

Effect of Exergaming and Resistance Training on Obesity: A Review Article

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Abstract

Background: Obesity-related comorbidities preventive interventions are active area of research recently. Appropriate management of obesity should provide multiple health benefits beyond weight loss. For years, caloric restriction and more energy expenditure are the first and most cost-efficient strategies to manage obesity. Physical activity has been recommended as an important non-pharmacological strategy to manage obesity and have multimodal beneficial effect on obese subjects.

Aim of Study: Is to review the effect of exergaming or (virtual reality exercise) and resistance training on body fat and obesity co-morbidities.

Conclusion: Although the positive physiological effect of exergaming on health related outcome measures in obese individuals it is considered an appealing method to encourage and engage obese people in higher levels of physical activity, there is still lack of evidence on its effect compared to the effect of traditional exercises as resistance training on reducing obesity complications.

Key Words: Obesity – Exergaming – Resistance training – Body fat.

Introduction

OBESITY is a complex phenomenon that increases the risk of cardiovascular diseases (CVD), strokes and diabetes [1]. It's a leading cause of preventable death; Egypt is one of the leading countries in the prevalence of obesity, with higher incidence reported among females compared with males. The total annual cost of treatment of obesity co-morbidities was estimated to be over 60 million EGP. Besides, the economic burden of obesity complications, the clinical burden of obesity is undeniable [2].

Etiology of obesity is complex, but the key drivers of the obesity pandemic are behavioral and

environmental aspects (sedentary lifestyles combined with excess energy intake) [3]. The recent worldwide quarantine and the world wide lockdown in reaction to COVID19 pandemic may promote more sedentary lifestyle and a home centered environment. That is anticipated to have bad influence on number of obese population all over the world [4].

In the last few years, there was an increased interest of using virtual reality (VR) technology in management of obesity. Exergaming, active video games or also named virtual reality exercise (VRE) is a new and innovative technology, which immerses individuals in multi-sensory, three-dimensional world generated by computer wherein they interact with the virtual environment [5]. Virtual reality exercise integrates exercise and games into a virtual environment with the purpose of boosting higher physical activity among people [6,7]. A combination of physiological and psychological benefits of physical activities makes VRE an appealing strategy to encourage sedentary people to exercise [8].

Resistance training (RT) is safe form of exercise and its inclusion, as an integral part of an exercise therapy program for weight management, is recommended [9]. Evidence suggests that RT enlarges muscle mass, which may lower metabolic risks as dyslipidemia, and type 2 diabetes mellitus, and cardiovascular disease [10].

Recently there was growing evidence of effectiveness of high volumes of resistance training (HVRT) as strategy for reducing body fat, and obesity related blood biomarkers [11]. The purpose of this review is to evaluate the potential clinical effectiveness and biological mechanisms of HVRT and VRE in the treatment of obesity and preventing

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obesity-comorbidities as cardiovascular CVD, dyslipidemia and type 2 diabetes.

Clinical effect of virtual reality exercises on management of obesity:

Mechanism of action of virtual reality exercises:

Virtual reality exercises (VRE) require the players to be physically engaged with onscreen avatars and require the players to do variety of body actions such as kicking, punching, jumping and ducking. It utilizes the time spent in front of the television to promote a playful form of physical activity and weight reduction [12]. In the last decade, VRE have been proposed in obesity prevention and treatment as a potential tool to increase physical activity with better adherence level and more engaging form of exercise compared to traditional exercise [13]. Increased energy expenditure might result in a negative energy balance which might accelerate the reduction of adipose tissue lipoprotein concentrations [14]. Reduction in lipoproteins and adipose tissue is associated with lowering cardio-metabolic risks [15].

Effect of virtual reality exercises on body fat:

Studies on the usefulness of VRE in changing body composition have demonstrated mixed results. Despite the fact that most of VRE are limited to light-moderate energy expenditure [16], some studies have shown that VRE is effective in promoting weight loss in obese population with a decrease in body fat [17-20].

