Life Science Journal

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Relation between history of obesity and handgrip strength and inflammation after aerobic training in obese female

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Abstract: The purpose of this study was to evaluate that early onset of obesity is associated with lower hand grip, the roles of inflammation on the association between obesity history and hand grip strength and the effect of aerobic training on hand grip strength in obese female (class II). Methods: Forty class II obese female (their age from 30-40 years) were assigned into 2 groups, group (A) and group (B). Subjects: group (A) (n=20) have obesity since 5 years, while group (B) (n=20) have obesity since 10 years. Both groups received aerobic training by treadmill for 3 times per week for 60 min/session for 16 weeks. The following parameters including body mass index, hand grip strength and CRP were measured before and after intervention. Results: the outcome of this study is reduction in Body Mass Index (BMI), rise in hand grip strength and decrease in C- Reactive Protein (CRP) in both groups after aerobic training, while in group (A) has more improvement in hand grip strength than group (B). Conclusion: long period of obesity is associated with less hand grip strength and increase CRP while decrease body weight by aerobic training will improve hand grip strength and decrease inflammation.
[Mona Mohamed Abdelkhalek. **Relation between history of obesity and handgrip strength and inflammation after aerobic training in obese female.** *Life Sci J* 2020;17(7):22-29]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). http://www.lifesciencesite.com. 4. doi:10.7537/marslsj170720.04.

Keywords: Obesity | Handgrip | Inflammation | Aerobic training |Dynamometer

1. Introduction

The population statistics of most countries of the planet are indicating that manufacture and mechanization are related to a rise in sedentariness and a lot of recently with a major shift from a healthy weight to overweight and obesity (Jean and Angelo,2009).

Previous studies have provided some evidences to demonstrate that low level of physical activity and being overweight are associated with low hand grip strength (Ai Kah Ng et. al., 2019).

Experimental evaluation of physical performance was manipulated, in studies, as well as grip strength, balance, four-meter walking speed, and repeated chair rising, inflammatory biomarker interleukin-6 (IL-6), CRP and tumor necrosis and anthropometric measures. (Tina et al., 2009).

Adipose tissue works as an endocrine tissue, discharging several inflammatory cytokines as well as IL-6, that stimulates hepatic production of CRP, that the elevation of C-reactive protein (CRP) could contribute to poorer physical performance and physical incapacity by reductions of protein in skeletal muscle and loss of muscle build and strength. (Tina et al., 2009).

Obesity will increase the danger of impairments in physical performance, because of magnified levels of fat mass are a lot of indicative of loss of function, wherever increase fat build shares to the magnified making of inflammatory cytokines that successively lead to muscle weakness, loss of muscle build and reduce physical performance. (Gary et al., 2006).

Obesity was related to having difficulty when performing physical perform tasks as picking up an object from the ground and lifting heavy weight objects or reaching an object. (Yves et al.,2009).

Grip strength measurement is a commonly used process for experimental besides scientific purposes. (Hahn et al.,2018).

Handgrip dynamometry is a simple, quick, and commercial method to assess muscle strength in population studies. (Johanna et al.,2016).

Weight loss for an obese woman can improve physical activities as move grocery baskets, cut toe nails and reach behind their backs and walk upstairs with grocery bags. And, the 6-minute walk distance and step climb time improved with intensive weight loss. (Ulla EL2004).

Aerobic exercise is a physical movement which needs the cardiopulmonary system to effort more to satisfy the more need of oxygen for the body. Aerobic exercise increases the flow of oxygen in the blood, for instance walking, running, ski machines, treadmills, rower, jumping rope and bicycling. Treadmills are

safe, simple to use and very convenient. Exercising on a treadmill is a very effective cardio workout to burn calories. (David 2009).

We hypothesize that longer exposure to obesity might exacerbate the complication of obesity, such as increased inflammation, and cause lesser muscle strength and aerobic training will improve the hand grip strength in obese female. Thus, the objective of this study was to evaluate that early onset of obesity is associated with lower hand grip, the roles of inflammation on the association between obesity history and hand grip strength and the effect of aerobic training on hand grip strength in obese female.

