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Effect of Treadmill Training Versus Short Circuit Exercises on Total Cholesterol for Obese Children

[1]A.R. Tawfiq, [1]E.S. Salem, [2]M. Tawfiq and [2]N.A. Abo Ella
[1]Department of Physical Therapy for Growth and Developmental Disorder in Children and its Surgery, Faculty of Physical Therapy, Cairo University, Cairo, Egypt
[2]National Institute of Nutrition, Egypt

Corresponding Author: A.R. Tawfiq, Department of Physical Therapy for Growth and Developmental Disorder in Children and its Surgery, Faculty of Physical Therapy, Cairo University, Egypt

ABSTRACT

The purpose of this study was to compare the effect of treadmill training program and the short circuit training program on total cholesterol level in the obese children. Forty obese children were selected from both sexes. Their ages ranged from 6-10 years old. They were assigned randomly into two groups of equal numbers, study group (I) and study group (II). Each patient of the two groups was evaluated before and after treatment by using body mass index and laboratory fasting total cholesterol level before and after twelve successive weeks of the training programs. The study group (I) received a balanced diet regimen for weight reduction and special treadmill training exercise program. The study group (II) received the same diet regimen for weight reduction and a specific short circuit training exercises. The training programs were conducted at 3 times/week basis for twelve successive weeks. The pre-treatment results revealed no significant difference in all measured variables between the two groups. Pre and post treatment results within each group had significant difference. Total cholesterol level post treatment results for both groups were significantly reduced in favor of study group (II) in comparison with study group (I).

Key words: Obese children, total cholesterol level, balanced diet regimen, short circuit, treadmill, body mass index

INTRODUCTION

Obesity is on the rise among adults, adolescents and children worldwide including populations living in developing countries. When the body mass index of adolescents from Egypt and Mexico evaluated in attending public schools, the girls were overweight, 6% of boys and 8% of girls were obese (Salazar-Martinez *et al*., 2006).

The prevalence of obesity has increased in America. To be classified as obese, a person must have a Body Mass Index (BMI) of above 30 kg m^{-2} (A normal BMI is between 18 and 25 kg m^{-2}). When a child reaches a large BMI, children are grouped into a high risk category for many diseases. One of the most prevalent is type 2 diabetes. Type 2 diabetes is associated with a poor response to insulin's effect on glucose uptake (Kramer *et al*., 2010).

Childhood obesity is a condition, where excess body fat negatively affects a child's health or well-being. As methods to determine body fat directly are difficult, the diagnosis of obesity is often based on Body Mass Index (BMI). Due to the rising prevalence of obesity in children and its many adverse health effects, it is being recognized as a serious public health concern (Kopelman, 2005).

The term overweight rather than obese is often used in children as it is less stigmatizing (Bessesen, 2008). The previous studies demonstrated that the unfit girls and boys have hypercholesterolemia and low level of the High Density Lipoproteins (HDL) cholesterol by comparison to their moderately and high fit beers. Few studies examined the effect of exercise interventions on changes in blood lipids and lipoproteins (Janssen and LeBlanc, 2010).

Treadmill activity may not only increase aerobic capacity but may increase lower limb strength as well. Treadmill training is not usually thought as a strength training activity but can be effective in this regard if one has been accustomed to do lower body weight training. Walking on a treadmill seems different initially from free walking (Singh, 2000).

The circuit training consists of series of resistance training exercises performed in succession with minimal rest (15-30 sec) between exercises. The circuit training program can vary depending on the goals of the program. The number of circuit can be increased as the person adapts to the training. Examples for a total body circuit weight training as leg extension, arm curl, push up, squatting, overhead press and back extension (Fleck and Kraemer, 2014).

The purpose of this study was to compare between the effect of treadmill training program and the short circuit training program on total cholesterol level in the obese children.

MATERIALS AND METHODS

Forty obese children with borderline total cholesterol level according to their previous laboratory data were examined before study demonstration. Children were selected according to the following criteria.