In 2021 a systematic review was conducted by Valeriani et al., to analyze the use of VRE as a therapy of children obesity, revealed a potential favorable effect of VRE on weight-related variables in obese children and adolescents. However, the authors claimed that owing to the small number and the heterogeneity of the existing research, it is yet unclear if VRE is beneficial enough to maintain weight reduction and improving overall body composition for obese children [21].

In 2016, Zeng and Gao [22] tried to analyze the available literature to study the possible impact of active video games on health-related outcomes in overweight/obese individuals. Of the seven randomized controlled trials and the comparative research that they assessed for adiposity outcomes, four found beneficial effect of VRE on body mass index (BMI), body composition, or fat mass.

Effect of virtual reality exercises on obesity comorbidities:

A 2017 study by Amorim et al. [23] looked at the effects of exergaming using Xbox 360 Kinect

Just Dance game on cardiovascular risk factors and adipokine levels in adult female participants. The data show that blood and body adiposity were improved as cholesterol, low density lipoprotein (LDL), triglycerides, leptin along with fatty acid concentrations, fat percentage and waist hip ratio were all decreased. Also, the inflammatory mediators associated with cardiovascular risks as tumor necrotic factor (TNF) and C-reactive protein (CRP) were also shown to decrease significantly following the training period. So, exergaming was successful in reducing cardiovascular risks for women.

In 2019 Rahayu et al. [24] studied the effect of performing VER on blood glucose, heart rate, and oxygen saturation levels in college students. The results showed that there was a significant difference between the control and treatment groups regarding the blood glucose and heart rate with no significant difference in percentage of oxygen saturation.

In 2018 Staiano et al. [25] investigated the effect of VRE on cardio-metabolic health among children with overweight and obesity. They observed meaningful improvements in children's systolic and diastolic blood pressure, total cholesterol, and LDL.

Based on these findings VRE can be an appealing alternative to traditional exercises routines for promoting health and limiting obesity related health burdens. But we should keep in mind that most of the available randomized controlled trials in literature conducted on VRE had a control group with no intervention. So, this suggests that VRE may play beneficial role on body weight and blood biomarkers by replacing sedentary activities but the question if it as beneficial as traditional exercises is still not answered.

Clinical effect of high volume resistance training on management of obesity:

Mechanism of action of high volume resistance training:

Resistance training (RT) is the anaerobic type of exercise in which the muscle works out against an unusual weight in order to increase the strength [26]. There is a wealth of research describing the beneficial effects of RT on symptoms and management of several chronic diseases such as diabetes and cardiovascular disease [27].

This can be explained by the fact that resistance training increase muscle mass [28]. Greater muscle mass necessitates more energy at rest for ongoing tissue maintenance so increasing resting metabolic

rate. A 1kg increase in trained muscle tissue may elevate resting metabolic rate by about 20 calorie per day, which seems to be a major factor in fat loss [9]. According to the American College of Sports Medicine position stand on Exercise and Physical Activity for Older Adults, there is evidence to show that resistance training may minimize cardiovascular illnesses by lowering LDL, triglycerides levels and boosting high density lipoprotein (HDL) values [29].

This exercise modality is associated with improved insulin sensitivity and quicker rapid glucose uptake. That can be explained by increase in muscle cross-sectional area, which is associated with qualitative improvements in muscle metabolic properties, including increase in the density of glucose transporter type 4, glycogen synthase content/activity, and insulin-mediated glucose [30,31]. A result of a recent systematic review, found a dose-response relationship between training volume and muscle hypertrophy. Higher volume of training induces more muscle mass [32]. So, higher volume of training would produce better clinical effect on body composition and blood biomarkers.

Effect of high volume resistance training on body fat:

A significant number of studies have shown that RT has little or no effective change in total body weight, as it is associated with a decrease in fat mass (FM) and a concomitant increase in lean body mass (LBM) [9,33,34]. Exercise volume appears to play an important role in response magnitude of fat loss [35]. High volume resistance training (HVRT) sessions with short to moderate recovery between sets (<3min) are common practices used for muscular hypertrophy [36,37]. These programs included total repetition ranges of 24-150 per exercise and were conducted at least twice a week-found to have significant effect on body fat mass reduction [38].