The aim of this study was to evaluate that early onset of obesity is associated with lower hand grip, the roles of inflammation on the association between obesity history and hand grip strength and the effect of aerobic training on hand grip strength in obese female (class II).

2. Materials and Methods

Subjects:

Forty volunteer obese young women joined in this study. They were carefully chosen from the obesity clinic at Badr University.

Inclusion criteria:

All women were class II obesity, BMI from 35.0–39.9 (Wen 2004). Their age extended from 30 - 40 years, they did not join in systematic exercises or diet three months before sharing in the study.

Exclusion criteria:

Women with orthopedic disorder, chest diseases, heart disease metabolic disorders or any systemic diseases affecting the results at the end of the study. the method and possible side effects had been clarified to them then the consent form was signed. Patients were randomly divided into two groups. Group (A) (n=20) have obesity since 5 years with the same BMI, while group (B) (n=20) have obesity since 10 years with the same BMI, both groups received the same program of aerobic exercises.

Equipment:

Assessment equipment:

1. Scale and audiometer for measuring weight and height: computerized type, ITO models and made in England with serial number2444.

2. Sphygmomanometer: mercury type to confirm that patients under constant condition: Cast Aluminum Medical Mercury made in China with model x008.

3. Calculator: for calculate of BMI, Vintage Calculator Casio Fx 3800p made In Japan.

4. Dynamometer: for assessment of handgrip. Basline – Models, serial number (10533) made in U.S.A (Clovis).

Treatment equipment:

1-Electronic treadmill motorized: for aerobic training stealflex type with serial number (5667), made in Taiwan.

Procedure:

I -Evaluative Procedure:

The assessment was completed before the program and after 16weeks of program. Blood pressure and pulse rate were measured before the tests to confirm about patient's health stability. (Ethel et al., 2011).

1-Height and weight measurements:

Class II obese female were selected by measuring the body mass in kilograms and height in centimeters. (Fig.5)

$$\text{Body mass index (BMI)} = \frac{\text{Weight (kg)}}{\text{Height (m2)}}$$ (Tina et al, 2009).

Patient's preparation:

-Comfortable clothing

-Suitable shoes

-A very small meal was allowed before test, with no less than two hours.

-Patients should be at rest and relaxed two hours of start the test (Ethel et al., 2011).

-Provide brief description of the procedure: the subject was pre-screened according to approved study protocol and was familiarized with the testing procedures.

-Potential risks to be explained before obtaining consent as minimal discomfort only. Some muscle soreness for 1-2 day following the assessment.

- The place which the process took place should be quiet, well-lit, comprehensive, well aired and the temperatures not more 30°C.

2- Hand grip strength

Modifiable grip strength dynamometer was used to measure the grip strength of both hands. The physiotherapist demonstrated the procedure to the subject before giving them the dynamometer, reminded the issue that the handle did not move but they needed to squeeze as hard as they can for 3-4 seconds. Three trials must be completed with a gap of about 15-20 seconds between every trial to avoid muscle exhaustion. Participants performed the test with every hand, and maximum overall value was used in the analyses.

3- C-reactive protein

Participant must be fasting at night than in the morning samples of venous blood were taken. The samples were instantly centrifuged and stored at –80°C till final analysis. Normal determinations of C-

reactive protein with normal range (0–1 mg/dl) (Francesco et al., 2007).

II- Interventions procedure

Participants involved in an exercise training program 3 times per week for 60 min/session. The exercise program be made up of:

-Warm-up phase (5 minutes): in the form of diaphragmatic breathing exercises, repeated for 5 times and moderate stretching exercise for upper and lower extremities.

-Aerobic phase (15 minutes), walking on the electrical treadmill within a heart rate range of 60-75% of heart rate reserve.

-Heart reserve= maximum heart rate (220-age) - resting heart rate (Gary et al.,2006).

Statistical analysis:

Data were coded, characterized and treated using Statistical Package for Social Sciences (SPSS) software version 16.

• Kolmogorov-Smirnov test was used to test the data.

•The quantitative variables were expressed as mean ± standard deviation (SD).

