Effects of Physical Activity and Garlic in lipids profile and Preventing the Risk of Coronary Heart Disease

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ABSTRACT

In this study, plasma total cholesterol (T.C), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and triglycerides (TGs) were investigated in a sample of cardiovascular disease free people, in order to find out the effects of each of physical activity and garlic and the inheritance of these factors, on the incidence of ischemic heart disease. This work was carried out for a total of (818) subjects of whom 504 were following aerobic exercise and 314 was given and investigated for garlic. Enzymatic colorimetric methods were used in all parameters studied. In both sexes, regular physical activity improved plasma lipid profile (T.C, LDL-C and TGs). The above three parameters were reducing proportionally depending deeply upon frequency intensive time (FIT) scoring of physical activity, considerable decreasing showed only with the people who followed a regular aerobic exercise, whereas plasma HDL-C levels followed a positive correlation with (FIT) physical activity scoring, and showed significant increasing only for those who followed an active lifestyle. Also experimental results indicated beneficial effects of commercial garlic, significant rising on HDL-C and considerable reducing on T.C, LDL-C and TGs with high dose. Furthermore in either physical activity or garlic the results did not show any considerable differences between males and females for any of the tested parameters.

Key words: Cholesterol; Physical Activity; Garlic; Cardiovascular disease.

1. INTRODUCTION

Cardiovascular disease (CVD) might classified like cancer and road accidents as a statistical ailment. For any of us, the living of a normal life is accompanied by certain risk, which can rise or fall in direct correlation with a large number of variables. For most populations it is fairly simple to determine what is the relative morbidity or mortality rate of the disease, and it is very useful epidemiological exercise to correlate mortality or morbidity data with other measurable parameters of any population under study. These correlations endowed with the title "risk factors" which can be classified in several ways, but the more useful classifications at least for coherent discussion is dividing the factors into primarily genetic, primarily behavioral and primarily nutritional (John, 1997).

It is well known that high serum total cholesterol (T.C) levels correlate positively with increased risk of coronary heart disease (Stamler, 2000; Zhang, 2003). However, the relations with stroke and stroke subtypes are controversial. Prospective studies of Americans (Jakobsen, 2003), (Yuan, et al. 2002), Europeans (Ahmed, 2011) and Japanese-American men (Proper, 2011) indicate a positive association between serum total cholesterol concentration and risk of ischemic stroke, while study of Japanese showed no association of serum total cholesterol with risk of ischemic or total stroke (Nakayama, 2001). On the other hand, prospective studies of Japanese men and women (Ueshima, 2002), Chinese Cohort (Zhang, 2005), American men (Yuan, et al. 2002), elderly American men and women (Siri-Tarino, 2010), Swedish women (Gatchev, 1998), and Scottish men and women (Hart, 2000), but not all (Suh, 2001) showed that serum total cholesterol levels was inversely associated with risk of intra-parenchymal hemorrhage.

One interesting observation is that the exercise lowers plasma cholesterol in general. Inactivity is one of the four major risk factors for coronary artery disease, equally with smoking, unhealthy cholesterol and high blood pressure. In fact, studies (Fiorentino, et al. 2005) suggesting that people who change their diet in order to control cholesterol levels are successful in lowering their risk for heart disease only when they also follow a regular aerobic exercise program. Study the effect of physical activity on HDL-C and body mass index (BMI) among Saudis men and women, reported significant increase in plasma HDL-C levels and moderate reduction in BMI (Abdul and Syed, 2005). Common genetic variants that are linked with HDL-C levels are modified by physical activity levels, according to the results of a new study (Ahmed, et al. 2011). We hypothesized that both physical exercise and garlic may improve lipid profile and lowering risk of developing coronary heart disease.

