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*Original Research / Orijinal Araştırma*

# *The Effect Of Weight Loss With Lifestyle Changes On LDL Cholesterol: Retrospective Cohort Study*

## Yaşam Tarzı Değişikliğiyle Kilo Kaybının LDL Kolesterol Üzerine Etkisi: Retrospektif Kohort Çalışması

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## Abstract

**Aim**: This study aimed to investigate the rate of decrease in lipid levels with effective lifestyle changes (LC) and the minimum body weight loss necessary for effective lipid reduction in obese patients.

**Method**: The study is a retrospective cohort study. The study included 71 patients who were followed up in the obesity clinic, who were diagnosed with hyperlipidemia but did not use any hyperlipidemia treatment. The patients' high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), total cholesterol, triglyceride, body fat ratio and mass, body mass index (BMI), height and weight information were recorded at the first visit and the 6th month. In our study, patients were divided into two groups (based on the weight loss rates in the 6-month follow-up) those who lost less than 10% of their previous weight and those who lost 10% or more weight and their lipid parameters were compared.

**Results**: LDL-C reduction rates of patients classified according to their weight loss rates were found to be statistically significantly (p=0.011) higher in those with 10% or more weight loss than (group 1=18.48%) in those with less than 10% weight loss (group 2=13.04%). Total cholesterol reduction rates were also significantly (p=0.015) higher in the 1st group than in the 2nd group. According to the findings of our study, at least 10% weight loss is required to decrease total cholesterol and LDL-C significantly.

**Conclusion**: Implementation of primary and secondary prevention strategies to reduce the risk of cardiovascular disease is important in the context of primary care. To reach the targeted LDL-C values, the weight monitoring of obese patients should be considered, and the importance of losing at least 10% of weight as one of the first steps should be emphasized.


**Keywords**: lifestyle changes, hyperlipidemia, primary prevention


## Özet

**Amaç**: Bu araştırmada etkili bir yaşam tarzı değişikliği (YTD) ile obez hastaların lipit düzeylerinde yüzde kaç oranında düşüş sağlanabileceği ve etkili lipit düşüşü için en az ne kadar kilo verilmesi gerektiği araştırılmak istenmiştir.

**Gereç ve Yöntem**: Çalışmamız retrospektif bir kohort çalışmasıdır. Çalışmaya obezite polikliniğinde izlenen, hiperlipidemi tanısı alıp herhangi bir hiperlipidemi tedavisi kullanmayan 71 hasta dahil edilmiştir. Hastaların ilk gelişte ve 6. aydaki yüksek yoğunluklu lipoprotein kolesterol (HDL-K), düşük yoğunluklu lipoprotein kolesterol (LDL-K), total kolesterol, trigliserit, vücut yağ oranı ve kitlesi, beden kitle indeksi (BKİ), boy, kilo bilgileri kaydedilmiştir. Çalışmamızda hastalar (6 ay sonraki takiplerindeki kilo düşüş oranları baz alınarak) önceki kilolarına göre %10 dan daha az kilo verenler ve %10 ve daha fazla kilo verenler olarak iki gruba ayrılarak lipit parametreleri karşılaştırılmıştır.

**Bulgular**: Kilo verme oranlarına göre sınıflandırılan hastaların LDL-K düşüş oranları karşılaştırıldığında; %10 ve daha fazla kilo verenlerin LDL-K düşüş oranları (1. Grup= %18.48) %10 'un altında kilo verenlere göre (2. Grup= %13.04) anlamlı olarak daha fazlaydı (p=0.011). Total kolesterol düşüş oranları da 1. Grupta 2. Gruba göre anlamlı olarak daha fazlaydı (p=0.015).

**Sonuç**: Birinci basamak yaklaşımında kardiyovasküler riski azaltmak için birincil ve ikincil korunmanın uygulanması önemli bir konudur. Hiperkolesterolemi tespit edilen obez hastalarda hedeflenen LDL-K değerlerine ulaşmak amacıyla hastalara yaşam tarzı değişiklikleri önerilmeli ve en az %10 kilo vermenin önemine vurgu yapılmalıdır.


