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Effects of Diet Control and Physical Activity for 10 Weeks on Body Mass Index and Lipid Profile

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Abstract

Background: The combined effects of diet and exercise lead to a change in body fat and lipid profile. *Aim:* To investigate the combined influence of dietary control and physical activity after 10 weeks of intervention on body mass index (BMI) and lipid profile. *Methods:* Twenty subjects (4 male, 16 female) were included in the study after ethical approval has been taken from university committee. Anthropometric measurements (height in cm and weight in kg) were taken. Close dietary instruction and supervision were maintained throughout the study. The basal BMI was calculated and the basal lipid profile was measured, which included high density lipoprotein (HDL), low density lipoprotein (LDL), triglycerides (TG), and total cholesterol (TC). After week 6 and 10, BMI was calculated again, while after week 10 lipid profile was measured again. The level of physical activity was assessed at week 9 using a physical activity questionnaire. The data collected were analyzed using SPSS software. *Results:* A significant decrease BMI was found between basal and week 6 values (26 ± 5 vs. 25 ± 6; $p = .019$), and basal value and week 10 value. Compared to the basal value, week 10 showed an increase in HDL, a significant decrease in TC ($p = .017$), and a non-significant decrease in LDL and TG. The sample population did spend more time participating in moderate activities (55 minutes, 5 days a week) compared with vigorous activities (40 minutes, 2 days a week). *Conclusion:* Dietary control programs prepared by dieticians combined with participation in structured physical activity programs constructed by physical trainers and observed by a sports medicine physician should be established.

Keywords: Diet Control • Physical Activity • Body Mass Index • Lipid Profile • Diet and Exercise Management

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Generally, physical inactivity and obesity are among the major public health and clinical problems in modern societies (Lakka & Bouchard, 2005). It is stated that a sedentary lifestyle and unhealthy diet as well as obesity markedly increased the risk of cardiovascular diseases. However, excess weight is due to an imbalance between physical activity and dietary energy intake (Lakka & Bouchard, 2005).

Previous researches have reported that excess body weight is associated with cardiovascular diseases (CVDs) and increased morbidity and mortality rates (Poirier & Despres, 2001). In fact, regular physical activity is accepted as a factor that reduces all-cause mortality and improves a number of health outcomes (Kesaniemi et al., 2001; Sesso, Paffenbarger, & Lee, 2000). In this context, various studies have demonstrated that the low levels of habitual physical activity are associated with increased all-cause mortality rates (Blair et al., 1989; Hahn, Teutsch, Rothenberg, & Marks, 1990; McGinnis & Foege, 1993; Paffenbarger, Hyde, Wing, & Hsieh, 1986).

Lipid profile is a panel of blood tests that serves as an initial broad medical screening tool for abnormalities in lipids, such as cholesterol and triglycerides (TG). The National Cholesterol Education Program (NCEP) reported that analysis and results of a lipid profile can determine approximate risk for cardiovascular disease and other diseases (NCEP, 2002). Medically an unfavorable lipid profile is associated with development of CVD (Moraleda et al., 2013). However, Caro et al. (2013) concluded that moderate regular physical activity is associated with an improved lipid profile. Additionally, current guidelines from the NCEP to maintain plasma lipids at desired levels include weight reduction, physical activity, and a decrease in consumption of total fat, saturated fat, and cholesterol (National Cholesterol Education Program, 2002).

In order to improve lipid profile parameters and weight loss, lifestyle changes and behavioral modifications are the main current recommendation. Leblanc, O'Connor, Whitlock, Patnode, and Kapka (2011) stated that populations, particularly those at increased health risk with high lipid profile, should be encouraged to be involved in programs for weight loss and physical activity. In a meta-analysis study, the authors concluded that an improvement in dietary habits would significantly improve CVD risk factors, particularly lipid profile (Banel & Hu, 2009).

