Impact of Virtual Reality on Body Composition in Children With Obesity

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ABSTRACT

Obesity particularly in childhood considered a great problem around the world specially in developed countries .This phenomena should attract the attention of investigators to search for the actual causes of problem exaggeration and to find a national strategy for stopping the prevalence of this phenomena .The nature and style of modern life and distribution of fast meals rich in fats and oils is considered responsible factors leading to obesity in very young ages and adolescents. The advancement of modern technology and industries, which attract the youth and children for entertainment with computer games and electronic plays without doing physical activities. Therefore, we must find a suitable way for attracting children and adolescents to the preferred activities and working in groups instead of sedimentary activities. Video game is a seated activity, which increases the sedentary behavior of children in spite of considering as one of the most favorite activities for children. However, the target of the present study is to decrease the passive activity to the active activity. The new type of virtual reality named active video games (AVG) may enhance innovation for active life pattern. The recent models of AVG tools need children's physical interaction that gives the chance for young ages and adolescents to do their favorite activity and make exercises together. Virtual Reality (VR) is considered a pleasure tool to overcome both the overweight and sedentariness in infants. Recently, a team of multi-interested researchers including physiotherapists, psychologists, engineers, and pediatricians has worked in a team to judge this advanced technology.

Methods: Eighty overweighed and obese children of both sexes were selected from nutrition clinics to participate in this study: 40 children were treated with diet and virtual reality (study group), and 40 children were treated with diet only (control group) for four months and their ages range from 15 to 18 years in both sexes. BMI of forty overweighed children was 85% to 95% and their Bioelectrical Impedance (BIA) (inbody 120) evaluated by treating with virtual reality and diet regime and forty children were treated with diet regime only.

Findings: T-test was conducted for comparison between both groups and revealed significant difference between both groups in body mass index and weight before and after treatment.

Interpretation: Based on the previous findings, there is positive efficacy of virtual reality on children with obesity.

Key Words: Children obesity, Virtual Reality, BIA, Low Calorie Diet, Active Video Games.

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INTRODUCTION

Obesity in childhood is known as a fat increase in the body (BF) while no accord is found on a cutoff point for elevated fats percentage of overweight or obesity among infants and adolescents. Over weight was defined as equal or higher than 95 % of body mass index (BMI) for age and "at risk for overweight" as between 85 to 95% of body mass index

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for age as defined previously by the Center for Disease Control and Prevention [1] while the European investigators defined the overweight as equal or more than 85% and identified the obesity as equal or higher than 95 % of BMI [2].

Obesity can have a drawback effects on a child's health represented mainly in the appearance of many diseases as hyperglycemia , tumors and cardiovascular illness and depressing psychosocial effect such as low identity esteem and dishonor [3].In addition, about 40% to 70% of the obesity in childhood can extend to adulthood [4],the causes of obesity among childhood and adolescents are multifarious and multifactorial comprises unhealthy eating styles and an inactive lifestyle, together or each of them could be attributed to amplify during tiresome, watching TV and on stage videogames [5].

Physical activity (PA) beside changes in the dietary behavior has established to become useful in improving body condition, lipid profile concentration, hypertension, insulin activity, self-appreciate, cardio-respiratory fitness (CRF) and neurocognitive function [6]. There are promising information to propose that CRF attenuates some of the causal factors to metabolic syndrome in adolescence, often in parallel of adiposity [7].The profit of physical activity in obese persons treatment seems to be clear, but the study results explain that the optimal exercise modality remains unclear to be recommended for its treatment. The impracticality to make the sort of PA typically suggests such as type, frequency, period & intensity, the absence of an apparent report about its defined target and the truth of the prescribed PA are some of the causes described in the articles to clarify the low observance and efficiency of infants' obesity management programs [8].

With respect to the role of virtual reality (VR) technology which found to be increase the capability for the multisensory, establishment of convenient, interactive, three-dimensional objects, motivation of the environments, through which human being presentation can be provoked, measured, recorded, and donate scientific evaluation and options for intervention which can`t obtained via conventional methods [9].

The use of VR technology is less common among children and adolescents. It is usually used in infants' complaining from special disabilities (autonomic nervous system motor affections, brain lesions, autism,), behavioral disorders and psychological phobias [10], but it has been mainly used for leisure purposes. In this last condition, investigators demonstrated the significance and applications of interaction devices in the market and the tools which permit for excessive use and permit persons to intermingle with digital data via natural body actions more than possibility during playing customary game interfaces (for example , Sony EyeToy, Konami Dance Dance Revolution (DDR), Microsoft Kinect, Nintendo Wii,) [11]

The most essential thoughts concerning the return of virtual reality is the behavior that enable the persons to involve in an experiment and training activity providing that are forced to join in any digital game implanted in a VE. This perception encouraged study to investigate the importance of such technologies and the degree of usefulness for pediatric health concern issues and disadvantages[12].

