Response of Lipid Profile to Aerobic Exercises and Natural Extract in Women with Metabolic Syndrome

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Abstract

Background and Purpose: Aerobic training and Natural Extract (green tea) for women with metabolic syndrome improves the level of lipid profile, exercise capacity, prevent cardiovascular complication and decrease morbidity. The effects of three months aerobic exercise training and natural extract on lipid profile in women with metabolic syndrome were compared in this study.

Patients and Methodology: Sixty women complained of metabolic syndrome patients as a result of some metabolic and cardiovascular disease with age of 40-50 years were included in the present study. Their Body Mass Index (BMI) was ranged from 30 to 39.9kg/m^2). They were randomly divided into three equal groups. Group (A) who participated in a program of aerobic exercise in the form of walking on treadmill (4 times per a week) for 30min and drank 5 cups of the water extract of the dried green tea leaves daily, Group (B) who participated in the same program of aerobic exercise only as Group (A), and Group (C) who drank the same green tea extract in the same manner as Group (A) but without application of any aerobic exercise at all. The study was conducted from May 2015 till August 2015, at PT Departement of El-Monira Hospital.

Biochemical changes in lipid profile (TC, LDL, and HDL) were measured at the beginning of the study and after twelve weeks, for all groups.

Results: Revealed a significant decrease in the total blood cholesterol and LDL-C. The best percentage of improvement in the LDL-C, TC and HDL-C were found for Group (A) followed by Group (C) then Group (B).

Conclusion: It was concluded that aerobic exercise when combined with the green tea extract can produce a high significant improvement for women with metabolic syndrome rather than when any of both applied separately.

Key Words: Aerobic exercise and natural extract – Lipid profile – Metabolic syndrome.

Introduction

THE metabolic syndrome refers to a constellation of clinical factors associated with an increased risk of diabetes and coronary artery disease; these factors include abdominal obesity, hypertension, dyslipidemia, impaired glucose metabolism, prothrombotic state and proinflammatory state. Also called the dysmetabolic syndrome, syndrome X or insulin resistance syndrome, this condition entered the scientific field about 15 years ago as investigators sought to understand the link between insulin resistance and other metabolic factors in the development of coronary artery disease. Consistent, comprehensive results accumulated since then have confirmed that this syndrome leads to heart disease [1].

Metabolic syndrome has been shown to increase the risk of diabetes and cardiovascular disease assuming that cardiovascular risk is amplified more than is expected from the effect of single risk factors [2].

The association between high serum cholesterol level and the incidence and severity of coronary heart disease is so pronounced in epidemiological studies that the National American Heart, Lung and Blood institute recognizes this association as causal. Recent overviews have indicated that a 1% reduction in persons total serum cholesterol level yields a 2 to 3% reduction in the risk of coronary heart disease, experts are certain that aerobic exercise have a positive effect on cholesterol levels. Aerobic exercise for more than 12 minutes, which requires the body to increase its oxygen intake and raises its heart rate, has been shown to have the greatest benefit. Studies have shown that 30 minutes/day
of aerobic exercise whether low or high impact raises HDL levels and lowers LDL levels [3].

Low Density Lipoprotein (LDL) is the primary transport carrier of cholesterol in circulation. About 50-60% of cholesterol is delivered to the cells by LDL. Evidence suggests that LDL may directly contribute to the cellular alterations of the inner walls of arteries which may ultimately lead to the development of atherosclerotic plaque. Thus, LDL is proposed to be more highly associated with Coronary Heart Disease (CHD) than total cholesterol. On the other hand, High Density Lipoprotein (HDL) has an inverse relationship with coronary heart disease, offering a protecting mechanism against the development of CHD. It is considered to be the most powerful lipid parameter for predicting CHD in people of all ages. The primary function of HDL is to transport cholesterol from the tissues and blood to the liver for excretion from the body or resynthesised into bile acids. HDL also prevents the uptake of LDL-C at receptor sites in the body and participates in the metabolism of other lipoproteins [4].

