

Effect of Rebound Exercises in Overweight Individuals on BMI, Waist- Hip Ratio and Lung Functions : Randomized Control Trial

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ABSTRACT

Background: Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. Overweight and obesity is commonly assessed by using Body Mass Index (BMI), and waist hip ratio. Therapies like pharmacotherapy, aquatic therapy, aerobic exercises, and aerobic exercises along with diet therapy have proven to be beneficial in weight loss interventions. Also it is been proved that there is a inverse relationship in between overweight/ obesity and BMI, Waist – hip ratio and lung functions. One of the therapy is the Rebound therapy. Trampoline is easily used in conjunction with balls and wedges to produce more dynamic effects.

Aim: To compare the effects of Rebound Exercises along with Diet protocol with Diet protocol alone in overweight individuals in terms of: BMI, Waist hip ratio, Lung function : FEV1, FVC and FEV1/FVC ratio.

Material and methodology: 64 consenting participants fulfilling the selection criteria were included. All the subjects were evaluated on outcome measures like BMI, Waist –hip ratio and lung functions before and post 4 weeks of intervention. Participants were randomly allocated in 2 groups. Group A followed only diet protocol and Group B received Rebound exercises along with diet protocol. The data was collected and analysed. Paired t test was used for inter- group comparison and unpaired t test was used for intra –group comparison.

Results: Statistical significant improvement was seen in BMI, waist circumference, FEV1 and FVC with $p < 0.05$ in both the groups. There was no significant difference in between the groups in terms of BMI, waist –hip ratio and lung functions.

Conclusion: The study concludes that Diet protocol with Rebound exercises was equally effective than Diet protocol alone in reducing weight in overweight adolescent population in terms of BMI, waist circumference and improving lung functions in terms of FEV1 and FVC after four weeks of intervention.

Keywords: Rebound Exercises, Overweight Individuals, BMI, Lung Functions.

I. INTRODUCTION

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. ⁽¹⁾ There are many causes for overweight and obesity. Understanding the causes of overweight and obesity is one of the first steps in halting the epidemic. Weight gain is the normal physiologic response that

occurs when energy intake exceeds energy expenditure. ⁽²⁾ Human obesity results from a complex interaction of factors, including genetic, environmental, metabolic, physiologic, behavioural, social and racial influences.

Changes in diet and reduced energy expenditure via patterns of work and leisure contribute greatly to the

increase in obesity worldwide. Research demonstrates that fast food consumption directly relates to Total Energy Intake and inversely relates to diet quality; moreover a direct and positive association exists between fast food and body weight in adolescents primarily those who are overweight and obese.

Environmental risk factors for overweight and obesity are very strong and inter-related. Sub-optimal cognitive stimulation at home and poor socioeconomic status predict development of obesity. The treatment of overweight and obesity in children and adolescents requires a multidisciplinary approach with a holistic outlook. The components of overweight and obesity treatment include dietary management, physical activity enhancement, restriction of sedentary behaviour, pharmacotherapy and surgery.

Dietary management should aim at weight maintenance or weight loss without compromising appropriate calorie intake and normal nutrition. Due emphasis should be given to initiate and maintain healthy eating patterns.

Physiotherapy plays an important role in weight loss interventions. Therapies like aquatic therapy, aerobic exercises, and aerobic exercises along with diet therapy have proven to be beneficial in weight loss interventions. One of the therapies is the 'Rebound Therapy'. The phrase 'Rebound therapy' was coined by the founder Eddy Anderson in 1969; to describe use of trampolines in providing therapeutic exercise and recreation for people with wide range of special needs.⁽³⁾ It allows opportunities for an individual to 'more experience' the stimulating feedback from dynamic feedback. Bouncing on a trampoline may sound more like fun than therapy that has developed in leaps and bounds over past 20 years. The experience is so liberating that 'clients do not realize how hard they are working'. Trampoline is easily used in conjunction with balls and wedges to produce more dynamic effects. Risk of injury from falls, which a physiotherapist sometimes faces when working on

patients with balance skills are reduced by the more forgiving surface of trampoline.⁽⁴⁾

However, there is limited evidence on effect of rebound exercises in overweight/ obese population. Also, there is lack of evidence to study addition of diet protocol along with rebound exercises therefore, the purpose of this study is to compare the effects of Rebound Exercises along with Diet protocol with Diet protocol alone in overweight individuals in terms of: BMI, Waist hip ratio, Lung function : FEV1, FVC and FEV1/FVC ratio.

II. METHODOLOGY

The study was approved by ethical committee of the institute. The study was conducted in Pune. It was a single blinded- randomized control trial. Sample size was 70. 800 individuals were screened and those who fulfilled the inclusion and exclusion criteria were selected in study using simple random sampling. 256 subjects fulfilled the inclusion and exclusion criteria of which 70 willingly consented and participated in the study. 6 participants dropped out from the study. 64 consenting participants with age between 18- 24 years, both genders, BMI 25 – 29.9 kg/m² were included in the study, while subjects with any smoking or alcohol addiction, fractures, cardiac or respiratory disorders and participants already enrolled in other exercise protocols and diet plans were excluded. Participants were randomly allocated in 2 groups using chit method. All the subjects were evaluated on outcome measures like BMI, Waist –hip ratio and lung functions pre and post 4 weeks of intervention. Group A followed only diet protocol (prescribed by dietician) and Group B received Rebound exercises along with diet protocol. Rebound exercises were given 3 times per week in non-consecutive days for 4 weeks and 40min total duration each session.

