JOURNAL OF NUTRITION FASTING AND HEALTH

The Effect of 8 TRX on Myeloperoxidase and Total Antioxidant Capacity as Indicators of Vascular Endothelial Function in Obese Women

Shima Gharah Dashkhany Gordeh [1], Abdol Ali Banaeifar [2]*, Yaser Kazemzadeh [3], Saeid Sedaghaty[4], Keyvan Molanorouzi[5]

1. PhD Candidate, Department of Exercise Physiology, Islamshahr Branch, Islamic Azad University, Tehran, Iran.
2. Associated Professor, Department of Exercise Physiology, South Tehran Branch, Islamic Azad University, Tehran, Iran.
3. Assistant Professor of Exercise Physiology, Islamshahr Branch, Islamic Azad University, Tehran, Iran.
4. Assistant Professor of Physical Education and Sport Sciences, Islamshahr Branch, Islamic Azad University, Tehran, Iran.
5. Assistant Professor of Physical Education and Sport Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.

ARTICLEINFO

Article type:
Research Paper

Article History:
Received: 26 Jul 2023
Accepted: 29 Aug 2023
Published: 20 Sep 2023

Keywords:
Obesity
Stress oxidative
Vascular endothelial function
TRX

ABSTRACT

Introduction: Vascular endothelial dysfunction is one of the consequences of obesity or increased body fat mass. This study aimed to determining the effect of TRX training on myeloperoxidase (MPO) and total antioxidant capacity (TAC) as markers of vascular endothelial function in inactive obese women.

Methods: 28 inactive middle-aged obese women aged 42±3 years of old (30 ≤ BMI ≤ 36) were randomly divided into of TRX (8 weeks, 3days/weekly, n= 14) and control (no training, n = 14) groups. Fasting levels of TAC and MPO activity and anthropometric indices were measured before and 48 hours after lasting exercise session of groups. Independent and paired t -test use to compare inter and intra-group change of variables (P< 0.05).

Results: No significant difference was found in TAC (P= 0.356) and MPO (P= 0.268) between groups at baseline (P> 0.05). TRX led to a significant increase in TAC activity compared (P= 0.004) but MPO remained no change by TRX (P= 0.459). None of these variables were changed in the control group (P > 0.05).

Conclusion: Emphasizing the increase in TAC, it is concluded that TRX training are associated with improved vascular endothelial function in inactive obese women.

► Please cite this paper as:
Gharah Dashkhany Gordeh Sh, Banaeifar AA, Kazemzadeh Y, Sedaghaty S, Molanorouzi K. The Effect of 8 TRX on Myeloperoxidase and Total Antioxidant Capacity as Indicators of Vascular Endothelial Function in Obese Women. J Nutr Fast Health. 2023; 11(3): 200-207. DOI: 10.22038/JNFH.2023.74009.1456.

Introduction

Obesity is a global epidemic whose impact on public health has become a major concern, and the prevalence of obesity is expanding in different societies. In the country of Iran, inactivity has been reported to be significantly higher than the average of world statistics, and this issue has a significant effect on causing obesity and its complications (1). Clinical studies have revealed that the decrease in cardiovascular function, which often occurs in response to the decrease or dysfunction of vascular endothelial function, is one of the most important complications caused by obesity, especially in sedentary people (2). So that the increase in body fat is associated with an increase in inflammatory factors, the production of reactive oxygen species (ROS) and the disruption of hormonal and enzyme mediators effective in vascular endothelial function (3).

On the other hand, apart from homocysteine, nitric oxide and vascular endothelial growth factor, myeloperoxidase (MPO) has also been introduced as one of the most important effective mediators in vascular endothelial function. MPO is a hemoprotein and a member of the large peroxidase family, which is a derivative of leukocytes and is often found in neutrophils, monocytes and tissue macrophages, and as a result of their activation, it is released as a

* *Corresponding authors:* Abdol Ali Banaeifar, Associated Professor, Department of Exercise Physiology, South Tehran Branch, Islamic Azad University, Tehran, Iran. Tel: +98 9056636426, Email: banaeia2006@yahoo.com.
© 2023 mums.ac.ir All rights reserved.
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/3.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

response to various stimuli. (4) The role of MPO in inflammatory processes and oxidative stress is through catalyzing the respiratory burst reaction causing the conversion of hydrogen peroxide to hypochlorous acid (HOCL) (5, 6). This enzyme has been identified in arterial plaques and its proatherogenic effects have been confirmed. Also, MPO causes peroxidation of low-density lipoprotein (LDL), oxidative changes in high-density lipoprotein (HDL), and decreases the ability of reverse cholesterol transfer by HDL (7). This enzyme reduces the biological production of nitric oxide, and as a result, it causes disruption in the function of vascular endothelium (6).