• Paired t-test was used before and after the intervention to compare variables.

•Comparison between 2 different groups was done using unpaired T-test.

•Pearson's correlation coefficient "r" used to assess the correlation between each quantitative variable in all subjects.

•A simple regression analysis was performed to develop a prediction equation CRP.

•All P-values in the analysis were considered statistically significant when $P \leq 0.05$.

3. Results:

In this study, 40 females were enrolled. Their mean age was 36±3.5 years (range 30-40years). Regarding their anthropometric baseline characteristics (table 1), their mean weight was 93.6. ±7.7 Kg (range 79-109 Kg) while their mean height was 159.6 ± 4.8 cm (range 150-167 cm). All women were class II obesity, BMI range 35.02–39.8 kg/m2 the mean BMI before intervention was 36.7±1.5.

Results of Interventions procedure (Intervention Efficacy)

Table (2) and figures from 1-3 shows that there was a significant ($P \leq 0.05$) difference before and after intervention regarding all parameters in the group (A). Comparing weight before and after intervention 95.3 ± 6.1 versus 84.3 ± 8.2. Also, this difference appeared in BMI before and after intervention 37.03 ± 1.3 versus 32.7 ± 2.3.

Regarding the items, RT hand grip strength increased from 28.1 ± 2.9 to 30.4 ± 2.8 after intervention. LT hand grip strength increased from 24.4 ± 3.1to 26.6 ± 3.2 after intervention. The CRP showed significant reduction from 6.2 ± 2.5 to 1.8 ± 1.2 after intervention.

Table (1): Characteristics of the study sample

Characteristics	Mean ±SD	Range
Age (years)	36±3.5	30-40
Weight (Kg)	93.6. ±7.7	79-109
Height (Cm)	159.6 ± 4.8	150-167
BMI (Kg/m2)	36.7 ±1.5	35.02–39.8

Table (2): Comparison of different parameters before and after intervention in the group (A)

		Mean ±SD (n = 20)	Paired t test
Weight	**Before**	95.3 ± 6.1	$P = 0.000^*$
	After	84.3 ± 8.2	
BMI	**Before**	37.03 ± 1.3	$P = 0.000^*$
	After	32.7 ± 2.3	
RT hand grip	**Before**	28.1 ± 2.9	$P = 0.002^*$
	After	30.4 ± 2.8	
LT hand grip	**Before**	24.4 ± 3.1	$P = 0.000^*$
	After	26.6 ± 3.2	
CRP	**Before**	6.2 ± 2.5	$P = 0.000^*$
	After	1.8 ± 1.2	

Table (3) and figures from 4-6 shows that there was a significant ($P \leq 0.05$) difference before and after intervention regarding all parameters in the group (B). Comparing weight before and after intervention 92.9 ± 8.2 versus 82.1 ± 8.6. Also, this difference appeared in BMI before and after intervention 36.6 ± 1.5 versus 32.3 ± 1.9. Regarding hand grip strength, RT hand grip strength increased from 20.9 ± 2.1 to 24.5 ± 3.5 after intervention. LT hand grip strength increased from 19.2 ± 2.9 to 21.4 ± 2.9 after intervention. The CRP showed significant reduction from 14.05 ± 3.3 to 7.2 ± 3.8 after intervention.

In table (4), Fig (8) and Fig. (9) The long duration of beginning of obesity had been the minor the present hand grip strength was and significant negative association between CRP and hand grip strength. The facilitating role of inflammation in the connection between obesity history and hand grip strength was studied by adjusting for CRP.