Inflammatory activation with increased serum cytokine levels has been described by several authors as an important factor in the progression of the syndrome of Chronic Heart Failure (CHF). IL-6 is a "myokine," a cytokine produced from muscle, and is elevated in response to muscle contraction. It is significantly elevated with exercise, and precedes the appearance of other cytokines in the circulation. During exercise, it is thought to act in a hormone-like manner to mobilize extracellular substrates and/or augment substrate delivery [5].

There is a positive correlation between serum cholesterol levels and death from cardiovascular disease, especially coronary artery disease. The reduction of plasma lipid levels is one of the main goals of prevention. Researches have shown that green tea has beneficial effects on health due to polyphenolic substances (catechin) that it contains. Studies have shown that prolonged consumption of polyphenols has a positive effect on factors related to cardiovascular risk such as obesity, dyslipidemia and various indicators of oxidative stress [6].

Green tea treatment also reduced adipose tissue mass (21% decrease) and hepatic lipids (13% decrease) compared to control group, immunological analysis showed that 1% green tea extract treatment decreased hepatic expression of the inflammatory marker, Tumor Necrosis Factor (TNF)-α, in the liver and adipose tissue [7].

Purpose of the study:
To determine the response of lipid profile to aerobic training combined with natural extract on women with metabolic syndrome.

Patients and Methodology
Sixty metabolic syndrome untrained obese women, who were encouraged to follow their habitual life style throughout the study period, they were selected randomly and referred by the physician from the clinic of Internal Medicine in El-Monira Hospital and they were operated in the Department of Physical Therapy at El-Monira Hospital, one of the Egyptian Health Ministry Hospitals in Cairo, were participated in the study. Their weight and height allowed them to be considered obese according to Body Mass Index (BMI) equation, between (30-39.9 kg/m²), the study was performed from May 2015 till August 2015. The sixty women were randomly divided into three equal groups; each group consisted of twenty patients. The first group received a program of aerobic exercise and drank green tea in specific manner (Group A) and the second group (Group B) that performed the same program only as (Group A), while the third group drank only green tea without participation in any exercise at all (Group C). All groups were under their medical treatment prescribed by the physician. All women were previously diagnosed as having metabolic syndrome and the same inclusion criteria as follow: Age from 40-50 years, body mass index from (30 to 39.9 kg/m²), the onset of the disease was more than 5 years, and received the same necessary required drugs.

Any patient had hepatic disease; severe life limiting illness (cancer, renal failure), other endocrinal disorders, orthopedic limitation, severe hyper tension, chronic pulmonary disease was excluded from the study.

Instrumentation:
A treadmill was used for warming up exercise (Tunturi original treadmill W 1 electronics), Sphygmomanometer and stethoscope for measuring blood pressure before, during and after training sessions. Weight & height scale: (Healthy scale 160kg) to evaluate the height, weight & calculate BMI.

\[
\text{BMI} = \frac{\text{Weight (Kg)}}{\text{Height (m²)}} \quad [8]
\]

Kits and tubes of blood sample and measurement of lipid profile was done.
A- Evaluation session:

After selection of the patients an informed consent was taken from all patients who accepted to participate in the study. Before starting the study all patients were informed about the nature, benefits and procedure of the study, the sample was randomly divided into three groups equal in number, 20 for each group; Group (A) received a program of aerobic exercise training and drank 5 cups of green tea per day, Group (B) performed a program of aerobic exercise only as Group (A), and Group (C) in which women drank green tea only in the same manner as the Group (A).

Plasma or serum samples were obtained by venipuncture (arterial cannula used in Larsen’s study) and stored on ice. Samples of a lipid profile of the total blood cholesterol, LDL and HDL levels, it were measured by commercially available Enzyme-Linked Immunosorbent Assays (ELISAs) [9].

B- Aerobic training (program for Group A & B):

All patients in the (Group A), and Group (B) attended the program of aerobic exercises for 12 weeks according to the following parameters:
- Mode of exercise was regular aerobic exercise for large group of muscles (legs and arms) in form of walking used treadmill.
- Intensity of exercise equal to 60 to 70% of Target Heart Rate (THR) and the THR=60 to 75% Maximum Heart Rate (MHR=220-age) [10].
- Duration: The first five to ten minutes of each session was dedicated to warming up exercise on a treadmill and the same for the cooling down phase. There was a thirty minute of aerobic exercise.
- Frequency: Four times per week for three months.
- Treadmill training recommendations for patients with metabolic syndrome were described by Warm up and cool down duration from 5-10 minutes, active phase 30 minutes, the duration of session was 40-50min., the mode was aerobic exercises training in form of walking.
- Blood pressure was measured before, during and after session.