In study comparing low versus high volume resistance training, even though percentage of body fat was reduced in both trained groups, HVRT seems to be necessary to reduce abdominal adiposity [39]. In more recent study also compared low volume resistance training versus high volume resistance training in adult untrained women, the high volume seems to be necessary to promote significant reductions in trunk fat [11].

Effect of high volume resistance training on obesity comorbidities:

An increasing number of studies concluded that resistance training was also able to promote a

reduction in triglyceride, LDL, and cholesterol, when practiced in a regular and oriented manner. The effectiveness of resistance exercise as a way to promote lipid profile adjustments in different age range has been observed by several authors [40-43]. More recently a randomized controlled trial was conducted to investigate the effect of resistance training on metabolic biomarkers and functional fitness on 168 older women. The results indicated that resistance training produced significant benefits on functional fitness and metabolic biomarkers including fasting blood glucose, triglycerides, total cholesterol, high and low density lipoprotein [44].

When high volume is compared with low volume of resistance training on blood biomarkers (IL-6, TNF- α , LDL, glycated hemoglobin "HbA1c"), the results showed that HVRT was necessary to improve these variables [40]. Although high volume has shown better adaptations in these variables, this can be a limiting factor for adherence to the exercise [45].

In a recent systematic review, Lee et al., found that evidence from well-designed randomized trials suggests that in the absence of weight loss, resistance exercise alone is associated with a significant increase in muscular strength and reductions in total fat and insulin resistance in previously sedentary adolescents with obesity. However, whether resistance training alone is associated with improvements in CVD factors is less clear [46].

Conclusion:

The results of this review suggest a possible positive effect of VRE on weight-related outcomes in obese population. However, due to the limited number and the great variation of the available studies, it is not yet possible to define if they can be effective enough to sustain weight loss and prevent obesity comorbidities especially in obese adult population. Despite psychological effect and high adherence level to VRE, it is still unclear if it's effective enough to substitute the traditional exercises' as resistance training and produce the same physiological effects on body fat and blood biomarkers in obese adult population. Therefore, further high-quality research is needed to compare VRE effect to scientifically credible form of exercises as HVRT.

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تأثير تمارين ألعاب الواقع الافتراضى وتمارين المقاومة على السمنة : مقال مراجعة

التدخلات الوقائية المرتبطة بالسمنة هي مجال نشط للبحث في الآونة الأخيرة. يجب أن توفر الوسائل العلاجية للسمنة فوائد صحية متعددة تتجاوز فقدان الوزن فقط. لسنوات عديدة، كان الحد من السرعات الحرارية وزيادة بذل الطاقة عن طريق زيادة النشاط البدني هي الإستراتيجيات الأولى والأكثر فعالية وأقل تكلفة لعلاج السمنة. تمت التوصية بالنشاط البدني باعتباره استراتيجية غير دوائية مهمة لعلاج السمنة وله تأثير مفيد على جوانب متعددة للصحة في الأشخاص الذين يعانون من السمنة.

الهدف من هذا البحث : هو مراجعة تأثير ألعاب الواقع الافتراضى أو تمرين الواقع الافتراضى وتمارين المقاومة على دهون الجسم والأمراض المصاحبة للسمنة.

الخلاصة : على الرغم من التأثير الفسيولوجى الإيجابى لتمارين الواقع الافتراضى على مقاييس صحية مختلفة للأفراد الذين يعانون من السمنة حيث يعتبر طريقة جذابة لتشجيع الأشخاص الذين يعانون من السمنة المفرطة وإشراكهم فى مستويات أعلى من النشاط البدني، لا يزال هناك نقص فى الأدلة على تأثيره مقارنة بالتأثير الناتج من التمارين التقليدية كتمارين المقاومة للحد من مضاعفات السمنة.