Randomization:

All children were randomly divided into two groups of equal number (forty for each) and their body composition were measured by BIA (Inbody 120).

Group (A):- forty over weighted children whose BMI Percentile was between 85% and 95%.

Group (B):- forty over weighted children whose BMI Percentile was between 85% and 95%.

Both groups received low calorie diet for four months and study group used virtual reality in form of active video games with low calorie diet.

MATERIALS AND METHODS

Eighty over weighted and obese children of both sexes were selected from nutrition clinics to participate in this study: 40 children were treated with diet and virtual reality (study group), and 40 children were treated with diet only (control group) for four months.

The inclusion criteria included Children's ages range from 15 to 18 years in both sexes. BMI percentile of forty over weighted children was 85% to 95% treated with virtual reality and diet regime and forty children were treated only with diet regime and their body composition were measured by BIA (inbody 120) .

The Exclusion criteria included any genetic disorders, chromosomal, endocrine, or psychiatric disorders taking antidepressant medications or cortisone and engaging in any kind of sport, any musculoskeletal or neuromuscular dysfunction.

Tools and Instrumentation:

A-For subject's selection

For evaluation:

The body mass index (BMI):

It is a value derived from the mass (weight) and height of an individual. The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m^2 resulting from weight in kilograms and height in meters.

Inbody 120

Bioelectrical impedance was measured using the Inbody 120 multi-frequency analyzer (Biospace). The InBody 230 is a segmental impedance device, which uses a tetra polar 8-point tactile electrode method [13]. Ten impedance measurements are performed by using 2 different frequencies (20 and 100 kHz) at each segment (right arm, left arm, trunk, right leg, and left leg). Subjects removed their shoes and socks and wore light clothing. The participants then stood on the device while it measured body weight. Thereafter, the subjects' identification number, age, sex, and height were entered into the machine. Impedance was measured with the subject standing still and holding handgrips that were slightly abducted. Data output, as calculated by the manufacturer's algorithm, included fat mass, % body fat, FFM, trunk FFM, and appendicular FFM (sum of right arm, left arm, right leg, and left leg). All subjects were first tested with the same Inbody 120).

2) For treatment:

a) Low calorie diet for both groups

b) X-box as a virtual reality tool:

Figure 1: Virtual Reality tool.

X-box and Kinect (Figure 1) are Microsoft latest technologies, which study body movements and create their games in a way that let X-box 360° users control characters and play the games only by body movements and this technology will determine body movements by guessing from latest records. Kinect is an X-box camera like a webcam but smarter than that.

Procedures:

A) For evaluation

- The **body mass index:**

It is a value derived from the mass (weight) and height of individuals of both groups, their BMI will be from 85 to 95 percentile.

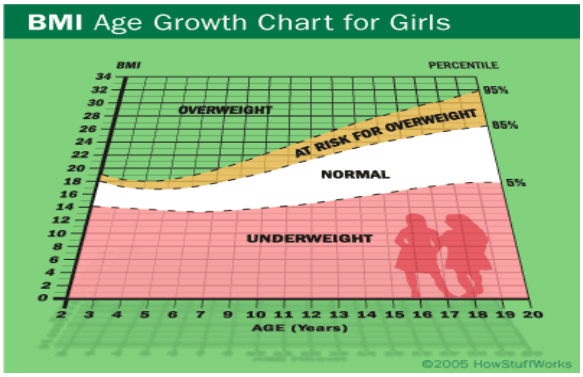
A) BMI chart was used for both groups to assess their obesity before and after treatment.

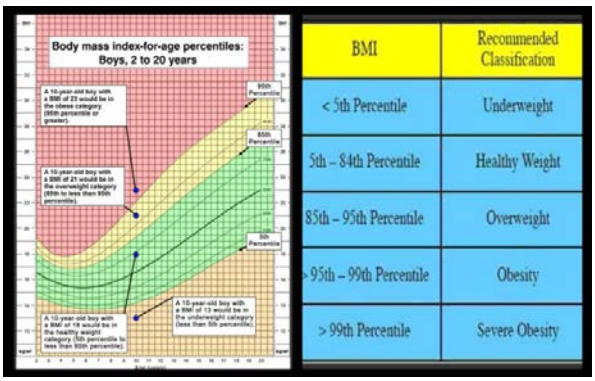
- Body Mass Index (BMI) is a number calculated from a child's weight and height.