C- Regimen of natural extract drink for Group (A) & (C):

Each women of the Group (A) and those of the Group (C) drank 5 cups of green tea every day for 3 months in specific manner as they drank without sugar and with the following procedure taking in consideration that extraction of the dried leaves with water through heating with a temperature exceeding 45°C may result in hydrolysis of the bioactive constituents included in the water extract as follow:
- Use 2 grams (one tea spoon) of tea/cup (each cup bears about 150ml of water).
- Fill a kettle with cold water and bring to a boil.
- After unplugging the kettle allow it to stand for up to fifteen minutes.
- Pour the heated water over the tea and allow it to steep for up to 10 minutes.

After 12 weeks program, another blood sample was taken and lipid profile of the total blood cholesterol, LDL and HDL levels was measured and then the pre and post samples for the three groups were compared.

Statistical analysis:

Descriptive statistics and MANOVA-test were conducted for comparison of subject characteristics between groups. MANOVA-test was conducted for comparison of pre and post treatment mean values of lipid profile between the three groups. Paired t-test was conducted for comparison between pre and post treatment mean values of lipid profile in each group. The level of significance for all statistical tests was set at \( p<0.05 \). All statistical measures were performed through the Statistical Package for Social Studies (SPSS) version 19 for windows.

Results

Table (1), showed the mean ± SD and BMI of Group A, B, and C. There was no significant difference between the three groups in the mean age and BMI (\( p>0.05 \)), at the beginning of the study.

Between group comparison:

There was no significant difference in TC, LDL, and HDL between groups pre-treatment (\( p>0.05 \)). (Table 2).

Post treatment, there was a significant decrease in TC of Group A compared with Group B (\( p=0.01 \)), no significant difference in TC between Group A and Group C (\( p=0.91 \)), and a significant decrease in TC of Group B compared with Group C (\( p=0.04 \)). Regarding LDL, there was a significant decrease in LDL of Group A compared with Group B (\( p=0.003 \)), a significant decrease in LDL of Group A compared with Group C (\( p=0.04 \)), and no significant difference in LDL between Group B and Group C (\( p=0.05 \)). Regarding HDL, there was a significant decrease in HDL of Group A compared with Group B (\( p=0.003 \)), a significant
decrease in LDL of Group A compared with Group C ($p=0.01$), and no significant difference in LDL between Group B and Group C ($p=0.88$) [(Table 3) & Fig. (1)].

Within group comparison:
There was a significant decrease in TC and LDL, and a significant increase in HDL post-treatment compared with pre-treatment in the three groups ($p=0.0001$). Group A showed highest percent of decrease in TC and LDL of 10.43 and 19.59% respectively followed by Group C with percent of decrease of 6.43 and 7.95%. Group B showed the lowest percent of decrease in TC and LDL of 4.1 and 6.98% respectively. Also, Group A showed highest percent of increase in HDL of 29.01% followed by Group C with percent of increase of 18.51%. Group B showed the lowest percent of increase in HDL of 17.48% [(Table 2) & Fig. (1)].

Fig. (1): Pre and post treatment mean values of TC, LDL, and HDL of Group A, B, and C.

<table>
<thead>
<tr>
<th>Group</th>
<th>TC (mg/dl)</th>
<th>LDL (mg/dl)</th>
<th>HDL (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>240.7±15.5</td>
<td>159±18.33</td>
<td>43.8±2.54</td>
</tr>
<tr>
<td>B</td>
<td>261.8±28.32</td>
<td>179.85±18.89</td>
<td>38.3±5.84</td>
</tr>
<tr>
<td>C</td>
<td>243.65±25.32</td>
<td>173.6±19.44</td>
<td>39.05±5.95</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>TC (mg/dl)</th>
<th>LDL (mg/dl)</th>
<th>HDL (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X±SD</td>
<td>X±SD</td>
<td>X±SD</td>
</tr>
<tr>
<td>B</td>
<td>X±SD</td>
<td>X±SD</td>
<td>X±SD</td>
</tr>
<tr>
<td>C</td>
<td>X±SD</td>
<td>X±SD</td>
<td>X±SD</td>
</tr>
</tbody>
</table>

X : Mean. SD : Standard Deviation. $p$-value : Level of significance. Non-significant.

