Volume : 2 | Issue : 8 | August 2013 • ISSN No 2277 - 8179

Research Paper

Association of ambient air quality with hemoglobin concentration of trained and untrained school-going boys of West Bengal, India

Environment

KEYWORDS : Air pollution, Footballers, Sprinters, Hemoglobin concentration

Paulomi Das — Department of Environmental Science, University of Kalyani, Kalyani- 741235, West Bengal, India

Pinaki Chatterjee — Office of the Secretary, Faculty Councils for Postgraduate Studies, University of Kalyani, Kalyani- 741235, West Bengal, India

ABSTRACT

Purpose of the study was to assess effects of air pollution on hemoglobin concentration of trained and untrained school-going boys of West Bengal. Sample consisted of 60 footballers, 60 sprinters, 127 untrained boys, subdivided into two groups from two zones namely Tollygunge and Sonarpur. Air concentration of SPM, RPM, SO2, NO2 were monitored for both zones. Height, weight, BSA, BMI and Hemoglobin concentration were measured. Results revealed that pollutant concentrations were significantly higher in Tollygunge than Sonarpur. Hemoglobin concentration of untrained boys was significantly higher than footballers in both regions but no significant difference were observed when compared with sprinters. Hemoglobin concentration of both trained and untrained boys of Sonarpur was significantly higher than Tollygunge. Air pollutants might have adverse effect on hemoglobin concentration of both trained and untrained boys which may be confirmed by longitudinal studies.

INTRODUCTION

Air pollution is one of the most serious environmental problems in the world. Several studies stated the effects of air pollution on increasing risk of cardiorespiratory mortality and morbidity (Oliveira et al., 2006; Brook 2008). Toxic substances from air may damage red blood cells as well as reduce hemoglobin concentration, erythrocytes number and hematocrit, thus leading to anemia (Stanković et al., 2006).

Concern has also been raised about problems associated with exercising in polluted air. Air pollution may affect athlete's health and performance (Rundell, 2012). According to Sharman 2005 people should not be deterred from regular exercise as it is of known benefit, but during exercising they should avoid areas with high pollutant concentrations. Air pollution adversely affected cardiorespiratory fitness and some hematologic factors in young individuals during exercise (Kargarfard et al., 2011). Variation of red blood cell system has been reported to have considerable influence on physical performance. Specific type and duration of exercise is highly significant in adaptations of blood cell system and iron metabolism (Schumacher et al., 2002). However, studies on effects of air pollution on hemoglobin concentration in trained school-going boys are scanty. Attempt has been made to observe relation of magnitude of effects with game specific training on hemoglobin concentration with respect to untrained boys and to find out if there is any association of air pollution with hemoglobin concentration of trained and untrained boys.

METHODS

Two zones namely, Tollygunge and Sonarpur in West Bengal, India were selected for present study. Air concentration of suspended particulate matter (SPM), respirable particulate matter (RPM), sulphur dioxide (SO_2), oxides of nitrogen as nitrogen dioxide (NO_2) were monitored for both zones.

Subjects:

247 healthy boys (14-16 years) volunteered and sample consisted of 60 footballers (30 from Tollygunge & 30 from Sonarpur), 60 sprinters (30 from Tollygunge & 30 from Sonarpur), 127 sedentary boys (60 from Tollygunge & 67 from Sonarpur). Footballers and sprinters (trained) were in regular practice and they had a training background of minimum 3 years. Participants were residents in those two zones for a minimum period of three years. All boys were from same economic status and nutritional status. All institutional policies concerning the human subjects in research were followed. Ethical approval was taken from the competent authority.

Data Collection:

Height, weight, BSA (Du-Bois and Du-Bois, 1916), BMI (Meltzer et al., 1988) and hemoglobin concentration (Drabkin and Austin, 1935) were measured.

RESULTS AND DISCUSSION

SPM, RPM, SO_2, NO_2 were significantly higher in Tollygunge than Sonarpur (Table 1). Mean ± SD of all parameters is given in Table 2. Hemoglobin concentration of untrained boys was significantly higher than footballers in both regions but no significant difference were observed when compared with sprinters (Table 3). Hemoglobin concentration of both trained and untrained boys was significantly higher in Sonarpur than Tollygunge (Table 4). Highly significant negative correlation of SPM, RPM, SO_2, NO_2 with hemoglobin concentration were obtained (Table 5).