2. MATERIALS AND METHODS

This study was conducted at Jeddah region in the Kingdom of Saudi Arabia, between (may2011- dec., 2012), for adults people. The study comprised investigations for total of (818) healthy subjects of whom 504 were following aerobic exercise, 314 were given and investigated for garlic. All investigated people were normal healthy, they were not on any treatment for high cholesterol or other lipids at the time of study. Some of the investigated adults are officers following sedentary lifestyle; some are students, few of them only with free lance. The questionnaire included socio-demographic data in the form of age, gender, lifestyle, smoking and educational level. People were asked about the status of both smoking and exercise. The questionnaire included a comprehensive account of their physical activity profile, based on frequency (F), intensity (I) and...
time (T) duration of exercise. A scoring system of 1-5 depending on level of activity was assigned. If the frequency of exercise was daily or 6-7 times a week, it was given a score of 5, and for one per month the score was one. The scores of 2-4 were for the frequency in between. The intensity of physical activity was judged on the levels of aerobic exercise, "Aerobic activity resulting in heavy breathing and perspiration" was given a score of 5 while light aerobic (for example normal walking) was scored as one. The moderate aerobic depending on intensity were scored from 2-3. The maximum score of 4 for parameter of time (duration of exercise) was earned by the subject who exercised more than 30 minutes every day. Exercise for less than 10 minutes a day was scored as one. The score of 2-3 were for the timings of more than 10 minutes, but less than 30 minutes. Finally, F, I and T scores were multiplied (F × I × T) to achieve FIT value. On the bases of subjects scoring 0, the second group treated with a low dose of garlic was comprised in this study, comprised 311 subjects (153 males and 161 females) who were non-smokers, also they were following sedentary lifestyle and they were under commercial garlic treatment (including in the diet) for eight weeks. Cholesterol and triglycerides were standardized using a calibrator for automated systems (c.f.a.s). For (HDL-C) c.f.a.s. lipids is used. For plasma cholesterol (total) and triglycerides, two levels of controls often assayed at least once a day. Preinum U as low control, and Preciphath U as high control. Preinum L and Preciphath L were used as low and high levels for HDL-C respectively.

2.1. Collection of blood samples

Venous blood samples were taken with the subject in a sitting position using venoject vacuum containers, between 8.00 and 9.00 after a 12-14 hours overnight fasting period and collected in tubes containing heparin (final concentration up to 75 U/ml). The blood immediately centrifuged at 4000 rpm for 10-15 minutes by labofuge centrifuge, (model 405, Germany). The resulting plasma was analysed freshly (without being frozen) for lipoproteins, however cholesterol and triglycerides were performed in plasma which had been frozen at -20°C within a period not exceeding two hours.

2.2. Methods

For all tests required (total Cholesterol, HDL-C, LDL-C and triglycerides) enzymatic methods, and a (autoanalyser 900 s plus) autoanalyser (Tokyo, Japan) instrument with ready to use Boehringer Mannheim kits were used. The instrument is calibrated and controlled pre-running the samples. LDL-C was calculated according to the Friedewald formula (LDL-C = total cholesterol – HDL-C – Triglycerides / 5).

2.3. Statistical analysis

Statistical analysis was performed using Statistical Package for Social Science (SPSS). The data for numerical values were expressed in mean ± standard deviation (SD). Differences between each investigated groups whenever in exercise or garlic were obtained, the results were consider statistically significant when the differences show equal or more than (SD).

3. RESULTS

A total of 818 healthy normal adults people were included in this study, comprised 504 subjects were investigated for aerobic exercise. They were classified into four groups according to (F=I=T), sedentary, light, moderate and heavy and a scoring system of 1-5 was assigned depending on the level of activity, and each of these four groups classified into two subgroups according to sex. 314 normal subjects (sedentary and non-smokers) were classified into three groups based on a dose of garlic including in the diet, the first group free garlic diet (as a control), the second group treated with a low dose of commercial garlic (75mg/Kg daily) for eight weeks, whereas the third group of subjects were treated with high dose (150mg/Kg daily). Total cholesterol, triglycerides, HDL-C and LDL-C were measured for all studied groups pre and post treatment. Results were presented and means for total cholesterol, HDL-C, LDL-C and triglycerides are given for both males and females in each subgroups for the two factors.

Table 1 Plasma lipids and lipoproteins in different levels of physical activity groups

<table>
<thead>
<tr>
<th>Physical activity group</th>
<th>N</th>
<th>Mean (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HDL-C</td>
</tr>
<tr>
<td>Sedentary</td>
<td>Man</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>Woman</td>
<td>91</td>
</tr>
<tr>
<td>Light</td>
<td>Man</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Woman</td>
<td>121</td>
</tr>
<tr>
<td>Moderate</td>
<td>Man</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Woman</td>
<td>33</td>
</tr>
<tr>
<td>Heavy</td>
<td>Man</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Woman</td>
<td>29</td>
</tr>
</tbody>
</table>

Footnotes: N; Number of subjects, T.C; Total cholesterol, HDL-C; High density lipoprotein cholesterol, LDL-C; Low density lipoprotein cholesterol, TGs; Triglycerides.