Table (3): Comparison of different parameters before and after intervention in the second group (B) (age 25 to 30 years)

		Mean ±SD (n = 20)	Paired t test
Weight	**Before**	92.9 ± 8.2	$P = 0.000^*$
	After	82.1 ± 8.6	
BMI	**Before**	36.6 ± 1.5	$P = 0.000^*$
	After	32.3 ± 1.9	
RT hand grip	**Before**	20.9 ± 2.1	$P = 0.002^*$
	After	24.5 ± 3.5	
LT hand grip	**Before**	19.2 ± 2.9	$P = 0.000^*$
	After	21.4 ± 2.9	
CRP	**Before**	14.05 ± 3.3	$P = 0.000^*$
	After	7.2 ± 3.8	

Table (4): Comparison of after intervention between group (A) and group (B)

	Mean ±SD group (A) (n = 20)	Mean ±SD group (B) (n = 20)
RT hand grip	30.4 ± 2.8	24.5 ± 3.5
LT hand grip	26.6 ± 3.2	21.4 ± 2.9
CRP	1.8 ± 1.2	7.2 ± 3.8

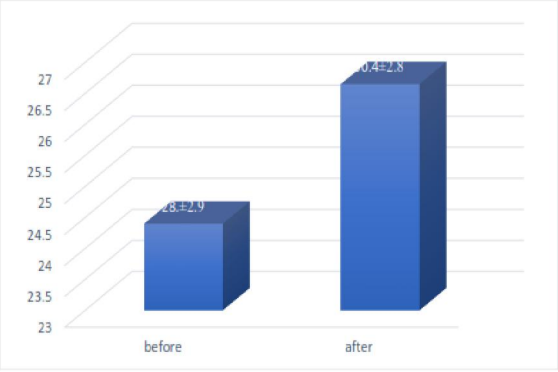

Fig (1) Comparison between mean of right-hand strength before and after intervention of group (A)

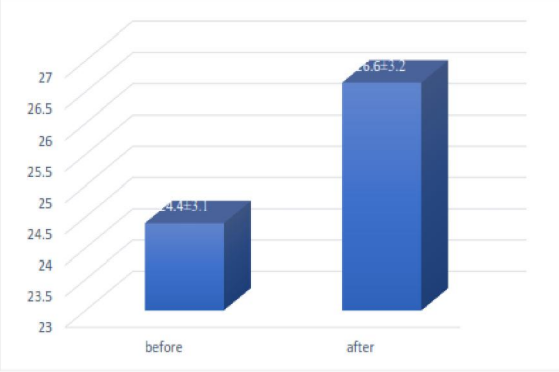

Fig. (2) Comparison between mean values of left-hand strength before and after intervention of group (A)

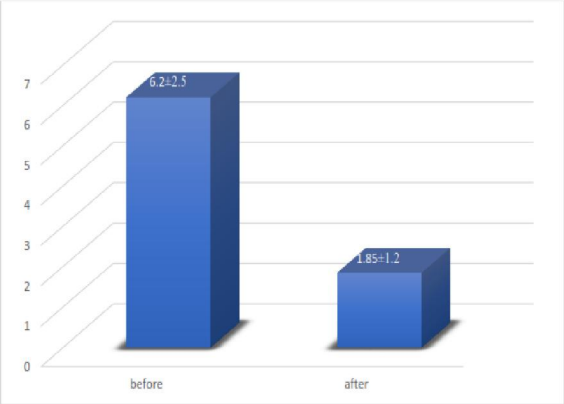

Fig (3) Comparison between mean values of CRP before and after intervention of group (A)

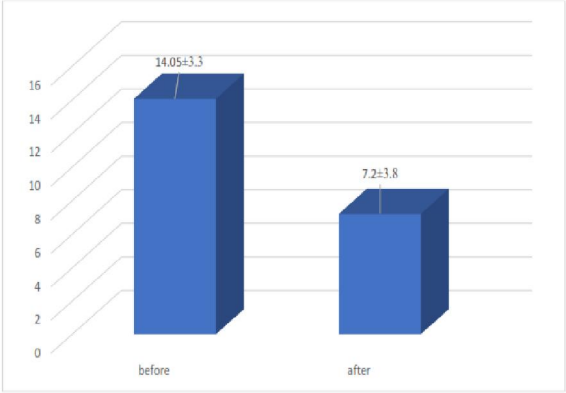

Fig. (6) Comparison between mean values of CRP before and after intervention of group (B)

