ABSTRACT
The visceral fat is the accumulation of the fat tissue in the abdominal internal organs. It's a gelatinous fat mass that actually surround the internal abdominal organs, including the liver, pancreas and kidneys. Main purpose of this work is to search studies that focus on the effects of exercise training in reducing visceral fat mass. We searched in PubMed using these key words: exercise training, visceral fat: Filter used were; studies in the last 12 years; studies that were complete, free full papers, and studies that have used exercise interventions program for visceral fat. From 17 studies, only 4 were selected to be part of this research. Exercise intervention varied from 12 to 3 months. A total of 146 subjects 18 years + were enrolled in these studies. In general, all exercise intervention programs have been effective in reducing visceral fat and also improving insulin sensitivity and secretion. Other studies should be carried out on a larger scale, taking into account more age groups, alternative methods of addressing the issue, inclusion of various combinations of medication therapies, nutrition, and standardized and specific exercise regimens according to age groups.

Keywords: exercise training; intervention program; insulin sensitivity; therapy; visceral fat

1. Introduction
The visceral fat is the accumulation of the fat tissue in the abdominal internal organs. This phenomenon is also known as the deep deposition of fat mass, and which is different from the subcutaneous fat. It's a gelatinous fat mass that actually surround the internal abdominal organs, including the liver, pancreas and kidneys. Increase of waist perimeters in children and adolescents (Li C et al., 2003; McCarthy HD et al., 2005) and the addition of fat mass to the abdominal part especially in the internal organs of this area, is a stronger risk factor for insulin resistance and cardiometabolic diseases than BMI (Lee S et al., 2006a; Lee S et al., 2006b). The extra body weight from the fat deposits in the internal organs of the abdomen are regarded as toxic since they generate several issues for the body and can bring about or induce different inflammations. Fat tissue functions as the specific organ by secreting hormones and inflammatory agents. Excessive fat deposits surrounding organs stimulate the production of cytokines, pro-inflammatory chemicals that cause inflammation. At the same
time, they disrupt the hormones that control hunger, weight, mood, and cognitive function. According to a recent meta-analysis (Escalante Y et al., 2012), combined exercise enhances HDL concentration whereas aerobic exercise conducted for 60 minutes three times per week reduces the concentration of LDL cholesterol and triglycerides in obese children. Contrary to the build-up of subcutaneous fat in the periphery, type 2 diabetes and cardiovascular disease are significantly associated with excessive abdominal internal organ fat accumulation (Nicklas B.J et al., 2004). The usefulness of physical exercise in treating metabolic syndrome is supported by facts and statistics on the beneficial impact it has on enhancing new risk factors for the development of the condition, such as issues with adipokine production and low-grade inflammation. (You T, Nicklas BJ., 2008). In overweight women who participated in a training program with endurance exercises, high-intensity exercise was shown to be more effective at reducing visceral abdominal fat than low-intensity exercise. This effect was partially attributed to a greater negative energy balance and potential increases in the secretion of lipolytic hormones (Irving et al., 2008). Particularly, lipolytic hormones and catecholamines stimulate lipolysis via B3-adrenoceptors, which are more prevalent in fat mass around the internal organs of the belly than in fat mass beneath the skin. (Ibrahim., 2010). It has long been understood that exercise is crucial for the non-pharmacological treatment of dyslipidaemia as well as for the management and prevention of obesity. Regular exercise (30–60 minutes/day, 3 days/week) has been linked to significant decreases in abdominal fat mass and improvements in glycemia and insulin resistance in adults (Irwin ML et al., 2003; Sigal RJ et al., 2007; Ross R et al., 2000; Poehlman ET et al., 2000).

2. Objectives
Main purpose of this work is to search studies that focus on the effects of exercise training in reducing visceral fat mass.

3. Methodology
We searched in PubMed using these key words: exercise training, visceral fat: Filter used were; Studies in the last 12 years; Studies that were complete, Free full papers, and studies that have used exercise interventions program for visceral fat.

4. Results and Discussion
From a total of 17 studies that have been shown in the general search from PubMed website have been selected in the first phase, and after the review and selection criteria control, only 4 of them have been selected to be part of this research. All selected studies are listed as below:
1. Lee S et al., 2012
2. Monteiro AP et al., 2015
3. Zhang H et al., 2017
4. Meng C et al., 2022
Table 1. Data for research type, subjects age, intervention duration, type of intervention and methodology used in the reviewed studies

