Influence of Negative Calorie Foods on Atherogenic Indices in Overweight Women

Mohammadreza Rezaeipour

1. Department of Physical Education and Sport Sciences, University of Sistan and Baluchestan, Zahedan, Iran.

***Correspondence:**
Mohammadreza Rezaeipour, Department of Physical Education and Sport Sciences, University of Sistan and Baluchestan, Zahedan, Iran.
Tel: (98) 915 341 4047
Email: rezaeipour@ped.usb.ac.ir

Received: 15 April 2019

Accepted: 14 September 2019

Published in November 2019

Abstract

Objective: The present study aimed to determine the effects of diet of negative calorie foods (NCF) on weight, atherogenic lipids, and atherogenic ratio and compare its efficiency with diet of low calorie foods (LCF).

Materials and Methods: In this randomized clinical trial, the participants were randomly selected from inactive overweight females (age 45-75 years) by parallel assignment were distributed randomly into two groups: NCF group that received a high-carbohydrate (75%), and low-fat (10%) diet, and LCF group had a dietary recipe with 55% of carbohydrate and a little fat (30%) content. Both groups had a healthy calorie restriction (15%) from their daily caloric requirements within three months. Evaluation of body weight, atherogenic lipids (total-C, HDL-C and LDL-C), and atherogenic ratio (total-C to HDL-C) were performed pre- and post-intervention for all subjects and compared to each other.

Results: The results of the within-group comparison of NCF and LCF on weight (respectively, *P*-value= 0.04; *P*-value= 0.03), total-C (respectively, *P*-value= 0.02; *P*-value= 0.03), HDL-C (respectively, *P*-value= 0.04; *P*-value= 0.01) and LDL-C (respectively, *P*-value= 0.01; *P*-value= 0.03) revealed significant effects. Also, significant differences were observed between groups in atherogenic lipid profile, total-C (*P*-value: 0.03), HDL-C (*P*-value: 0.001), and LDL-C (*P*-value: 0.03). The result of the between-group comparison was also significant in atherogenic ratio (*P*-value: 0.04).

Conclusion: Contrary to expectation, dietary regimen demonstrated a similar pattern of weight loss in females. The NCF when compared to the LCF, is not a healthy choice for weight loss in sedentary females with overweight.

Keywords: Caloric restriction, Healthy lifestyle, Nutrition policy, Nutritive value; Weight loss diet.

Introduction

Weight gain disorders are one of the most important public health problems in the 21st century and greatly raise the risk of developing various diseases. The word "Globesity" in some reports shows the seriousness of this problem

[DOI: 10.18502/ijdo.v11i2.2656]

at the global level. According to the latest statistical data provided by the World Health Organization, 1/3 of world population is overweight, and 1/10 is obese (1). Around, 70% of the middle-aged and older populations (age≥ 45 years) have an unusual weight gain (2). Physical dysfunctions, higher medicinal services costs, and raised morbidity and mortality, are a few results of obesity (3). Diet is effective to prevent or control these problems. Today, medications and diets are broadly utilized for weight loss and body fitness and may affect people's health (4).

Based on the principle of using food that creates a negative calorific influence leading to proper weight loss, the diet of negative calorie foods (NCF) is a modern diet. For instance, for digesting a bit of a sweet containing 400 calories, the body needs 150 calories of vitality and the staying 250 calories add to the body fat. The NCF comprises of foods that require 150 calories to digest just 100 calories' worth of food (rather than 400); thus, the body should burn 50 extra calories simply by eating the food. This idea of weight cut is engaging. This gives these foods, a characteristic fat-consuming property. These foods are called catabolic nourishments. Another food regime is low calorie foods diet (LCF) that does not contribute to burning calories but by reducing total caloric intake helps to weight loss (5,6). A large part of the NCF contains high-fiber, low-calorie fruits and vegetables (7,8). In line with the claims of NCF's supporters, this diet will contribute more than other diets to weight loss. In other words, more eating decreases more weight (5,6).