On the other hand, the reduction of antioxidant capacity leads to the strengthening of reactive oxygen species, which leads to cell wall damage, mitochondria, DNA and functional proteins, dysfunction and even cell death (8). In this context, it has been pointed out that the reduction of TAC and the increase of MPO derived from activated neutrophils and monocytes as one of the agents of oxidative stress due to the reduction of NO leads to dysfunction of the vascular endothelium (9).

In summary, obesity leads to a decrease in vascular endothelial function by increasing MPO levels and decreasing TAC. Under these conditions, physical activity and regular exercise training help to reduce cardiovascular risk factors, especially in healthy or sick obese individual, by improving body composition and regulating endothelial indices (10). Some researchers have pointed out that exercise training, by reducing MPO and increasing TAC, leads to a reduction in inflammatory processes and oxidative stress and prevents LDL oxidation, which in turn is associated with the prevention of atherosclerosis and vascular endothelial dysfunction (11). In Hijazi et al's study (2014), 12 weeks of aerobic training led to a decrease in MDA and an increase in TAC in obese women (12). Nevertheless, Shemshahi et al (2011) reported no change in MPO after 8 weeks of stationary training (13). TRX or total body resistance training, has recently received a lot of attention, so that this unique training method, which uses tools such as two straps and handles, uses body weight as resistance, and its implementation in any place and environment from its distinctive features are (14). Sports science researchers have pointed to the reduction of body fat levels in parallel with the increase in muscle mass in response to TRX (15). For example, in Hosseini et al.'s study (2020), despite a significant increase in glutathione peroxidase in response to 8 weeks of TRX training in obese women, hydrogen peroxide levels did not change (16). In Gaedtke study (2016), 8 weeks of resistance training and TRX led to increased balance and functional ability and strength in elderly people (17). Despite the mentioned evidence, the effect of TRX on TAC and MPO as indicators of vascular endothelial function in obese women has been less studied. Therefore, based on the contradiction regarding the effect of different exercise training and also the lack of a study on the effect of TRX on these variables, the present study aims to determine the effect of TRX on MPO and TAC as two effective indicators on vascular endothelial function in inactive obese women.

Materials and Methods

The current study is semi-experimental and has a pre-test and post-test design with a control group. The statistical population of the current research consisted of 28 inactive obese women with a body mass index higher than 30 kg/m2 and an age range of 40-50 years. Statistical samples were randomly divided into TRX group and control groups. All the subjects were informed by the researcher about the objectives of the study and possible injuries caused by sports exercises, then they completed the consent form.

Inclusion and Exclusion Criteria

The study subjects were non-athletes and non-smokers. Also, their weight fluctuation in the last 6 months was less than one kilogram and they did not have a defined diet. The studied women were not pregnant and did not intend to become pregnant during the study. The absence of history of chronic diseases such as diabetes, cardiovascular, respiratory and kidney diseases, epilepsy, convulsions, as well as any orthopedic abnormalities that make it difficult to perform exercise training are among the criteria for entering the study. Not taking medicine continuously before or during the training program is one of the criteria for inclusion and exclusion from the study. Lack of proper attendance at training sessions, suffering from metabolic diseases, use of pharmaceutical or food supplements to reduce weight or increase physical performance during the study, as well as supplements that disrupt metabolism are among the exclusion criteria.

Anthropometric Measurements

Before and after TRX protocol, anthropometric indices were measured in both groups. The weight and height were measured without shoes and with minimal clothing. So that height was measured using a wall-mounted caliper with an accuracy of 0.1 cm. Weight, percentage of body fat as well as visceral fat were measured by body composition analyzer (OMRON 508, Finland). Body mass index was calculated by dividing weight (kilograms) by height (square meters) (18). Abdominal circumference after a normal exhalation in the thickest area was measured by an inflexible tape measure with an error accuracy of less than 0.1 cm (18).

