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Research Article

IMPACT OF GRADED ISOTONIC EXERCISE ON OCULAR PERFUSION PRESSURE IN OBESE YOUNG ADULTS

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A B S T R A C T

Objective: To study and compare the effect of graded Isotonic exercise on Ocular Perfusion Pressure (OPP) in obese young adults.
Method: 100 healthy young adult volunteers comprising 50 obese and 50 non-obese of either gender in the age group of 18-21 years were selected among MBBS Phase I students of JSS Medical college, Mysuru. Isotonic exercise was performed using a treadmill of both mild and moderate grade under Bruce protocol. IOP and BP were recorded before and after performing exercise using standard methods. Mean arterial pressure (MAP) and OPP were calculated. Statistical analysis was done using paired t test to test the difference between the groups.
Results: OPP increased by 5.62±0.3 mm Hg after mild isotonic exercise in obese (3.13±0.16 in non-obese) and by 9.75±0.02 mm Hg after moderate isotonic exercise in obese (10.91±1.29 in non-obese). The changes were statistically significant (P< 0.001).
Conclusion: There was a significant increase in OPP after performing both grades of Isotonic exercises in obese individuals. Moderate intensity Isotonic exercise proves to be beneficial for ocular health as well as systemic health as it improves ocular perfusion.

INTRODUCTION

Obesity is a clinical condition which is defined as "abnormal or excessive fat accumulation that may impair health" by World Health Organization (WHO). Incidence of obesity in childhood and young adults is increasing nowadays because of faulty food habits and lack of physical exercise. It is associated with number of co-morbidities such as cardio-vascular diseases (CVD), hypertension, Type 2 diabetes, musculo-skeletal disorders & disabilities and some cancers, whose manifestations appear quite later in life, though risk related behaviour patterns are evident in childhood and adolescence. Ocular health is also affected by obesity.

Ocular Perfusion Pressure (OPP) is defined as the pressure difference between the arterial Blood Pressure (BP) and the Intra Ocular Pressure (IOP).[1] A decrease in perfusion pressure may significantly decrease ocular blood flow in the absence of vascular autoregulation. Decreased OPP would be a major cause for glaucomatous damage.

Isotonic exercise comprises the muscle contraction during which the muscle changes its length with a constant tension. The two primary responses occurring in the eye as a result of exercise are decrease in IOP and Ocular blood flow alterations. This leads to an increase in OPP. Lower levels of physical activity, which is one of the major cause for obesity is also associated with lower OPP.[2] There is sparse knowledge about the grade of exercise to be followed in order to maintain a healthy OPP. So present study was undertaken to know the effect of graded Isotonic exercise on Ocular Perfusion Pressure (OPP) in obese young adults.

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MATERIALS AND METHODS

This is a comparative study which includes participants from medical students (n=100) of JSS Medical College (JSSMC), Mysore. The study was done after obtaining an ethical clearance from ethical committee of JSSMC, Mysore.

Subjects were screened using a questionnaire which included inclusion and exclusion criteria. Subjects with history of pre-existing refractive errors, glaucoma, migraine, any systemic illness, intake of any drug affecting IOP, Smokers and alcoholics were excluded. Subjects were informed about the purpose of the study, the study protocol and the informed consent was obtained and confidentiality of the data was maintained.

The weight, height, Waist Circumference (WC) and Hip Circumference (HC). BMI was calculated by dividing weight in kgs by the square of height in meter and Waist Hip Ratio (WHR) was computed. IOP& BP were measured and OPP was

calculated for each subject. Subjects were considered for the study depending upon the inclusion and exclusion criteria.
Depending on the BMI cut-off for Indian population, the subjects will be classified into two groups.

- ✓ Group A (BMI >25 kg /m ^{2}) = 50 obese healthy young adults of both sex were considered to form study group.
- ✓ Group B (18 – 22.9 kg/ m^2) = 50 non obese healthy young adults of both sex were considered to form control group.