Correlation coefficient between FIT and each of the four parameters

<table>
<thead>
<tr>
<th>HDL-C</th>
<th>LDL-C</th>
<th>T.C</th>
<th>TGs</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>0.995</td>
<td>-0.998</td>
<td>-0.996</td>
</tr>
<tr>
<td>P</td>
<td>0.004</td>
<td>0.002</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Source; Analysis Results

3.1. Effect of physical activity on total cholesterol and lipoproteins

Table 1 indicated lipid profile for different groups of physical activity in males and females. HDL-C was the only lipid parameter that was different among groups, there was a positive stepwise correlation between HDL-C and physical activity groups was obviously shown [R= 0.995], the values were (Male=46±5.1mg/dl, Female=47±5.6mg/dl) (Male=47±5.9mg/dl, Female=49±6.5mg/dl), (Male=54± 8.9mg/dl, Female=57±7.3mg/dl) (Male=62±9.0mg/dl, Female=63±8.1mg/dl) for sedentary, light, moderate and heavy physical activity groups respectively. The above values indicated the considerable effects in moderate group of physical activity and strong effects within heavy group wherein the higher HDL-C value. Generally, the effect increased with increasing of FIT scoring of physical activity group. The mean values of LDL-C for sedentary people group indicated the highest values with comparison to the rest of physical activity groups (table 1), whereas LDL-C decreased with increasing of FIT scoring [R=0.998], (the lowest values with higher physical activity), the measured values were Male=134±6.0mg/dl, Female=135±6.7mg/dl, (Male=128±5.1mg/dl, Female=130±6.1mg/dl) (Male=117±5.9mg/dl, Female=120±5.8mg/dl), (Male=103±6.6mg/dl, Female=107±8.0mg/dl) for sedentary, light, moderate and heavy physical activity group respectively. Physical activity also indicated clear obvious effects to total cholesterol and triglycerides in both physical activity groups.
males and females. This effect shows slight decrease in light group and more effective decrease in both moderate and heavy groups of physical activity, wherein total cholesterol and triglycerides were decreasing obviously stepwise (comparing to sedentary group) from light to heavy group, wherein the lowest mean values. Total cholesterol mean values were (Male=204±6.9 mg/dl, Female=207±7.2 mg/dl), (Male=200±8.0 mg/dl, Female=204±8.3 mg/dl), (Male=187±7.5 mg/dl, Female=188±7.8 mg/dl), (Male=170±7.2 mg/dl, Female=176±7.3 mg/dl) for sedentary, light, moderate and heavy physical activity groups respectively. The mean concentrations of triglycerides follow the same manner as in total cholesterol, wherein the adjusted values were (Male=140±9.8 mg/dl, Female=142±9.1 mg/dl), (Male=137±8.7 mg/dl, Female=139±8.4 mg/dl), (Male=126±7.7 mg/dl, Female=121±6.0 mg/dl), (Male=107±6.7 mg/dl, Female=111±7.4 mg/dl) for sedentary, light, moderate and heavy physical activity groups respectively.

3.2. Effect of Garlic on Plasma Total Lipids and Lipoproteins

Plasma measurement values of total cholesterol, triglycerides and LDL-C shows negative stepwise association with different doses of commercial garlic [R=0.999, 0.979, 0.962], whereas HDL-C shows positive correlation [R=0.953] (increase with increasing of dose, Table 2). Adjusted values of HDL-C were (male: 45±7.4 mg/dl, female: 46±7.4 mg/dl), (male: 48±6.8 mg/dl, female: 50±7.1 mg/dl), (male: 60±6.3 mg/dl, female: 62±8.2 mg/dl) for different levels of garlic dose, A (control group), B and C respectively. This is because the intake of saturated fats elevates the plasma total lipids profile, and triglycerides and elevates plasma HDL cholesterol. There is evident that the intake of garlic decreases with increasing of physical activity, but significant only in heavy and moderate activity groups.

| Table 2 Plasma lipids and lipoproteins in different dose of garlic |
|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| (according to dose) | N | HDL | LDL | T.C | TG |
|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Level A | Men | 51 | 45±4.7 | 138±7.0 | 206±7.3 | 136±7.1 |
| Women | 59 | 46±4.4 | 136±8.0 | 205±9.0 | 138±7.4 |
| Level B | Men | 54 | 48±6.8 | 130±7.4 | 193±6.2 | 126±7.3 |
| Women | 49 | 50±7.1 | 131±7.6 | 195±7.3 | 127±8.1 |
| Level C | Men | 48 | 60±6.3 | 114±6.5 | 180±7.3 | 103±7.6 |
| Women | 53 | 62±8.2 | 115±9.0 | 181±9.1 | 105±10.0 |

Values are Mean ±SD

Correlation coefficient between garlic dose and each of the four tested parameters