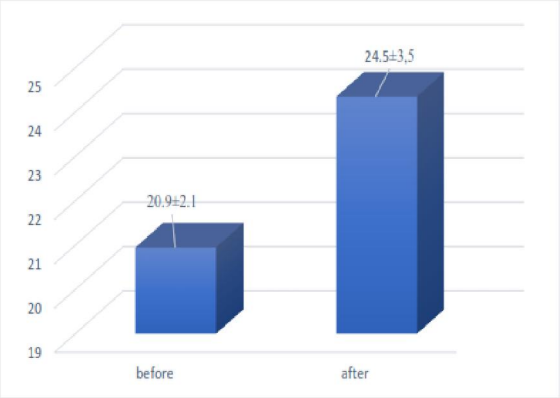

Fig. (4) Comparison between mean values of right-hand strength before and after intervention of group (B)

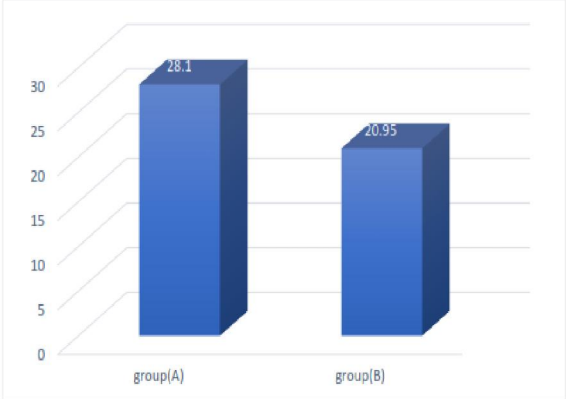

Fig. (7) Comparison between mean values of right hand after intervention between group (A) and group (B)

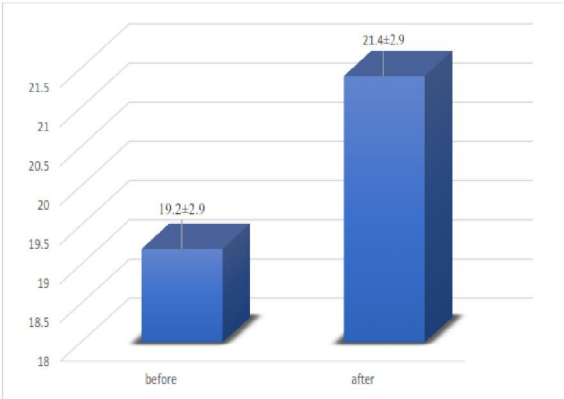

Fig. (5) Comparison between mean values of left-hand strength before and after intervention of group (B)

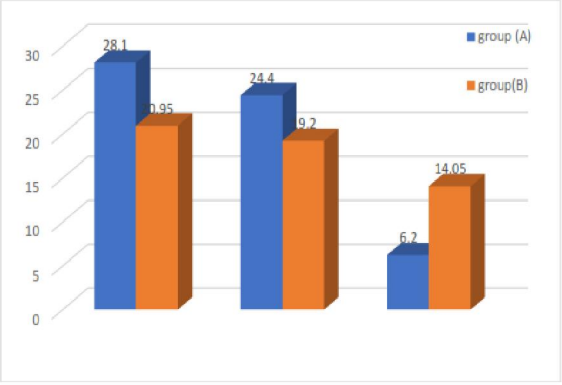

Fig. (8): Comparison between mean values of right hand, left hand strength and CRP before intervention between group (A) and group (B)

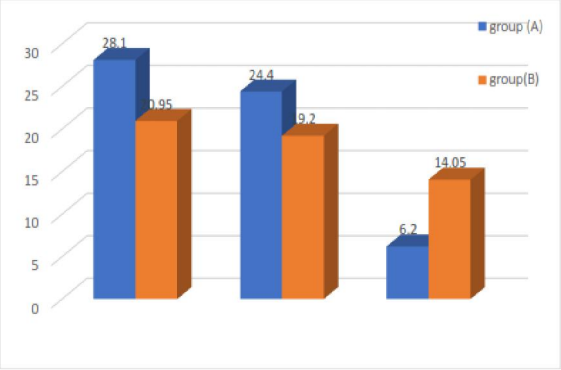

Fig. (9): Comparison between mean values of right hand, left hand strength and CRP after intervention between group (A) and group (B)

4. Discussion

The present study was designed to assess the effects of the history of obesity on hand grip strength and on inflammation after aerobic training. The study was directed on forty obese females, their age ranged from 30 to 40 years old.