BMI-for-age weight status categories and the corresponding percentiles are shown as follows:

Weight Status Category Percentile Range

- Underweight -----Less than 5 percentile.
- Healthy weight ----5 percentile to less than 85 percentile.
- Overweight---- 85 to less than 95 percentile.
- Obese----- equal to or greater than 95 percent.





B) Weight and height of both groups.

b) Bioelectrical impedance (Inbody 120)

Key Specifications

Bioelectrical Impedance (BIA) Measurement Items Bioelectrical Impedance (Z) 10 Impedance Measurements by Using 2 Different Frequencies (20kHz, 100kHz) at Each of 5 Segments (Right Arm, Left Arm, Trunk, Right Leg, and Left Leg)

Electrode Method Tetra polar 8-Point Tactile Electrodes

Measurement Method Direct Segmental Multi-frequency Bioelectrical Impedance Analysis Method, DSM-BIA

Output (Thermal Results Sheet) Results:

• Weight
• Muscle Mass
• Percent Body Fat
• Body Mass Index

Outputs

(InBody Results Sheet via Data Management Software Lookin'Body)

Results and their Interpretation

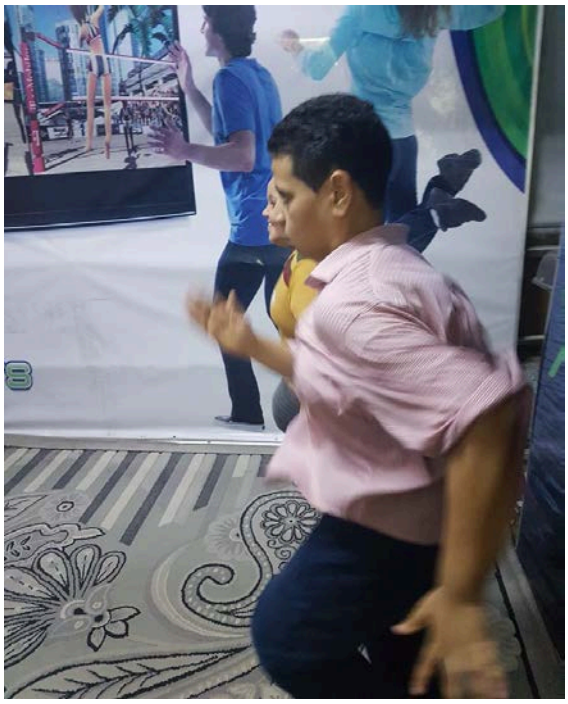
• Body Composition Analysis (Body Fat Mass, Weight)
• Muscle-Fat Analysis (Weight, Skeletal Muscle Mass, Body Fat Mass)
• Obesity Analysis (Body Mass Index, Percent Body Fat)
• Body Composition History (Weight, Skeletal Muscle Mass, Percent Body Fat)
• Weight Control (Target Weight, Weight Control, Fat Control, Muscle Control)

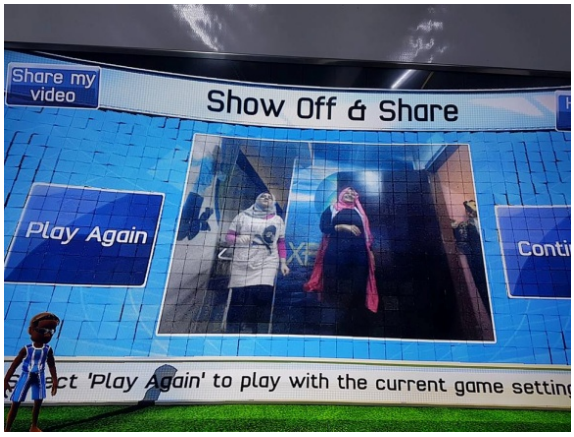
B) For treatment:

The children were divided into two groups (control group and study group).

- Control group took diet regime to control their diet under supervision of nutritionist and their parents.
- Study group took diet regime with active videogames (x-box); for overweight children (Wii sports boxing, tennis, and bowling) for Upper body obesity [14] and overweight children Xbox (Dance Dance Revolution DDR Ultramix 2) Lower body obesity [15].

AVG type was coded based on the main body movements required to play the games: upper body movements (e.g., Wii sports), lower body movements (e.g.,(DDR) DDR).





Each treatment session lasted an hour for each child of study group and 3 times per week for 4 months.
In treatment sessions, I used tennis, bowling, boxing, volleyball, running, football, aerobic exercises (DDR).