In the present study, it was found that there was a significant decrease in the total blood cholesterol, LDL and a significant increase in the HDL levels in response to the designed aerobic exercise program with green tea (Group A) with percentages of improvement of 10.43%, 19.95%, and 29.01% respectively and in Group (B) was 4.1%, 6.98%, 17.48% respectively, and in Group (C) was 6.43%, 7.95%, 18.51% respectively. So the effect was highly significant in the Group A followed by Group C, then Group (B) we can said that aerobic exercise when combined with drinking green tea had a highly significant effect on lipid profile than when any of each was used separately.

This comes in support with Paul et al., [11], who performed a meta-analysis of 52 exercise training trials of >12 weeks' duration including 4700 subjects their results demonstrated an average increase in HDL-C levels of 4.6% and reductions in triglyceride and LDL-C concentrations of 3.7% and 5.0%, respectively, the largest and most carefully controlled exercise trial the health risk factors exercise training and genetics (HERITAGE) study, included 675 normolipidemic subjects who participated in 5 months of aerobic exercise training. HDL-C increased 1.1mg/dL (3%) among the 299 men studied, whereas triglycerides and LDL-C decreased 5.9 and 0.9mg/dL or 2.7% and 0.8%, respectively. HDL-C among the 376 women increased 1.4mg/dL (3%), and triglycerides and LDL-C decreased 0.6 and 4.4mg/dL or 0.6% and 4%, respectively, evidence was found that aerobic exercise training programs on treadmill can lower lipid profile values in patients with metabolic syndrome compared to healthy matched controls.

This also comes in support with Huttunen et al., [12], who performed a controlled trial about the effects of mild-to-moderate physical aerobic activity on serum lipoproteins. After two baseline examinations 100 asymptomatic middle-aged men were randomly assigned to exercise and control groups. The exercise group participated in a 4-month exercise program that consisted of 3-4 weekly sessions. The control group was advised to maintain their previous exercise habits. At the end of the study it was found that serum triglycerides decreased from 1.54±0.10 to 1.27±0.08mmol/l (p less than 0.001) and High-Density Lipoprotein

Discussion

The purpose of the present study was designed to determine the response of lipid profile to aerobic training and natural extract on women with metabolic syndrome. Sixty metabolic syndrome untrained obese women who were encouraged to follow their habitual life style throughout the study period, they were selected randomly and referred by the physician from the clinic of internal medicine and they were operated in the Department of Physical Therapy at El-Monira Hospital one of the Egyptian Health Ministry Hospitals in Cairo.

The sixty women with metabolic syndrome were randomly divided into three equal groups; each group consisted of twenty patients. The first received a program of aerobic exercise and drank green tea in specific manner (Group A) and the second group (Group B) that performed the same program as (Group A), the third group drank only green tea without participation in any exercise at all. A lipid profile for the total cholesterol, LDL-c and HDL-c was performed before and after 12 weeks from the beginning of the study for each patient in the three groups.

In the present study it was found that there was a significant decrease in the total blood cholesterol, LDL and a significant increase in the HDL levels in response to the designed aerobic exercise program with green tea (Group A) with percentages of improvement of 10.43%, 19.95%, and 29.01% respectively and in Group (B) was 4.1%, 6.98%, 17.48% respectively, and in Group (C) was 6.43%, 7.95%, 18.51% respectively. So the effect was highly significant in the Group A followed by Group C, then Group (B) we can said that aerobic exercise when combined with drinking green tea had a highly significant effect on lipid profile than when any of each was used separately.

