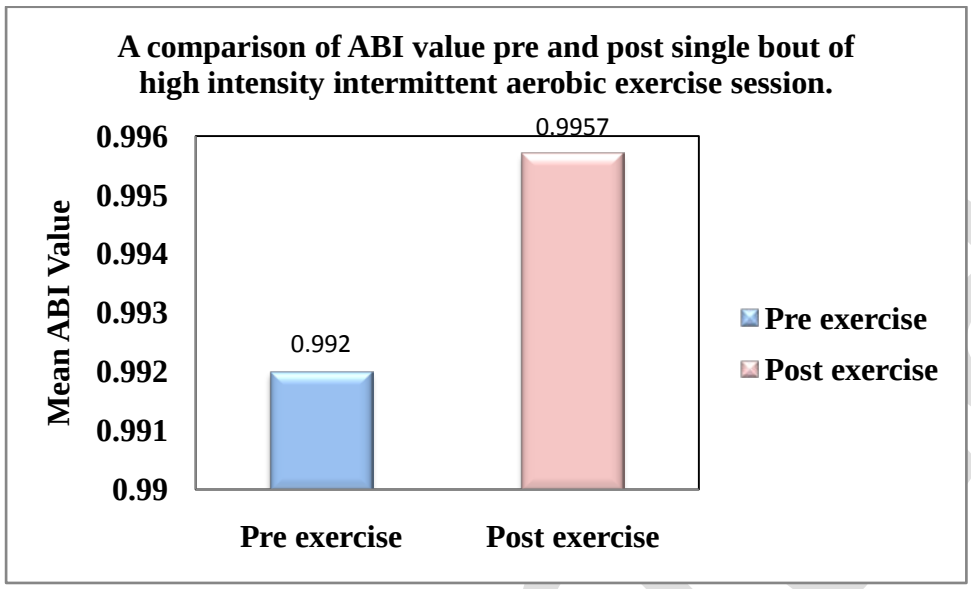
Table 1:

Gender	**Males**	**Female**
Number of Participants	**6**	**24**
Mean Age (in years) (SD)	**21.33(±0.82)**	**20.25(±1.48)**
Mean VO_{2max} (in ml/kg/min)(SD)	**32.67(±8.86)**	**16.83(±5.30)**

Table 2:

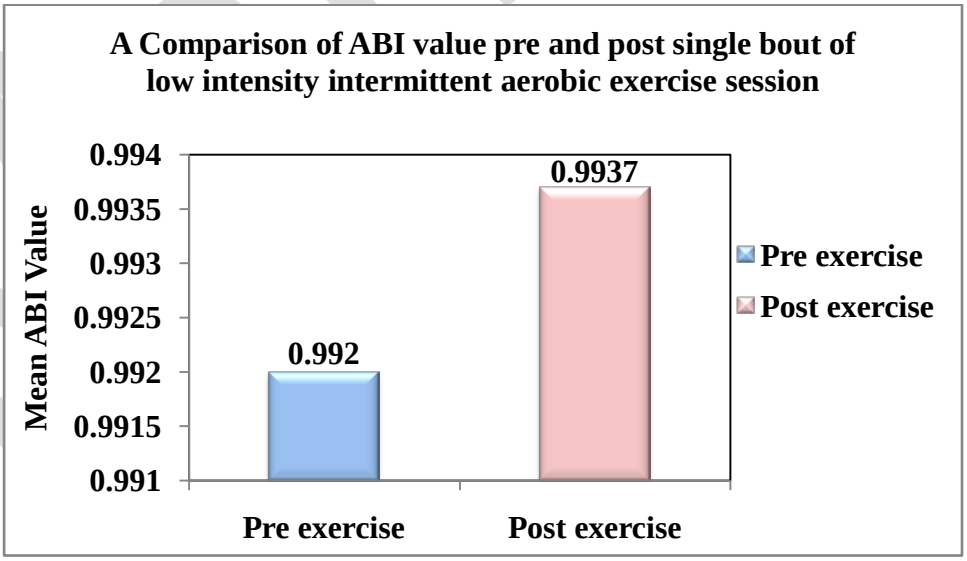
ABI Values	**High Intensity Intermittent Aerobic Exercise session**	**Low Intensity Intermittent Aerobic Exercise session**
Pre mean	**0.9920**	**0.9920**
Post mean	**0.9957**	**0.9937**
Mean of differences	**0.0037**	**0.0017**

Figure 1 : A comparison of ABI value pre and post single bout of high intensity intermittent aerobic exercise session.