Inclusion criteria:

- Their age ranged from 6-10 years old
- Obesity was determined by percentile body mass index (Equal to/or greater than the 95th percentile)
- Their total cholesterol level was on the borderline as ranged from 170-199 mg dL^{-1} according to the National Cholesterol Education Program (NCEP) (Conti, 1992)
- Obesity due to nutritional causes
- They were able to follow and understand the given orders

Exclusion criteria: Children were excluded if they had any of the following:

- Associated neurological or genetic disorders (e.g., Down's syndrome, diabetes, hypothyroidism … etc.)
- Practicing regular sport activities
- Unstable heart conditions
- Liver problems
- Kidney problems
- Severe musculoskeletal problems (physical injury-atlantoaxial instability)
- Visual problems
- Severe hearing problems

Design: All Children were assigned randomly into two groups of equal numbers (study group I and study group II), through the lottery method. Each of the children is assigned a unique number.

The numbers are placed in a bowl and thoroughly mixed. Then, a blind-folded researcher selected numbers. Children, who had the selected odd numbers are assigned in the study group (I), while Children who had the selected even numbers are assigned in the study group (II).

Study group (I): Twenty obese children, who received a balanced diet regimen for weight reduction and special treadmill training exercise program

Study group (II): Twenty obese children, who received the same diet regimen for weight reduction and a specific short circuit training exercises

*Both groups received 3 sessions/week for12 successive weeks.

Instrumentation and tools for evaluation:

- Standard weight and height scale for measuring weight in kilograms (kg) and height in centimeters (cm) to evaluate the body mass index
- Laboratory fasting total cholesterol level that described by NCEP risk categories (TC<170 mg dL^{-1} acceptable, TC 170-199 mg dL^{-1} borderline and ≥200 mg dL^{-1} high (Kavey *et al*., 2011)

Instrumentation and tools for treatment:

- **Treadmill electronic device:** Treadmill l770 CE, 220 V, 50 HZ, used for warming up for group (I), group (II) and also for training program of group I
- **Fitness type mat:** Its dimensions were (160 cm length×100 cm width×10 cm thickness) was used to perform squat, push up and extension lying exercises for group II
- **Stopwatch:** It was used to determine the time of session for short circuit training exercises

Evaluation procedures:

- Evaluation for group (I) and group (II) was conducted before and after 12 successive weeks of treatment
- **Body mass index (weight/height):** It was calculated for each child of the two study groups. Each child was asked to stand erect with bared feet on the standard weight and height scale to measure both weight (kg) and height (cm). Height was measured through the transverse arm on the top of the vertex and weight was determined on the scale. The children were categorized as obese according to percentile body mass index (Equal to or greater than the 95th percentile)
- **Laboratory fasting total cholesterol testing:** A selected sample of blood was withdrawn by the laboratorial technique from each child of two study groups in a fasting period ranged from 8-10 h

Treatment procedures: For both groups:

- Selected balanced diet program for weight reduction, establishing a negative energy balance by reducing energy intake and increasing physical activity. In each visit (every week) the total caloric intake was calculated and 500 kcal were reduced from the diet consumed until it reached 1200-1600 kcal, according to WHO guidance. The balanced diet that was given for both

Table 1: Treadmill training program protocol according to (Brown and Levine, 2007)