**Anahtar Kelimeler**: Yaşam tarzı değişiklikleri, Hiperlipidemi, Primer koruma

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## Introduction

Hyperlipidemia is a modifiable risk factor related to the leading causes of morbidity and mortality in our country. According to the 2020 Cause of Death Statistics from the Turkish Statistical Institute, circulatory system diseases accounted for 36% of all deaths. Of these deaths, 41.5% were due to ischemic heart disease, 23.8% were due to other heart diseases, and 19.6% were due to cerebrovascular diseases.[1]

Targeted LDL-C levels in patients should be determined based on individual risk assessments.[2]

In 2021, the European Society of Cardiology (ESC) published new guidelines. These guidelines now use lifetime Atherosclerotic Cardiovascular Disease (ASCVD) risk estimations instead of 10-year risk algorithms.[3,4] Diet and LC, quitting smoking, reducing alcohol intake, and reducing systolic blood pressure below 160 mmHg are recommended for all patients. Turkey is classified as a high-risk country for ASCVD by the World Health Organization.[4]

LC and dietary habits play an essential role in the effective management of hyperlipidemia at every stage of treatment. When making dietary changes, it is important to limit saturated fats (including trans fatty acids) to no more than 10% of daily calorie intake (and no more than 7% in the presence of hypercholesterolemia). Cholesterol intake should be reduced to below 300 mg/day, especially in patients with high cholesterol levels. Other crucial LC involve quitting smoking and decreasing alcohol consumption, limiting cholesterol intake. Maintaining a healthy body weight can be achieved by doing a total of 150 minutes of moderate-intensity exercise or 75 minutes of high-intensity exercise in 7 days.[5,6,7,8]

LDL-C levels should be re-evaluated six weeks after implementing LC, and if the target values are not reached, the program should be intensified. Additionally, the use of plant-derived sterols or stanols should be increased. If the desired level of control is still not achieved after three months, medical treatment should be considered. A body of research indicates that lifestyle modifications can positively impact insulin resistance and oxidative stress indicators, with a body weight loss of approximately 10% being a notable predictor of these outcomes.[9] The objective of this study was to assess the impact of a targeted 10% reduction in body weight, coupled with an efficacious LC, on lipid profiles in individuals with a BMI within the obese range. This highlights the importance of maintaining LC as the first step in the treatment of hypercholesterolemia.

## Material and Methods

### Study design and participants

The study is a retrospective cohort study. The basis of this research is based on the evaluation of 71 cases between the ages of 18 and 75 who applied to the Istanbul Medeniyet University Göztepe Prof. Dr. Süleyman Yalçın Training and Research Hospital Obesity Polyclinic between April 2015 and August 2017. The study included 71 patients who were followed up in the obesity clinic, who were diagnosed with hyperlipidemia but did not use any hyperlipidemia treatment, and who did not have any other known endocrinological diseases such as hyperthyroidism, diabetes mellitus (DM), Cushing's syndrome.

The study included 63 female and 8 male participants who met the specified inclusion criteria and were classified as obese. The patient data for this study were extracted from the electronic medical record system of the hospital.

Demographic characteristics (age, sexual category, BMI, weight, fat ratio, weight loss, etc.) of the patients who were screened within the specified date range were recorded first. It was confirmed from their medical histories that all included cases received exercise program information and nutritional information at their first interview. All the individuals included in the study were formed from the cases who came to the control every two weeks. The data of all cases over an average of six months were analyzed. During these six months, changes in body weights, body fat ratios, body fat masses, and lipid parameters were recorded in all cases. Those with missing data were not included.

The necessity of regular exercise, a reduction in cholesterol intake, and a balanced diet for effective weight loss were emphasised to patients. Weight, fat, and body mass index measurements were taken at follow-up appointments for patients who had set themselves the goal of losing 10% of their body weight in line with the recommendations made. These measurements were taken every two weeks. Patients were categorized into two groups: those who experienced a weight loss of less than 10% from their initial weight and those who achieved a weight loss of more than 10% (determined by weight reduction rates approximately 6 months later during follow-up). Group 1 comprised patients with a weight loss of 10% or more, while Group 2 included patients with a weight loss of less than 10%.