Materials

- ✓ Schiotz tonometer (Reister, Germany)
- ✓ Sphygmomanometer
- ✓ Stethoscope
- ✓ Treadmill (Dynatrac)
- ✓ Pulse-oximeter

The study was conducted in the research laboratory, department of Physiology, JSS Medical College, Mysore. Informed and written consent was taken from the subjects who underwent the study with their own will and wish. The study was carried out in a quiet room, by a single examiner between 3pm to 5pm to minimize the bias of examiners and diurnal variations of IOP. Subjects were briefed about the study before the experiment session and asked to relax for 15 minutes in supine position. Resting IOP was recorded using Schiotz indentation tonometer.

Resting Heart rate was recorded using pulse-oximeter. Resting BP was measured using Mercury Sphygmomanometer in supine position. Then the subjects were asked to do isotonic exercise using treadmill with modified Bruce protocol. Pulse-oximeter was applied onto their finger to record their heart rate. Both IOP and BP were recorded as the average of 3 sequential measurements in mm Hg in supine posture at first minute, five minutes, ten minutes and fifteen minutes after the exercise.

The exercise was started as per the modified Bruce protocol. Initially subjects were asked to do mild grade exercise, as per heart rate recorded by a pulse-oximeter. Subjects were asked to do the exercise for 3 minutes with a steady speed of 2.7 km/hour at grade 0%& 5%. This exercise load is equivalent to stage I &II of modified Bruce protocol and calculated equivalent METs is approximately 1.6-4.IOP and BP were recorded immediately (1 minute), again after 5, 10, 15 minutes after exercise. They were asked to relax till their heart rate reaches to their resting rate. Next they were asked to do moderate grade exercise, i.e. Subjects were asked to do the exercise for 3 minutes with a steady speed of 2.7 km/hour at grade 10%. This exercise load is equivalent to stage III of modified Bruce protocol and calculated equivalent METs is approximately 4-5. IOP and BP were recorded immediately(1 minute), again after 5, 10, 15 minutes after exercise. OPP was calculated using formula,

OPP =2/3 MAP – IOP

Statistical Analysis

Mean and standard deviation were worked out to assess the estimate of various parameters under study. Paired t-test and ANOVA was applied to test the significance of changes in parameters studied. Microsoft Excel and SPSS version 19 software were used for data entry and statistical analyses respectively. P value < 0.05 was considered as significant.

RESULTS

The study included 100 young adults in the age group of 18-19 years (obese group n=50 and non-obese group n=50). The characteristics of the study and groups are represented in Table I. There was significant difference in weight, BMI, WHR, MAP, IOP and OPP between the two groups. Age and height showed no significant difference between the two groups.

Table I Physiological Characteristics of the study and control groups

Parameter	Study Group (n = 50)	Control Group (n = 50)	'p' value
Age (Years)	18.26 ± 0.44	18.26 ± 0.44	1.000
Weight (Kg)	73.56 ± 8.38	56.12 ± 7.61	0.000*
Height (Cm)	162.72 ± 7.44	162.34 ± 10.83	0.838
BMI	27.76 ± 2.27	21.28 ± 1.13	0.000*
WHR	0.95 ± 0.08	0.83 ± 0.03	0.000*
MAP (mmHg)	93.93±4.75	91.37±2.71	0.001*
IOP (mm Hg)	16.71±1.07	16.170± 0.969	0.010*
OPP(mm Hg)	51.48±3.227	50.14 ±1.574	0.010*

*Statistically significant (p<0.05)

Table II demonstrates that the MAP and OPP responses were statistically highly significant between mild and moderate grade exercises, the responses being high in latter. Similarly, table III shows the difference in response to mild and moderate exercise for control and study groups respectively.

Table II Comparison of study parameters after graded isotonic exercise (n=100).