TRX Protocol

Training program in the form of 8 weeks of TRX with three 20-minute sessions repeated in the first two weeks, which reached 50 minutes in the last two weeks. The initial training sessions started with the lowest intensity of this range. The step-by-step loading method (slope measurement and markings on the ground) was done every two weeks. In the next sessions, the training intensity was gradually increased by increasing the number of exercises and activity time in the session. In this way, before starting the exercises, the subjects were familiarized with this scale and its range, and in order to unify the way of performing the exercises, the speed of the movements in all the subjects was standardized by a metronome of one beat per second (19).

Blood Sampling and Assay

All subjects were requested to avoid any physical activity 48 hours before blood sampling. A fasting blood sample was taken after 10-12 hours of overnight starvation from the study subjects in both control and TRX groups in order to measure the activity of TAC and MPO. So that 5 cc of blood was taken from the brachial vein of the left hand in a sitting position while fasting, and at the end of the training program. All measurements of weight and body mass index were repeated in the same conditions as before the implementation of the study, and also 48 hours after blood sampling was done again from the last training session. All blood samples were centrifuged immediately after sampling to separate the serum. The serum level of TAC and MPO was measured by a specialized kit of Navnad Salamat Company (Iran) by calorimetric method.

Statistical Methods

SPSS version 22 statistical software was used for statistical analysis. Shapiro-Wilk Test was used to ensure the normal distribution of the data. Independent t-test was used to compare data in pre-test and post-test conditions between two groups. The paired t-test was used to determine intragroup changes in each group. The significance level of the tests was considered as ρ>0.05.

Ethical Considerations

This study was approved by the Ethics Committee of Islamic Azad University, Islamshahr Branch (Code: IR.IAU.PIAU.R.1401.001).

Table 1. Pre and post-training of anthropometrical variables of the subjects

Variables	TRX group			Control group		
	Pre-training	**post-training**	**Sig**	**Pre-training**	**post-training**	**Sig**
Weight (kg)	82.9 ± 8.68	80.2 ± 8.13	0.001	85.8 ± 5.88	85.7 ± 6	0.449
AC (cm)	114 ± 8.40	105.5 ± 7.77	0.001	119 ± 6.20	119 ± 6.26	0.998
Body fat (%)	46 ± 2.58	43.11 ± 2.31	0.001	47.8 ± 2.01	47.6 ± 7.54	0.323
BMI (kg/m2)	33.24 ± 3.25	32.16 ± 3.08	0.001	33.89 ± 2.11	33.83 ± 2.14	0.454
Visceral fat	9.21 ± 1.05	8.71 ± 0.83	0.013	9.71 ± 0.61	9.79 ± 0.70	0.583

***AC**, abdominal circumference; **BMI:** body mass index*

Results

Anthropometric indices before and after TRX are shown in Table 1. The findings of the independent t-test revealed that there is no significant difference in the baseline levels (pre-test) of anthropometric indices between the two groups ($P > 0.05$). Examining intra-group changes by paired t-test revealed that TRX lead to a significant reduction in body weight, body mass index, abdominal circumference, body fat percentage and visceral fat. But in the control group, there was no significant difference between the pre-test and post-test levels of any of these indicators ($P > 0.05$). The significant values of changes in each of the variables are shown in Table 1.

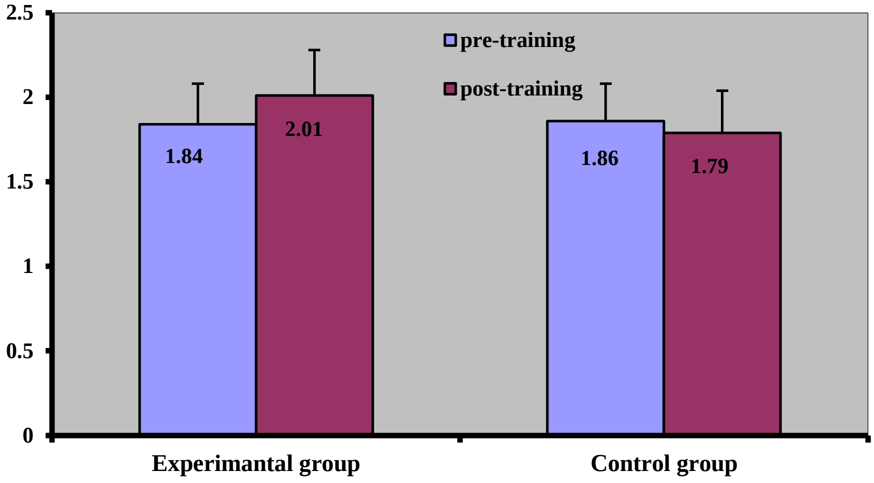

Figure 1. The pattern of total antioxidant capacity changes in the conditions before and after resistance intervention in the studied groups