Patients who were not under any treatment for hyperlipidemia in the last 6 months and who did not follow an effective diet and exercise program for hyperlipidemia were included. The triglyceride level of all cases was below 400mg/dL, and all cases were over the age of eighteen. Patients using statin and fibrate-derived drugs for the treatment of hyperlipidemia, and patients using oral antidiabetic or insulin were not included. Moreover, patients with a diagnosis of ischemic heart disease, and patients with endocrinopathy that may affect blood lipid levels such

as hyperthyroidism, DM, and syndrome of Cushing were also excluded from the study. Similarly, pregnant women and cases with osteopathy that may cause physical activity limitation were excluded (Figure 1).
In the study, measurements were taken at two different times, and differences were observed between two independent groups with a weight loss rate of ≥10% (group 1) and a weight loss rate of <10% (group 2) during the follow-up period. Consequently, the effect size for two independent groups and two repeated measurements was calculated as 0.25 (medium level), 80% power, and 5% Type I error, and the expected minimum sample size was at least 66. The calculation was evaluated in the G*Power 3.1.9.4 program.
It should be noted that the distribution of individuals into groups is not homogeneous and is determined at the end of the follow-up period, which represents a limitation of the study.
Ethical approval was obtained from the Istanbul Medeniyet University Göztepe Prof. Dr. Süleyman Yalçın Training and Research Hospital Clinical Research Ethics Committee on 18/11/2020 and numbered 2020/0660.

**Statistical Method**

The data from the study were subjected to analysis using the SPSS Statistics software (IBM), version 20.0. Descriptive statistical methods as numbers and percentages were used in the analysis of categorical data, and mean±standard deviation was used in the evaluation of variable data. First visit and after six months of visits variables with continuous normal distribution were compared with the paired sample t-test. Lipid parameter reduction rates, measured at the initial admission and follow-up for patient groups, underwent comparison through the Mann-Whitney U Test, Statistical significance was considered for P values ≤ 0.05.

## Results

The demographic characteristics of the individuals forming the sample at the beginning of the study are as follows.

**Table 1.** Findings of individuals who applied to the obesity outpatient clinic

| **Parameters** | **Values (Mean±SD)** |
|---|---|
| Average age (year) | 51.27 ± 10.37 |
| Gender (Female/Male)(n) | 63/8 |
| Average Body Mass Index (kg/m$^2$) | 38.32 ± 5.92 |
| Total Cholesterol Value (mg/dL) | 212.80 ±40.01 |
| LDL-C (mg/dL) | 139.35 ±30.91 |
| HDL -C (mg/dL) | 48.05 ± 9.12 |
| Triglyceride (mg/dL) | 132.63 ±54.06 |
| Average body weight (kg) | 97.41 ± 15.81 |
| Average fat mass (kg) | 38.48 ± 10.13 |
| Average percentage of body fat (%) | 39.04 ± 4.77 |

