

Exercise Induced Changes in the Levels of Oxygen Saturation among Adult Males and Females

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ABSTRACT

OBJECTIVE: To compare the pre and post exercise SaO₂ values in males and females.

STUDY DESIGN: Comparative cross-sectional study

STUDY SETTING: Department of Physiology, Baqai Medical University, Karachi.

STUDY DURATION: 15th October, 2014 to 26th February, 2015

MATERIAL AND METHOD: Two hundred healthy participants having age ranges from 18-24 years were selected. With their consent, demographic data was recorded. Before exercise, participants' SaO₂ was measured by Pulse Oximeter. Participants were then subjected to run 3 Km on a motorized treadmill. Post exercising SaO₂ was recorded immediately after exercise. Data analyzed on SPSS version 20.0 by applying t-test with significant $p < 0.05$.

RESULTS: The pre and post exercise changes were evaluated with age groups of <20 years and ≥20 years and with BMI among both genders. The results have shown a significant difference $p < 0.05$ in pre and post exercise SaO₂ levels in both genders. However, with both genders of same age groups (<20 & ≥20 years) & same BMI categories, the pre and post exercise SaO₂ changes were found to be non significant.

CONCLUSION: The study has shown that all the values of SaO₂ were within the normal ranges. Whereas there is no significant difference with the post exercise SaO₂ in the same age groups and BMI categories of both genders due to the limited range of age and participants.

KEY WORDS: Body Mass Index, Exercise, Treadmill, Oxygen saturation, Pulse Oximeter.

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INTRODUCTION

Physical exercise refers to a physiological state of well being that allows one to meet the demands of daily living or establish the sports performance, or both.¹ All endurance sports require some combination of three components, briefly, high oxygen transport capacity, high fatigue resistance in working muscles, and high efficiency of transfer of physiological work to mechanical movement.²

During exercise, cells may need to use over six times the oxygen used during rest. Aerobic exercise is also limited by the ability of the cardiovascular system to deliver oxygenated blood to the muscles.³ The chemical reactions utilize oxygen to completely break down carbohydrates e.g; glycogen, glucose and fats for energy turnover and can be continued for long periods of time.⁴ The oxygen saturation (SaO₂) is the statistical average of the entire oxygen bound to haemoglobin,⁵ furthermore, it establishes a significant indicator of cardio-respiratory status.⁶ The SaO₂ concentration in 100 mL of arterial blood represents the overall per-

centage of binding sites on hemoglobin. In healthy individuals SaO₂ is 96%-98%. The highest volume of oxygen the blood carries when fully saturated with hemoglobin is approximately 20 ml oxygen per 100 ml of blood.⁷

Therefore, the objective of present study was to establish normal reference ranges of Pre & Post Exercise SaO₂ levels among healthy university individuals of 18 -24 Years in relationship to Age & BMI.

MATERIAL AND METHOD

This comparative cross-sectional study was carried out in the Department of Physiology at Baqai Medical University from 15th October, 2014 to 26th February, 2015 after the approval from ethical committee of the institution. The study included 200 adult healthy individuals, 100 males with mean age 20.4 ± 1.340 years and 100 females with mean age 19.59 ± 1.356 years, who have no known co-morbid. All individuals were briefed about the exercise along with the significance of this research procedure. The written consent was obtained from participants. The history was also

obtained from every individual prior to the study in which their personal details, medical record, family background, socio-economic status, diet and physical activity was asked. The anthropometric parameters were also measured and BMI (kg/m²) was calculated according to the WHO standard criteria; underweight <18.5, normal 18.5-24.99, overweight 25-29.99, obese ≥30.⁸ The demographic data was also recorded including age, height and weight. Then the process of handling the treadmill Model No: SPR-OMA 8300 was demonstrated to the participant and they were asked to run for 3 Kilometers.⁹ Immediately after exercise SaO₂ was measured. Oxygen saturation was recorded 5 minutes prior to exercise and immediately after exercise. Using Pulse Oximeter Model no:A320, Shenzhen Aeon Med. The Pulse Oximeter was attached to the index finger of the left hand of subjects and readings were recorded from the screen, pre and immediately after exercise. The Pulse Oximeter used according to the method described by Berry DC and Seitz RS.¹⁰