Determining the effect of TRX on TAC and MPO activity is the main objectives of the study. The mean and standard deviation and the significance level related to the pre- and post-test of these variables are shown in Table 2. Comparison of pre-tests by independent t-test revealed that there is no significant difference in the baseline levels of TAC and MPO between the two groups. On the other hand, despite the lack of MPO difference (P= 0.326), a significant difference in TAC activity was observed in the post-test conditions between the two control and TRX groups (P= 0.013, Fig 1). Thus, TAC levels in the TRX group are significantly higher than the control group.

Table 2. Mean and standard deviation of TAC and MPO of studied groups.

Variables	TRX group			Control group			Pre-test difference	Post-test difference
	Pre-test	post-test	*p-value**	Pre-test	post-test	*p-value**	(*p-value*) †	(*p-value*)†
TAC (ng/ml)	1.84 ± 0.24	2.01 ± 0.27	0.004*	1.86 ± 0.22	1.79 ± 0.25	0.246	0.356	0.013†
MPO (U/mL)	27.91 ± 2.71	27.69 ± 2.41	0.459	29.61 ± 2.61	28.71 ± 3.12	0.652	0.268	0.326

* represent significant level between pre and posttest (intra-group change: data by paired t test)

† represent significant level of post-test between groups (inter-group change: data by independent t test)

Also, comparing pre-post training in each group (intra-group changes) by paired t-test showed that TRX lead to a significant increase in TAC compared to pre-test levels. However, there was no significant difference in MPO between the pre-post training conditions in the TRX group. On the other hand, no significant difference was observed in these variables in the control group. The significant values of changes in each of the variables are shown in Table 2.

Discussion

The main finding of the present study is the increase in TAC in response to TRX. In other words, 8 weeks of TRX, 3 sessions per week led to a significant increase in TAC in obese women who previously had an inactive lifestyle. However MPO serum levels did not change significantly in response to TRX intervention compared to the control group.

In this regard, in line with the present study, Carlsohn et al (2010) showed in a research that TAC values increase following regular sports activities (20). In the study of Sari-Sarraf et al (2016) after 8 weeks of progressive aerobic training and one session of sedentary activity in young inactive men, they reported an increase in TAC in the training group (21). The researcher has pointed out the increase in TAC due to the increase in glutathione levels and the effect of this increase on the change in TAC levels. Also, in the study of Pashazadeh et al (2019), who investigated the role of aerobic exercise on oxidative stress indicators in the heart tissue of bisphenol A (BPA)-poisoned rats, TAC levels decreased in the poisoned groups, but it showed a significant increase in the aerobic exercise group (22). In other words, aerobic training could reduce the intensity of oxidative stress caused by poisoning. The researcher has stated that the increase in TAC after 8 weeks of aerobic training is due to the increase in the production of antioxidant enzymes inside cardiac myocytes (22). Studies show that regular exercise plays a role in reducing the production and secretion of adipocytokines and inflammatory cytokines from skeletal muscles, endothelial cells and the immune system, as well as improving the state of antioxidants as a kind of intervention to reduce systemic inflammation. In the meta-analysis study of De Sousa et al (2017), it was also revealed that depending on the intensity, volume and type of exercise and the studied population, antioxidant indices tend to increase and oxidant indices tend to decrease (23).

In explaining the main mechanisms responsible for the development of TAC, it can be pointed out that performing regular sports exercises, including TRX exercises, through regulating and modulating the synthesis of both enzyme antioxidants glutathione peroxidase (GPX), superoxide desmutase (SOD), catalase and non-enzymatic (uric acid, albumin and ceruloplasmin) in different cells of the body including muscle cells, heart and other organs improves the total antioxidant capacity (24). It also seems that the increase in the levels of nitric oxide, ascorbic acid, bilirubin and indicators such as plasma glutathione can be effective in improving TAC caused by exercise (25). It seems that an increase in glutathione (GSH) levels following TRX training can lead to an increase in TAC levels (26). It should be noted that although the measurement of TAC as a result of enzymatic antioxidants is one of the strengths of the present study, the lack of measurement of oxidative stress markers such as MDA is one of the weaknesses of this study.