	REST	MILD EXERCISE	MODERATE EXERCISE	'p' value
HR	75.47±4.23	101.69±1.87	126.11±2.59	<0.001*
MAP	92.65±4.05	97.73±4.75	104.89±4.68	<0.001*
IOP	16.44±1.05	14.96±1.04	13.17±1.18	<0.001*
OPP	50.81±2.63	55.18±3.09	61.13±3.04	<0.001*

Table III Changes in study parameters in non-obese and obese groups after exercise.

	NON-OBESE(n=50)	OBESE(n=50)	'p' value
HR(beats/min)			
At Rest	74.28±3.85	76.66±4.30	0.004*
After Mild exercise	101.74±2.01	101.64±1.76	0.79
After Moderate exercise	125.74±3.00	126.46±2.09	0.16
MAP(mm Hg)			
At Rest	91.37±2.71	93.93±4.75	0.001*
After Mild exercise	94.69±2.92	100.79±4.26	0.001*
After Moderate exercise	104.41±4.44	105.37±4.91	0.308
IOP(mm Hg)			
At Rest	16.17±0.97	16.71±1.08	0.009*
After Mild exercise	14.78±0.97	15.14±1.10	0.082
After Moderate exercise	12.84±1.24	13.53±1.01	
OPP(mm Hg)			
At Rest	50.13±1.57	51.48±2.36	0.01*
After Mild exercise	53.27±1.73	57.10±2.97	0.001*
After Moderate exercise	61.05±2.86	61.23±3.25	0.766

Table IV depicts the significant gender difference in MAP and OPP of the study groups. It can also be seen that following exercise, there was a noticeable rise in both parameters, which again was significant between two gender groups.

Table IV Gender differences in study parameters in non-obese and obese groups after exercise.

	NON-OBESE		p	OBESE		p
	MALES (n=25)	FEMALES (n=25)		MALES (n=25)	FEMALES (n=25)	
HR(beats/min)						
At Rest	75.64±3.86	72.92±3.40	0.01*	78.12±4.21	75.20±3.95	0.01*
Mild exercise	101.64±2.27	101.84±1.75	0.72	101.64±1.89	101.64±1.66	1.00
Moderate exercise	125.68±2.59	125.80±3.40	0.88	126.12±2.44	126.80±1.66	0.25
MAP(mm Hg)						
At Rest	92.35±1.67	90.40±3.20	0.001*	96.93±2.87	90.93±4.37	0.001*
Mild exercise	95.73±2.23	93.65±3.19	0.07	103.01±3.12	98.56±4.13	0.001*
Moderate exercise	105.17±3.55	103.65±1.34	0.23	106.45±4.20	104.29±5.40	0.12
IOP(mm Hg)						
At Rest	16.24±0.82	16.10±1.11	0.59	16.70±0.95	16.72±1.22	0.93
Mild exercise	14.78±0.91	14.78±1.04	0.98	15.08±0.99	15.20±1.21	0.71
Moderate exercise	12.58±1.11	13.06±1.34	0.18	13.40±0.86	13.66±1.15	0.38
OPP(mm Hg)						
At Rest	50.73±0.91	49.55±1.87	0.007*	53.49±1.87	49.47±3.14	0.008*
Mild exercise	53.97±1.30	52.58±1.86	0.004*	58.62±2.04	55.57±3.01	0.001*
Moderate exercise	61.67±2.55	60.43±3.07	0.13	62.03±2.72	60.43±3.58	0.03*

DISCUSSION

Obesity is considered as an independent risk factor for development of multi-organ dysfunction. Prevalence of obesity and over weight is increasing in children and adolescents globally, due to lack of physical activity and faulty food habits. Earlier studies [3,4,5] have consistently shown a positive relationship between obesity and IOP and the Epic-Norfolk Eye study[2] concluded that lower levels of physical activity were associated with lower OPP.