RESULTS

The data were analyzed using SPSS-20. Paired sample t-test was used to compare the pre and post exercise levels of SaO₂ and p<0.05 was considered significant. The anthropometric parameters were observed in 200 subjects with age ranging from 18-24 years. The age group is sub divided into <20 years old and ≥20 years in both genders, whereas BMI is categorized into underweight, normal, overweight and obese. In the present study, the pre and post exercising SaO₂ changes of males and females according to their ages were found to be significant p<0.05. However, with both genders of same age groups i.e. <20 & ≥20 years, the pre and post exercise SaO₂ changes were found to be non significant (Table I).

In the present study, the pre and post exercising SaO₂ changes of males and females according to different categories of BMI were found to be significant p<0.05. However, with both genders of same BMI categories, the pre and post exercise SaO₂ changes were found to be non significant (Table II).

TABLE I: PRE AND POST SAO₂ EXERCISE CHANGES IN MALES AND FEMALES WITH AGE

Age	SaO ₂ (%)	N	Male	Female	T-Test	p-value
<20 Years	Pre Exercise	78	98.82±0.77	98.98±0.80	1.272	0.20**
	Post Exercise		94.91±2.06	94.81±1.75	0.327	0.74**
T-test			15.70	19.13		
p-value			0.0001*	0.0001*		
≥20 Years	Pre Exercise	122	99.12±0.66	99.11±0.83	0.104	0.917**
	Post Exercise		94.95±2.74	94.55±1.99	1.304	0.193**
T-test			16.34	23.36		
p-value			0.0001*	0.0001*		

*p-value significant

**p-value non significant

TABLE II: PRE AND POST EXERCISE SAO₂ CHANGES IN MALES AND FEMALES WITH BMI

SaO ₂ (%)	Underweight		T-Test	P value	Normal		T-Test	P value	Overweight		T-Test	P value	Obese		T-Test	P value
	Male N=18	Female N=34			Male N=59	Female N=58			Male N=21	Female N=6			Male N=2	Female N=2		
Pre Exercise	99.176 ±0.528	99.088 ±0.621	0.512	0.61**	99±0.669	99.051 ±0.846	0.362	0.72**	98.952 ±0.864	98.5±1.378	0.987	0.33**	100±0	99.5±0.707	1.002	0.422**
Post Exercise	94.47±4.155	94.5±1.926	0.035	0.97**	95.44±1.632	95.103 ±1.618	1.121	0.264**	94.142 ±3.037	93.5±1.224	0.502	0.620**	93.333 ±2.309	90±0	2.041	0.178**
T-Test	4.766	13.219	--	--	15.503	16.46	--	--	6.991	6.645	--	--	4.083	19.002	--	--
P value	0.0001*	0.0001*	--	--	0.0001*	0.0001*	--	--	0.0001*	0.0001*	--	--	0.05*	0.002*	--	--

Underweight <18.5, Normal 18.5-24.99, Overweight 25-29.99, Obese ≥30
 *p-value significant **p-value non significant

DISCUSSION

In the present study, the correlation of SaO₂ (%) with pre- and post- induction of exercise were measured in healthy, untrained, non-athletic males and females with an age ranging from 18-24 years. The SaO₂ level was measured before and immediately after exercise. According to the WHO, the BMI value for normal subjects of Asian population varies from 18.5 to 24.9 Kg/m².⁸ However, the normal resting values of SaO₂ in healthy individual ranges from 95%-100% for both males and females. Therefore; in the present study, the pre exercise SaO₂ levels of both gender fall within the normal ranges and supporting the previous studies^{7,11} while the post-exercise SaO₂ levels of both genders in both age groups were almost similar¹² and fall within the normal range of below 95%¹³ ranges from 94% - 98%.¹⁴