A past study has shown the comparison of NCF and LCF on the weight-loss trend of sedentary overweight/obese middle-aged and older men (6), but there has been no scientific evidence about the efficacy and effects of these diets on weight, atherogenic lipids and atherogenic features of sedentary middle-aged/older overweight females. The present study was aimed to evaluate the effects of NCF on weight loss and compare its efficacy with LCF in sedentary middle-aged/older overweight females. Changes in total cholesterol (total-C), a pro-atherogenic lipid which is characterized by low-density lipoprotein -cholesterol (LDL-C), an anti-atherogenic lipid which is characterized by high-density lipoprotein -cholesterol (HDL-C), body weight, and atherogenic ratio (total-C to HDL-C) were assessed pre- and post-intervention to evaluate the weight loss trend.

Materials and Methods

Participants (n= 87) were selected among sedentary overweight females aged 45–75 years who came to get weight loss consulting programs at the Ukrainian Sports Medicine Center (Kyiv) by convenient method. Participants completed a questionnaire about medical history and physical activity. Of all 87 participants, 57 women presented permission of their personal physician stating that the intended research was not contraindicated for them. The remaining participants by parallel assignment divided randomly into two groups: group I or NCF group who received 15% protein, carbohydrate 75%, and 10% of fat (29 participants). NCF is a high-carbohydrate and low-fat diet that its fiber content is high (5,6,9,10). The group II or LCF group (28 participants) that received the LCF diet (details of diet: 15% protein, 55% carbohydrates, 30% fat). The LCF has high-carbohydrate content and a little fat (5,6,11). The two groups had 15% calorie restriction from their maintenance energy requirements. The sample size was calculated by Cochran's sample size formula for 0.05 (error of 5%). The simple randomization was performed. Participants were nonsmokers and weight-stable (± 2 kg, for over one year) with no history of standard exercise in three months before the study. The participants with cardiovascular disease (CVD), metabolic or endocrine disorders, food allergies, chronic medications, any history of anti-obesity medication or weight loss program, kidney disease, malignancy, and depression were exclusion criteria.

[DOI: 10.18502/ijdo.v11i2.2656]

The participants were surveyed for vital signs, and their blood pressure was measured after the 10-min rest period on a seat from right arm (twice, five-minute interval) with a manual mercury sphygmomanometer. The midpoint value of three measurements was utilized to helping the investigation. Those subjects with blood pressures lower than 140/85 mm Hg entered the trials. Participants' height and weight were computed by wearing light clothing without shoes using a digital scale (Scale-Tronix model 5002, Wheaton, IL, USA) and a stadiometer with accurate 0.1 cm, and 0.1 kg, respectively (12). BMI, as body weight (kg)/ height (m^2), equivalent to or higher than 25.0 kg/m^2 were characterized as excessive weight condition. Following the underlying evaluations, the participants were divided randomly. There were no other limitations (such as blocking and block size); however, there was a harmony between the examinations bunches in size and standard attributes (13).

Participants utilized a diary that was beforehand endorsed based on household measures. They recorded food and beverage consumption (counting water) for four days (three days a week + a weekend day). They did it at the start of the study (baseline) and every month during the investigation. Diaries for completeness and energy were checked. Macronutrient compositions were calculated from the software (Diets In Details program) (5,14). Daily calorie requirements and maintenance calorie needs have been estimated by multiplying the subjects' physical activity level (PAL) and baseline metabolism (BMR). For a more exact gauge of BMR in females, Eq. (1) and Eq. (2) was utilized for the 31-60 years and over 60-year participants, respectively (15).

Eq. (1) (Weight in kg × 8.7) + 829

Eq. (2) (Weight in kg × 10.5) + 596

The PAL is proportion of total daily energy expenditure to BMR. At baseline, for choosing participants with a sedentary lifestyle, the PAL values were determined using a customized self-report questionnaire. The questionnaire consisted of a Likert-type scale with 7-point ranging from not at all (1 point) to each day (7 points). The PAL value was classified into one of seven categories as follows: Not at all, less than once a month, 1-2 times a month, about once a week, 2-3 times a week, 4-5 times a week and every day. The exercise frequency of 1-2 times a month or less was considered as continuously inactive (8,15). Before and during the study, the participants had an inactive lifestyle (exercise session less than 1-2 times a month), and PAL was considered 1.2.