In the present study it was observed that the OPP increased profoundly in both groups immediately in post-exercise period. During exercise, there will be vasodilation in active muscles partly due to accumulation of metabolites. This leads to a decrease in systemic vascular resistance that is proportional to the involved muscle mass. In order to maintain arterial blood pressure, there will be increased sympathetic activity. This causes vasoconstriction in inactive tissues, like splanchnic bed as well as increased venous return to maintain cardiac filling volume and pressure. The milking effect of muscular activity also leads to increased venous return. Thus the sympathetic over activity causes an increased chronotropic and inotropic action of heart resulting in increased cardiac output, SBP and thus MAP. Obesity leads to an increase in IOP through increased episcleral venous pressure. High IOP in obese individuals is also due to increase in orbital fat.

Exercise cause increase in SBP and a decrease in IOP. These two components are strongly influenced by the autonomic nervous system, and the net result is an increase in OPP. Dynamic exercise changes Ocular perfusion pressure (OPP), and produces increased tissue blood flow in the retina in the immediate post exercise period.

It was observed that the changes in OPP values after moderate exercise (Mean difference b/n baseline to immediate post-IE 9.74±4.09) is much higher than that of mild-grade exercise (Mean difference between baseline to immediate post-IE 5.61±1.11) in both the groups. A study found that moderate physical exercise performed about 15 years previously was associated with a 25 percent reduced risk of low ocular perfusion pressure (OPP), an important risk factor for glaucoma[2].

Kozobolis *et al*.[6], who studied the effects of dynamic physical exercise on ocular perfusion pressure (OPP) & ophthalmic artery (OA) blood flow on thirty male subjects concluded that maximal physical exercise increases OPP. In our study we attained an increased OPP immediately after mild and moderate exercise, the changes being higher in latter.

Alon[7] and colleagues were successful in demonstrating the IOP reduction effect of graded exercise. They also made an observation that IOP reducing effect of exercise was more in sedentary persons rather than in trained individuals.

A large population study involving 5650 middle-aged men & women showed a high level of habitual physical activity at baseline period was associated with a reduced risk of low OPP and DOPP 10 years later[7]. Stimulation of sympathetic nervous system during and in post exercise period is well documented and leading to the release of large quantities of epinephrine and nor-epinephrine from adrenal medulla[8]. Many studies reported that epinephrine reduces IOP by lowering outflow resistance and by lowering the rate of aqueous formation[9]. Epinephrine produces many of its effect by stimulating the synthesis of cyclic adenosine monophosphate (cAMP). cAMP regulates the activity of protein kinases, these in turn phosphorylate and thereby activate or inhibit key enzymes that control intracellular metabolic pathways. It has been shown that activation of cAMP decreases IOP by decreasing the aqueous humor production[10]. Higher levels of physical activity are associated with lower risk of arterial stiffness[11] and it suggests that the beneficial effects of physical activity on ocular perfusion may be due to differences in arterial compliance. A study carried out in Osaka, Japan investigated the control mechanisms for ocular blood flow changes after dynamic exercise and concluded that dynamic exercise changes OPP and produces increased tissue blood flow in the retina in the immediate post-exercise period[12].

The OPP changes were noticeably high in obese subjects (mean±SD =57.10±2.97) when compared to non-obese (mean±SD =53.27±1.73) following mild grade exercise.

In this study, it was found that there was a significant difference in baseline MAP and OPP between two genders and these values were higher in males to that of females. A study comprising 72 women and 68 men, showed higher values for ocular blood flow in men compared to women[13]. These findings were statistically significant only in the younger age group (< 40Yrs).

Lee[14] in his landmark study on 6828 healthy Korean population concluded that mean IOP was significantly higher in males when compared with females. They also concluded IOP increased significantly with increasing SBP, DBP and BMI. Tadashi Nakano[5] also reported similar findings that increase in IOP is related to rise in SBP, BMI and haematocrit. A study conducted in Genoa, Italy evaluated the retinal blood flow before and after dynamic exercise to assess the autoregulation of retinal blood flow in young healthy subjects and concluded that in normal subjects, auto regulation is sufficient to maintain the increase in blood pressure following exercise and maintain a stable retinal blood flow.[15]

Following exercise, there was a significant difference with regard to OPP changes between males and females. After mild exercise, there was significantly higher response in males

(55.57 ± 3.01) compared to females(58.62 ± 2.04) in both control and study groups and changes being more in study group. But there was no statistical difference in genders in response to moderate exercise, in either groups.