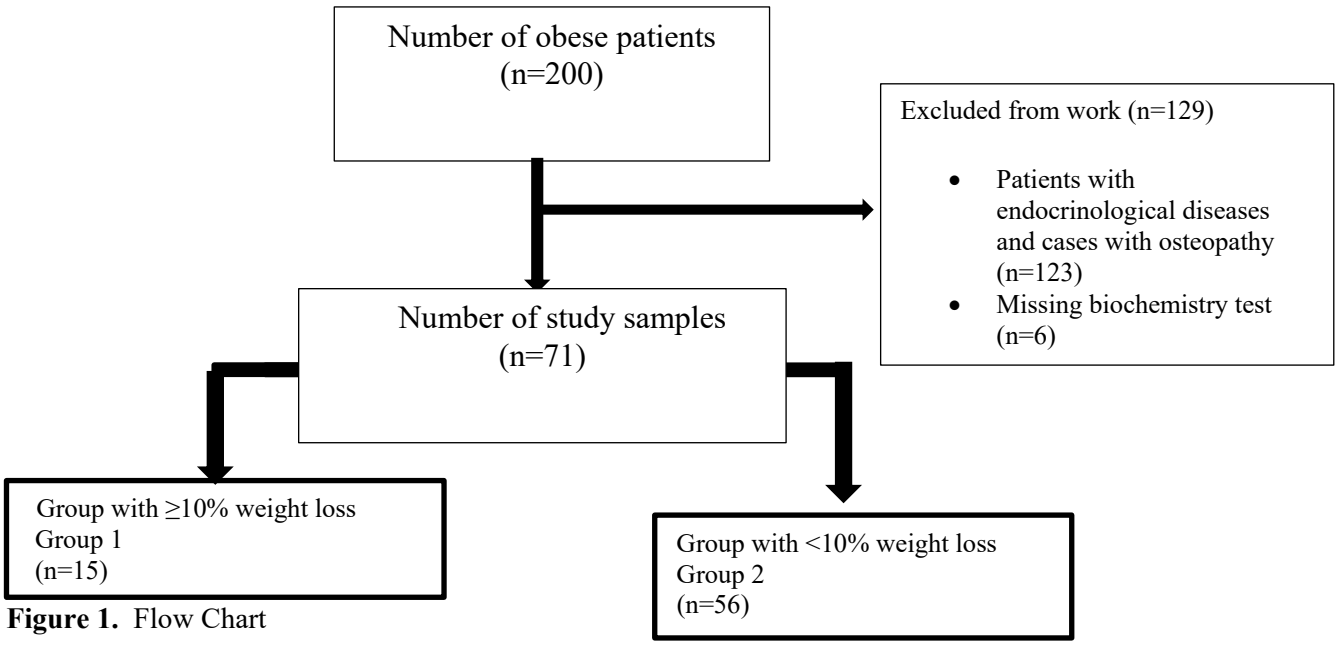
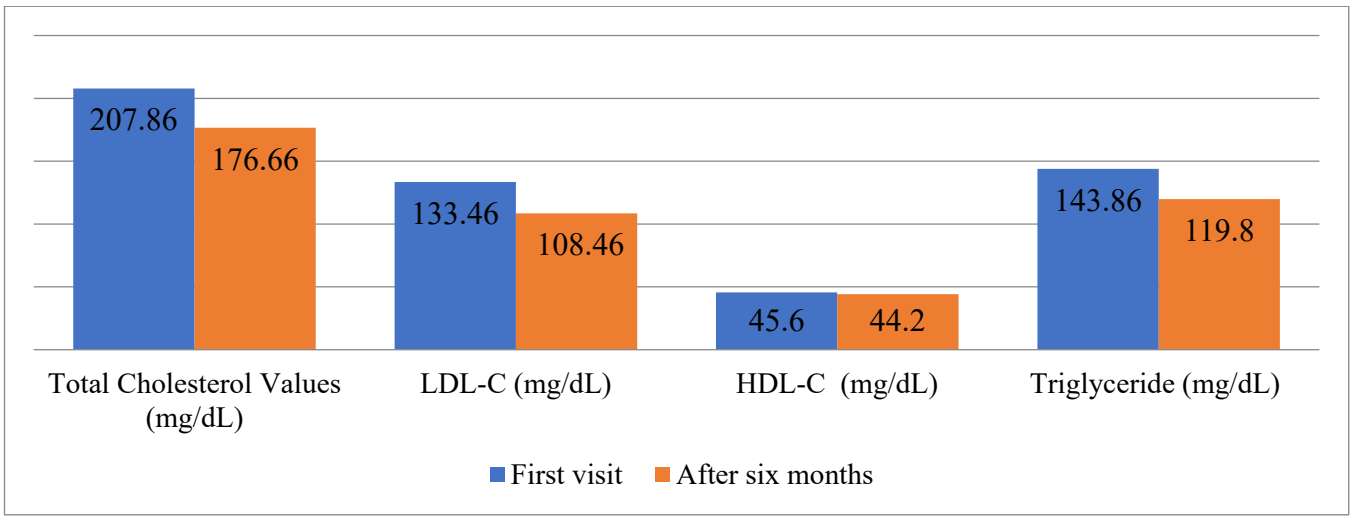
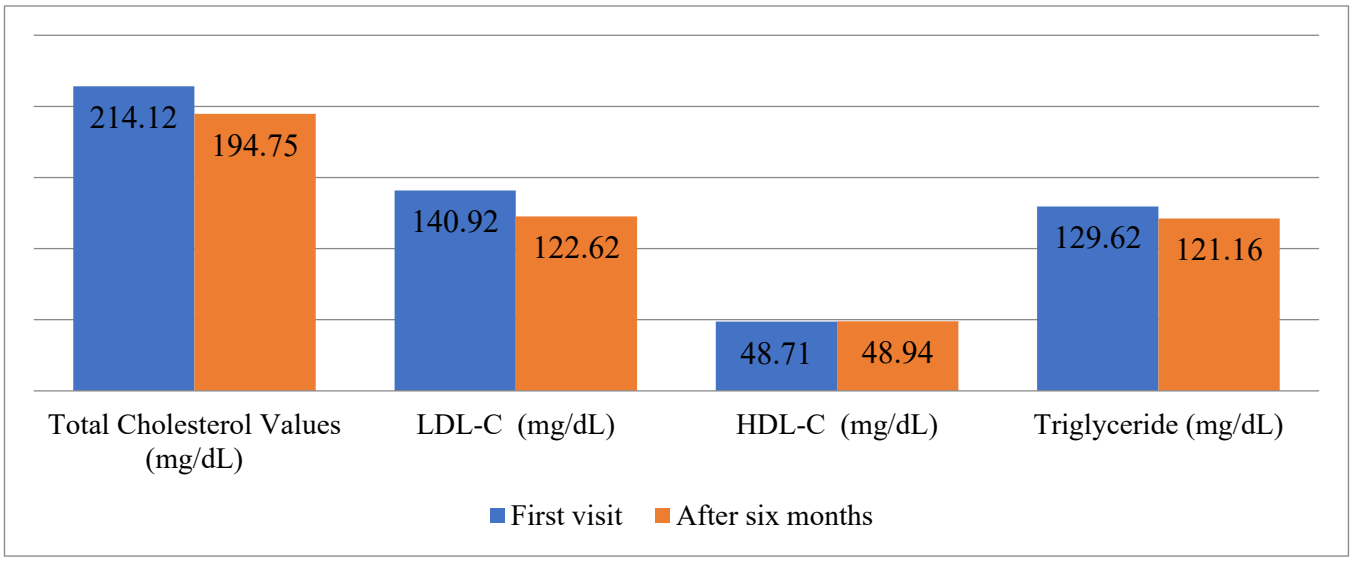