Regarding the effect of training methods on MPO, Rahimi Moghadam et al (2020) have mentioned that in the subjects who regularly participated in public sports activities, MPO levels did not change significantly compared to the control group 24 hours after the Bruce sports test. However, its value increased in the control group. These researchers believe that the subjects' active and continuous lifestyle is the cause of lower myeloperoxidase levels in the training group than in the control group (27). On the other hand, Shemshahi et al (2001) reported no change in MPO after a period of stationary exercise in inactive women (13). Nevertheless, the study of Ojaghi et al (2021) has pointed to the decrease of MPO along with the increase in the activity of antioxidant enzymes and the decrease of myeloperoxidase in the heart tissue of rats suffering from cardiac ischemia following increasing endurance exercises (28). These researchers have concluded that adapting to exercise increases antioxidant enzymes against oxidative stress damage and by positively regulating the antioxidant defense system by chaperone proteins, it protects the heart against ischemia (29).

Despite no change in MPO in response to TRX training in the present study, the enzyme MPO is a highly cationic protein that binds to endothelial cells, leukocytes, and LDL. The association of MPO with LDL leads to an increase in the oxidation of this lipoprotein (30). An increase in MPO leads to an increase in the production of some reactive oxidant species, such as hypochloric, chloramine, and tyrosine radicals, which oxidize proteins, lipids, and HDL (31). MPO enzyme is stored in the azerophilic granules of primary neutrophil cells

(30), which plays a very important role in inflammatory processes and oxidative stress, and by catalyzing the respiratory burst reaction, it causes the conversion of hydrogen peroxide into hypochlorous acid (32).
In a summary, despite no change in MPO, but relying on the increase in TAC, it can be concluded that TRX exercises are associated with improving vascular endothelial function in obese women. The increase in TAC activity may be attributed to their weight loss and reduction in body fat mass following the training period. Because obesity and high levels of body fat mass are associated with an increase in ROS and lipid peroxidation due to an increase in the availability of fat substrate (33, 34). Scientific documents show that TRX training or total body resistance training leads to a reduction in body fat percentage. In some cases, this article indicates the reduction of fat mass (35, 36,37). In the end, it is pointed out that only measuring the changes of MPO and TAC does not indicate the vascular endothelial effects of TRX exercise in obese women, but determining the changes of other antioxidant or oxidative stress markers such as nitric oxide or vascular endothelial growth factor to determine the endothelial effects of exercise is needed and lack of measurement of these variables is one of the limitations of the present study and their measurement is suggested in future studies

Conclusion

TRX training is associated with increased vascular endothelial function in obese women. Based on the findings of the present study, relying on the significant increase in TAC even in the absence of MPO change, it is possible to refer to the cardiovascular and endothelial effects of this training method. Understanding the mechanisms responsible for this training method on cardiovascular function requires more studies in this field.

Declarations

Acknowledgments

The authors wish to thank the Islamic Azad University of Islamshahr Branch for their support and assistance.

Ethical Considerations

This study was approved by the Ethics Committee of Islamic Azad University, Islamshahr Branch (Code: IR.IAU.PIAU.R.1401.001).

Funding

This research was funded by Islamic Azad University, Islamshahr Branch (Code: IR.IAU.PIAU.R.1401.001).

Authors' Contributions

All authors equally contributed to preparing this article.

Conflict of Interest

The authors declared no conflict of interest.