Previous studies have been conducted to evaluate the combined effects of dietary control and exercise on lipid profile and body mass index. Volpe, Kobusingye, Bailur, and Stanek (2008) concluded that a supervised exercise program combined with nutritional modifications was effective in obtaining a significant loss of body weight among sedentary people. Weight-loss interventions using a dietary restriction regime accompanied by participation in exercise is associated with moderate weight loss at 6 months. According to the latest nutritional study, an advice-only group concerning the reduction of energy intake and exercise-alone played an important role in the weight loss of high lipid profile patients (Franz et al., 2007). Therefore, in the current study we hypothesize that there is a positive impact on lipid profile and body mass index (BMI) after 10 weeks of combined intervention of exercise and dietary control. The present study aimed to investigate the influence of 10 weeks of intervention on the combined effects of exercise and dietary control on lipid profile and BMI.

Materials and Methods

Ethics

A volunteer information sheet was given to all intended populations for participation in the study. This was intended to clarify the aims of the research and its possible positive resulting effects. A consent form was signed by 60 subjects who agreed to take part in the study and attend the preliminary test session. All subjects were recruited randomly. At the first meeting, full detailed answers to all questions asked by the subjects and an explanation of the experimental protocol were given. Furthermore, a health questionnaire was completed by all the subjects followed by the measurement of blood pressure (BP).

Inclusion and Exclusion Criteria

Any participant with a history of heart disease, family history of cardiac problems, or a medication that alters the cardiovascular system was excluded. Additionally, subjects with high BP at the first meeting were excluded.

Subjects

The cross-sectional study was conducted at Benghazi University from April 2013 until the end of June 2013. Twenty healthy subjects (4 male, 16 female) who completed the experimental protocol were included in the statistical analysis. The mean age was 25 ± 7 years.

Protocol

Anthropometric measurements were taken from all subjects including height (cm) and weight (kg), which allowed us to calculate the basal BMI (before interventions) for each participant. Subjects were then categorized into 4 groups based according on basal BMI as follows: underweight, normal, overweight, and obese. Consequently, all subjects underwent biochemical investigation for lipid profile (basal values): serum high density lipoprotein (HDL), low density lipoprotein (LDL), triglycerides (TG), and total cholesterol (TC).

All subjects were asked to record their diet for 3 days in order to manipulate the diet. The dietary manipulation was conducted using a series of energy calculation equations based on BMI category. The energy expenditure value in kilocalories was calculated based on the height, weight, and age for each participant. Consequently, calculated values using standard energy equations (i.e., subtracting 500 or 330 to 500 kcalories) were used for overweight and obese groups.

All subjects were asked to start consuming the controlled diet and start doing physical activity for 10 weeks according to available facilities and their interest. The level of the physical activity was assessed subjectively using a self-prepared physical activity questionnaire during week 9. Consequently, the time spent participating in activities by all subjects was categorized into two main classes: moderate and vigorous. During the 10-week protocol height and weight was measured and BMI was calculated on week 6 and 10. Additionally, lipid profile measurements were evaluated again at week 10.

Therefore, basal as well as week 6 and 10 values were obtained for BMI. Additionally, basal measurements were obtained for lipid profile as well as week 10. The level of the physical activity was assessed at week 9. Based on the subjective answers of subjects and the classification of activities in previous reports, such as Sabia et al. (2012), the time spent on two main types of activities (moderate or vigorous) was reported.

Statistical Analysis

Collected data were organized in an Excel sheet and uploaded to SPSS software, version 16. Simple analytical statistics were applied. Data were presented as the mean and standard deviations (±). A paired t-test (dependent sample) between BMI and lipid profile at different time points (i.e., basal, week 6, and week 10) was applied. The level of significance was set at ≤0.05.

Results

BMI

The mean height of the subjects was 165 ± 8 (cm) and the mean weight was 71 ± 16 (kg). The calculated basal BMI was 26 ± 5. There was a significant decrease in BMI at week 6 compared with the basal measurement (25.5 ± 6 vs. 26 ± 5; $p = .013$) after the combined intervention (i.e., dietary control and exercise participation). Similarly, there was a significant decrease in BMI at week 10 compared with the basal value (24.9 ± 5 vs. 26 ± 5; $p = .001$) after the combined intervention. Compared with BMI at week 10, BMI at week 6 significantly decreased ($p = .019$). The results can be seen in Table 1

