VOLUME-7, ISSUE-2, FEBRUARY-2018 • PRINT ISSN No 2277 - 8160

Original Research Paper

Physical Education

IMPACT OF EXERCISE ON AEROBIC CAPACITY AND LIPID PROFILE WITH SPECIAL REFERENCE TO VARYING LEVEL OF AIR POLLUTANTS – A STUDY IN YOUNGSTER FOOTBALLERS

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ABSTRACT Present study was carried out with an objective to find out effects of exercise on aerobic capacity and lipid profile of school-going trained boys in environments differing in air pollution level but with similar climatic characteristics. 40 youngster footballers (14-16 years) of West Bengal volunteered for this study. Two places with similar climatic conditions, but low and high levels of air pollutants were selected. Height, weight were measured. Shuttle run test was conducted for assessment of VO_{2max} in both areas after a one week gap in both zones. Immediately after completion of shuttle run test, venous blood sample was drawn from cubital vein and Cholesterol, Triglycerides, HDL-Cholesterol, LDL-Cholesterol, Cholesterol/HDL-Cholesterol ratio were estimated by standard methods. Measured parameters were compared between two areas. A significant decrease in mean VO_{2max}, HDL-Cholesterol, as well as significant increase in Cholesterol, Triglycerides, LDL-Cholesterol, Cholesterol/HDL-Cholesterol ratio was observed in higher-polluted than in lower-polluted area. Exercise in high-polluted air may affect sports performance level adversely causing a less favourable lipid profile and reduction in aerobic capacity in trained school-going boys.

KEYWORDS : Air pollution, Aerobic power, lipid, Trained boys

INTRODUCTION

The world is facing unprecedented set of problems related to environmental pollution, increasing with every passing year and causing rigorous and irreversible damage. Chatterjee & Das, 2013[1] showed the adverse effects of air pollution on cardiovascular health and fitness. Aerobic activity is one of the most important that we can do for our health. But the environment where we exercise, mainly the air quality is an important factor. Rundell, 2012 [2] revealed that air pollution adversely affects athletic performance during both training and competition. The air pollution dosage during exercise is much higher than during rest due to both nasal and oral breathing during exercise and also due to the fact that ventilatory rate is increased during exercise [3]. A study by Das & Chatterjee (2014) [4] revealed that environmental air pollutants might have an adverse effect on pulmonary function irrespective of whether the boys were undergoing regular physical training or not.

OBJECTIVES

An attempt has been made to evaluate effects of exercise on aerobic power and lipid profiles among youngster footballers (Age range 14-16 years) in environments with similar climatic conditions but differing in their air pollutant level.

MATERIALS AND METHODS

40 youngster healthy, non-smoking, nonalcoholic footballers of age range 14-16 years volunteered for this study. They had no history of any chronic medication use and acute or chronic diseases and they are participating physical training sessions (Football) for at least 3 times a week round year. All institutional policies concerning human subjects in research were followed. Ethical approval was taken from the competent authority.

Two zones namely, Tollygunge and Sonarpur in West Bengal, India were selected for present study. Air quality of these two zones was monitored for 24 hrs during winter season for the period from 1st March, 2017 to 31st May, 2017 (three months) and suspended particulate matter (SPM), respirable particulate matter (RPM), sulphur dioxide (SO_2), oxides of nitrogen as nitrogen dioxide (NO_2) were assessed by standard procedures described below. Average values (Mean ± Standard Deviations) of air pollutants were then taken into account.

Participants underwent a shuttle run test for assessment of aerobic capacity (VO_{2max}) in both areas after a one week gap. Venous blood sample was drawn from cubital vein immediately after completion of shuttle run test and Cholesterol, Triglycerides, HDL-Cholesterol, LDL-Cholesterol, Cholesterol/HDL-Cholesterol ratio were estimated by standard methods. Blood sample was analyzed for estimation of lipid profile by spectrophotometer (Hitachi, Japan) following standard methodology [5]. Age of subjects was calculated from birth date. Standing height in cm was measured with shoes removed, feet together. Weight in kg was measured with shoes and Jackets removed. VO_{2max} was predicted using equation of Chatterjee et al. (2005) [6] in case of footballers.