III. STATISTICAL ANALYSIS

Statistical analysis was done using Graph Pad Instat Software. As the data was parametric, Paired t test was used to compare the differences of scores on pre and post intervention within a single group. Unpaired t test was used to compare differences between the two groups i.e. Group A and Group B. Results were concluded to be statistically significant with $p < 0.05$.

IV. RESULTS

There were no significant differences in between the two groups before the training, implying that the subjects were equally assigned to both groups and the groups were comparable. Both the training programs showed statistically significant difference ($p < 0.05$) after four week of training which suggest that both trainings were effective in reducing weight, BMI, and waist circumference.

There was no significant difference ($p > 0.05$) after four week of training in reducing hip circumference and waist- hip ratio which suggest that both trainings were not effective.

A significant difference was seen ($p < 0.05$) after four week of training in both groups on FEV1 and FVC. These findings suggest that both trainings were effective in improving lung function via FEV1 and FVC.

There was no significant difference ($p > 0.05$) after four week of training on FEV1/FVC ratio in both groups because both FEV1 and FVC improved. No significant difference was noted ($p > 0.05$) after four week training. These findings suggest that both trainings were equally effective in reducing weight, BMI, waist circumference, and improving FEV1 and FVC. Although, both trainings were not effective in reducing hip circumference, waist- hip ratio and improving FEV1/FVC ratio.

V. DISCUSSION

The study examined the effect of Rebound exercises along with diet protocol as compared to diet protocol only in overweight adolescent individuals.

The result of the study showed significant reduction in BMI after four weeks of intervention in both groups (Table 1). For group A there was a decrease in fat intake. Along with low fat diet fresh fruits and vegetables were recommended. Weight loss was mainly due to burning of calories. The total energy expenditure and resting energy expenditure might have increased.⁽⁵⁾ For group B bouncing on a mini-trampoline in one place influences metabolic output. Pattern of jogging or bouncing on a mini-trampoline is primarily vertically oriented. Raising centre of gravity usually costs more metabolically as seen with activities like treadmill walking with a graded incline, or activities similar to hiking. Jogging on a mini-trampoline seems more unstable than on treadmill and therefore exercising on mini-trampoline should result in higher caloric expenditure. The mini- trampoline has a comparable metabolic expenditure to treadmill.⁽⁶⁾

The study showed no statistical significant difference in waist –hip ratio in both the groups pre and post intervention (Table 3). In Group A weight reduced, BMI reduced, which might be the reason for decrease in waist circumference (Table 2). Study supporting this is Lee Hooper et al in 2012 conducted a study which stated that meta-analysis of 9 randomized control trials found significantly lower BMI and waist circumference following low fat diet. ⁽⁷⁾ Moreover consumption of green tea elevates both, the metabolic rate and the rate of fat oxidation. ⁽⁸⁾

Group B revealed mean reduction in waist circumference. Study supporting this result is Lawrence D. Koning et.al in 2007 conducted a study which stated that although there may be advantages

of the WHR over the WC, but WHR is more difficult to perform and is a less reliable measure than WC. Moreover, WHR may be inappropriate to assess obesity or weight loss. A non-obese and obese individual may have the same WHR which could remain constant during weight change. ⁽⁹⁾

There was improvement in FEV1 and FVC both (Table 5, 6). In subjects of group A fruits and vegetables contain significant amounts of antioxidant vitamins C and E and beta-carotene, which may protect the lungs from oxidative damage due to pollution. Vitamin C is present in intracellular and extracellular lung fluids and supports the normal hydration of airway surfaces. Its deficiency may lead to dry sticky mucous membranes lining the airway which may increase the resistance of airway passage. Vitamin E is present in extracellular lung fluid and lipid membranes, where it converts oxygen radicals and lipid peroxyl radicals to less-reactive forms. Beta-Carotene is a free radical scavenger present in tissue membranes. Consumption of fruits and vegetables exhibited an increase in FEV1. ⁽¹⁰⁾

In subjects of group B keeping balance and position on trampoline burden a lot of pressure on antigravity muscles and increases the blood flow to active muscles; subsequently increasing functional capacity. Movement on trampoline has a vibrational effect on muscle spindles that fine tune the muscle tension. At a certain level of oxygen intake the pulse rate is lower on trampoline compared to running on treadmill and oxygen efficiency is higher in trampoline exercise. This study also showed that FEV1, FVC improved. Regular exercise improves pulmonary function and also improves work tolerance by decreasing ventilation rate for given workload. Improvement in respiratory muscle strength, cellular respiration and Cardiovascular systems along with revascularization of muscles are among direct physiological effects. ⁽¹¹⁾ Rebound exercises were given only for 4 weeks and 12

sessions which might be the reason that Group B was equally effective as Group A.