<table>
<thead>
<tr>
<th></th>
<th>HDL</th>
<th>LDL</th>
<th>T.C</th>
<th>TG</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>0.953</td>
<td>-0.962</td>
<td>-0.999</td>
<td>-0.979</td>
</tr>
<tr>
<td>P</td>
<td>0.195</td>
<td>0.175</td>
<td>0.029</td>
<td>0.132</td>
</tr>
</tbody>
</table>

respectively. The number of participants with low HDL-C values ≤ 40 mg/dl for each level were also different. This difference decrease with increasing of garlic dose. The decrease was level A (13.6%), level B (10.7%), level C (3.9%). The plasma lipid profile values in table 2 generally shows strong effects with high dose of commercial garlic (level C) and moderate effects with low dose (level B). The mean values of LDL-C, total cholesterol and triglycerides in level A (control group) indicated the highest values with comparison to the rest of commercial garlic dose (B and C), these values decrease with increasing of garlic dose in both genders. The adjusted values for LDL-C were (male: 136±7.0 mg/dl, female: 136±8.0 mg/dl, (male: 130±7.1 mg/dl, female: 131±7.6 mg/dl, (male: 114±6.5 mg/dl, female: 115±9.0 mg/dl) for level A, B and C respectively. High dose of commercial garlic also indicated clear and strong effects to total cholesterol and triglycerides (level C) in both genders whereas low dose of garlic shows moderate effects (level B) in comparison to control level (A). The mean values of total cholesterol were (male: 206±7.3 mg/dl, female: 205±9.0 mg/dl, (male: 193±6.2 mg/dl, female: 195±7.3 mg/dl), (male: 180±7.3 mg/dl, female: 181±9.1 mg/dl) for A, B and C levels respectively, whereas the mean values of triglycerides were (male: 136±7.1 mg/dl, female: 138±7.4 mg/dl), (male: 126±7.3 mg/dl, female: 127±8.1 mg/dl), (male: 103±7.6 mg/dl, female: 105±10.0 mg/dl) for A, B and C levels respectively.

4. DISCUSSION

This study comprised investigation for total of (818) healthy subjects of which (504) subjects were investigated for aerobic exercise, 314 were treated and investigated for garlic. All investigated people are healthy; they were not on any treatment for unhealthy cholesterol or other lipids at the time of study. Most of the investigated adults' subjects are officers; some are students, few of them only with free lance. The questionnaire includes data in the form of age, gender, behaviors, lifestyle and educational level.

Saudis populations in majority have strong desire and tendency to the animal products in their food and there is a general agreement that the amount and the degree of saturation of fat in the food are responsible for the effect on plasma lipid profile. This is because the intake of saturated fats elevates the plasma triglycerides, total and LDL cholesterol. There is evident that the intake of garlic decreases with increasing of physical activity, but significant only in heavy and moderate activity groups. Plasma total cholesterol, LDL-C and triglycerides for sedentary group indicated the highest levels in comparison to the physical activity groups in both sexes, wherein HDL-C showed the lowest levels in sedentary people than in the rest of the physical activity groups. Plasma total cholesterol in sedentary group was on average of 4 and 3 mg/dl higher than in the light physical activity group for males and females respectively, and continuous to decrease proportionally with increasing of FIT scoring. This decrease indicated significant effects in both moderate and heavy groups. In moderate and heavy physical activity groups, the results showed 17 and 34 mg/dl lower than in sedentary group for males respectively. Similar to males, plasma levels of total cholesterol for females indicated the values of 19 and 31 mg/dl lower than in sedentary people group respectively. Plasma LDL-C follows the same manner as in total cholesterol, wherein the differences between each group and the next one showed 8, 11 and 14 mg/dl in males, and 5, 10 and 13 mg/dl for females. Also in both sexes plasma triglycerides decreases with increasing of physical activity, but significant only in heavy and moderate activity groups, (33 mg/dl for males) (31 mg/dl for females ) in heavy group and (20 mg/dl for male) (19 mg/dl for female) in moderate one, lower than in sedentary physical activity group, whereas slight reduction was found in the light group, (3 mg/dl in male) and (3 mg/dl in female).
RESEARCH

