



Efficacy of Exercise Time Models in Weight-Loss and Coronary Risk Panel of Middle-Aged Females

Mohammadreza Rezaei-pour ^{1,*} and Apanasenko Gennady Leonidovich ²

¹Department of Sports Sciences, University of Sistan and Baluchestan, Zahedan, Iran

²Center of Sports Medicine, Kiev, Ukraine

*Corresponding author: Department of Sports Sciences, University of Sistan and Baluchestan, Postal Code: 9816745639, Zahedan, Iran. Tel: +98-9153414047, Email: rezaei-pour@ped.usb.ac.ir

Received ; Revised 2018 November 12; Accepted 2018 November 14.

Abstract

Background: Age-related obesity, besides genetics, depends on diet and exercise. There are various strategies for the time duration of exercise. Nevertheless, there continues to be little knowledge about its diverse models for women in middle-age.

Objectives: This study investigated the impacts of interval training on the loss of weight and coronary risk panel and compared its effectiveness with continuous training effectiveness.

Methods: This research was a simplified randomized trial. Participants (n = 86) were selected among sedentary overweight or obese women aged 45 - 65 years who had attended (during the three months before the study) weight-loss consulting programs. Of all 86 participants, 74 completed the study. They were randomly divided into 2 groups: A group with continuous training and a group with interval training. The weight assessment parameters, including change of weight, body composition, and blood sample tests, were carried out before and after the 12-week intervention.

Results: In comparison with baseline data, all parameters changed significantly in both groups. The study groups showed a similar weight loss pattern after the intervention. The same changes were noticed in the body mass index (BMI), total cholesterol (TC), and low-density lipoprotein (LDL) cholesterol levels in post-test groups ($P > 0.05$). Elevation in high-density lipoprotein (HDL) cholesterol levels differed significantly in post-test groups ($P < 0.05$). The decrease in the ratio of TC to HDL-C was more in interval exercise than in continuous training.

Conclusions: Both exercise time models could improve significantly the weight loss parameters but it seems that the interval-training pattern provides more health along with weight loss. This may be clinically useful and provide a physical activity guideline for body weight loss in middle-aged women.

Keywords: Exercise Test, Middle Aged, Obesity, Overweight, Problems and Exercises, Weight Reduction Programs

1. Background

Higher morbidity/mortality and higher social insurance costs are some effects of obesity among elderly grown-ups (1, 2). Aging is associated with obesity (3). Around 70% of the populations of middle age or older (≥ 45 years of age) have an abnormal weight pick-up and these people are at a raised peril for obesity (4). Although the changes connected with age have a strong hereditary part, they are also influenced by diet and exercise (5). Exercise has additive effects on changing plasma lipoprotein particles to diet-induced weight loss, especially in individuals with increased cardiovascular risk (6). The fat cut is great got through an aggregate of eating regimen and aerobic exercising (7). Time or duration of the exercise is part of the workout prescription. Although exer-

cise time models are an essential thing among the clinical guides for weight loss, our knowledge about influences of diverse time models of exercise on weight loss parameters of middle-aged is still little. In addition, epidemiological information demonstrates that most of the adult populace fails to meet recommended physical activity. This contributes to a global epidemic of overweight/obesity and related coronary heart disease (CHD). A reason frequently mentioned for the failure to engage in regular exercises is a perceived shortage of time.

Interval and continuous workout are potent educational techniques for physical activity. Continuous training is a form of exercise time that includes performing a session of workout for a long time, frequently longer than 20 minutes without a rest. A further type of exercise time model is interval training. It is a type of intermittent train-

ing, which incorporates a sequence of bodily exercises alternating with periods of rest or relief. In this situation, bouts of exercise that last for at least 10 minutes are added together to provide a total time or duration for a given day (8-10).

2. Objectives

This study investigated whether exercise time models per se (as exercise program components) would have beneficial cardiovascular (coronary risk panel) and weight loss effects in sedentary overweight/obese middle-aged females.