$Y = 5.99 + 5.28X - 1.35A + .001AX$, Where
$Y = VO_{2max}$ (ml/kg/min)
X= Maximal shuttle run speed (km/hr)
A=Age (year)

All values are expressed as Mean ± Standard Deviations (SD). Statistical package for the social science (SPSS) version 20 was used for analysis. Paired T test were adopted for statistical analysis of the data.

RESULTS

Mean ±SD of height and weight of participants was 158.72 4.66 cm and 42.78 3.65 kg, respectively. Ambient air quality data showed in Table 1 revealed that all air quality parameters (SPM, RPM, SO_2, NO_x) were significantly higher in Tollygunge area than Sonarpur. Mean ± SD of VO_{2max} and lipid profiles and the difference of changes in variables after exercise in areas with high and low polluted air showed in table 2 indicated a significant increase in mean TC, TG, LDL-C and TC/HDL-C, as well as significant decrease in VO_{2max} and HDL-C in the higher-polluted than in the lower-polluted area.

DISCUSSION

This study was carried out to evaluate consequences of exercise on aerobic capacity and lipid profiles in areas with low and high levels of air pollution among trained individuals and showed that exercise in high-polluted air resulted a significant reduction in aerobic capacity and made negative impact on lipid profile of boys after physical exertion. Ambient air pollution, specially particulate matter (PM), has been documented as a hazard to cardiovascular health [7]. Long-term exposure to moderate levels of fine PM may cause reduction of life expectancy by as much as several months [8]. Present study established a significant reduction in aerobic power in the high- than in low-polluted air which exemplified that endurance performance decreased in the polluted air. This might be associated with an impaired oxygen distribution system and pulmonary dysfunction in polluted air during activity [9]. Exposure to high level of air pollution may decrease the maximal oxygen consumption

(VO_{2max}) which is possibly due to low level of oxygen transport from the pulmonary alveoli [10]. Kargarfard et al. (2009) [11] showed the effects of raised COHb on performance and indicated a significantly lower VO_{2max}, anaerobic threshold, and oxygen pulse (VO_2/heart rate), and a significantly higher heart rate and pulse pressure.

This research has revealed that high air pollution exposure is associated with poor lipid profile among active individuals. Significant increases in TC, TG, LDL-C and TC/HDL-C after exercise in high polluted air might be due to exposure to higher air pollutant level which was supported by another study in Taiwan by Chuang et al. (2010) [12] where increased 1-year average ozone, PM and nitrogen dioxide were associated with elevated total cholesterol. Air pollution could be the reason of dyslipidemia among people mainly in urban area. A comparative study by Tomao et al. (2002) [13] showed the significant differences in average values of HDL cholesterol and triglycerides between the exposed traffic police group and the control group. Their results suggest the possibility of an alteration in the lipid balance among asymptomatic people who are exposed to air pollution. Singh et al. (2013) [14] reported that traffic exhaust was positively correlated with S. Cholesterol, LDL, and S. triglycerides. In a study in Italy, carboxyhaemoglobin concentration had an inverse correlation with HDL-C [15]. According to McCafferty (1981) [16], athletes are at special risk of inhaling pollutants, as during exercise, with increase in minute ventilation there is a proportionate increase in the quantity of pollutants inhaled. Actually pulmonary diffusion capacity has been shown to increase with exercise and as a result diffusion of pollutant gases increases with exercise [17].

CONCLUSIONS

Exercise in high air pollution may lead to a significant decrease in performance level with a reduction in aerobic capacity in school-going trained boys. This study indicates that air pollution could have negative effects on lipid profile of trained boys. Keeping in view the clinical importance, further longitudinal studies to evaluate the impact of air pollution on sports performance and lipid profile is the need of the hour.

ACKNOWLEDGMENTS

Financial support from the authority of University of Kalyani under the scheme of PRG is highly acknowledged.