<table>
<thead>
<tr>
<th>ID and research type</th>
<th>Subject number</th>
<th>Subjects age</th>
<th>Intervention duration</th>
<th>Type of intervention and methodology used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lee S et al., 2012, A Randomized, Controlled Trial</td>
<td>45 obese male adolescents</td>
<td>12–18 years of age</td>
<td>3 months</td>
<td>The aerobic exercise program mandated that participants work out three times per week on treadmills, ellipticals, or stationary cycles for 60 minutes per session (including a 5-minute warm-up and a 5-minute cool-down). The resistance program consisted of ten whole-body workouts that were performed three times a week for 60 minutes each. Each workout includes the following exercises using stack weight equipment: leg press, leg extension, leg flexion, chest press, latissimus pulldown, seated row, biceps curl, and triceps extension. Participants used adequate lifting methods to complete one or two sets of 8–12 repetitions at 60% of their baseline repetition maximum (RM) throughout the first four weeks. The individuals worked out to exhaustion over two sets of 8–12 repetitions throughout weeks 4–12. Between sets of equipment, subjects rested for 1-2 minutes. For the control group researchers, required the subjects to continue their daily life routine activity.</td>
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<td>2. Monteiro AP et al., 2015</td>
<td>32 obese adolescents</td>
<td>11-17 years old</td>
<td>20 weeks</td>
<td>Two distinct workout programs were used. 1. 50-minute sessions of aerobic exercise 3 times/week (walking and jogging). The teenagers started the intervention’s first two weeks at Stage 1, which involved moderately intense exercise (13-14 on the Borg scale), with the goal of training between 65%-85% of VO2peak. 2. Concurrent training was done three times a week, with each session lasting 60 minutes and included equal amounts of resistance and aerobic exercise (the aerobic exercise protocol was followed, but only for 30 minutes). Adolescents in the control group were told not to alter their typical food or exercise habits over the whole 20-week period.</td>
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<td>3. Zhang H et al., 2017 Research Article</td>
<td>43 obese female adolescents HIIT (n = 15), MICT (n = 15), no training (CON, n = 13)</td>
<td>18–22 years</td>
<td>12 weeks</td>
<td>The MICT group members engaged in continuous exercise on a cycle ergometer (Monark, 839E, Sweden) at a 60% V-O2max intensity throughout each training session until the desired 300 kJ of work was completed. The individuals in the HIIT group, on the other hand, repeatedly performed 4-minute cycling activity sessions at 90% of their maximum heart rate, followed by a 3-minute passive recovery, until the desired 300 kJ of effort was accomplished. Exercises for the warm-up and cool-down were uniform and the same for both groups. The participants in the two</td>
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Different exercise programs ranged in length from 12 weeks to 3 months. 146 participants aged 18 or older in total were included in these investigations. All exercise intervention programs have, on the whole, proved successful in lowering visceral fat and enhancing insulin sensitivity and secretion. In order to highlight the advantages of aerobic exercise on young people's insulin sensitivity and secretion, abdominal organ fat mass, and belly fat mass, Lee S et al. (2012) compared aerobic exercise versus resistance training. 45 male teenagers from two different fitness programs were chosen at random and participated in them for three months. The abdominal fat buildup was reduced using magnetic resonance imaging. Both types of exercise were effective in reducing the amount of abdominal fat and raising (dropping) insulin sensitivity and secretion. Also, in the research conducted in 2015 by Monteiro AP et al. the main goal was to compare the effects of two different types of training on body composition and metabolic profile in obese adolescents: aerobic training and "concurrent" training (a type of training that combines weight training with cardiovascular/endurance training). 32 obese adolescents who had participated in two different training groups for a total of 20 weeks (50 min x 3/week) were compared to a control group of 16 individuals. The percentage of body fat mass (%BF), also known as fat-free body mass, was measured before and after the exercise intervention using an x-ray scanner. Examining the effects of high-intensity interval training and continuous exercise on the amount of fat mass in the internal organs of the belly section of young overweight girls (HIIT) was the main objective of the Zhang H et al. 2017 study. 43 people in total—15 in the experimental groups exercised for 200 kJ for one session per day, three days per week for the first four weeks (warm-up and cool-down not included). The training frequency was raised to four days per week from the fifth through twelfth weeks, and both groups performed 300 kJ worth of work in each session. Exercise heart rate and subjective physical effort (on a Borg scale of 6–20) were measured for each participant under close supervision.

Training session began with a 5-min warm-up and cool-down at 55 to 60% of one's maximum heart rate. The warm-up exercise consisted of three minutes of moderate-intensity jogging, one minute of dynamic stretching, and one minute of accelerated running. In the first 4 weeks of MICT, individuals ran for 30 minutes at 60% of MAS; the next two weeks, the training intensity was raised to 65% and 70%, respectively. Participants in the HIIT regimen ran for the first four weeks at 90% of MAS, then rose to 95% for weeks 5-8, and finally 100% for weeks 9-12.

Overall total subjects' number

| 165 | 12 weeks to 3 months |
HIIT group, 15 in the continuous, moderate-intensity exercise group, and 13 in the control group—were involved in this study. The 12-week exercise programs are already over. The individuals’ fat mass was calculated using the scanner. In the study conducted by Meng C et al. in 2022, 45 overweight adolescent boys took part in this program with the main goal of investigating the effects of high-intensity exercise and interval training on body composition, cardiorespiratory fitness, and cardiometabolic indicators in overweight boys aged 10 to 13. Random selection was used to determine which set of 15 participants would receive HIIT (n = 15), or high-intensity training. Both the control group (CON, n = 15) and the group that would engage in continuous workouts of average intensity (MICT, n = 15) each received an additional 15 patients. The training groups experienced a 12-week regimen of three sessions per week of instruction.

5. Conclusions

Overall, reviewed studies suggested that exercise training, particularly HIIT, also a combination of resistance and aerobic training, moderate-intensity aerobic exercise, and regular supervised exercise training can effectively reduce visceral fat in adults over 18 years old. Nevertheless, even though regular supervised exercise training is recommended and can lead to significant reductions in visceral fat, it is also important for reducing the risk of several chronic diseases such as diabetes, cardiovascular disease, and cancer. Based on these studies review results, we can say that in general all types of exercise were effective in reducing abdominal fat and enhancing (decreasing) insulin sensitivity and secretion throughout the course of several weeks of training compared to the respective control group. More extensive research should be done, taking into account more age groups, other approaches to the problem, a range of drug therapy combinations, nutrition, and standardized exercise programs tailored to each age group.

6. Bibliography


Total and Intraabdominal Body Fat in Postmenopausal Women: A Randomized, Controlled Trial. *Obstetrical & Gynecological Survey.*
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