The antecubital vein was selected for blood sampling. Total-C and HDL-C were measured utilizing an enzymatic kit (Elitech Diagnostics, Sees, France) by spectrophotometry at 500nm. LDL-C was computed utilizing the Friedewald equation characterized as LDL-C = total-C – HDL-C – TG/5 (16). The participants did not eat or drink, except water, for 9-12 h before the blood test.

At the beginning of the study, the participants had a week by week meeting. They found out how to adhere to their eating routine and develop their motivation and sense of responsibility towards the program. Variations in activity levels or diets are associated with potential confounding effects during such studies. They were instructed for protecting their present PALs and diets throughout the intervention and report any problems that could influence their contribution to the investigation. Weight loss evaluation parameters and laboratory tests were performed before and after intervention for all subjects and compared with each other. The technique did not change during the study. All systems and necessities were clarified for subjects. They voluntarily signed a consent form before enrolling in the investigation. The local ethics committee endorsed the investigation protocol [NMAPE, (2015) No. 04112-10].

Statistical analysis

Every single measurable datum of the investigation was communicated as a mean

[DOI: 10.18502/ijdo.v11i2.2656]

±standard deviation (SDs). The Kolmogorov-Smirnov test turned into used to investigate normal distributing of data. The data were normally distributed. The pre- and post-intervention results for the groups were compared utilizing the paired T-test, and the differences between the groups were assessed by the independent T-test. The linear regression analysis (R) was utilized to look for a relation among all significant values (dependent) and weight change (independent). The statistical analysis was made by the IBM SPSS Statistics (version 19.0; IBM, Armonk, NY, USA) for Windows. The statistical significance was considered at *P*-value< 0.05, and the confidence interval was considered 95%.

Ethical considerations

ClinicalTrials.gov of U.S. National Library of Medicine (www.clinicaltrials.gov) with NCT03066882 code. In addition at the beginning of the study, all patients completed written consent.

Results

Fifty-seven females participated at the beginning of this study, but finally, 37 participants completed the 3-month study. Nineteen females (mean age, 53.5 ± 6.9 years) were in the NCF group and eighteen females (mean age, 56.4 ± 8.4 years) were in the LCF group. The reasons for their drop out were loss of motivation (eight women), treatment for hypertension (four women) and diabetes mellitus (five women), as well as dissatisfaction with their randomization (three women).

As shown in Table 1, the two groups had a 15% calorie restriction from their maintenance energy requirements. The intra-group evolutions of NCF and LCF in terms of time (before and after) on weight (respectively, *P*-value= 0.04; *P*-value= 0.03), total-C (respectively, *P*-value= 0.02; *P*-value= 0.03), HDL-C (respectively, *P*-value= 0.04; *P*-value= 0.01) and LDL-C (respectively, *P*-value= 0.01; *P*-value= 0.03), demonstrated significant changes (Table 2). No significant differences were observed in body weight between NCF and LCF groups after the intervention (*P*-value: 0.16). Whereas, comparison of the two groups at post-intervention revealed significant differences between groups regarding total-C (*P*-value: 0.03) and HDL-C (*P*-value: 0.001) values, and also LDL-C (*P*-value: 0.03) levels. The result of the between-group comparison was also significant in atherogenic ratio (*P*-value: 0.04).

Linear regression analysis was carried out to find a relation between all significant values and weight change. This showed a significant effect between weight change and atherogenic lipids, such as total-C, HDL-C, and LDL-C (*P*-value: 0.001). Regression analysis confirmed that the predictions of weight loss

Table 1. Daily calorie requirements, its levels of change and daily energy intake (mean ± SD).

Group	Daily calorie requirements*	Levels of change	Daily energy intake** (kcal)
NCF diet (I)	1855 (± 79)	- 15%	1577 ± 67
LCF diet (II)	1907 (± 123)	- 15%	1639 ± 119

*: Daily calorie requirements = BMR × PAL, **: Daily energy intake = Daily caloric requirements – Levels of change, NCF: negative calorie foods, LCF: low calorie foods.

Table 2. The evolution of the studied parameters of both groups during the intervention (mean ± SD).