3. Methods

3.1. Study Population

This study was designed as a simplified randomized trial (the CONSORT statement). Participants with a sedentary lifestyle (86 persons) were chosen randomly from among women aged 45 to 65 years with overweight or obesity that referred (within 12 weeks preceding the study) to the Sports Rehabilitation Department of the Ukrainian Sports Medicine Center (Kiev) for joining in weight loss guiding projects. Participants were weight-stable (± 2 kg for over one year) and non-smokers with no history of structured exercise training in no less than three months prior to the research. None of them had a history of CHD or other illnesses such as metabolic disorders, psychiatric disorders, abnormal or disturbed eating habits, chronic drugs consumption, kidney diseases, cancer, allergies, or food intolerance. Individuals with irregularities in the thyroid gland or the electrocardiograph, any history of anti-obesity drug and weight cut drugs, or dietary supplements for weight control were excluded from the investigation. Persons with a blood pressure of less than 140/85 mmHg entered the analysis.

3.2. Interventions

After the initial tests, the participants were randomly divided into two exercise groups to conduct a 12-week intervention. Group I consisted of 45 participants with a continuous training program and group II included 41 participants in an interval-training program. Based on the dietary guidelines from the USDA (the United States Department of Agriculture) and the FSA (The UK Food Standards Agency), both study groups received a recipe (low-calorie diet (details: 15% protein, 55% carbohydrate, and 30% fat)) (11, 12). To evaluate the weight cut in a healthy and effective rate, we looked at the 15% cut (10 percent of energy expenditures and five percent of restriction on calories) in the

maintenance of calorie requirements (11, 13, 14). The cost of energy raised equally by structured exercise, five days a week (two sessions of weight training and three sessions of aerobic exercise training in each week) in the groups (13, 14).

3.3. Measurement

Every participant, first, underwent anthropometrical measurements of body weight, height (13, 14), and blood pressure. All bodily measurements were performed using Light Street clothing and without footwear. After these measurements, BMI was calculated and expressed as kg/m^2 . A BMI value of equal to or higher than $25.0 \text{ kg}/\text{m}^2$ was characterized as overweight and obesity condition. Blood samples were taken from the ulnar veins. HDL-C, triglycerides (TG), and T-C were measured by the method of spectrophotometry at 500 nm utilizing an enzymatic kit (Elitech Diagnostics, Sees, France). LDL-C was evaluated using the Friedewald formula described as $\text{LDL-C (mg/dL)} = \text{TC (mg/dL)} - \text{HDL-C (mg/dL)} - \text{TG (mg/dL)}/5$ (15). Attendees had no meal or drink, aside from the water, for nine to 12 hours before the test of blood. The normal values of the blood checks for further analyses were considered as follows: the concentration in plasma of TC lower than 200 mg/dL, LDL-C lower than 130 mg/dL, TG lower than 150 mg/dL, and the HDL-C in plasma lower than 40 - 60 mg/dL.

Attendees utilized a proper manner to distinguish their habit to food and tendency to drink. They wrote down the consumed meals and drink (containing water) for four days (three days a week plus one weekend day). They performed this procedure at the begging of the research (basic level) and every month during the research. These logbooks were checked for complementary and energy; micronutrient combinations were computed utilizing the software of Diets In Details (13, 14, 16).

Daily caloric requirements for each participant were calculated by multiplying the physical activity level (PAL) and the basal metabolic rate (BMR). Table 1 shows the daily caloric requirements and exercise time models. The ratio of the total daily cost of energy to the BMR is named PAL. To better estimate BMR in women, Equations 1 and 2 were utilized for 31 to 60-year-old and more than 60-year-old participants, respectively (11, 14, 16).

$$(\text{Weight in kg} \times 8.7) + 829 \quad (1)$$

$$(\text{Weight in kg} \times 10.5) + 596 \quad (2)$$

In selecting participants with an inactive lifestyle, PAL values were assessed using a customized self-report questionnaire. The questionnaire had a Likert-type scale with seven points ranging from "Not at all" (one point) to "Everyday" (seven points) (17). Exercise frequencies of one to

Table 1. The Exercise Time Models and Daily Energy Intake (Mean ± SD)

Group	Exercise Time Model	Daily Calorie Needs ^a (kcal)	Daily Energy Intake ^b (kcal)
I	Continuous training	2338 ± 94	2220 ± 89
II	Interval training	2399 ± 172	2278 ± 164

^a BMR × PAL.