References

1. Chamani K, Hamedinia MR, Moeinfard MR, Amiri Parsa T. The survey of pervalence of obesity and some factors of breeding and its related physical activities in females aged 30-50 years of the city of Bojnord. Journal of Sabzevar Medical University. 2022; 8(1): 13-21.
2. Zhang M, Feng L, Li J, Chen L. Therapeutic potential and mechanisms of berberine in cardiovascular disease. Curr Pharmacol Rep. 2016; 2:281-92.
3. Burcelin R, Serino M, Chabo C, Blasco-Baque V, Amar J. Gut microbiota and diabetes: from pathogenesis to therapeutic perspective. Acta Diabetol. 2011; 48(4):257-73.
4. Sugiyama S, Okada Y, Sukhova GK, Virmani R, Heinecke JW, Libby P. Macrophage myeloperoxidase regulation by granulocyte macrophage colony-stimulating factor in human atherosclerosis and implications in acute coronary syndromes. Am J Pathol. 2001; 158(3):879-91.
5. Nicholls SJ, Hazen SL. Myeloperoxidase and cardiovascular disease. Arterioscler Thromb Vasc Biol. 2005; 25(6):1102-11.
6. Vita JA, Brennan ML, Gokce N, Mann SA, Goormastic M, Shishehbor MH, et al. Serum myeloperoxidase levels independently predict endothelial dysfunction in humans. Circulation. 2004; 110(9):1134-9.
7. Shao B, Oda MN, Bergt C, Fu X, Green PS, Brot N, et al. Myeloperoxidase impairs ABCA1-dependent cholesterol efflux through methionine oxidation and site-specific tyrosine chlorination of apoli-poprotein A-I. J Biol Chem. 2006; 281:9001-4.
8. Maes M, Galecki P, Chang YS, Berk M. A review on the oxidative and nitrosative stress (O&NS) pathways in major depression and their possible contribution to the (neuro) degenerative processes in that illness. Prog Neuropsychopharmacol Biol Psychiatry. 2011; 35(3):676-92.
9. Scharnagl H, Kleber ME, Genser B, Kickmaier S, Renner W, Weihrauch G, et al. Association of myeloperoxidase with total and cardiovascular mortality in individuals undergoing coronary