Table 1: Table 1: Difference in Air Pollutant concentration between two zones

Air Pollutant	Tollygunge	Sonarpur	'T' – test
SPM (µg/m^3)	269.85±54.76	81.58±18.28	p<0.01
RPM (µg/m^3)	154.08±44.72	33.28±10.17	p<0.01
SO_2 (µg/m^3)	11.54±3.98	0.64±1.53	p<0.01
NO_x (µg/m^3)	86.77±17.30	10.03±5.28	p<0.01

Table 2: Measured Physical parameters and hemoglobin concentration (Hb. Conc.) of school-going boys of different groups (Mean ± SD)

Parameters	Tollygunge			Sonarpur		
	Footballers (n=30)	Sprinters (n=30)	Untrained Boys (n=60)	Footballers (n=30)	Sprinters (n=30)	Untrained Boys (n=67)
Height (cm)	158.82 ± 4.66	157.19 ± 5.99	157.61 ± 9.15	156.40 ± 8.46	161.03 ± 7.08	161.83 ± 6.0
Weight (kg)	42.18 ± 3.95	41.5 ± 5.35	43.23 ± 11.63	41.33 ± 6.64	44.95 ± 6.01	47.72 ± 8.41
BSA (m^2)	1.39 ± 0.08	1.37 ± 0.11	1.39 ± 0.20	1.36 ± 0.14	1.44 ± 0.12	1.48 ± 0.14
BMI (kg/m^2)	16.71 ± 1.19	16.73 ±1.41	17.18 ± 3.35	16.79 ± 1.35	17.26 ± 1.32	18.16 ± 2.68
Hb. conc. (gm%)	11.50 ± 1.36	11.91 ± 0.88	11.89 ± 1.35	12.56 ± 1.35	13.81 ± 1.10	13.84 ± 1.55

Volume : 2 | Issue : 8 | August 2013 • ISSN No 2277 - 8179

Table 3: Difference in hemoglobin concentration between trained and untrained boys of two zones

Parameters	Tollygunge		Sonarpur	
	Footballers Vs Untrained boys	Sprinters Vs Untrained boys	Footballers Vs Untrained boys	Sprinters Vs Untrained boys
Hb. conc. (gm%)	p<0.05	NS	p<0.01	NS

Table 4: Difference in hemoglobin concentration of boys of different groups between two zones

Parameters	Tollygunge Footballers Vs Sonarpur Footballers	Tollygunge Sprinters Vs Sonarpur Sprinters	Tollygunge Untrained boys Vs Sonarpur Untrained boys
Hb. conc. (gm%)	p<0.05	p<0.01	p<0.01

Table 5: Correlation among parameters of Sprinters

Parameters	SPM	RPM	SO_2	NO_2	Hb conc.
SPM	-				
RPM	.991**	-			
SO_x	.956**	.951**	-		
NO_x	.968**	.954**	.975**	-	
Hb. conc.	-.584**	-.580**	-.585**	-.610**	-

****Correlation is significant at 0.01 level (2-tailed)**

Study was undertaken to estimate hemoglobin concentration among trained and untrained boys of two regions of West Bengal. Several authors demonstrated decreased hemoglobin in athletes ignoring their sporting discipline compared with physically inactive controls, others disagreed that these changes are not mainly depending on physical activity itself but on specific type of exercise (Sawka et al., 2000). Present study supported previous findings (Hasilbeder et al., 1987; Biancotti et al. 1992) that following any kind of chronic as well as intensive training programme red blood cell variables undergoes changes which are training specific. In our study of both Tollygunge and Sonarpur region, hemoglobin concentration of untrained boys was significantly higher than footballers but no significant difference was observed when compared with sprinters. According to Moosavizademonir, 2011, athletes especially endurance athletes have less HCT & Hb. in comparison to untrained people which supports our finding for most popular endurance game like football. Exercise induced increased secretion of antidiuretic hormone and aldosterone retains water from the kidneys and thereby increases plasma volume (Wilmore and Costill, 1999). As a result, following intense endurance training, due to an increase in blood plasma volume, blood volume may be increased (Schmidt et al. 1988; McArdle et al. 1996). Increase in RBC volume also contributes to increase blood volume. However, increase in RBC volume is not proportional with increase in plasma volume (Green et al., 1991). In present study, hemodilution among footballers, may be due to fact that increase in plasma volume following endurance training is much higher than increase in RBC count.

In spite of belonging to same socioeconomic and nutritional status, hemoglobin concentration of footballers, sprinters and untrained boys of Tollugunge region (High pollution) was significantly lower than their counterparts in Sonarpur region (Less Pollution). Thus present investigation has shown that exposure to high air pollution is associated with occurrence of decreased hemoglobin concentration among trained and untrained boys. Correlation of data revealed significant decrease in hemoglobin concentration in association with higher air pollution exposure. Several studies (Posin et al., 1978; Sydbom et al., 2001) revealed relationship between exposure to air pollutants and changes in hemoglobin concentration, hematocrite (packed cell volume) and red blood cell count. McCafferty, 1981 showed athletes are at special risk of inhaling pollutants i.e. during exercise minute ventilation (V_E) increases, and in turn, there is a proportionate increase in quantity of pollutants inhaled through mouth, effectively bypassing the normal nasal mechanisms for filtration of large particles and soluble vapours. Study by Kargarfard et al., 2011 showed significant decreases in RBC count, hemoglobin, hematocrit, and mean corpuscular hemoglobin after exercise in polluted air. In our study, a highly significant negative correlation obtained between air pollutant parameters and hemoglobin concentration revealed the adverse effect of air pollution on hemoglobin concentration.