**Figure 1.** Flow Chart




*p: Paired Sample t test*

**Figure 2.** The results of the evaluated biochemical parameters of cases who lost 10% or more of weight (group 1) at the time of the first visit and six months after the LC.




*p: Paired Sample t-test*

**Figure 3.** The results of the evaluated biochemical parameters of cases with less than 10% weight loss (group 2) at the first visit and six months after the LC.

**Table 2.** Rates of decrease in lipid values by groups at the first application and 6 months later

| | **group with ≥10% weight loss (group 1)** | **group with <10% weight loss (group 2)** | **p-value** |
|---|---|---|---|
| Total cholesterol (%) | 14.65±6.71 | 8.52±12.83 | 0.015 |
| LDL - cholesterol (%) | 18.48±6.83 | 13.04±7.37 | 0.011 |
| HDL - cholesterol (%) | 2.05±14.62 | -0.59±13.68 | 0.757 |
| Triglyceride (%) | 13.09±26.25 | -1.08±42.10 | 0.328 |

*p: Mann-Whitney U test*

LDL-C reduction rates of patients classified according to their weight loss rates were found to be statistically significantly (p=0.011) higher in those with 10% or more weight loss than (group 1=18.48%) in those with less than 10% weight loss (group 2=13.04%). Total cholesterol reduction rates were also higher in the 1st group than in the 2nd group (p=0.015).

The study findings indicate that a minimum of 10% weight loss is necessary to reduce total cholesterol and LDL-C levels. In group 1, where patients effectively implemented LC, an average decrease of 18.48% in LDL-C levels was observed.