It was shown that in this study there was strong positive correlation between HDL-C and physical activity. The lowest plasma HDL-C values registered with sedentary group of people, then started to elevate as increasing of physical activity (FIT scoring) throughout all groups, but significant and marginal significant only through heavy and moderate physical activity groups respectively, whereas slightly in the light group, the adjusted values were on average of 1.5 mg/dl higher than in sedentary people group for light one, 8-10 mg/dl higher for moderate group and on average of 16 mg/dl, higher than in sedentary group for heavy one. From the above indication it is obvious that, there is no considerable effect of gender on plasma lipids and lipoproteins for all investigated parameters. Comparatively, several epidemiological studies confirmed that a regular physical activity has long been associated with an increase of HDL-C plasma levels, contributing to reduce risk of coronary heart disease (CHD) because a higher HDL-C is linked with the lower risk of heart disease. Aerobic physical activity can also help controlling diabetes and high blood pressure and raises the heart and breathing rates. One study (Fiorito, et al. 2005) investigated 1442 subjects (627 male, 815 female) age over 20 years old, they selected people according to sex, age and cigarette smoke and cardiovascular diseases to analyze in each group the relation between energy expenditure in physical activity (EEPA/day) and HDL-C plasma levels. Results suggest a statistical significance between HDL-C and EEPA in all non-smokers. Moreover this significance was more important in non-smoker without CVD, whereas no significance difference found related to age. And that strongly confirmed the present study.

Also in this study, 314 subjects were investigated for effects of commercial garlic, 110 (35%) were sedentary people (control group), 103 (32.8%) were for low garlic dose and 101 (32.2%) were studied for high dose of garlic. Table 2 indicated clear obvious negative stepwise association of total cholesterol, LDL-C and triglycerides with different levels of commercial garlic whereas positive stepwise of HDL-C values were obviously shown depending deeply upon garlic dose (increase with increasing of dose). Plasma total cholesterol measurement values for sedentary people, generally indicated higher mean values in comparison to garlic treated subjects, this values decreases significantly with increasing of garlic dose through B and C level groups, wherein the effect was strong and more significant regarding C level group. In B and C level groups, the results indicated values of 13 and 26 mg/dl [SD = ±12 - ±14] lower than in sedentary people (level A) for males, and lower by 10, 24 mg/dl [SD = ±13 - ±14] for females respectively.

As in total cholesterol, LDL-C and triglycerides follow the same pattern, but the significant effect indicated only in high garlic dose (level C) for both parameters, whereas the slight effects were shown in level B group (low dose). Plasma LDL-C for each of B and C levels were lower by 6 and 22 mg/dl [SD = ±13 - ±14] than in sedentary people in males and by 5, 21 mg/dl [SD = ±14 - ±15] lower than in sedentary people group respectively for females. In this study, experimental evidence indicates that garlic ingestion improved plasma cholesterol concentrations; the garlic had considerable effects when substituted in normal diet, the influence of garlic depends deeply upon the dose, may be due to high concentration of dietary fibers in commercial garlic. Therefore may be commercial garlic could be valuable components for preventing CVD if taken in optimal doses.

Garlic is regarded with much interest by the general public as a mean to safely reduce plasma cholesterol levels, indeed, early studies suggested that garlic improved cholesterol levels. One study (Gebhardt, 1993) of cholesterol synthesis indicated that garlic decreased 3-hydroxy-3-methylglutaryl HMG-Co reductase activity, which basically responsible for controlling the rate of cholesterol biosynthesis. Moreover and comparatively, an earlier study (Shela, 2006) of evaluation the dose-dependent influence commercial garlic on rats fed cholesterol-containing diets, it was found that garlic contains high concentrations of dietary fibers; therefore commercial garlic could be valuable components of atherosclerosis-preventing diets only in optimal doses. Furthermore, study the effect of garlic in the diet. They found that raw garlic had a profound effect in reducing cholesterol and triglycerides levels and elevates HDL-C and triglycerides and elevates HDL-C and triglycerides and control the rate of cholesterol biosynthesis. Moreover and comparatively, an earlier study (Fiorito, et al. 2005) investigated 1442 subjects (627 male, 815 female) age over 20 years old, they selected people according to sex, age and cigarette smoke and cardiovascular diseases to analyze in each group the relation between energy expenditure in physical activity (EEPA/day) and HDL-C plasma levels. Results suggest a statistical significance between HDL-C and EEPA in all non-smokers. Moreover this significance was more important in non-smoker without CVD, whereas no significance difference found related to age. And that strongly confirmed the present study.

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5. CONCLUSION

This paper studied the effects of each of physical activity and commercial garlic on lipids profile and the inference of these two factors on the incidence of (CHD) and stroke. The results showed that both regular aerobic exercise and garlic improved lipids profile, raises HDL-C and reduced T.C, LDL-C and triglycerides. It has been shown that moderate and heavy physical activity significantly lowers plasma lipids profile (total cholesterol, LDL-C and triglycerides) and elevates HDL-C. Also the experimental results indicated that garlic had a beneficial and profound effect when substituted in normal diet. The results reported a significant reduction on plasma total cholesterol, LDL-C and triglycerides and considerable rising on HDL-C levels with high dose of garlic.

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