Table I: Level of significance of difference in Air Pollutant concentration between two zones

Air Pollutant	Tollygunge	Sonarpur	'T' – test
SPM ($\mu g/m^3$)	269.8554.76	81.5818.28	p<0.01
RPM ($\mu g/m^3$)	154.0844.72	33.2810.17	p<0.01
SO_2 ($\mu g/m^3$)	11.543.98	0.641.53	p<0.01
NO_x ($\mu g/m^3$)	86.7717.30	10.035.28	p<0.01

Table II: Comparison of changes in variables after exercise in high and low polluted areas

Parameters	High polluted area	Low polluted area	Level of significance
VO_{2max} (ml/kg/min)	50.32 3.05	53.91 2.82	p<0.05
Cholesterol (mg. dl-l)	144.0910.15	140.019.93	p<0.05
Triglycerides (mg. dl-l)	59.494.26	57.204.01	p<0.05
HDL-Cholesterol (mg. dl-l)	46.206.65	49.60 6.61	p<0.05
LDL-Cholesterol (mg. dl-l)	99.485.17	96.255.90	p<0.05
Cholesterol/HDL-Cholesterol ratio	3.120.81	2.820.77	p<0.05

REFERENCES

1. Chatterjee, P. & Das, P. (2013). Changes in Lung Function status of Adult Female over last one decade: A Cross-Sectional study in Kolkata, India. Int. Res. J. Environment Sci, 2(7), 1-5.
2. Rundell, K, W. (2012). Effect of air pollution on athlete health and performance. Br J Sports Med, 46(6), 407-412.
3. Pierson, W.E., Covert, D.S., Koenig, J.Q., Namekata, T. & Kim, Y.S. (1986). Implications of air pollution effects on athletic performance. Med Sci Sports Exerc, 18(3), 322-7.
4. Das, P. & Chatterjee, P. (2014). Association of ambient air quality with pulmonary function of youngster footballers. Asian Journal of Sports Medicine, 5(1), 39-46.
5. Chattopadhyay, P. (2011).Practical physiology. Kolkata: New Central Book Agency (P) Ltd.
6. Chatterjee, P., Banerjee, A.K., Das, P., Debnath, P. & Chatterjee, P. (2005). Validity of the 20 m multistage shuttle run test for the prediction of maximal oxygen uptake in trainee footballers. Indian Biologist, 37(2), 31-35.
7. Nel, A. (2005). Atmosphere. Air pollution-related illness: effects of particles. Science, 308(5723), 804-806.
8. World Health Organization. (2009). Global health risks: mortality and burden of diseases attributable to selected major risks. Geneve: WHO; 23-53.
9. Williams, C. (2011). Environmental factors affecting elite young athletes. Med Sport Sci, 56, 150-70.
10. Liu, X., Song, X. & Meng, Z. (2008). Effects of airborne pollution on cardiopulmonary function of healthy person. Wei Sheng Yan Jiu, 37(4), 429-32.
11. Kargarfard, M., Rouzbahani, R., Rizvandi, A., Dahghani, M. & Poursafa, P. (2009). Hemodynamic physiological response to acute exposure to air pollution in young adults according to the fitness level. ARYA Atherosclerosis Journal, 5(3), 1-9.
12. Chuang, K.J., Yan, Y.H. & Cheng, T.J. (2010). Effect of Air Pollution on Blood Pressure, Blood Lipids, and Blood Sugar: A Population-Based Approach. Journal of Occupational & Environmental Medicine, 52(3), 258-262.
13. Tomao, E., Tiziana, P.B., Rosati, V., Marcellini, L. & Tomei, F. (2002). The effects of air pollution on the lipid balance of traffic police personnel. Ann Saudi Med, 22(5-6), 287-90.
14. Singh, R., Singh, M., Garg, R. & Natu, S. (2013). Effect of respirable suspended particulate matter in urban ambient air on health of traffic policemen. Int J Pharm Bio Sci, 4(3), (B) 633- 637.
15. Biava, P.M., Audisio, R., Centonze, A., Barbieri, A., Bisanti, L. & Duca, G. (1992). An epidemiological study of the health conditions of Milan traffic police with respect to pollution from vehicular traffic. Lav, 83(3), 249-58.
16. . McCafferty, W.B. (1981). Air pollution and athletic performance. Springfield: Charles C. Thomas.
17. Fisher, J.T. & Cerny, F.J. (1982). Characteristics of adjustment of lung diffusion capacity to work. J Appl Physiol, 52(5), 1124-7.