## Discussion

The importance of nutrition in preventing cardiovascular diseases has been widely emphasized in studies, and prospective studies suggest that dietary change is a positive epigenetic factor that increases the risk of cardiovascular diseases such as dyslipidemia and hypertension.[10,11] In a cross-sectional study by Zhang et al., it was found that blood lipid parameters were correlated with BMI and the prevalence of dyslipidemia was higher in overweight individuals compared to normal-weight individuals.[12] In the treatment of hyperlipidemia, especially in obese, it is an important approach to effectively make LC to the patient before or during medical treatments. However, the extent to which weight loss with LC contributes to LDL cholesterol reduction is still under investigation. In general, a low-cholesterol dietary program is the primary recommendation for patients. In one study of 47 patients who were not receiving hyperlipidemia treatment, a fat-free diet was recommended for 3 months, and the patients were followed. As a result, a decrease in LDL subgroups was observed in patients, but this decrease was not considered significant due to the small number of people in the study.[13] In a study conducted with rats for 10 days, lifestyle intervention was applied especially as an exercise program and a significant decrease in LDL cholesterol level was found in this way.[14] At this point, it is observed that there are difficulties in achieving the desired LDL cholesterol targets with dietary recommendations alone. In addition, the patient's understanding and feeling of LC and measuring compliance with the program are among the other problems encountered. For these reasons, there is a need for an indicator to determine the effectiveness of LC in lowering LDL cholesterol and the extent to which patients implement these changes. Looking at the literature, a 12-month study conducted in Germany in 2018 showed that a good lipid profile was achieved with weight loss in patients as a result of LC.[15]

It is generally known that for every 10 kg of weight loss, there is an 8 mg/dL decrease in LDL-C levels.[16,17] It is observed that regular physical activity alone has less effect on the reduction of LDL-C levels compared to weight loss.[18,19] A daily intake of 3-10 g of viscous fiber can lead to a 3-5% reduction in LDL-C levels.[20] In addition, the inclusion of stanol esters in the diet may result in a 12-20% reduction in LDL-C levels. It is important to note that these findings are objective and supported by research.[21,22] The study found that weight loss of at least 10% was effective in significantly reducing total cholesterol and LDL-C. When patients who lost more than 10% weight were considered to have effectively applied the LC, an average decrease of 18.48% in LDL was observed during follow-up.

A study was conducted on the effects of a Mediterranean diet, which primarily consists of plant-based foods, fish, and olive oil. The study found that as the Mediterranean diet score increased, the total cholesterol and HDL ratio decreased while HDL cholesterol values increased.[23] In another study in which 50 individuals with high cardiovascular disease risk were followed up for 3 months, it was reported that triglyceride and VLDL values decreased with the Mediterranean diet.[24]

In our study, the LDL-C reduction rates of those who lost 10% or more weight (Group 1= 18.48%) were statistically significantly higher than those who lost less than 10% weight (Group 2= 13.04%) (p=0.011). Total cholesterol reduction rates were significantly higher in Group 1 than in Group 2 (p=0.015).

Similarly, in a study in the literature in which 41 patients diagnosed with obesity were included and intensive lifestyle modification was applied for 8 weeks, a decrease in LDL-C values and an increase in HDL-C values were found. However, the correlation between the rate of weight reduction and LDL-C level was not examined in this study.[25]

In our study, we think that we will contribute to the management of dyslipidemia and patient compliance with treatment by investigating the questions of at least how much weight loss can be appropriate for individuals to achieve effective lipid reduction and what percentage reduction in lipid levels can be achieved in obese patients with an effective LC.

One limitation of our study is that we were only able to include a limited number of patients due to our exclusion criteria and 6-month process management. Therefore, future studies should aim to include a larger number of patients and longer follow-up intervals to further contribute to the research.

In our study, most of the participants (n=63) applied to our obesity outpatient clinic motivated to reach their ideal weight. In future studies, motivation to reduce body weight can be determined with the help of a scale. Another limitation is that we did not analyze lipoprotein subfractions.

This study was presented as an abstract at the 15th Fall Family Medicine School Congress on 20-23 October 2021.