angiography--the LURIC study. Int J Cardiol. 2014; 174(1):96-105.
10. Nasi M, Patrizi G, Pizzi C, Landolfo M, Boriani G, Dei Cas A, Mattioli AV. The role of physical activity in individuals with cardiovascular risk factors: an opinion paper from Italian Society of Cardiology-Emilia Romagna-Marche and SIC-Sport. J Cardiovasc Med. 2019; 20(10), 631-9.
11. Kraus WE, Powell KE, Haskell WL, Janz KF, Campbell WW, Jakicic JM, et al. Physical Activity, All-Cause and Cardiovascular Mortality, and Cardiovascular Disease. Med Sci Sports Exerc. 2019;51(6):1270-81
12. Hejazi M, nezamdoost Z, Saghebjoo M. Effect of Twelve Weeks of Aerobic Training on Serum Levels of Leptin, Vaspin and Some Indicators of Oxidative Stress in Obese Middle-Aged Women. Iranian Journal of Endocrinology and Metabolism. 2014; 16 (2): 111-8.
13. Shemshahi A, Askari Z, Hedayati M. The effect of a selected stationary training course on plasma myeloperoxidase in women. Journal of Exercise Physiology and Physical Activity. 2011; 8: 647-52.
14. Kosmata A. *Functional exercise training with the TRX suspension trainer in a dysfunctional, elderly population.* Doctoral Dissertation, Appalachian State University. 2014.
15. Dolati M, Ghazalian F, Abednatanzi H. The effect of a period of TRX training on lipid profile and body composition in overweight women. International Journal of Sports Science. 2017; 7(3): 151-8.
16. Housini S L, Eizadi M. The effect of 8 weeks TRX training on glutathione peroxidase (GPx) and hydrogen peroxide (H2O2) in sedentary middle-aged obese men. RJMS. 2020; 27 (5): 210-9.
17. Gaedtke A, Morat T. Effects of two 12-week strengthening programmes on functional mobility, strength and balance of older adults: Comparison between TRX suspension training versus an elastic band resistance training. Central European Journal of Sport Sciences and Medicine. 2016; 13(1): 49-64.
18. Timorthy L.G, Roche A.F, Martorell R. Anthropometric standardization reference manual. Pediatric Exercise Science. 1988; 4:34-42.
19. Housini SL, Eizadi M. The effect of 8 weeks TRX training on glutathione peroxidase (GPx) and hydrogen peroxide (H2O2) in sedentary middle-aged obese men. Razi Journal of Medical Sciences. 2020; 27(5):210-9.
20. Carlsohn A, Rohn S, Mayer F, Schweigert FJ. Physical activity, antioxidant status, and protein modification in adolescent athletes. Med Sci Sports Exerc. 2010; 42(6):1131-9.
21. Sari-Sarraf V, Amirsasan R, Zolfi H R. Effects of aerobic and exhaustive exercise on salivary and serum total antioxidant capacity and lipid peroxidation indicators in sedentary men. Feyz 2016; 20 (5) :427-434
22. Pashazadeh F, Tofighi A, Asri Rezaei S, Tolouei Azar J. Effect of aerobic exercises on oxidative stress indices in heart tissue of male Wistar rats after poisoning with Bisphenol A. J Gorgan Univ Med Sci. 2021; 22 (4) :54-62.
23. de Sousa CV, Sales MM, Rosa TS, Lewis JE, de Andrade RV, Simões HG. The antioxidant effect of exercise: a systematic review and meta-analysis. Sports Medicine. 2017; 47(2), 277-93.
24. Lira Ferrari GS, Bucalen Ferrari CK. Exercise modulation of total antioxidant capacity (TAC): towards a molecular signature of healthy aging. Frontiers in Life Science. 2011; 5(3-4):81-90.
25. Brites F, Travacio M, Gambino G, Jaita G, Verona J, Llesuy S, Wikinski R. Regular exercise improves lipid and antioxidant profile. Atherosclerosis. 2011; 1(151), 261.
26. Al-Qattan KK, Thomson M, Al-Mutawa'a S, Al-Hajeri D, Drobiova H, Ali M. Nitric oxide mediates the blood-pressure lowering effect of garlic in the rat two-kidney, one-clip model of hypertension. J Nutr. 2006; 136(3 Suppl):774S-6S.
27. Rahimi Moghaddam SR, Elmieh A, Fadaei MR. Acute response of myeloperoxidase and total cancer status to increasing exercise activities in trained and non-trained middle-aged men. Metabolism and Exercise. 2020; 10(1): 79-90.
28. Ojaghi A, Ghazalian F, Vahdatpour T, Vahedi P, Abednatanzi H, Badalzadeh R. The effect of progressive endurance training on heart resistance induced by infusion ischemia in healthy male rats. Daneshvar Medicine. 2021; 29(2):67-77.
29. Quindry JC, Schreiber L, Hosick P, Wrieden J, Irwin JM, Hoyt E. Mitochondrial KATP channel inhibition blunts arrhythmia protection in ischemic exercised hearts. Am J Physiol Heart Circ Physiol. 2010; 299(1):H175-83.
30. Tang WHW, Katz R, Brennan ML, Aviles RJ, Tracy RP, Psaty BM, et al. Usefulness of myeloperoxidase levels in healthy elderly subjects to predict risk of developing heart failure. Am J Cardiol. 2009; 103:1269-74.
31. Borregaard N, Cowland JB. Granules of the human neutrophilic polymorphonuclear leukocyte. Blood. 1997; 89(10):3503-21.
32. Hazen SL, Hsu FF, Duffin K, Heinecke JW. Molecular chlorine generated by the myeloperoxidase-hydrogen peroxide-chloride system of phagocytes converts low density lipoprotein cholesterol into a family of chlorinated sterols. J Biol Chem. 1996; 271(38):23080-8.
33. McMurray F, Patten DA, Harper ME. Reactive oxygen species and oxidative stress in obesity recent findings and empirical approaches. Obesity (Silver Spring). 2016; 24(11):2301-2310.
34. Görlach A, Dimova EY, Petry A, Martínez-Ruiz A, Hernansanz-Agustín P, Rolo AP, et al. Reactive oxygen species nutrition hypoxia and diseases: problems solved?. Redox Biol. 2015; 6:372-85.
35. Linda S Pescatello, Ross Arena, Deborah Riebe, Paul D. Reviewed by Brad Ferguson. ACSM's guidelines for exercise testing and prescription. J Can Chiropr Assoc. 2014; 58(3): 328.
36. Cosio-Lima LM, Reynolds KL, Winter C, Paolone V, Jones MT. Effects of physioball and conventional floor

exercises on early phase adaptations in back and abdominal core stability and balance in women. The Journal of Strength & Conditioning Research. 2003; 17(4):721-5.
37. Banz WJ, Maher MA, Thompson WG, Bassett DR, Moore W, Ashraf M, et al. Effects of resistance versus aerobic training on coronary artery disease risk factors. Experimental Biology and Medicine. 2003; 228(4):434-40.