In the present study, the pre and post exercise SaO₂ changes in males and females at <20 and ≥20 years were also under the normal ranges. Therefore, this finding is also significant with the previous study done on healthy individuals of 20 to 50 years of age, which has showed that the alteration in oxygen saturation is dependent on the changes in muscle mass with respect to the height and age of the individual.¹⁵

Limitation of the study

The age that is <20 and ≥20 does not affect the post exercise changes of SaO₂ which is due to less number of participants in both age groups of both genders as well as range of age is also limited.

CONCLUSION

There is significant difference in the pre- and post-exercise SaO₂ levels in both genders. However the difference is non significant within the same age groups and BMI categories of both genders.

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REFERENCES

1. Thompson HJ. Pre-clinical investigations of physical activity and cancer: a brief review and analysis. *Carcinogenesis*. 2006;27(10):1946-49.
2. Shephard RJ, Astrand PO. Determinants of endurance performance. *The Encyclopaedia of Sports Medicine: An IOC Medical Commission Publication, Endurance in Sport*, 2000; 2: 21.
3. Gonzalez-Alonso J, Crandall CG, Johnson JM. The cardiovascular challenge of exercising in the heat. *Jphysiol* 2008.586(Pt 1):45-53.
4. Spencer M, Bishop D, Dawson B, Goodman C. Physiological and metabolic responses of repeated-sprint activities: specific to field based team sports *Sports Med* 2005;35(12):1025-44.
5. Faber DJ, Aalders MCG, Mik EG, Hooper BA, van Gemert MJ, van Leeuwen TG. Oxygen Saturation-Dependent absorption and scattering of blood. *Phys. Rev. Lett.* 2004; 93:028102.
6. Moller JT, Johannessen NW, Espersen K, Ravlo O, Pedersen BD, Jensen PF, et al. Randomized evaluation of pulse oximetry in 20,802 patients: II. Perioperative events and postoperative complications. *Anesthesiology*, 1993; 78(3): 445-53.
7. Schutz S.L. Oxygen saturation monitoring by pulse oximetry. In: Lynn-McHale D.J., Carlson K.K., editors. *AACN procedure manual for critical care*. 4th ed. W. B. Saunders; Philadelphia: 2001.
8. WHO. Expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 2004;363:157-63.
9. Sherman WM, Lash JM, Simonsen JC, Bloomfield SA. Effects of Downhill Running on the Responses to an oral Glucose Challenge. *Int J Sport Nutr*; 1992;2:251-59.
10. Berry DC, Seitz RS. Educating the Educator: Use of Pulse Oximetry in athletic training. *Athl Train Educ J*. 2012; 7(2):74-80.
11. Lavelle-Jones M & Dent JA. *Master Medicine: Surgery Third Edition Elsevier Health Sciences, China, 3rd ed; 2008: page 400.*
12. West JB, Lahiri S, Gill MB, Milledge JS, Pugh LGCE, Ward MP. Arterial oxygen saturation during exercise at high altitude. *J Appl. Physio.* 1962; 17(4):617-21.
13. Astrand P, Rodahl, K, Dahl H.A, Stromme S.B. *Textbook of work physiology: Physiological basis of exercise.* Human Kinetics, Edward Brothers,

- Champaign, U.S.A, 4th ed; 2003: page 201.
14. O'Driscoll BR, Howard LS, Davison AG. BTS Guideline for emergency oxygen use in adult patients. Thorax. 2008; 63(Suppl 6): vi1-68.
15. Casanova C, Celli BR, Barria P, Casas A, Cote C, De Torres JP et al. The 6-min walk distance in healthy subjects: reference standards from seven countries. Eur Resp J. 2011; 37(1):150-56.



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