## Conclusion

Our research has shown that when LC are implemented correctly and systematically, they can lead to better lipid reduction than initially predicted. The key difference between target-specific LC and diet is that the former aims to achieve a minimum of 10% weight loss. Regular follow-up is necessary to ensure that the recommended LC is properly adapted and implemented. This can be achieved through weight monitoring and, if possible, fat measurements in primary care medicine. Therefore, primary care plays a crucial role in this process. In both primary and secondary prevention, close monitoring and follow-up of patients is essential. Our study has

found a correlation between the proper implementation of LC and the amount of weight loss achieved by patients. In the treatment of hyperlipidemia, weight loss through proper nutrition and regular physical activity, prioritizing drug-free treatments, can significantly reduce healthcare costs. Our study also reveals the optimal rate of weight loss for effective LDL-C reduction. To reach the targeted LDL-C values, it is important to closely monitor the weight of patients and emphasize the importance of achieving at least a 10% weight loss. Therefore, primary care medicine plays a crucial role in this process. In both primary and secondary prevention, it is essential to closely monitor and follow the progress of patients.

**Conflicts of Interest**

The authors have stated that they do not have any competing interests.

**References**


1. TÜİK, Cause of death statistics, 2020 Issue: 37243, February 23, 2023. Available from: https://data.tuik.gov.tr/Bulten/Index?p=Olum-ve-Olum-Nedeni-Istatistikleri-2020-37243 Date of Access: 31.12.2023
2. TEMD, Dyslipidemia diagnosis and treatment guide, 2021. Turkish Endocrinology and Metabolism Association, Calculation of total cardiovascular risk, p: 25-31. Available from: https://file.temd.org.tr/Uploads/publications/guides/documents/20211026164301-2021tbl_kilavuzb66456ad2f.pdf Date of Access: 31.12.2023
3. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, et al. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J. 2021;42(34):3227-337. doi: 10.1093/eurheartj/ehab484
4. SCORE2-OP working group and ESC Cardiovascular risk collaboration. SCORE2-OP risk prediction algorithms: estimating incident cardiovascular event risk in older persons in four geographical risk regions. Eur Heart J. 2021 Jul 1;42(25):2455-2467. doi:10.1093/eurheartj/ehab312.
5. Mach F, Baigent C, Catapano AL, et al. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. Eur Heart J. 2020;41(1):111-188. doi: 10.1093/eurheartj/ehz455
6. Arnett DK, Blumenthal RS, Albert MA, et al. ACC /AHA Guideline on the primary prevention of cardiovascular disease. circulation. 2019 Sep 10;140(11):e596-e646. doi: 10.1161/CIR.0000000000000678
7. Athyros, VG., Katsiki, N., Doumas, M., Karagiannis, A., & Mikhailidis, DP. Effect of tobacco smoking and smoking cessation on plasma lipoproteins and associated major cardiovascular risk factors: a narrative review. Curr Med Res Opin 2013, 29(10), 1263-1274. doi:10.1185/03007995.2013.827566
8. Brien, SE., Ronskley, PE., Turner, B. J., Mukamal, K. J. & Ghali, WA. Effect of alcohol consumption on biological markers associated with risk of coronary heart disease: systematic review and meta-analysis of interventional studies. BMJ 342, d636 (2011). doi: https://doi.org/10.1136/bmj.d636
9. Low AK, Bauldin MJ, Sumrall CD, Loustalot FV, Land KK. A Clinician's approach to medical management of obesity. Am J Med Sci 2006;331:175-182. doi: 10.1097/00000441-200604000-00003
10. Mente A, de Koning L, Shannon HS, Anand SS. A Systematic Review of the Evidence Supporting a Causal Link Between Dietary Factors and Coronary Heart Disease. Arch Stajyer Med. 2009;169:659–69. doi.org/10.1001/archinternmed.2009.38.
11. Capra ME, Pederiva C, Viggiano C, Fabrizi E, Banderali G, Biasucci G. Nutritional Treatment in a Cohort of Pediatric Patients with Familial Hypercholesterolaemia: Effect on Lipid Profile. Nutrients 2022;14(14):2817. doi.org/10.3390/nu14142817
12. Zhang R, Dong SY, Wang F, Ma C, Zhao XL, Zeng Q, Fei A. Associations between Body Composition Indices and Metabolic Disorders in Chinese Adults: A Cross-Sectional Observational Study. Chin Med J (Engl). 2018 Feb 20;131(4):379-388. doi: 10.4103/0366-6999.225059
13. Kaçar Mutlutürk Ü, Çiçek B, Bayram F, Doğruel F. Effect of Low Fat and Low Cholesterol Diet Intervention on LDL Subgroups in Dyslipidemic Patients: Epidemiological Observational Study. Turk J Diab Obes. August 2023;7(2):145-151. doi:10.25048/tudod.1182426
14. Keskin A, Aci R. Investıgatıon of Lipid Profile, Malondialdehyde, Sodium, Potassium, Chloride Levels in Rats with Weight Loss. Turk J Diab Obes. April 2022;6(1):10-15. doi:10.25048/tudod.935233
15. König D, Hörmann J, Predel HG, Berg A. A 12-Month Lifestyle Intervention Program Improves Body Composition and Reduces the Prevalence of Prediabetes in Obese Patients. Obes Facts. 2018;11(5):393-399. doi: 10.1159/000492604
16. Nordmann AJ, Nordmann A, Briel M, et al. Effects of low carbohydrate vs low-fat diets on weight loss and cardiovascular risk factors: a meta-analysis of randomized controlled trials. Arch Intern Med. 2006;166(3):285-93. doi: 10.1001/archinte.166.3.285