Table 1
Basal, week 6, and week 10 BMI

Measurement	Result
BMI (basal)	26 ± 5
BMI (week 6)	25 ± 6*
BMI (week 10)	24 ± 5**/***

*significant difference between basal and week 6 ($p = .013$)
**significant difference between week 6 and 10 ($p = .019$)
***significant difference between basal and week 10 ($p = .001$)

Lipid Profiles

There was a non-significant (NS) increase in HDL at week 10 after dietary control and exercise compared with the basal value (63 ± 15 vs. 61 ± 14, $p = 0.432$). Alternatively, there was a decrease in LDL at week 10 after the combined intervention compared with the basal value (70 ± 25 vs. 73 ± 20, $p = .520$). The results can be seen in Table 2

Examining the changes in TG between basal and week 10 after the intervention, there was a NS decrease at week 10 compared with the basal measurements (70 ± 33 vs. 72 ± 19, $p = .487$). There was a significant decrease in TC at week 10 compared with the basal measure after the combined intervention (127 ± 36 vs. 147 ± 29, $p = .017$). The results can be seen in Table 3.

Table 2
Changes from Basal to Week 10 in HDL and LDL

	Basal	week 10
HDL	61 ± 14	63 ± 15
LDL	73 ± 20	70 ± 25

Table 3
Changes in TG and TC from Basal to Week 10

Measure	Basal	Week 10
TG	72 ± 19	70 ± 33
TC	147 ± 29	127 ± 36*

*significance difference was found

Compared with vigorous activities (Karate, running, and jumping), subjects did spend more time participating in moderate activities (walking fast and bicycling) (55 minutes, five days a week vs. 40 minutes, two days a week).

Discussion

The current study found a significant decrease in BMI at week 6 and 10 compared with the basal measurements. Although the decrease in LDL and TG at week 6 compared with the basal values was not significant, both are considered desired changes that would influence the individual's health and decrease the risk of CVD. The current study also found a significant decrease in TC and that the sample population did spend more time participating in moderate activities rather than vigorous activities.

It well-known that obesity is an important public health problem associated with multiple chronic health conditions including heart disease, hypertension, hyperlipidemia, diabetes, hyperinsulinemia, and cancer (Layman et al., 2005). It is acceptable to consider that BMI is a proxy measure of obesity instead of measures of body composition (e.g., percentage of body fat) or body fat distribution (Heitmann, Erikson, Ellisinger, Mikkelesen, & Larsson, 2000). Therefore, it was recommended that adults who are overweight or obese reduce daily energy intake and increase physical activity (Layman et al., 2005). In the present study, BMI did decrease significantly after 10 weeks of combined dietary control and exercise intervention at both week 6 and 10 compared with the basal measure. This result is in agreement with Lakka and Bouchard (2005) who stated that the optimal approach to weight reduction programs appears to be a combination of regular physical activity and caloric restriction.

As previously stated, obesity is a chronic metabolic disorder associated with CVD and increased morbidity and mortality. Poirier and Despres (2001) stated that there is strong evidence that weight loss in overweight and obese individuals improves risk factors for many health problems such as diabetes and CVD. Accordingly, the noticeable and significant decreases in BMI in the current study after the combined intervention at week 6 and 10 would be considered of valuable clinical importance. Therefore, it is essential for primary care physicians to evaluate obesity because it is associated with higher mortality and comorbid conditions (e.g., diabetes mellitus and hypertension) (Jarolimova, Taqoni, & Stern, 2013). Furthermore, the established strategies should include nutritional programs for dietary control and encouragement for participation in physical activity (Jarolimova et al., 2013).

Data available in the literature showed that different randomized controlled trials have examined the combined effects of aerobic exercise and diet aimed at improving lipid profiles; however, concerning TC, LDL, HDL and TG in adults conflicting conclusions were found (Agurs-Collins, Kumanyika, Ten Have, & Adams-Campbell, 1997; Anderssen, Hjelstuen, Hjermann, Bjerkan, & Holme, 2005; Arciero et al., 2006; Avila & Hovell, 1994; Hagan, Upton, Wong, & Whittam, 1986; Hirose, Tajima, & Miura, 2002; Hopewell, 1989; McAuley et al., 2002; Miller et al., 2002; Nieman, Brock, Butterworth, Utter, & Nieman, 2002).