CONCLUSION

Game specific training plays a role in differentiation of hemoglobin concentration in athletes. Our findings highlighted the association of hemoglobin concentration with air pollutants in both trained and untrained school-going boys of West Bengal which may be confirmed in future by longitudinal studies. Environmental protection concerns should be considered a top priority for exercising individual.

ACKNOWLEDGEMENT

Authors express their grateful thanks to the DST-PURSE Programme, University of Kalyani, West Bengal for giving financial assistance.

REFERENCE

1. Biancotti, P.P., Caropreso, A., DiVicenzo, G.C., Ganzit, G.P., & Gribaudo, C.G. (1992). Hematological status in a group of male athletes of different sports. Journal of Sports Medicine and Physical Fitness, 32, 70-75. | 2. Brook, R.D. (2008). Cardiovascular effects of air pollution. Clin Sci (Lond), 115(6), 175-87. | 3. DuBois, D., & DuBois, E.F. (1916). Clinical colorimetry. A formula to estimate the approximate surface area if weight and height is known. Arch. Int. Med., 17, 863-871. | 4. Drabkin, D.L., & Austin, J.H. (1935). Determination of haemoglobin in blood cyanomethaemoglobin method. J. Biol. Chem, 112, 51-53. | 5. Green, H.J., Sutton, J.R., Coates, G., & Jones, S. (1991). Response of red cell and plasma volume to prolonged training in humans. Journal of Applied Physiology, 70, 1810-1815. | 6. Hasilbeder, W., Schobersberger, W., & Mairbarul, H. (1987). Red cell oxygen transport before and after short term maximal swimming in dependence on training status. International Journal of Sports Medicine, 8, 105-107. | 7. Kargarfard, M., Poursafa, P., Rezanejad, S., & Mousavinasab, F. (2011). Effects of Exercise in Polluted Air on the Aerobic Power, Serum Lactate Level and Cell Blood Count of Active Individuals. Int J Prev Med, 2(3), 145-150. | 8. McArdle, W.D., Katch, F.I., & Katch, V.L. (1996). Exercise Physiology- Energy, Nutrition and Human Performance (4th Ed.). Dona Balado ed.; Williams & Wilkins, Pennsylvania. p 292. | 9. McCafferty ,W.B. (1981). Air pollution and athletic performance. Springfield: Charles C. Thomas. | 10. Meltzer, A., Muller, W., Annegers, J., Grines, B., & Albright, D. (1988) Weight history and hypertension. Clinical Epidermiology, 41, 867-874. | 11. Moosavizademonir. (2011). Effect of one period of training on hemoglobin, hematocrit and RBC of athlete girls. Annals of Biological Research, 2(6), 642-644. | 12. Oliveira, R.S., Barros Neto, T.L., Braga, A.L.F, Raso, V., Pereira, L.A.A., Morette, S.R., & Carneiro, R.C. (2006). Impact of acute exposure to air pollution on the cardiorespiratory performance of military firemen. Braz J Med Biol Res, 39(12), 1643-9. | 13. Posin, C., Clark, K., Jones, M.P., Patterson, J.V., Buckley, R.D., & Hackney, J.D. (1978). Nitrogen dioxide inhalation and human blood biochemistry. Arch. Environ. Health, 33, 318. | 14. Rundell, K.W. (2012). Effect of air pollution on athlete health and performance. Br J Sports Med, 46, 407-412. | 15. Sawka, M.N., Convertino, V.A., Eichner, E.R., Schnieder, S.M., & Young, A.J. (2000). Blood volume: importance and adaptations to exercise training, environmental stresses, and trauma/sickness. Med. Sci. Sports Exerc, 32, 332-348. | 16. Schmidt, W., Maassen, N., Trost, F., & Boning, D. (1988). Training induced effects on blood volume, erythrocyte turnover and hemoglobin oxygen binding properties. European Journal of Applied Physiology, 57, 490-498. | 17. Schumacher, Y.O., Schmid, A., Grathwohl, D., Bültermann, D., & Berg, A. (2002). Hematological indices and iron status in athletes of various sports and performances. Med Sci Sports Exerc, 34(5), 869-75. | 18. Sharman, J.E. (2005). Clinicians prescribing exercise: is air pollution a hazard? MJA, 182(12), 606-607. | 19. Stanković, A., Nikić, D., & Nikolić, M. (2006). Relationship between exposure to air pollution and occurrence of anemia in pregnancy. Facta Universitatis Series: Medicine and Biology, 13(1), 54- 57. | 20. Sydbom, A., Blomberg, S., Parnia, N., Stenfors, T., & Sandström, S. (2001). Health effects of diesel exhaust emissions. Eur Respir J, 17, 733. | 21. Wilmore, J.H., & Costill, D.L. (1999). Physiology of Sport and Exercise. (2nd Ed); Human Kinetics, Champaign (USA). pp 287-290.