^b Daily calorie needs - 5%.

two times a month or less were regarded as a sedentary lifestyle. Throughout the research, PAL of participants was considered 1.5 because their lifestyle was active and they had more than three exercise sessions a week.

The oxygen peak consumption was extended from 65% to 85% (at the initial phase, the oxygen peak consumption was considered about 40%). The measurement of exercise-induced heart rate [$220 - \text{age} \times (65 \text{ to } 85\%)$] was done by heart-rate monitors (Bowflex, Nautilus, Inc, Canada). Thus, indirect calorimetry (Fitmate, Cosmed, Italy) was utilized to gauge energy expenditure equivalent to 10% of everyday calorie needs in every session for every person.

3.4. Method Management

The research team had four members who had a genuine collaboration, one physician, and two volunteer nurses from among partners working at the center. Registration, grouping, and allocation of the participants in the investigations were done under the surveillance of a doctor. The method was not changed during the investigation. The evaluation of weight loss parameters and paraclinical analysis were performed at baseline and after the study for all participants and compared. At the beginning of the experiment, the participants had a weekly meeting. We explained all the procedures and requirements to the subjects. Alterations in physical activity levels or dietary levels are linked to potentially conflicting effects on the research. Therefore, we recommend them preserving their current PALs and diets throughout the research. They were trained to report any trouble that could influence their participation in the research (13). This research was subjected to an approval by the ethics committee. All participants were informed of this study and provided written informed consent before data collection.

3.5. Statistical Methods

The data were normally distributed. The normal distribution of the collected data was estimated with the test of Kolmogorov-Smirnov. All the statistics of the research were expressed as means ± standard deviation (SD). The results of the pre and post-test were compared by using

the paired *t*-test. Differences between groups were evaluated by the use of an independent *t*-test. The Pearson's Chi-squared test (χ^2) was used to investigate whether the distributions of categorical variables differ from each other. A P value of less than 0.05 was considered significant. Statistical analysis was conducted using SPSS software (version 24.0 for Windows).

4. Results

Out of 86 participants, 74 people finished the research process. Table 1 indicates daily calorie needs.

20 participants did not fulfill the conditions of the study; thus, they were not included in more assessments. Morphological characteristics of the final sample are provided in Table 2. Most of the attendees were white (about 92%) and the rest of them were African (n = 3) and the other (n = 4).

Table 2. Subjective Morphological Characteristics in Each Group Before the Study (Mean ± SD)

Parameter	Group I	Group II
Gender		
Female, n	37	37
Race		
White, n	34	33
Non-white, n	3	4
Age, y	53.7 ± 5.4	55.7 ± 5.5
Height, cm	172.9 ± 5.2	174 ± 6.8

Analysis of χ^2 did not show a significant difference in completion rates between the groups. The baseline analysis of age, body weight, BMI, and coronary risk panel among participants who finished or left this research showed no significant differences (data not shown). There were no restrictions such as blocking and block size though there was a balance between the study groups in terms of size and baseline characteristics (14, 18). The duration of physical activity of leisure time, total energy consumption, and the proportion of energy intake consumed as dietary fat did not show significant differences between

the groups. The effects of the research made significant differences in all parameters before and after the research period in both groups, as shown in Table 3.