Statistical analysis

Descriptive statistics and t-test were conducted for comparison of subject characteristics between both groups. T test was conducted to compare mean values of weight, muscle mass and PBF between both groups; and paired t test was conducted to compare between pre and post treatment mean values of the measured variables in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical tests were performed through the statistical package for social sciences (SPSS) version 19 for windows (IBM SPSS, Chicago, IL,USA).

RESULTS AND DISCUSSION

Characteristics of subject:

As shown in table (1), the mean ± SD of ages of groups were control and studied. The results revealed that no significant differences was recorded between two groups concerning the subject characteristics ($p = 0.13$).

Table (1): Comparison of subject characteristics between control and study groups:

	x̄±SD		MD	t-value	p-value
	Control group	Study group			
Age (years)	14.45 ± 1.05	14.81 ± 1.07	-0.36	-1.52	0.13*

x̄,Mean; SD, Standard deviation; MD, Mean difference; p value, Probability value; *, Non significant.

Within group comparison:

There was a significant decrease in weight, muscle mass and PBF post treatment in control group compared with that pretreatment ($p = 0.0001$).The percent of decrease in weight, muscle mass and PBF were15.24, 7 and 11.52%, respectively.(table 2, figure 1).

Regarding the study group, the results showed that post treatment in both weight and PBF was significantly decreased ($p = 0.0001$) in comparison with pretreatment, where the decline recorded in weight and PBF were average 22.81 and 16.52 %, respectively. On the other hand, post treatment of the muscle mass was increased significantly ($p= 0.001$) if compared with that in pretreatment and the increments were reached 2.55% (Table 2, Figure 1).

Table (2): Comparison of weight, muscle mass and PBF between pre and post treatment in control and study groups.

	x̄±SD		MD	% of change	t-value	p-value
	Pre treatment	Post treatment				
Control group						
Weight (kg)	93.93 ± 14.53	79.61 ± 13.32	14.32	15.24	38.68	0.0001**
Muscle mass (kg)	28.85 ± 6.59	26.83 ± 6.9	2.02	7	18.28	0.0001**
PBF (%)	45.18 ± 4.49	40.42 ± 5.04	4.76	10.53	11.52	0.0001**
Study group						
Weight (kg)	95.34 ± 14.14	73.59 ± 11.96	21.75	22.81	36.62	0.0001**
Muscle mass (kg)	29.38 ± 7.31	30.13 ± 7.56	-0.75	2.55	-3.75	0.001**
PBF (%)	44.79 ± 5.86	37.39 ± 5.79	7.4	16.52	14.38	0.0001**

x̄,Mean; SD, Standard deviation; MD, Mean difference; p value, Probability value; **, Significant.

Comparison between groups:

The obtained results pointed out non-significant variations ($p>0.05$) in weight, muscle mass and PBF in pre-treatment and control group , whereas, there was a significant decrease ($p < 0.05$) in the weight and PBF between control and study groups and post-treatment groups , in addition to the presence of significant increase($p < 0.05$) in muscle mass of treated group compared with control group as shown in table 3.

Table (3): Comparison of weight, muscle mass and PBF between control and study groups pre and post treatment.

	x̄±SD		MD	t-value	p-value
	Control group	Study group			
Pre treatment					
Weight (kg)	93.93 ± 14.53	95.34 ± 14.14	-1.41	-0.44	0.66*
Muscle mass (kg)	28.85 ± 6.59	29.38 ± 7.31	-0.53	-0.33	0.73*
PBF (%)	45.18 ± 4.49	44.79 ± 5.86	0.39	0.33	0.74*
Post treatment					
Weight (kg)	79.61 ± 13.32	73.59 ± 11.96	6.02	2.12	0.03**
Muscle mass (kg)	26.83 ± 6.9	30.13 ± 7.56	-3.3	-2.03	0.04**
PBF (%)	40.42 ± 5.04	37.39 ± 5.79	3.03	2.48	0.01**

x̄, Mean; SD, Standard deviation; MD, Mean difference; p value, Probability value; *, Non-Significant; **, Significant.

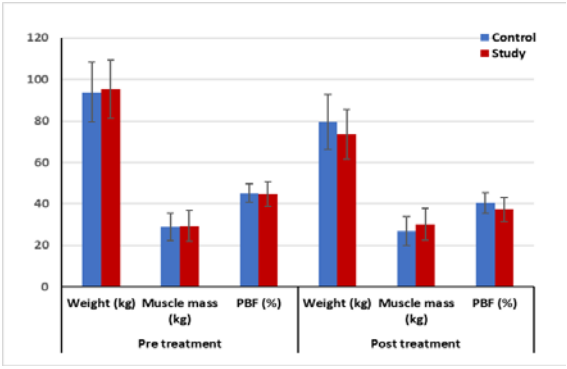


Figure (1) Mean weight, muscle mass and PBF pre and post treatment in control and study groups.

