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Research Article

PULSED LOW FREQUENCY MAGNETIC FIELD ON OBESE SUBJECTS

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ABSTRACT

Background: Obesity is a chronic disease characterized by excessive body fat that causes damage to the individual's health and is associated with comorbidities such as Diabetes mellitus, Hypertension and vascular dysfunction. Common traditional treatments utilized for obesity include medications, surgicalinterference, exercises and diet programs. Few studies have investigated magnetic field treatments for obesity.
Purpose: Toinvestigate the effect ofpulsed low frequency magnetic field on obese subjects.
Material and Methods: Forty subjects from both genders having body mass index from 30 to 40, their ages ranged from 35 to 45 years oldwere selected.
Results: Within 2 groups: There was a significant decrease in body mass index and triglyceride. In group A, there was a significant increase in total cholesterol, low density lipoprotein and decrease in high density lipoprotein, In group B there was a significant decrease in T.CH, LDL and increased in HDL.
Conclusion: The application of LF-PMF on obese subjects has apositive effect on BMI and serum TGs, but it has anegative effect on HDL, serum T.CH and LDL.

INTRODUCTION

Obesity is a worldwide disease that is accompanied by several metabolic abnormalities such as hypertension, hyperglycemia and dyslipidemia. The accelerated adipose tissue growth and fat cell hypertrophy during the onset of obesity precedes adipocyte dysfunction. One of the features of adipocyte dysfunction is dysregulatedadipokine secretion, which leads to an imbalance of pro-inflammatory, pro-atherogenic versus anti-inflammatory, insulin-sensitizing adipokines. The production of renin-angiotensin system (RAS) components by adipocytes is exacerbated during obesity, contributing to the systemic RAS and its consequences. Increased adipose tissue RAS has been described in various models of diet-induced obesity (DIO) including fructose and high-fat feeding (Frigolet *et al*., 2013). EMFs have been found to produce a variety of biological effects. These effects of EMFs depend upon frequency, amplitude and length of exposure. They are also related to intrinsic susceptibility and responsiveness of different cell types. EMFs can influence cell proliferation, differentiation, cell cycle, apoptosis, DNA replication and protein expression. These effects are important considerations for the application ofEMFs for wound healing, tissue regeneration (Patruno *et al*., 2010).

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The lipid profile is a group of tests that are often ordered together to determine risk of coronary heart disease (CHD) in obese population. The lipid profile typically includes total cholesterol (TC), High density lipoprotein-cholesterol; often called good cholesterol. Low density lipoprotein-cholesterol; often called bad cholesterol and Triglycerides (Labib, 2003).

MATERIALS AND METHODS

Subjects

Forty obese subjects with ages were ranged from 35 to 45 years and were suffered from obesity as their BMI from 30 to 40. They were selected from the faculty of Physical Therapy, Cairo University.

Subjectswere assignedintotwogroups;

Group (A): Twenty obese subjects were received pulsedmagnetic field (20 minutes session 3times per week for two successive months)

Group (B): They were received the aerobic exercises and cycling training on bicycle ergometer (30 minutes session 3 times per week for two successive months).

Inclusive criteria

- Subjects ages were ranged from 35-45years.
- Their BMI from 30 to 40
- All subjects aware of consciousness.

Exclusive criteria:

Subjects were excluded when have one of the following criteria:
- Cancer, neither neurological nor orthopedic problems.
- Active kidney or hepatic disease.
- Diabetes mellitus or thyroid diseases.
- Previous surgeries, fibrosis or adherence in the abdomen.
- Pregnancy and/ or lactation.

Equipments

1- Measuring Equipments

***A.*Weighing machine (Floor type):** A self-indicating dial is equipped for easy reading, showing accurate weight both in Metric and in British systems by an indicator which is connected with the lever mechanism by means of gears and coiled spring. **(4).**

***B.*Height measuring standard:** composed of three round tubes of different calibers: the outer tube is rigidly fixed onto the column of the dial, while the middle and the inner tubes are closely inserted there in one after the other with both Metric and British units graduated thereon **(4).**

C.Body Mass Index (BMI) calculation: Body Mass Index (BMI) calculated according to the following equation:BMI= Weight (Kg)/Height (m) ^{2}.**(5).**

D.Blood lipid analyzer (Roche Hitachi 912 Che)

2-Therapeutic Equipments

A- ASA magnetic field (Automatic PMT Quattro PRO)

- The intensity and spatial layout of the generated magnetic field depend on the type of solenoid used. The intensity of magnetic field of solenoid installed on bed is 85 gauss while the intensity of magnetic field of solenoid on stand is 80 gauss.

B-Bicycle Ergometer:

Procedures of the study:

The procedures of the study included the following:

A – **Measurement procedures**

1- The measurements of the BMI was conducted before the first session (pre treatment record) and after 2 months of treatment (post treatment record). The measurement steps as follow:-

BMI CALCULATION:

After the measurement of weight and height.

