“The effects of resistance training on body composition in postmenopausal women”

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ABSTRACT: Obesity especially abdominal fat accumulation after menopause is the main reason of metabolic disorders. The effect of different interventions on visceral fat is a matter of importance though. The aim of this experimental study was to investigate the effects of resistance exercise training on body composition in postmenopausal women. Postmenopausal women were divided into experimental (EXP; n=10) and control (CON; n=10) groups. The exercise consisted of 24 weeks of resistance exercise (3 days/week, 60-75 min/day). Results show that after 24 weeks of training, there was a significant difference between CON and EXP groups in body fat percent, waist circumference and waist to hip ratio (WC, %FB and WHR); however, no significant differences in body weight, body mass index, body fat mass and basal metabolic rate (BW, BMI, BFM and BMR) were observed between them. These results suggest that 24-week exercise training induces a decrease in visceral fat, and this reduction is without weight loss in postmenopausal women. So, we concluded that resistance exercise training is a positive strategy to control visceral fat accumulation in postmenopausal women.

Key words: Body fat mass, Body fat percent, Body mass index, body weight, waist circumference, Waist to hip ratio.

INTRODUCTION

Obesity especially abdominal fat accumulation after menopause is the main reason of metabolic disorders (Carr, 2003; Turgeon et al., 2006). Results of different studies show that Estrogen plays an important role in weight control and fat distribution (Cooke and Naaz, 2004). Evidences show that when Estrogen decreases due to menopause, accumulation of fat in abdomen occurs (Evans et al., 2001; Piche et al., 2005). This change in distribution pattern of fat related to undesired metabolic changes (Tchernof et al., 2000) and is a risk factor for metabolic syndrome (Carr, 2003; Piche et al., 2005). On the other hand, reports show that aging in menopause related to decrease in physical activity. This situation has a key role in the progression of cardiovascular diseases (Bauman, 2004; Thompson, 2003). In the past few years there have been a number of studies on the relationship between physical activity and diseases due to lack of physical activity and obesity in postmenopausal women. The relationship between these two could be justified by the effects on risk factors such as visceral fat. Results of the studies show that physical activity lowers visceral fat and improves body composition (Bauman, 2004; Tsutsumi et al., 2001; Giannopoulou et al., 2005). Whereas there is a strong relationship between obesity, especially abdominal obesity and metabolic disorders, it seems that losing weight and fat mass could lead to a decrease in visceral fat and a marked improvement in body composition. The effect of different interventions on visceral fat is a matter of importance though. Some results show that when physical activity is a part of intervention for losing weight a great deal of losing visceral fat happens while there is a little weight loss (Thomas et al., 2004; Damirchi et al., 2010). Therefore, physical activity has been used as a safe and effective treatment for body composition in past studies (Tsutsumi et al., 2001). According to several reports, body composition changes desirably after different exercise training programs before postmenopausal in human and animals (Latour et al., 2001; Tsutsumi et al., 2001; Giannopoulou et al., 2005). However, the effects of resistance training on body composition in women facing lack of endogen estrogen is less paid attention to and there are inconsistencies in the results (Bonganja et al., 2011; Orsatti et al., 2012; Phillips et al., 2012). Moreover, whereas decrease in muscle strength and muscle mass start from middle age and
continue to old age (Hunter et al., 2004; Bonganha et al., 2011), it seems that resistance training must take a main part in exercise training programs for elders. Strength training not only increases muscle strength and improve physical performance, but also increase energy expenditure and fat oxidation and lead to a decrease in visceral fat (Bonganha et al., 2011; Orsatti et al., 2012). Therefore, in this research, the effects of 24-week resistance training on body composition of postmenopausal women facing estrogen deficiency were studied.

MATERIALS AND METHOD

After the first recall, 32 postmenopausal women were volunteered in our exercise training program. A number of 20 obese healthy women, whose BMI were above 30 kg/m^2 were chosen. They were at least 1 and most 6 years away from their last menstruation period, had no family history of diabetes, heart failure, myocardial heart attack, kidney diseases, eye lattice bleeding, hypertension, and cancer according to the questionnaires. From at least a year before the study, none of them took part in any exercise training or drug treatment for losing weight and had no history of hormone-therapy. They were randomly divided into two EXP and CON groups. An introduction session was held during which participants were informed of the purposes of this study and its steps then testimonials were signed by participants. In order to keep the life styles the same for both groups, a meeting was held once in every two weeks. Background information on subject characteristics, the time since food was last eaten and the bladder last voided were recorded before testing.