Parameters	NCF Group (I)		LCF Group (II)		*P*-value[a]
	Before treatment, Mean ± SD	3 months, Mean ± SD	Before treatment, Mean ± SD	3 months, Mean ± SD	
Weight, kg	83.8 (± 6.28)	76.3 (± 6.12)[b]	88.8 (± 12.08)	81.2 (± 11.81)[b]	0.07
BMI, kg/m^2	27.9 (± 2.04)	25.4 (± 1.96)	29.9 (± 3.21)	27.3 (± 3.17)	0.09
Total-C, mg/dl	184.0 (± 9.41)	156.4 (± 8.52)[b]	184.8 (± 8.25)	168.0 (± 7.46)[b]	0.03
HDL-C, mg/dl	53.3 (± 3.03)	44.6 (± 3.52)[b]	53.4 (± 2.77)	52.5 (± 2.74)[b]	0.001
LDL-C, mg/dl	113.6 (± 8.09)	93.0 (± 8.05)[b]	117.2 (± 6.81)	99.4 (± 5.71)[b]	0.03
Total-C / HDL-C ratio	3.42 (± 0.25)	3.49 (± 0.35)	3.42 (± 0.25)	3.09 (± 0.24)	0.04

NCF: negative calorie foods; LCF: low calorie foods; BMI: body mass index; [a]: *P*-value derived from independent T-test; [b]: significant difference compared to pre-intervention measurements.

[DOI: 10.18502/ijdo.v11i2.2656]

in NCF compared to LCF was approximately the same (Figure 1).

Discussion

Aging is associated with degeneration, loss of functional ability, and obesity (17). Although age-related changes have a strong genetic part, they are also affected by diet and physical activity (18). In this way, middle-aged and older women were selected for research. Blood levels of TG are related to eating, and LCFs lessen its value. Thus, the TG variable was excluded from this investigation. As far as is concerned, this was the first randomized controlled trial investigating the influence of NCF on weight cut and atherogenic lipids in sedentary middle-aged/older women with excessive weight.

All parameters comprising Wight, Total-C, HDL-C, and LDL-C decline after intervention