This study consisted of small sample size and jumps that were tough to perform or had a risk of fall like kangaroo jumps were not included in the study. Long term follow up can be carried out in future studies. Other outcome measures like lean body mass, Calories expenditure, Resting metabolic rate and energy expenditure can be taken. The study can be carried out in other populations. Resistance exercises in Rebound Therapy can be added in future studies.

CLINICAL IMPLICATION

Mini-trampoline is affordable, safe and convenient for exercising at home especially for individuals who cannot go to gymnasium. Individuals don't realize how hard they are working on a trampoline. In a seriously stressed day-to-day living in the modern world, rebounding practice may help in reducing stress, anxiety and worry and increased self-esteem. Aerobic exercises help in reducing weight which is a proved fact but Rebound therapy is one which is cost effective and does not need any specific kind of exercise which needs supervision, so boredom is minimized. For receiving maximum possible value from rebounding, everyone should bounce at least 15-30 min daily. Bouncing on a trampoline is more like fun than therapy.

VI. CONCLUSION

The study concludes that Diet protocol with Rebound exercises was equally effective than Diet protocol alone in reducing weight in overweight adolescent population in terms of BMI, waist circumference and improving lung functions in terms of FEV1 and FVC after four weeks of intervention.

APPENDIX

Abbreviations:

1. BMI: Body Mass Index
2. WHR: Waist –Hip Ratio
3. FEV1: Forced Expiratory Volume in 1 sec
4. FVC: Forced Vital Capacity

5. WHO: World Health Organization
6. HRmax: Heart Rate Maximum
7. HR rest: Resting Heart Rate
8. RPE: Rate of Perceived Exertion

Protocol for Rebound Exercises ⁽³⁾:

Warm up	Stretching of Hamstrings, Quadriceps, Calves, Pectorals, Achilles tendon, Treadmill walking at 4mph for 10min
Cool down	Stretching of hamstrings, Calves, Quadriceps, Pectorals, Achilles tendon for 5 min
Week 1	HRmax calculation: $220 - \text{age}$ Target HR = $40\% (\text{HRmax} - \text{HR rest}) + \text{HRrest}$ RPE on Modified Borg's Scale: 1-3 Slow bounces Concentrate on breathing Variations: feet twists, feet forward-backward, arms apart to get bounce Pulse Pace Bouncing: Bird flying (arms up and down as bouncing). Variations: Punching up, arms forward, side punches
Week 2	Target HR = $60\% (\text{HRmax} - \text{HR rest}) + \text{HRrest}$ RPE on Modified Borg's Scale: 3-5 Add plus jumps Variations: Add arms to jumps Running in place Frequent flower bounce type, Add arms overhead and clap, Vice versa with leg variation. Jumping jacks.
Week 3	Target HR = $60\% (\text{HRmax} - \text{HR rest}) + \text{HRrest}$ RPE on Modified Borg's Scale: 5-7 Knees bend on trampoline, Twist arms and torso to one side while hips move the opp side. Variations: Add wind shield wiper twist, Add arms overhead.
Week 4	Target HR = $80\% (\text{HRmax} - \text{HR rest}) + \text{HRrest}$ RPE on Modified Borg's Scale: 5-7 Start with flying high. No arm movements necessary. Try to relax when in air. Arms up while going up and vice versa.

Table 1. BMI

Group	Pre intervention		Post intervention		Values		Inference
	Mean	SD	Mean	SD	p	t	
A	26.16	0.96	25.5	0.93	<0.0001	9.289	Significant

B	26.4	1.16	25.7	1.2	<0.0001	8.809	Significant
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Table 2. Waist

Group	Pre intervention		Post intervention		Values		Inference
	Mean	SD	Mean	SD	p	t	
A	92.3	5.6	92	5.9	<0.0001	2.061	Significant
B	90.03	5.7	89.43	5.8	<0.0001	4.443	Significant

Table 3. Waist- Hip ratio

Group	Pre intervention		Post intervention		Values		Inference
	Mean	SD	Mean	SD	p	t	
A	0.86	0.04	0.86	0.04	0.115	1.621	Not Significant
B	0.85	0.06	0.85	0.05	0.73	0.34	Not Significant

Table 4. FEV1

Group	Pre intervention		Post intervention		Values		Inference
	Mean	SD	Mean	SD	p	t	
A	2.5	0.21	2.62	0.24	0.0007	3.791	Significant
B	2.39	0.26	2.5	0.27	0.0004	4.012	Significant

Table 5. FVC

Group	Pre intervention		Post intervention		Values		Inference
	Mean	SD	Mean	SD	p	t	
A	2.87	0.22	2.98	0.21	0.0032	3.197	Significant
B	2.74	0.29	2.86	0.31	0.0018	3.406	Significant

Table 6. FEV1/FVC ratio

Group	Pre intervention		Post intervention		Values		Inference
	Mean	SD	Mean	SD	p	t	
A	87.12	4.3	87.79	4.6	0.353	0.942	Not Significant
B	87.22	4.5	88.16	4.7	0.333	0.982	Not Significant

VII. REFERENCES

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