17. Dattilo AM, Kris-Etherton PM. Effects of weight reduction on blood lipids and lipoproteins: a meta-analysis. Am J Clin Nutr. 1992; 56(2):320-8. doi: 10.1093/ajcn/56.2.320
18. Shaw K, Gennat H, O'Rourke P, et al. Exercise for overweight or obesity. Cochrane Database Syst Rev. 2006;4:CD003817. doi: 10.1002/14651858.CD003817.pub3
19. Huffman KM, Hawk VH, Henes ST, et al. Exercise effects on lipids in persons with varying dietary patterns does diet matter if they exercise? Responses in studies of a targeted risk reduction intervention through defined exercise I. Am Heart J. 2012 Jul;164(1):117-24. doi: 10.1016/j.ahj.2012.04.014
20. Pirro M, Vetrani C, Bianchi C, et al. Joint position statement on "nutraceuticals for the treatment of hypercholesterolemia" of the Italian Society of Diabetology (SID) and of the Italian Society for the Study of Arteriosclerosis (SISA). Nutr Metab Cardiovasc Dis. 2017;27(1):2-17. doi: 10.1016/j.numecd.2016.11.122
21. Miettinen TA, Gylling H. Regulation of cholesterol metabolism by dietary plant sterols. Curr Opin Lipidol. 1999;10(1):9-14. doi: 10.1097/00041433-199902000-00003
22. Musa-Veloso K, Poon TH, Elliot JA, et al. A comparison of the LDL-cholesterol lowering efficacy of plant stanols and plant sterols over a continuous dose range: results of a meta-analysis of randomized, placebo-controlled trials. Prostaglandins Leukot Essent Fatty Acids. 2011;85(1):9-28. doi: 10.1016/j.plefa.2011.02.001
23. Carter SJ, Roberts MB, Salter J, Eaton CB. Relationship between Mediterranean Diet Score and atherothrombotic risk: Findings from the Third National Health and Nutrition Examination Survey (NHANES III), 1988– 1994. Atherosclerosis 2010;210:630-636. doi: 10.1016/j.atherosclerosis.2009.12.035
24. Perona JS, Covas MI, Fitó M, Cabello-Moruno R, Aros F, Corella D, et al. Reduction in systemic and VLDL triacylglycerol concentration after a 3-month Mediterranean-style diet in high-cardiovascular-risk subjects. J Nutr Biochem 2010;21:892-898. doi:10.1016/j.jnutbio.2009.07.005
25. Bajer B, Rádiková Ž, Havranová A, et al. Effect of 8-week intensive lifestyle intervention on LDL and HDL subfractions. Obes Res Clin Pract. 2019;13(6):586-593. doi:10.1016/j.orcp.2019.10.010