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Table (4): Comparison of blood lipids between pre and post treatment in each group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre X ± SD</th>
<th>Post X ± SD</th>
<th>MD ± SD</th>
<th>% of change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>TC (mg/dl)</td>
<td>268.75±17.85</td>
<td>240.7±15.5</td>
<td>28.05</td>
<td>10.43</td>
</tr>
<tr>
<td></td>
<td>LDL (mg/dl)</td>
<td>197.75±23.84</td>
<td>159±18.33</td>
<td>38.75</td>
<td>19.59</td>
</tr>
<tr>
<td></td>
<td>HDL (mg/dl)</td>
<td>33.95±3.76</td>
<td>43.8±2.54</td>
<td>–9.85</td>
<td>29.01</td>
</tr>
<tr>
<td>Group B</td>
<td>TC (mg/dl)</td>
<td>273±27.35</td>
<td>261.8±28.32</td>
<td>13.12</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>LDL (mg/dl)</td>
<td>193.35±20.43</td>
<td>179.85±18.8</td>
<td>13.5</td>
<td>6.98</td>
</tr>
<tr>
<td></td>
<td>HDL (mg/dl)</td>
<td>32.6±5.86</td>
<td>38.3±5.84</td>
<td>–5.7</td>
<td>17.48</td>
</tr>
<tr>
<td>Group C</td>
<td>TC (mg/dl)</td>
<td>260.4±24.17</td>
<td>243.65±25.32</td>
<td>16.75</td>
<td>6.43</td>
</tr>
<tr>
<td></td>
<td>LDL (mg/dl)</td>
<td>188.6±19.13</td>
<td>173.6±19.44</td>
<td>15</td>
<td>7.95</td>
</tr>
<tr>
<td></td>
<td>HDL (mg/dl)</td>
<td>32.95±6.69</td>
<td>39.05±5.95</td>
<td>–6.1</td>
<td>18.51</td>
</tr>
</tbody>
</table>

X : Mean. MD : Mean difference. p-value : Level of significance. * : Non-significant. **: Significance.
(HDL) cholesterol increased from 1.27 ±0.04 to 1.41±0.04mmol/l (p less than 0.01) in the exercise group during the trial. No change was seen in the control group. The level of Low-Density Lipoprotein (LDL) cholesterol decreased in both groups during the trial. The alterations in serum triglycerides and HDL cholesterol in the exercise group were not dependent on weight reduction. Evidence was found that mild-to-moderate physical aerobic activity can lower serum lipoproteins in patients with metabolic syndrome compared to healthy matched controls.

Another study was performed by Miller et al., [13] conducted a trial to determine the effect of regular aerobic exercise on the ambulatory blood pressure, serum lipids, weight and fitness. 44 hypertensive overweight adults on a single blood pressure medication were randomly assigned to exercise and control groups. Subjects in the study group were participated in a supervised moderate intensity exercise program 3 times per week. At the end of intervention the study group experienced statistically significant improvements were observed for all lipids and lipoproteins. Reductions of approximately 2%, 3%, and 5%, respectively, were observed for TC, LDL-C, and TG, whereas an increase of 3% was observed for HDL-C this was due to the effect of aerobic training on the serum levels of lipo proteins.

Nearly the same results were obtained by Lmai & Nakachi [18], who performed a cross sectional study using 1371 Japanese men aged over 40 years and have been surveyed on their living habits including daily consumption of green tea. The obtained results showed that an increased consumption of green tea was associated with decreased serum concentrations of total cholesterol (p<0.001) and triglyceride (p=0.02) and an increased proportion of high density lipoprotein cholesterol together with a decreased proportion of low and very low density lipoprotein cholesterol (p=0.02), which resulted in a decreased atherogenic index (p=0.02). Moreover, increased consumption of green tea, especially more than 10 cups a day, was related to decreased concentrations of hepatic makers in serum: Aspartate aminotransferase (p=0.06), alanine transferase (p=0.07), and ferritin (p=0.02). Aerobic exercise prescribed for these patients to improve overall fitness and quality of life. Evidence was found that chronic aerobic exercise training programs can lower systemic inflammation in patients with chronic metabolic syndrome compared to healthy controls.