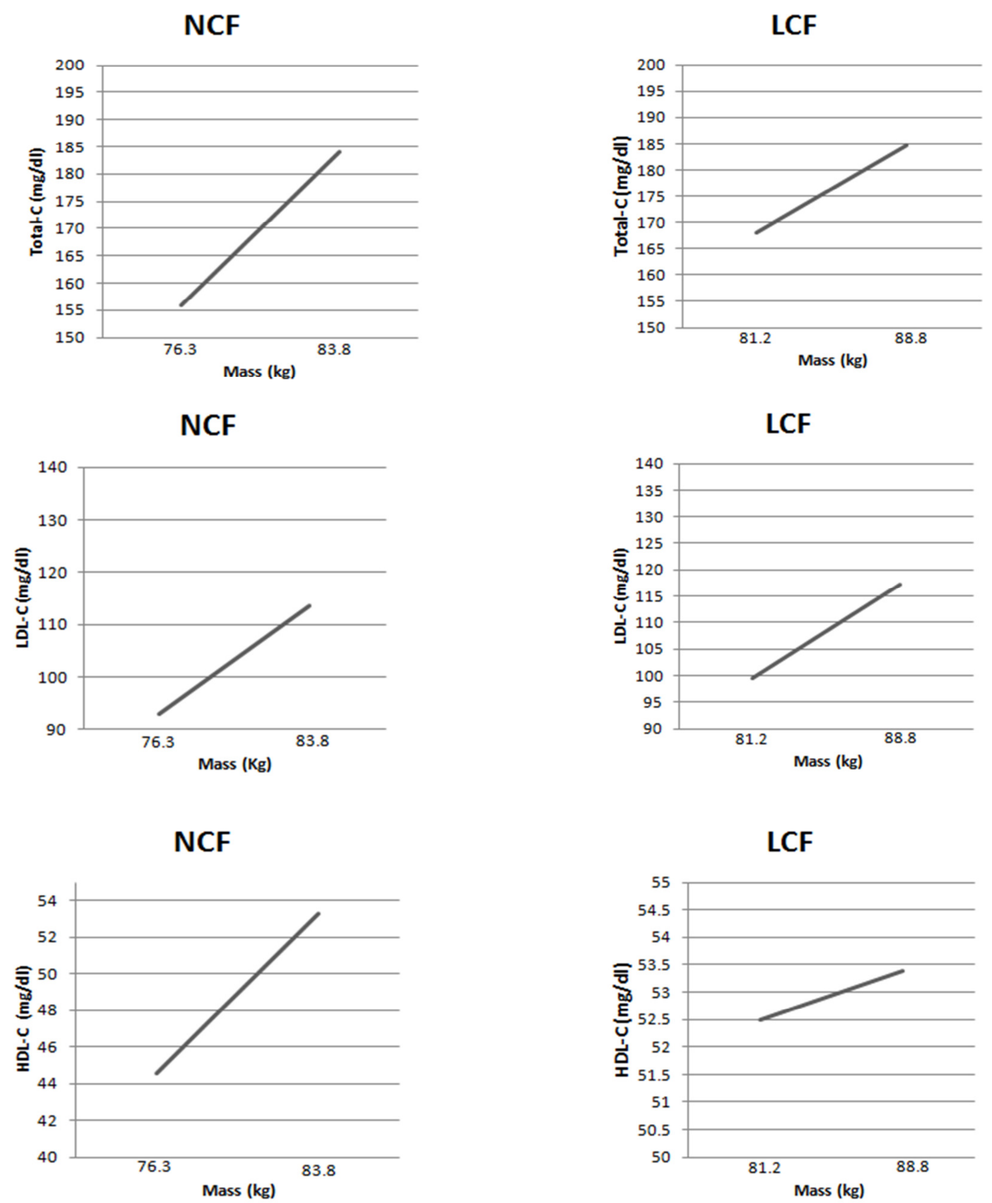

Figure 1. Linear regression between total-C, HDL-C, and LDL-C as atherogenic lipids and weight change (baseline versus three-month)

[DOI: 10.18502/ijdo.v11i2.2656]

compare to before intervention in both groups, which shows the adequacy of eating regimens. Diets are low in fat. Therefore, it appears the cholesterol level in each diet had an essential impact of the outcomes. The findings from this study support the findings of Franz et al.'s study assessing the weight cut efficacy of dietary interventions and meal replacements (19).

High blood lipids are risk factors for CVD, which is aggravated by age (20,21). Diminished total-C and pro-atherogenic lipid (LDL-C) induced by the NCF were similar to LCF results, but the effectiveness of diets was not similar for weight loss levels. Some other researchers have reported similar outcomes for different diets (19,21).

Some previous studies have confirmed that anti-atherogenic lipid (HDL-C) is affected by diet (5,6,22). This finding agrees with the data of the present study, which showed that the decrease in anti-atherogenic lipid in NCF was significantly greater than that of LCF. HDL-C is the most deciding part of CVD. Its change is of utmost critical in healthcare because one benchmark to estimate the risk of CVD is atherogenic ratio (total-C to HDL-C) (23-25). As appeared in Table 2, the atherogenic ratio was changed in both experimental groups. The differences in atherogenic ratio between before and after interventions were not significant; however, the effectiveness of diets was significant for total-C/HDL-C ratios between groups after intervention. The atherogenic ratio was raised in NCF but diminished in LCF. This finding may have clinical applications for weight cut.

Moreover, the results of the simple linear regression demonstrated that anti-atherogenic lipid diminishes more in the NCF group as compared with the LCF group for each weight unit raise (Figure). At long last, it ought to be noticed that fat is involved in building the layers of all body cells. What's more, it provides essential fatty acids, vitamins A; D and E. Fat in the NCF are less than the recommended food standards. Because of their high-carbohydrate content, this diets might contain over twice (40–70 g/day) the recommended fiber (10). High-fiber intake can decrease absorption of zinc, calcium, and iron (26). Complaints of flatus and abdominal fullness have also been reported (9). In this way, this diet is unsuitable for long-term use and probably will lead to some problems.

Conclusions

Weight loss in both experimental groups was similar. The NCF had no advantage over LCFs on the occurrence or development of cardiovascular dysfunctions in sedentary middle-aged/older women with excessive weight. Negative-calorie food has no outer meaning and application. Although some diets have the same effect for weight loss in a short time, they might lead to remarkable side effects in the physical health of patients. Using the negative calorie foods diet is not recommended in the sedentary, middle- to older aged females.