A decrease in HDL is considered as a major risk factor for coronary heart disease (Nieman et al., 2002). It was reported that exercise when combined with an energy-restricted diet attenuated the decrease in HDL that occurs with weight loss (Leaf, Parker, & Schaad, 1997; Nieman et al., 1990; Willams, Stefanick, Vranizan, & Wood, 1994; Wood, 1994). This finding supports the current results which showed that there was a NS increase after 10 weeks of intervention in HDL. Likewise, the combination of dietary control and exercise moderately increased HDL (5-10%) (NCEP, 2002). Similarly, various studies demonstrated a positive correlation between changes in body weight and HDL (Sallinen et al., 2007; Vincent, Braith, Bottiglieri, Vincent, & Lowenthal, 2003). Alternatively, Kelley et al. (2012) concluded that concurrent aerobic exercise and diet are associated with improvements in TC, LDL, and TG, but not HDL in overweight and obese adults.

Numerous studies have concluded that moderate exercise training has little effect on TC and LDL unless combined with a dietary control regimen (Dengel et al., 1994; Leaf et al., 1997; Nieman et al., 1990; Willams et al., 1994; Wood, 1994). Clinically, it is acceptable to state that as the level of TC and LDL cholesterol rises, the risk of coronary artery disease increases. Vatansev and Cakmakci (2010) stated that every 1% decrease in the level of LDL cholesterol lowers the risk of the coronary artery disease (CAD) by 2%. Although the current results illustrated a significant decrease in TC at week 10 compared with the basal measurement after combined interventions ($p = 0.017$), there was a NS decrease in LDL at week 10 after the combined interventions compared with the basal value. These results are of significant clinical importance as the decrease in LDL cholesterol, triglycerides levels, and increases in HDL cholesterol levels would decrease the risk of cardiovascular disease (Kelly et al., 2012; Maffeis, Pietrobelli, Grezzani, Provera, & Tato, 2001; Sarria, 2001).

Physical inactivity is the most important cause of the development of obesity. Previous research found that exercise causes a positive change in lipids and lipoproteins (Vatansev & Cakmakci, 2010). Researchers mentioned that a diet program combined with an exercise program will provide more productive results in obese people.

Due to severe types of exercise posing a risk, the American Heart Association, Centers for Disease Control and Prevention, and American College of Sports

Medicine (ACSM) recommend moderate-intensity regular physical activity for the prevention and complementary treatment of several diseases (Agrwal, 2012). The ACSM recommends that most adults engage in moderate-intensity training for ≥30 minutes a day, ≥5 days a week for a total of ≥150 minutes a week in order to develop and maintain cardiorespiratory, musculoskeletal, and neuromotor fitness (Garber et al., 2011). In the current study, subjects did spend more time participating in moderate activities (e.g., walking fast and bicycling) (55 minutes, five days a week vs. 40 minutes, two days a week) compared to vigorous activities (e.g., karate, running, and jumping). Caro et al. (2013) concluded that moderate regular physical activity is associated with higher insulin sensitivity and improved lipid profile.

The present study had two limitations. First, the sample size was small and further studies should include a larger number of subjects. Second, the assessment of the level of physical activity was subjective based on the answers given by the subjects.

In conclusion, physical activity causes favorable changes on lipid profiles and BMI when combined with dietary modification. An exercise program accompanied with dietary control makes the individuals feel psychologically good, healthy, and safe from atherosclerotic risk factors of obesity. Therefore, a diet program in addition to exercise will provide more beneficial results in obese people.

Author Contributions

Dr. Issam Denna formulated the idea, designed and managed the study, performed statistical analysis, supervised the whole process, and revised the final manuscript. Dr. Safaa Badr helped draft the manuscript, gave advice regarding the interpretation of results, and revised the collected literature. Others (N. Ali, Z. Alfergani, K. Jewily, and S. A. Almajouk) helped with data collection and statistical analysis, entered data, and reviewed the literature. All the authors have read and approved the final manuscript. There was no conflict of interest.

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