2-Serum lipid profile: the subjects was fasted nine hours before taking the sample.

B-Treatment procedures

1-ASA magnetic field (Automatic PMT Quattro PRO)

Subjects received PEMF with a frequency of 15 Hz, intensity of 60 gauss and duration of 20 min (in the manual instrument of the apparatus –the metabolism diseases). While subjects in supine lying position wear light clothes.

2-Bicycle ergometer treatment protocol (Group B)

15 minutes in the form of aerobic exercises in the gymnasium followed by 15 minutes cycling, total time of exercise divided into two to three intervals, and the frequency of this treatment protocol for each subjects was three sessions per week every other day for 2 months **(6)**

RESULTS

The purpose of this study was to investigate the effect of low frequency pulsedelectro magnetic field on obese subjects.

General Characteristics of the Subjects

In this study, forty subjects with age ranged from 35-40 years old and BMI ranged from 30 to 40 kg/m^2 were assigned into two groups.

Body Mass Index

i) Within Subjects

Group (A): There was a significant difference in the paired t-Test between pre and post treatment BMIas the mean value of pre treatment BMIwas (34.78± 3.2) and for post treatment BMIwas (32.01±3.21) where the t-value was (28.34) and P-value was (0.0001). The Percentage of improvement was 6.67 %.

Group (B): There was a significant difference in the paired t-Test between pre and post treatment BMIas the mean value of pre treatment BMIwas (35.02± 2.59) and for post treatment BMIwas (34.19±2.43) where the t-value was (11.51) and P-value was (0.0001). The Percentage of improvement was 2.37 %.

ii) Between Groups

Table (1) and Figure (1) revealed the independent t-Test results for the BMI pre and post treatment between groups A and B.

Table 1. Independent t-Test between groups A and B for BMI **pre and post treatment**

Independent t-Test	BMI			
	Pre treatment		Post	
	Group (A)	Group (B)	Group (A)	Group (B)
Mean	34.78	35.02	32.01	34.19
±SD	±3.2	±2.59	±3.21	±2.43
Mean difference	0.23		2.18	
t-value	0.26		2.42	
P-value	0.79		0.02	
S	NS		S	

*SD: standard deviation, P: probability, S: significance, NS: non-significant, S: significant.

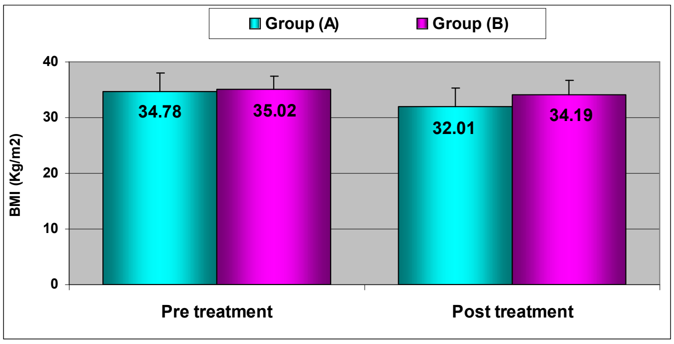

Fig.1. Mean and ±SD of BMI pre and post treatment of groups (A,B)

Total cholesterol:

i) Within Subjects:

Group (A): There was a significant difference in the paired t-Test between pre and post treatment Total cholesterolas the mean value of pre treatment Total cholesterolwas (183.3± 25.45) and for post treatment Total cholesterolwas (203.9±23.4) where the t-value was (6.24) and P-value was (0.0001). The Percentage of change was 11.23 %. (negative effect)

Group (B): There was a significant difference in the paired t-Test between pre and post treatment Total cholesterolas the mean value of pre treatment Total cholesterolwas (181.1±17.84) and for post treatment Total cholesterolwas (172.91±17.77) where the t-value was (10.35) and P-value was (0.0001). The Percentage of improvement was 4.51 %. (positive effect).

ii) Between Groups:

Table (2) and Figure (2) revealed the independent t-Test results for the Total cholesterol pre and post treatment between groups A and B.

Table 2. Independent t-Test between groups A and B forTotal cholesterol pre and post treatment

Independent t-Test	Total cholesterol			
	Pre treatment		Post	
	Group (A)	Group (B)	Group (A)	Group (B)
Mean	183.3	181.1	203.9	172.91
±SD	±25.45	±17.84	±23.4	±17.77
Mean difference	2.2		30.98	
t-value	0.31		4.71	
P-value	0.75		0.0001	
S	NS		S	

*SD: standard deviation, P: probability, S: significance, NS: non-significant, S: significant.