After fasting for at least 12 h, indexes of overall obesity (BW, BMI, %BF and BFM), central obesity (WC and WHR) and BMR were measured by Body Composition Analyzer (In Body; 3.0; Biospace Co Ltd, Seoul, Korea) using eight electrodes and four frequencies. These electrodes were in contact with the surface of each hand and foot at the thumb, palm and fingers, forehead and heel. In this method gender, age and height are entered manually into the system via a digital keyboard, and the subject’s BW, %BF, BFM, WHR, BMR and BMI are displayed immediately. These variables were measured with subjects wearing lightweight clothing. WC was measured in triplicate to the nearest 0.1 cm with a non-stretch measuring tape at midway between the lowest rib and the iliac crest (Pigford et al., 2011). All the measurements were done from 800-10:00 AM. BIA measurements were made by one trained experimenter and all anthropometric measures were done by another one. Standing height (HT) was measured without shoes. HT was measured to the nearest 0.1 cm during a maximal inhalation using a Schorr measuring board. Exercise training program was done for 24 weeks, 3 days a week, 60-75 minutes a day by an experienced supervisor. Each exercise session began with 10 minutes of warm up, 45 minutes of resistance training and 5 minutes of cool down. Strength trainings started with high frequency (16 repetitions) and low load (40% of their 1 repetition maximum or 1RM), and gradually load increased and frequency deceased by the same degree as in last 2 weeks it reached the lowest frequency (8 repetitions) and highest load (80% of their 1RM). The content of strength trainings was the same during these 24 weeks (Bemben et al., 2000). In the first 2 weeks, participants were taught how to work with weights, warm up and cool down. In the first 5 weeks the rate of increasing the load was low in order for the participants to get used to it and to motivate them the amount of load increase was due to their progression. The adding amount was added just when the participants could deal with the weights and pick them up easily. Resistance training program in the study were taken from Hartman et al (2007) which included in elbow flexion, elbow extension, seated overhead press, back extension, bent-leg sit-up, chest press, leg extension, leg curl, and Smith machine squat (Hartman et al., 2007). All exercises performed for 2 sets of 10 repetitions, except bent-leg sit-up performed for 15–20 repetitions. The reason to choose these exercises was that subcutaneous fat of these areas are measured for the assessments of fat percentage (one of the fat and body composition indexes) using caliber. Participants in CON group avoided any regular physical activity during the study. All data are presented as mean ± standard error. After 24 weeks of training, before statistical analysis, the normal distribution and homogeneity of the variances were tested. Statistical comparisons between groups were performed by independent-t test was used. All the statistical analyses were run according to the object by SPSS18 software and the level of statistical significance was set at P<0.05.

RESULTS

All participants successfully completed the intervention protocols. Baseline characteristics for the participants are reported in table 1. Results show that after 24 weeks of training, there was a significant difference between CON and EXP groups in %FB, WC and WHR; however, No significant differences in BW, BMI, BFM and BMR were observed between them (Table2).
Table 1. Baseline characteristics for the participants. Data are means ± standard error

<table>
<thead>
<tr>
<th></th>
<th>CON(n=10)</th>
<th>EXP(n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age(y)</td>
<td>54.12±1.38</td>
<td>53.4±0.95</td>
</tr>
<tr>
<td>Height(cm)</td>
<td>153±1.12</td>
<td>160± 1.58</td>
</tr>
<tr>
<td>BW (kg)</td>
<td>74.1±6.08</td>
<td>73.4± 4.10</td>
</tr>
<tr>
<td>%BF</td>
<td>43.07±1.66</td>
<td>44.12±1.58</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>33.2± 1.84</td>
<td>33.8± 1.75</td>
</tr>
<tr>
<td>WC(cm)</td>
<td>97.12±3.73</td>
<td>95.27± 4.01</td>
</tr>
<tr>
<td>WHR</td>
<td>1.05±0.025</td>
<td>1.02± 0.048</td>
</tr>
<tr>
<td>BFM</td>
<td>32.19±2.73</td>
<td>32.49±2.52</td>
</tr>
<tr>
<td>BMR</td>
<td>1152.99±33.49</td>
<td>1148.78±32.14</td>
</tr>
</tbody>
</table>

BW, Body Weight; BMI, Body Mass Index; WC, Waist Circumference; WHR, Waist to Hip ratio; %BF, Body Fat percent; BFM, Body Fat Mass; BMR, Basal Metabolic rate

Table 2. Body composition changes before (Pre) and after (Post) the strength training program. Data are means ± standard error