The mean weight loss was 7.5 kg in the group of continuous exercise and 7.9 kg in the interval-training group. The 12-week weight loss was higher in the interval exercise group, but this difference was not significant ($P > 0.05$). A similar change was found in BMI, TC, and LDL-C values in the groups at post-test ($P > 0.05$). HDL-C values were quite different between continuing training and interval training groups ($P < 0.05$). The HDL-C raising mean was 2.7 mg/dL for the group of continuous exercise and 9.6 mg/dL for the interval-training group (Table 3).

5. Discussion

Overweight and obesity are extended to worldwide and over 80% of patients with CHD are overweight or obese (19). Obesity is often considered a relatively "minor" CHD risk factor and weight loss is a "broadly effective" risk factor intervention (19). Exercise is meant by an essential part of behavior programs for losing weight (13, 14, 20). Some research workers believe that exercise and weight loss affect cardiovascular risk factors in people with abnormal weight gain (6, 21). Therefore, exercise plan recommendations are important for physicians and instructors. Time models of workout are part of the recommended program that is required for physical exercises (9) but it has not yet been adequately addressed in overweight/obese middle-aged women. In this research, the beneficial weight loss and cardiovascular (coronary risk panel) effects were studied clearly by prescribing exercise time models per se (continuous and interval) in sedentary overweight/obese middle-aged women. Based on previous studies, weight cut and changes in coronary risk panel through diet and exercise take place after at least 12 weeks and several researchers have utilized this plan (14, 15). Therefore, the study stopped after 12 weeks. The participants who did not adhere to their diet and/or PALs were excluded. Blood triglyceride ranges are linked to consuming, and the low-calorie diets cut these levels. Therefore, the TG variable was removed from this research (13, 14, 16). Based on the results of this study, exercise-induced weight loss and reducing pro-atherogenic lipoproteins were the same in both time models whereas improved HDL-C levels involved in cholesterol transport and T-C/HDL-C ratio were more by interval training than by continuous training in sedentary overweight/obese middle-aged women.

Weight loss parameters, consisting of body weight and coronary risk panel, changed at the post-test in comparison with the pre-test in both groups, indicating the efficacy of the interventions. Age advancement is associated with

overweight and obesity (3, 4), and these conditions are an independent risk factor for the development and progression of CHD (19, 22-24) because of hyperlipidemia (25, 26). Earlier research shows that the coronary risk panel can be heavily influenced by weight loss (6, 19, 23). The results of the present study are in agreement with these findings.

The absence of a significant difference in 12-week weight loss between the study groups may be due to that both groups reduced energy consumption. At the same time, the study results showed that the amount of raised HDL levels depended on the time models of exercise, not to the difference in energy cost. A change in HDL-C in health care is important, as one of the criteria for assessing the risk of CHD is T-C/HDL-C ratio (27-29). The decline in the TC/HDL-C ratio was greater in interval training than in continuous training. In addition, the study outcomes indicated that a change in TC and LDL-C was accompanied by changes in body weight that are consistent with the findings of other investigators (6, 30). Dietary in both groups (low-calorie diet) was similar and had a high-carbohydrate content and low fat. Accordingly, it seems that the cholesterol level in the diet has an important effect on the results. These outcomes are in line with the findings of Franz et al. study evaluating the weight-loss efficacy of dietary interventions, exercise, and meal replacements (31).

Adverse effects that occurred during this study (due to the use of a low-calorie diet) were headaches and constipation. These undesirable clinical effects have previously been recorded by other researchers (7, 32). There were no trial limitations such as potential bias, multiplicity of analysis, etc. during the study, except for the lack of commitment of some participants to their individual PALs and/or diets, which these participants were not included in the analysis. In this regard, the study of middle-aged men is recommended.

In conclusion, combining exercise time models with the same dietary leads to significantly reducing pro-atherogenic lipoproteins (T-C and LDL-C) and weight loss in 12 weeks. However, HDL-C raising due to the exercise time models can provide considerable efficiency for the interval exercise pattern and alter the incidence of cardiovascular disease or its improvement in middle-aged women with overweight and obesity. These findings are clinically useful and will assist in the right choice of exercise time models for losing body weight base on various conditions of the coronary risk panel that middle-aged women may have.

Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Table 3. The Demographic Characteristics of Participants in the Pre-test and Post-test, as Well as the P Values of Comparing Means Within the Groups (Mean ± SD)

Parameter	Group I (n = 37)		Group II (n = 37)	
	Baseline	After 12 Weeks	Baseline	After 12 Weeks
Weight, kg	84.7 ± 6.5	77.2 ± 6.6 ^a	89.1 ± 8.1	81.2 ± 7.5 ^a
BMI, kg/m ²	28.3 ± 1.9	25.7 ± 1.9 ^a	29.7 ± 3.1	27 ± 3.3 ^a
Total-C, mg/dL	183.8 ± 8.6	153.9 ± 8.5 ^a	187.9 ± 7.2	157.9 ± 4.1 ^a
HDL-C, mg/dL	53.2 ± 3.1	55.9 ± 3.5 ^{a, b}	54.2 ± 2.7	63.8 ± 3.3 ^a
LDL-C, mg/dL	113.5 ± 6.1	93.7 ± 7.9 ^a	117.6 ± 5.8	97.6 ± 4.5 ^a
TC/HDL-C ratio	3.43 ± 0.2	2.75 ± 0.22 ^{a, b}	3.41 ± 0.2	2.56 ± 0.15 ^a

^a P < 0.05 in comparison with pre-test measurement.

^b P < 0.001 in comparison with interval training (group II).

Acknowledgments

I thank my wife and colleagues in the Faculty and Sports Medicine Centre of Ukraine for their support.

Footnotes

Conflict of Interests: The author reports no conflicts of interest.

Funding/Support: This research received no specific funding.

References

- Case A, Deaton A. Mortality and morbidity in the 21(st) century. *Brookings Pap Econ Act.* 2017;**2017**:397–476. [PubMed: 29033460]. [PubMed Central: PMC5640267].
- Cawley J, Meyerhoefer C. The medical care costs of obesity: An instrumental variables approach. *J Health Econ.* 2012;**31**(1):219–30. doi: 10.1016/j.jhealeco.2011.10.003. [PubMed: 22094013].
- Guillory B, Chen JA, Patel S, Luo J, Splenser A, Mody A, et al. Deletion of ghrelin prevents aging-associated obesity and muscle dysfunction without affecting longevity. *Aging Cell.* 2017;**16**(4):859–69. doi: 10.1111/accel.12618. [PubMed: 28585250]. [PubMed Central: PMC5506439].
- Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in obesity among adults in the United States, 2005 to 2014. *JAMA.* 2016;**315**(21):2284–91. doi: 10.1001/jama.2016.6458. [PubMed: 27272580].
- Ahn WK, Lebowitz MS. An experiment assessing effects of personalized feedback about genetic susceptibility to obesity on attitudes towards diet and exercise. *Appetite.* 2018;**120**:23–31. doi: 10.1016/j.appet.2017.08.021. [PubMed: 28837820]. [PubMed Central: PMC5680145].
- Rosenkilde M, Rygaard L, Nordby P, Nielsen LB, Stallknecht B. Exercise and weight loss effects on cardiovascular risk factors in overweight men. *J Appl Physiol (1985).* 2018;**125**(3):901–8. doi: 10.1152/jap-physiol.01092.2017. [PubMed: 29543138].
- Foster-Schubert KE, Alfano CM, Duggan CR, Xiao L, Campbell KL, Kong A, et al. Effect of diet and exercise, alone or combined, on weight and body composition in overweight-to-obese postmenopausal women. *Obesity (Silver Spring).* 2012;**20**(8):1628–38. doi: 10.1038/oby.2011.76. [PubMed: 21494229]. [PubMed Central: PMC3406229].

- Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation.* 2007;**116**(9):1081–93. doi: 10.1161/CIRCULATIONAHA.107.185649. [PubMed: 17671237].
- Kisner C, Colby LA, Borstad J. *Therapeutic exercise: Foundations and techniques.* Fa Davis; 2017.
- Riebe D, Franklin BA, Thompson PD, Garber CE, Whitfield GP, Magal M, et al. Updating ACSM's recommendations for exercise preparticipation health screening. *Med Sci Sports Exerc.* 2015;**47**(11):2473–9. doi: 10.1249/MSS.0000000000000664. [PubMed: 26473759].
- Bean A. *Food for fitness.* A&C Black; 2009.
- US Department of Agriculture; US Department of Health and Human Services. *Dietary guidelines for Americans, 2010.* Washington DC: US Department of Health and Human Services; 2010.
- Rezaeipour M. Comparison of two types of diets on losing weight and lipid profile of overweight/obese middle-aged women under exercise condition. *Health Scope.* 2014;**3**(3). e15611. doi: 10.17795/jhealthscope-15611.
- Rezaeipour M, Apanasenko GL, Nychyporuk VI. Investigating the effects of negative-calorie diet compared with low-calorie diet. *Turk J Med Sci.* 2014;**44**(5):792–8. [PubMed: 25539547].
- Allain CC, Poon LS, Chan CS, Richmond W, Fu PC. Enzymatic determination of total serum cholesterol. *Clin Chem.* 1974;**20**(4):470–5. [PubMed: 4818200].
- Rezaeipour M, Apanasenko GL, Nychyporuk VI. Investigating the effects of negative-calorie diet compared with low-calorie diet under exercise conditions on weight loss and lipid profile in overweight/obese middle-aged and older men. *Kuwait Med J.* 2014;**46**(2):106–11.
- Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, Minson CT, Nigg CR; American College of Sports Medicine, et al. American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc.* 2009;**41**(7):1510–30. doi: 10.1249/MSS.ob013e3181a0c95c. [PubMed: 19516148].
- Efrid J. Blocked randomization with randomly selected block sizes. *Int J Environ Res Public Health.* 2011;**8**(1):15–20. doi: 10.3390/ijerph8010015. [PubMed: 21318011]. [PubMed Central: PMC3037057].
- Ades PA, Savage PD. Obesity in coronary heart disease: An unaddressed behavioral risk factor. *Prev Med.* 2017;**104**:117–9. doi: 10.1016/j.ypmed.2017.04.013. [PubMed: 28414064]. [PubMed Central: PMC5640469].
- Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS. The role of exercise and physical activity in weight loss and maintenance. *Prog Cardiovasc Dis.* 2014;**56**(4):441–7. doi: 10.1016/j.pcad.2013.09.012. [PubMed: 24438736]. [PubMed Central: PMC3925973].