Acknowledgments

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

Conflict of interest

The authors declare no conflict of interest regarding this study.

References

1. World Health Organization. World report on ageing and health. World Health Organization; 2015.
2. Wang Y, Beydoun MA, Liang L, Caballero B, Kumanyika SK. Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. Obesity. 2008;16(10):2323-30.
3. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight

[DOI: 10.18502/ijdo.v11i2.2656]

and obesity in the United States, 1999-2004. Jama. 2006;295(13):1549-55.
4. Ertin H, Özaltay B. Some ethical reflections on weight-loss diets. Turkish Journal of Medical Sciences. 2011;41(6):951-7.
5. 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. Turkish Journal of Medical Sciences. 2014;44(5):792-8.
6. Rezaeipour M, Nychyporuk GL. Investigating the effects of negative calorie diet compared with low-calorie diet on weight loss and lipid profilein sedentary overweight/obese middle-aged and olderMen. Kuwait Medical Journal. 2014;46(2):106-11.
7. Duyff RL. American dietetic association complete food and nutrition guide. Houghton Mifflin Harcourt; 2012.
8. Nestle M, Nesheim M. Why calories count: from science to politics. Univ of California Press; 2012.
9. Freedman MR, King J, Kennedy E. Popular diets: a scientific review. 2001.
10. Gidding SS, Lichtenstein AH, Faith MS, Karpyn A, Mennella JA, Popkin B, et al. Implementing American heart association pediatric and adult nutrition guidelines: a scientific statement from the American heart association nutrition committee of the council on nutrition, physical activity and metabolism, council on cardiovascular disease in the young, council on arteriosclerosis, thrombosis and vascular biology, council on cardiovascular nursing, council on epidemiology and prevention, and council for high blood pressure research. Circulation. 2009;119(8):1161-75.
11. Manore MM. Exercise and the institute of medicine recommendations for nutrition. Current sports medicine reports. 2005;4(4):193-8.
12. Rezaeipour MR. Study of exercise time models on weight loss and coronary risk panel in inactive middle-aged men by overweight or obesity. The Journal of Urmia University of Medical Sciences. 2018;29(5):389-97.
13. Efird J. Blocked randomization with randomly selected block sizes. International Journal of Environmental Research and Public Health. 20118(1):15-20.
14. 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).
15. Bean A. Food for fitness. A&C Black; 2009.
16. Allain CC, Poon LS, Chan CS, Richmond WF, Fu PC. Enzymatic determination of total serum cholesterol. Clinical chemistry. 1974;20(4):470-5.
17. Brief ND. Obesity among adults in the United States—no statistically significant change since 2003-2004.
18. 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.
19. 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. Journal of the American Dietetic Association. 2007;107(10):1755-67.
20. Expert Panel on Detection E. Executive summary of the 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). Jama. 2001;285(19):2486-97.
21. 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.
22. Brinton EA, Eisenberg S, Breslow JL. A low-fat diet decreases high density lipoprotein (HDL) cholesterol levels by decreasing HDL apolipoprotein transport rates. The Journal of Clinical Investigation. 1990;85(1):144-51.
23. Assmann G, Schulte H, von Eckardstein A, Huang Y. High-density lipoprotein cholesterol as a predictor of coronary heart disease risk. The PROCAM experience and pathophysiological implications for reverse cholesterol transport. Atherosclerosis. 1996;124:S11-20.
24. Kinosian B, Glick H, Preiss L, Puder KL. Cholesterol and coronary heart disease: predicting risks in men by changes in levels and ratios. ACC Current Journal Review. 1996;3(5):40.
25. Stampfer MJ, Sacks FM, Salvini S, Willett WC, Hennekens CH. A prospective study of cholesterol, apolipoproteins, and the risk of myocardial infarction. New England Journal of Medicine. 1991;325(6):373-81.
26. Insel PM. Discovering nutrition. Jones & Bartlett Publishers; 2013.

[DOI: 10.18502/ijdo.v11i2.2656]