In this study, we choose the female class II obesity according to BMI from 35.0–39.9 kg/m2 and this comes in agreement with (Prentice and Jebb,2001) who stated that BMI is a simple guide of weight-for-height that is usually used in categorizing overweight and obesity in adult and juvenile populations and it is the greatest appropriate measure of overweight and obesity for both sexes and also the results comes in agreement with (Sari et al.,2011).

Handgrip strength (HGS) has been introduced as a simple and inexpensive assessment tool for muscular strength. Since HGS was strongly correlated with total muscle strength, which comes in agreement with (Seungyoun,2019)

The results of this study revealed that there is significant reduction in BMI after aerobic training, this finding agrees with (Zi-Qi, 2018). Aerobic exercise means exercises in the case of enough oxygen. For people who want to lose weight, taking aerobic exercise is a long-term plan. Usual aerobic exercises are walking, jogging, climbing, rope skipping, swimming, and riding bikes. Aerobic exercise can use body fat, which in turn causes good weight loss effect. Aerobic exercise can increase blood flow and oxygen transmission capacity and promote blood circulation and inner metabolism. It can also help enhance the function of heart and lung, increase bone density to prevent osteoporosis, fight against ageing, and maintain good mood Therefore, most people take this way to lose weight.

In the present study, there is a significant increase in the hand grip strength measured by dynamometer after aerobic training and decrease BMI, this in agreement with (Jason et al.,2018) who compare handgrip strength, between healthy obese females aged 20 to 65 years with a BMI exceeding 30 kg/m^2 and lean control group non-athletic, healthy female with a BMI up 26 kg/m^2. Results shown lower handgrip strength in obese women. These findings due to impairment of physical fitness because of obesity and its metabolic complications. Also, the results of this study in agreement with (Sari et al., 2007). The combination of high body fat percentage and low handgrip strength is associated with higher levels of CRP, in addition to walking restriction, thus stressing the ring between obesity, muscle strength and functional restriction through cytokine production in adipose tissue, accelerated catabolism in muscle, and excess weight due to decreased physical activity.

In the current study, we have confirmed significantly higher levels of hsCRP in obese females. Also, the results of our study came in agreement with (Ilkay et al., 2010) who tested the connection between obesity and low-grade systemic inflammation as measured by serum high-sensitive C-reactive protein (hsCRP). A possible mechanism for the observed association may be the production of several cytokines by adipose tissue. For example, IL-6 production by adipocytes is the main hepatic stimulus for CRP synthesis.

In this study, there is a significant decrease in the hs-CRP after aerobic training, several other studies (Engeli et al.,2003), (Zoltan et al., 2008) and (Clifton et al.,2005) found that weight loss in obese patients lead to reduce in hs-CRP.

Also, in this study similar with other study, (Hamid et al., 2010) physical activity and exercises were significantly associated with decreased body mass index and obesity, therefore can reduce the inflammatory process, the cardiovascular risk factors, and may reduce CRP levels adequately by reducing adiposity.

The results of this study showed that there is more improvement in hand grip strength in group (A) more than group (B) and that Long-term exposure to obesity is associated with poor hand grip strength later in life which comes in agreement with (hung et al.,2008) that increase quantity of fat tissue may lead to loss of muscle mass and strength with aging, as adipose tissue is not just passive energy storage, but rather, an active metabolic tissue that secretes hormones and proteins. For example, in adipose tissue, either adipocytes directly or infiltrating macrophages produce proinflammatory cytokines and adipokines, which enhance the inflammatory reaction. Increased inflammation, in turn, may lead to destroy

muscles and contribute to muscle mass and strength decline.

The present study has key strengths. First, this study evaluated the effect of long exposure to obesity and hand grip strength. Second, the effect of aerobic exercises on weight reduction and on hand grip strength. Third, the association between the duration of exposure to obesity, inflammation and hand grip strength.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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7/6/2020