<table>
<thead>
<tr>
<th></th>
<th>CON(n=10)</th>
<th>EXP(n=10)</th>
</tr>
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<tbody>
<tr>
<td>BW (kg)</td>
<td>75.31±3.02</td>
<td>72.32±3.10</td>
</tr>
<tr>
<td>%BF</td>
<td>43.27±1.58</td>
<td>36.2±1.49**</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>33.12±1.52</td>
<td>28.14±1.13</td>
</tr>
<tr>
<td>WC(cm)</td>
<td>97.52±3.12</td>
<td>84.4±2.21**</td>
</tr>
<tr>
<td>WHR</td>
<td>1.08±0.032</td>
<td>0.94±0.018**</td>
</tr>
<tr>
<td>BFM</td>
<td>32.48±2.81</td>
<td>26.53±2.07</td>
</tr>
<tr>
<td>BMR</td>
<td>1152.71±33.24</td>
<td>1245.88±33.54</td>
</tr>
</tbody>
</table>

BW, Body Weight; BMI, Body Mass Index; WC, Waist Circumference; WHR, Waist to Hip ratio; %BF, Body Fat percent; BFM, Body Fat Mass; BMR, Basal Metabolic rate.

**P<0.01 vs. Control group

DISCUSSION

Results of the present study show that 24 weeks of resistance training without any changes in BFM and BW resulted in a significant difference in WC, WHR, and %BF in EXP group compared to CON group. These findings are consistent with Teixeira et al (2003) and Viljoen et al (2011) results. They found the same changes in postmenopausal women (Teixeira et al., 2003; Viljoen and Christie, 2011). Whereas, previously Joseph et al (1999) had reported that body composition did not change in postmenopausal women after 12 weeks resistance training (Joseph et al., 1999). Some studies compared changes of visceral fat after weight loss, before and after estrogen deficiency (due to menopause or ovariectomy). Cleifton et al (2004) reported that after 12 weeks of weight loss (due to low calorie diet), postmenopausal women lose more visceral fat than women who are in the ages before menopause (Cleifton et al., 2004). These findings are in contrast with those of Park and Lee (2003) who showed that after 12 weeks of interventions (life style changes) for weight losing, postmenopausal women lose less visceral fat than the premenopausal women (Park and Lee, 2003). Choi et al (2005) also compared trained ovariectomized and non-ovariectomized rats and concluded that after 8 weeks of training, body weight was lower in ovariectomized group, but the amount of visceral fat was meaningfully higher in ovariectomized (Choi et al., 2005). The reason why visceral fat decreases more due to training than other interventions is that visceral adipose tissue is more sensitive to lipolytic stimulation which is a response to catecholamine hormones (Giannopoulou et al., 2005). Regarding the role of estrogen in visceral fat metabolism, decrease of abdominal fat could be attributed to the estrogen biosynthesis after menopause. The main source of estradiol after menopause is transformation of testosterone to estrogen by aromatase enzymes (Misso et al., 2005). The information about how training affects aromatase enzymes is limited. However, research evidences suggest that the considerations should be made in studying the complicated relationships between estradiol, body weight, and metabolism in postmenopausal women are testosterone splash from adrenal and transformation of Androstenedione and Dehydroepiandrosterone to estrogen derivatives (Vella and Kravitz, 2002). As mentioned in the findings, there was no significant difference in BW and BMI between EXP and CON groups. Frost (1992) believed that mechanical stimulations can compensate the lack of estrogen in postmenopausal women and prevent the diminution of bone tissues through staying the absorbency of the bone (Frost, 1992). There have been lots of studies on the effects of physical activity as a physical stress on the bones. According to the evidences, exercise training as a therapeutic intervention, plays an important role in bone retrieval, lowering the diminution rate of the bone and increasing muscle mass (Bemben et al., 2000; Kerr et al., 2001; Bongantha et al., 2011; Orsatti et al., 2012; Westcott, 2012; ). Bone density and muscle mass did not assess in the study, but an increase in bone density and muscle mass due to resistance training could be a justifying reason for lack of weight loss in the EXP group of this study. In
summary, the results from the present study suggest that 24 weeks of resistance exercise training could improve body composition, losing body fat especially in central areas, and probably desired metabolic changes even without any change in body weight. Additional investigation is necessary to evaluate some effective factors on body weight such as density of minerals in the bones, the rate of energy expenditure and calorie intake. From a clinical point of view, resistance exercise training is a positive strategy to control visceral fat accumulation in postmenopausal women. Therefore, we suggest more studies with an extensive intervention time and an increased number of variables such as bone density, muscle mass, calorie intake, considering the changes promoted by resistance exercise training on the analyzed variables.

ACKNOWLEDGMENT

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REFERENCES