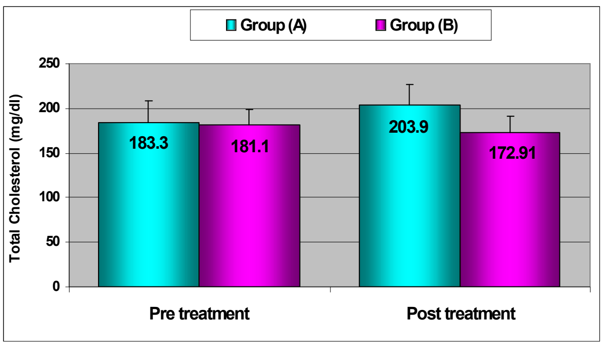

Fig. 2. Mean and ±SD of Total cholesterol pre and post treatment of groups (A,B)

Triglycerides:

i) Within Subjects

Group (A): There was a significant difference in the paired t-Test between pre and post treatment Triglyceridesas the mean value of pre treatment Triglycerideswas (116.95± 30.92) and for post treatment Triglycerideswas (103.32±28.33) where the t-value was (9.07) and P-value was (0.0001). The Percentage of improvement was 11.64 %. (positive effect).

Group (B): There was a significant difference in the paired t-Test between pre and post treatment Triglyceridesas the mean value of pre treatment Triglycerideswas (115.35± 22.34) and for post treatment Triglycerideswas (99.97±18.27) where the t-value was (12.13) and P-value was (0.0001). The Percentage of improvement was 13.33 %. (positive effect).

ii) Between Groups:

Table (3) and figure (3) revealed the independent t-Test results for the Triglycerides pre and post treatment between groups A and B.

Table 3. Independent t-Test between groups A and B forTriglycerides pre and post treatment

Independent t-Test	Triglycerides			
	Pre treatment		Post	
	Group (A)	Group (B)	Group (A)	Group (B)
Mean	116.95	115.35	103.32	99.97
±SD	±30.92	±22.34	±28.33	±18.27
Mean difference	1.6		3.35	
t-value	0.18		0.44	
P-value	0.85		0.65	
S	NS		NS	

*SD: standard deviation, P: probability, S: significance, NS: non-significant.

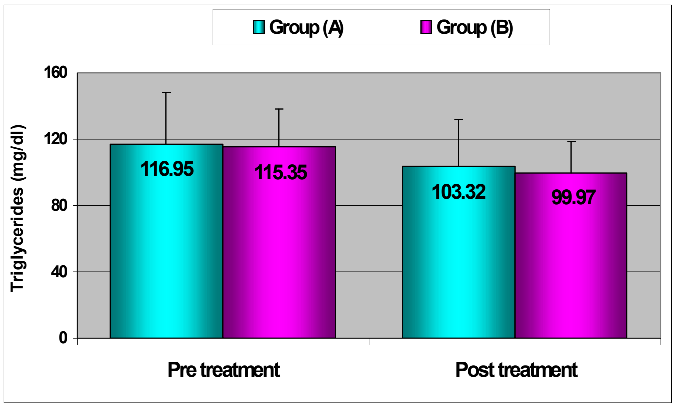

Fig. 3. Mean and ±SD of Triglycerides pre and post treatment of groups (A,B)

High Density Lipoprotein:

i) Within Subjects:

Group (A): There was a significant difference in the paired t-Test between pre and post treatment HDLas the mean value of pre treatment HDLwas (45.63± 5.9) and for post treatment HDLwas (40.75±4.32) where the t-value was (5.37) and P-value was (0.0001). The Percentage of change was 10.67 %.(negative effect).

Group (B): There was a significant difference in the paired t-Test between pre and post treatment HDLas the mean value of pre treatment HDLwas (46.21± 4.76) and for post treatment HDLwas (50.71±5.63) where the t-value was (6.96) and P-value was (0.0001). The Percentage of improvement was 9.71 %.(positive effect).

ii) Between Groups

Table (4) and figure (4) revealed the independent t-Test results for the HDL pre and post treatment between groups A and B.

Table 4. Independent t-Test between groups A and B forHDL pre and post treatment

Independent t-Test	HDL			
	Pre treatment		Post	
	Group (A)	Group (B)	Group (A)	Group (B)
Mean	45.63	46.21	40.75	50.71
±SD	±5.9	±4.76	±4.32	±5.63
Mean difference	0.58		9.95	
t-value	0.34		6.27	
P-value	0.73		0.0001	
S	NS		S	

*SD: standard deviation, P: probability, S: significance, NS: non-significant, S: significant.