The present study was conducted to determine the effect of virtual reality on reducing obesity in children.

Eighty children (were randomly selected) suffering from obesity selected from Nutrition Clinics. Their ages ranged from 15 to 18 years old (their ages were selected not to be affected with hormonal factor). BMI of 20 males and 60 females ranged from 30 to 38kg/ m². They were randomly selected into two groups. Both were equal in number. Group A (Control group) including 10 males and 30 females managed by low calorie diet. Group B (Study group) including 10 males and 30 females managed by low calorie diet and virtual reality in form of Xbox (Kinect active games). The mean ± SD BMI pretreatment of control group was 35.03 ± 2.9 kg/m² and that of study group was 35.4 ± 2.94 kg/m².

The result of the current study revealed that there were statistically significant reductions in body weight, BMI, and body fat percent in both groups. However, the percent of the reduction in body weight, BMI, WHR and PBF in study group treated by virtual reality and low calorie diet was more than control group treated by low calorie diet only. Moreover, there were rose in Skeletal Muscle Mass of study group but there was reduction in SMM.

Maddison et al. [16] demonstrated the role of active video games on infant`s body weight, body condition, suitability of body and activity levels within 6 months using a similarity process. The advantages of this study included long duration period, the big size of representative sample and a home-based setting if compared with other trials in this respect. About three hundred and twenty-two children were participated, their ages averaged 10 to 14 years old. They classified them into two nearly equal groups. The first group (160 children) used an active gaming system (included five active games) with intensity nearly equal to the daily physical activity. The second control group (162 child) as daily playing style. From the obtained results, its noticed little changes in both fat % and BMI among two groups (intervention Vs. control group), while no significant variations was found between two groups in both fitness and physical activity.

Some of investigators did not know about the degree or intensity of these games as a vigorous to cause remarkable effects on heart and cardiovascular system, respiratory system and on body structure to be fit enough. Another study was done by Strakeret al[17] said that playing active video games for 15 min per day will lose about 2.5kg of fat tissues per year if the energy balance will kept constant. Maddison et al[15] reported that children can lose 1kg of fat tissues within 9 weeks or about 6.0kg/year when playing video games for 30 min/day, 5 days/week when the other factors still constant along the experimental period. Also, the same authors, study the influence of a Dance Revolution intervention on BMI in thirty obese persons for about 6 months. The results revealed that no significant effects of the active video games on BMI when applied for either 3 or 6 months.

Barnett et al[18] and LeBlanc et al [19] studied the influence of active game intervention for 6 months on BMI and body confirmation of obese children aged 10-14 years, the results recorded a minor effect. They added that more investigations is required to cover much of aspects such as long term participation of the active games, and studying its effects over long time.

A study based on home intervention was carried on children played video game for 12 weeks using video game attached with peripheral device, the results revealed a non-significant variation in PA between control and intervention groups [20]Regardless of this result, Graves et al.(year..?) showed an increase of the active game in the case of using attached peripheral device and reduction of sedentary video games, but the disadvantages of this study was the low number of participants (2=42), beside

small numbers (29 of 42 participants) provided valid PA data.

Another study was conducted on two-arm parallel trial for estimation of the influence of an AVG for 24 weeks on body condition , physical fitness and PA, they reported that new generation of video games affect positively on BMI and body condition of overweight children [16]. This study reported a decline of the daily time spent for performing sedentary video games. Although the average time spending for MVPA did not change. A further limitation of this study, the snack food and video games diaries were not determined toward other parameters.

Baranowskiet al[21]. studied the influence of AVG for 13 weeks RCT on obese children , they found no great changes in the activity of children after using AVG or playing sedimentary video game .The same authors found that the outcomes were not moderated by parental apparent locality, demographic characteristics or BMI score of children . In addition, Maddison et al[22]. found that playing AVG for 6 consecutive months, RCT, had a positive role on body condition of obese or overweight children and this is due to improvement of aerobic robustness**.**

CONCLUSION

We can conclude that: the active video games require encouragement and attraction in their promotion of physical activity to harvest good health care. Active video games play a role in decreasing the time children spent during playing sedimentary action in spite of its difference in the real sports. To overcome the phenomena of obesity among children, playing active video games may be helpful.

The researchers must focus their work on large numbers of populations and sound intervention trials for estimating the effects on physical activity of children for long period. Advanced technology in designing games is continuously developing and refining to provide accommodation according to consumer demand for new gaming experiences. Interventions using this technology should take benefit of this to supply an attractive intervention to interested peoples .

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