21. Conroy MB, Sward KL, Spadaro KC, Tudorascu D, Karpov I, Jones BL, et al. Effectiveness of a physical activity and weight loss intervention for middle-aged women: Healthy bodies, healthy hearts randomized trial. *J Gen Intern Med*. 2015;**30**(2):207-13. doi: [10.1007/s11606-014-3077-5](https://doi.org/10.1007/s11606-014-3077-5). [PubMed: [25391601](https://pubmed.ncbi.nlm.nih.gov/25391601/)]. [PubMed Central: [PMC4314485](https://pubmed.ncbi.nlm.nih.gov/PMC4314485/)].
22. Celermajer DS, Sorensen KE, Spiegelhalter DJ, Georgakopoulos D, Robinson J, Deanfield JE. Aging is associated with endothelial dysfunction in healthy men years before the age-related decline in women. *J American College Cardiol*. 1994;**24**(2):471-6. doi: [10.1016/0735-1097\(94\)90305-0](https://doi.org/10.1016/0735-1097(94)90305-0).
23. Grundy S, Becker D, Clark L, Cooper R, Denke M, Howard J, et al. Third report of the national cholesterol education program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III) final report. *Circulation*. 2002;**106**(25):3143. doi: [10.1161/circ.106.25.3143](https://doi.org/10.1161/circ.106.25.3143).
24. Mendall MA, Patel P, Ballam L, Strachan D, Northfield TC. C reactive protein and its relation to cardiovascular risk factors: A population based cross sectional study. *BMJ*. 1996;**312**(7038):1061-5. [PubMed: [8616412](https://pubmed.ncbi.nlm.nih.gov/8616412/)]. [PubMed Central: [PMC2350910](https://pubmed.ncbi.nlm.nih.gov/PMC2350910/)].
25. Anagnostis P, Stevenson JC, Crook D, Johnston DG, Godsland IF. Effects of menopause, gender and age on lipids and high-density lipoprotein cholesterol subfractions. *Maturitas*. 2015;**81**(1):62-8. doi: [10.1016/j.maturitas.2015.02.262](https://doi.org/10.1016/j.maturitas.2015.02.262). [PubMed: [25804951](https://pubmed.ncbi.nlm.nih.gov/25804951/)].
26. Huang R. [Correlation among hypertension, hyperlipidemia, hyperglycemia and body mass index in aged people from communities]. *Chinese J Cardiovasc Rehabil Med*. 2015;**24**(3):260-3. Chinese.
27. Barter P, Gotto AM, LaRosa JC, Maroni J, Szarek M, Grundy SM, et al. HDL cholesterol, very low levels of LDL cholesterol, and cardiovascular events. *N Engl J Med*. 2007;**357**(13):1301-10. doi: [10.1056/NEJMoa064278](https://doi.org/10.1056/NEJMoa064278). [PubMed: [17898099](https://pubmed.ncbi.nlm.nih.gov/17898099/)].
28. Natarajan S, Glick H, Criqui M, Horowitz D, Lipsitz SR, Kinoshian B. Cholesterol measures to identify and treat individuals at risk for coronary heart disease. *American Journal of Preventive Medicine*. 2003;**25**(1):50-7. doi: [10.1016/s0749-3797\(03\)00092-8](https://doi.org/10.1016/s0749-3797(03)00092-8).
29. Stampfer MJ, Sacks FM, Salvini S, Willett WC, Hennekens CH. A prospective study of cholesterol, apolipoproteins, and the risk of myocardial infarction. *N Engl J Med*. 1991;**325**(6):373-81. doi: [10.1056/NEJM199108083250601](https://doi.org/10.1056/NEJM199108083250601). [PubMed: [2062328](https://pubmed.ncbi.nlm.nih.gov/2062328/)].
30. Gondim OS, de Camargo VT, Gutierrez FA, Martins PF, Passos ME, Momesso CM, et al. Benefits of regular exercise on inflammatory and cardiovascular risk markers in normal weight, overweight and obese adults. *PLoS One*. 2015;**10**(10). e0140596. doi: [10.1371/journal.pone.0140596](https://doi.org/10.1371/journal.pone.0140596). [PubMed: [26474157](https://pubmed.ncbi.nlm.nih.gov/26474157/)]. [PubMed Central: [PMC4608693](https://pubmed.ncbi.nlm.nih.gov/PMC4608693/)].
31. Franz MJ, VanWormer JJ, Crain AL, Boucher JL, Histon T, Caplan W, et al. Weight-loss outcomes: A systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. *J Am Diet Assoc*. 2007;**107**(10):1755-67. doi: [10.1016/j.jada.2007.07.017](https://doi.org/10.1016/j.jada.2007.07.017). [PubMed: [17904936](https://pubmed.ncbi.nlm.nih.gov/17904936/)].
32. Shai I, Schwarzfuchs D, Henkin Y, Shahar DR, Witkow S, Greenberg I, et al. Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet. *N Engl J Med*. 2008;**359**(3):229-41. doi: [10.1056/NEJMoa0708681](https://doi.org/10.1056/NEJMoa0708681). [PubMed: [18635428](https://pubmed.ncbi.nlm.nih.gov/18635428/)].