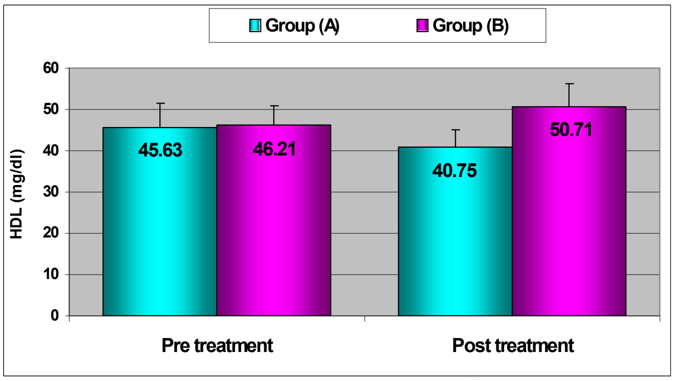

Fig.4. Mean and ±SD of HDL pre and post treatment of groups (A,B)

Low Density Lipoprotein:

i) Within Subjects:

Group (A): There was a significant difference in the paired t-Test between pre and post treatment LDLas the mean value of pre treatment LDLwas (98.14± 11.07) and for post treatment LDLwas (107.55±12.49) where the t-value was (4.67) and P-value was (0.0001). The Percentage of change was 9.57 %.(negative effect).

Group (B): There was a significant difference in the paired t-Test between pre and post treatment LDLas the mean value of pre treatment LDLwas (96.72± 9.15) and for post treatment LDLwas (90.47±8.72) where the t-value was (12.99) and P-value was (0.0001). The Percentage of improvement was 6.46 %. (positive effect)

ii) Between Groups

Table (5) and figure(5) revealed the independent t-Test results for the LDL pre and post treatment between groups A and B.

Table 5. Independent t-Test between groups A and B for LDL **pre and post treatment**

Independent t-Test	LDL			
	Pre treatment		Post	
	Group (A)	Group (B)	Group (A)	Group (B)
Mean	98.14	96.72	107.55	90.47
±SD	±11.07	±9.15	±12.49	±8.72
Mean difference	1.41		17.07	
t-value	0.44		5.01	
P-value	0.66		0.0001	
S	NS		S	

*SD: standard deviation, P: probability, S: significance, NS: non-significant, S: significant.

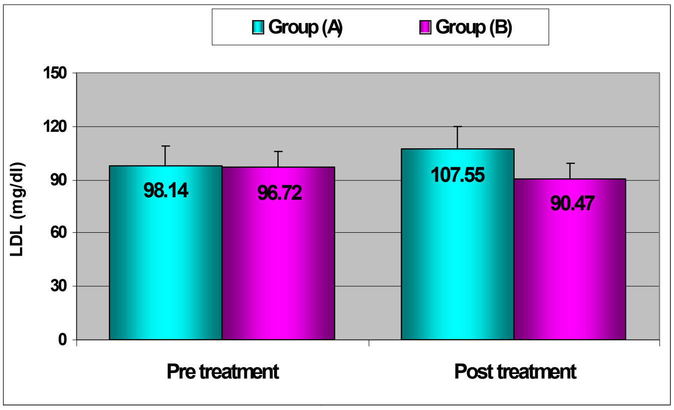

Fig. 5. Mean and ±SD of LDL pre and post treatment of groups (A,B)

DISCUSSION

To the best of our knowledge, this is the first study evaluating the effect of pulsed low frequency magnetic field on obese subjects, there were few studies investigated the influence of magnetic field on serum lipids in the rats. The results of the current study are contradicted with the findings of (Takuya Hori *et al.*, 2012) as both plasma total cholesterol ($P < 0.01$) and phospholipid ($P < 0.05$) in the group exposed to MF were lower than those in the control, but there was no difference in triacylglycerol or free fatty acid level Accorrding to (Jiang *et al.*, 2010) results he concloded that low-frequency rotary constant magnetic field has beneficial effect on fat metabolism, leading to reduced lipid peroxidation.

Most reports suggest that ELF-MF exposure might increase lipid metabolism, (Torres-Duran *et al.*, 2007) observed that one time exposure to ELF-MF significantly decreased total cholesterol levels and increased lipid peroxide content in the liver. Serum free fatty acids level were increased in their exposed rats compared to their control sham exposed rats.

Conclusions and Recommendations

The data concerning the BMI and serum lipids profile by using descriptive statistics (mean and standard deviation). t-Test was used to compare the pre-test and post-test values for BMI and serum lipids profile.

Conclusion

In conclusion, our findings showed that PLF-MF exposure had apositive effect on BMI and TGs but it had a negative effect on

TC, LDL and HDL.The mechanisms for the effects of MF on lipid metabolism are not well understand yet, but could be associated to lipid metabolism. To define the relationship of MF, and regulation of lipid metabolism further experiments are needed.

Recommendations

According to the results of the present study, the following further researches are highly recommended.

1. Replicate this study and make follow up to the two groups for three months, and measure the serum lipid profile after the 3 monthes.
2. Further studies including hormonal responses to pulsed electro magnetic field should be conducted.
3. Studying the effects of pulsed electro magneticfeild on insulin sensivity is required.

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