Stensvold et al., [16], studied the relation of green tea consumption to cholesterol, systolic blood pressure, and mortality from coronary heart disease and all causes. 9,856 men and 10,233 women without history of cardiovascular disease or diabetes were studied and provided these results: Mean serum cholesterol decreased with increasing tea consumption, the linear trend coefficient corresponded to a difference of 0.24mmol/liter (9.3 mg/dl) in men and 0.15mmol/liter (5.8mg/dl) in women between drinkers of less than one cup and those of five or more cups/day, when other risk factors were taken into account. Systolic blood pressure was inversely related to tea consumption with a difference between the same two tea groups of 2.1mmHg in men and 3.5mmHg in women. Altogether 396 men and 237 women died from all causes, and of these 141 and 18, respectively, died from coronary heart disease during the 12-year follow-up period. The mortality rate was higher (not statistically significant) among persons drinking no tea or less than one cup compared with persons drinking one or more cups/day. For men, the relative risk (one or more versus less than one cup) for coronary death from Cox regression was 0.64 (95% CI: 0.38, 1.07).

Unno T. et al., [17], studied the effect of green tea catechins consumption on the expected rise in blood fats. The volunteers each consumed 3 different doses of green tea catechines, one dose at a time: 10mg (control dose), 224mg (moderate dose) and 674mg (large dose). Each time they took the catechines they also ate a piece of bread with butter. Then their blood fats were measured 1, 2, 3, 4 and 6 hours later to see if the green tea catechines inhibited the expected rise in blood fats. When the volunteers consumed the moderate dose of green tea catechines along with their bread and butter, their blood fats measured 15.1% lower than was expected. When they took the large dose, their blood fats measured 28.7% lower than expected.
This trial demonstrated that tea catechins attenuated the postprandial increase in plasma triacylglycerol levels following a fat load.

Conclusion:
The results of this study support the good effect of aerobic exercise and green tea water extract on the blood cholesterol level. Both aerobic exercise and green tea when combined showed a significant decrease in the total blood cholesterol, LDL (bad cholesterol) and a significant increase in the HDL (good cholesterol). This combination between aerobic exercise and green tea can greatly lower the risk for coronary heart disease.

References
الملخص العربي

هدف البحث هو: هو تقييم إستجابية كوليسترول الدم للتمارين الهوائية مع أحد المشتقات الطبيعية لدى السيدات المصابات بمتلازمة الايض.

أجريت الدراسة على ستون مريضة من مستشفى двухي الفرد بالقاهرة حيث تراوح عمرهم ما بين أربعين وخمسون عاماً. اللاتي لياتين من متلازمة الايض، وقد وجدت هذه الدراسة على مدار اثنين عشر أسبوع لقياس نسبة دهون الدم في تسع مجموعات من ثلاث مجموعات كل مجموعات تكوين من عشر مريضة. المجموعة الأولى التي تلقت برنامج التمارينات الهوائية (0-40 دقيقة) وتناول كميات معينة من المستخلص المائي للشاي الأخضر، بينما المجموعة الثانية (ب) تلقت نفس البرنامج الذي أدنه المجموعة (أ) من التمارين الهوائية فقط. كما قامت المجموعة الثالثة (ج) فقط بتناول نفس جرعة الشاي الأخضر التي تناولت المجموعة (أ) بدون أي تمارين على الإطلاق. وقد استمر البرنامج لمدة أثني عشر أسبوعاً (بما في ذلك، لجسة من التمارين الهوائية أسبوعياً، خمس أكواب من الشاي الأخضر يومياً) وقد تم قياس نسبة كوليسترول الدم الكلي، الدهن عالية الكثافة والدهون منخفضة الكثافة قبل وبعد البرنامج العلاجي لكل سيده داخل الثلاث مجموعات.

النتائج: أظهرت نتائج هذه الدراسة وجود نقص في درجات احصائية في كل من كوليسترول الدم الكلي والدهون منخفضة الكثافة وزيادة ذات درجة احصائية في مستوى الدهن عالية الكثافة في كل من الثلاث مجموعات، ولكن بنسبة أكبر بكثير في المجموعة (أ) من المجموعة (ب) والمجموعة (ج). ويمكن استنتاج أن القيام بالتمارين الهوائية عندما يكون مصحوباً بشرب كميات من المستخلص المائي للشاي الأخضر يكون له تأثيراً إيجابياً على معدلات كوليسترول الدم.