CONCLUSION

The Following Conclusions were Drawn from this study

- The baseline Mean arterial pressure, Intra Ocular Pressure and Ocular Perfusion Pressure were significantly higher in obese group.
- Response to exercise: Following graded isotonic exercise there was a significant increase in OPP ascribed to a significant rise in MAP and an insignificant IOP fall.
- Furthermore moderate exercise is more beneficial as compared to mild grade, that the mean difference between baseline values and post-exercise values were noticeably higher following moderate exercise.
- Gender difference: There exists a significant gender difference in baseline MAP and OPP, which were comparatively being higher in males. This difference in profound in obese individuals compared to non-obese.
- Obese females were found to show a large increment in OPP post-exercise compared to non-obese females, non-obese males and obese male group.

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References

1. Cristina Leske M; Ocular perfusion pressure and glaucoma: clinical trial and epidemiologic findings. Current opinion in ophthalmology 2009, 20:73-78.
2. Jennifer LY Yip, David C Broadway et.al: Physical activity and ocular perfusion pressure: The Epic-Norfolk eye study: Inv. Ophthalm & visual sciences, Oct 2011, vol 52,no 11.
3. Shiose Y. The aging effect on intraocular pressure in an apparently normal population. Arch Ophthalmol.1984; 102: 883-887.
4. Lee JS, Choi YR, Lee JE, Choi HY, Lee SH, Oum BS. Relationship between Intraocular pressure and systemic health parameters in the Korean population. *Korean J Ophthalmol.* 2002 Jun; 16(1):13-19.
5. Tadashi N, Masayuki T, Yasuhiko M, Minoru S, Kinji K. Long-Term Physiologic Changes of Intraocular Pressure: A 10-year longitudinal analysis in young and middle-aged Japanese men. *J .ophthal.*2004; 10: 46.
6. Kozobolis, V.P., Detorakis, E.T., Konstas, A.G., Achtaropoulos, A.K. and Diamandides, E.D.: Retrobulbar blood flow and ophthalmic perfusion in maximum dynamic exercise. Clin Experiment Ophthalmol; 36(2): 123-129, 2008.
7. Alon Harris, Vic Malinovsky, Bruce M. Correlates of acute exercise- induced ocular hypotension. *Inv opthal & Visual Sci*. 1994; 35:11.
8. Richard JSF and Drance SM. The effect of 2% epinephrine on aqueous dynamics in human eye. *Can J. Ophthalmol*.1967; 2: 259-265.
9. Sutherland EW, Oyel and Buthcer RW. The action of epinephrine and the role of adenylcyclase system in hormone action. *Rect. Prog. Horm Res*. 1965; 21: 623-646.
10. Sears MC and Mead A.A major pathway for regulation of IOP. Int Ophthalmol clin. 1983; 6: 201-209.
11. Seals DR, Desouza CA, Donato AJ, Tanaka H. Habitual exercise and arterial aging. J Appl physiol. 2008; 105: 1323-1332.
12. Okumo T, Sugiyama T, Kohyama M. Ocular blood flow changes after dynamic exercise in humans. EYE (2006)20, 796-800.
13. Doreen Schmidl et.al. Gender Differences in Ocular Blood Flow. Review. Current Eye Research, Early Online, 1–12, 2014.
14. Lee JS, Choi YR, Lee JE, Choi HY, Lee SH, Oum BS. Relationship between Intraocular pressure and systemic health parameters in the Korean population. *Korean J Ophthalmol.* 2002 Jun; 16(1):13-19.
15. Michele Lester, Pier giacomotorre et.al. Retinal blood flow autoregulation after dynamic exercise in healthy young subjects. Ophthalmologica 2007; 221: 180-185.

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