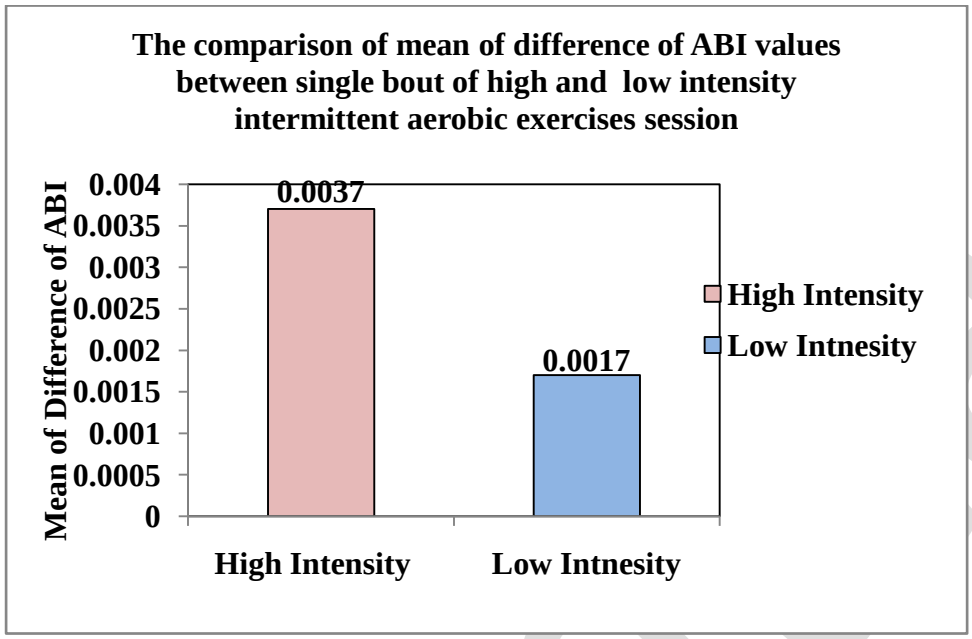
Interpretation : The above graph shows there is an increase in mean ABI value after single bout of high intensity intermittent aerobic exercise session clinically, but this increase is not of any statistical significance, with p value = 0.5000

Figure 2 :A comparison of ABI value pre and post single bout of lowintensity intermittent aerobic exercise session.



Interpretation : The above graph shows there is an increase in mean ABI value after single bout of low intensity intermittent aerobic exercise session clinically, but this increase is not of any statistical significance, with p value = 0.5000

Figure 3 :Thecomparison of mean of difference of ABI values between single bout of high and low intensity intermittent aerobic exercises session



Interpretation : The above graph shows there is more increase in mean ABI value after single bout of high intensity intermittent aerobic exercise session than that after low intensity intermittent aerobic exercise session clinically, but this increase is not of any statistical significance, with p value = 0.5000.

Discussion

In this present study that single bout of intermittent aerobic exercise session does alter ABI value immediately. This could be due to changes in the upper and lower extremity systolic blood pressure (SBP).

Post exercise there is an increase in the ABI value irrespective of exercise intensity. Though these changes are significant clinically they are not of any statistical significance.

The SBP primarily rises due to increase in cardiac output during dynamic exercise. During predominant lower limb exercises there is shunting of blood flow from upper extremity to lower extremity. The evidence says that the blood flow in the previously active calf muscles is around seven times more as compared to the blood flow in resting calf muscles immediately after exercise (30). Immediately after exercise there is increased systemic vascular resistance hence SBP remains elevated. As ABI is directly proportional to lower limb SBP, increase in SBP causes increase in the ABI.

When a comparison of change in ABI value post single bout of high and low intensity intermittent aerobic exercise session was done it should that the increase in ABI value post single bout of high intensity intermittent aerobic exercise session was more as compared to the same after

single bout of low intensity intermittent aerobic exercise session. But this difference is of no statistical significance.

Conclusion

The present study concluded that, single bout of intermittent aerobic exercise session increases ABI in healthy young adults irrespective of exercise intensity, but the increase is not of any statistical significance.

Single bout of high intensity intermittent aerobic exercise session caused more increase in ABI as compared to low intensity intermittent aerobic exercise session, but the increase is not of any statistical significance.

Abbreviations

- PAD : Peripheral Arterial Diseases
- TAO : ThromboangitisObliterans
- ABI : Ankle – Brachial Index
- PAR Q+ : Physical Activity Readiness Questionnaire +
- VO_{2max} : Maximal oxygen uptake
- SBP : Systolic Blood Pressure

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