Time periods	Total duration of the session	Warming up phase	Main exercise phase	Cooling down phase
First four weeks	20 min	Walk on the treadmill at (4 km h^{-1}) for 5 min	Main exercise phase: each child started a brisk walk, at a speed of about 5.6-6.4 km h^{-1} for 2-3 min. Every 2-3 min, the speed increased by 32 km h^{-1}. At the end of period of training speed reached 6.4 -7.2 km h^{-1}. The period of this phase was 10 min	Walk on the treadmill at (4 km h^{-1}) for 5 min
Second four weeks	22 min for the 5th week 24 min for the 6th week 26 min for the 7th week 28 min for the 8th week	Walk on the treadmill at (4 km h^{-1}) for 5 min	Each child started to increase the period that he/she is able to walk on the treadmill. Also higher speeds were introduced. The treadmill parameters were 6.4-7.2 km h^{-1} for the speed reaching to 8 km h^{-1} at the end of time of the training session. The duration of this phase was 12, 14, 16 min for the fifth, sixth and seventh weeks, respectively	Walk on the treadmill at (4 km h^{-1}) for 5 min
Third four weeks	28 min for the 9th week 30 min for the 10th week 32 min for the 11th week 34 min for the 12th week	Walk on the treadmill at (4 km h^{-1}) for 5 min	Each child started to increase the period that he/she reached to do great work then the time and speed were increased as follow: 7.2-8 km h^{-1} for the speed, reaching to 9.6 km h^{-1} by the end of time of training session. The duration of this phase was 18, 20, 22 and 24 min for the 10th, 11th, 12th, 13th weeks, respectively	Walk on the treadmill at (4 km h^{-1}) for 5 min

groups about from 1200-1600 kcal daily, with 25-35% was fats , 2-3 cups of dairy milk, from 3-4 cups of lean meat or beans,1.5 cups of fruits and 1.5 cups of grains

For children of group (I): Each child was asked to walk on the treadmill by 4 km h^{-1} 5-7 min as warming up and cooling down:

- A selected treadmill training program Table 1.

For children of group (II): Each child was asked to walk on the treadmill by 4 km h^{-1} for 5-7 min as warming up and cooling down:

- **Short circuit training exercises:** Each child of this group performed 3 exercises (squat-push-up extension lying-up) as 1 short circuit for totally 10 min per time and

increased gradually by the third four weeks to perform 2 short circuits training exercises for totally 20 min. Every exercise was performed for 3 sets and every set contained 10 repetitions that increased to 20 repetitions by the third and fourth weeks. Each station of every exercise (10 repetitions) performed in 45 sec with 15 sec rest between stations

Statistical analysis: The collected data was statistically analyzed using paired t-test and unpaired t-test. The results revealed significant improvement in the measuring variables of both study groups when comparing their total cholesterol pre and post training mean values. After termination of the training program, significant difference was recorded between the 2 study groups in favor of the study group II.

RESULTS AND DISCUSSION

Table 2 shows no significant difference between 2 groups in their age, height and BMI, where their p-values were 0.843, 0.794 and 0.415, respectively.

Table 3 shows, there was significant difference in subjects total cholesterol level before and after the study in both groups I and II as p-values were (0.015,0.000).

Table 4 shows no significant difference between two groups in their pre training total cholesterol, where their p-value 0.087, while there was significant difference between 2 groups in their post training total cholesterol level, where their p-value were (0.006):

- This study aimed to provide a direct comparison between the effect of treadmill training program and short circuit training program on the total cholesterol level of obese children
- Forty obese children of both sexes were randomly assigned into 2 groups of equal number; group I and group II. Children of group I received a balanced diet regimen for weight reduction and a special treadmill training exercise program, while those of group II received the same diet regimen for weight reduction and specific short circuit training exercises. According to the given protocol, they received 12-weeks (3 months), 3 days per week program of treadmill and specific short circuit training exercises, which agreed with Frenhall and Pitetti (2005)
- All children were evaluated by using body mass index and laboratory fasting total cholesterol level before and after 3 successive months of the training programs for both groups
- As indicated from the results of descriptive data of the 2 study groups (I and II), subjects were homogenous concerning age and BMI as shown in Table 2. The pre-treatment results revealed non significant difference in all measuring variables between the 2 groups, which confirm the homogeneity of the samples in the two study groups before starting the training program

Table 2: Descriptive data of both groups

	Groups (Mean±SD)			
Items	Group (I)	Group (II)	p-value	Significance
Age (years)	8.4±1.6	8.3±1.6	0.843	NS
Height (cm)	136.1±10.8	137.1±14.2	0.794	NS
Body mass index (kg m^{-2})	24.1±2.6	24.8±2.7	0.415	NS

SD: Standard deviation, NS: Non significant

Table 3: Pre and post training Mean±SD values within each group

Measured variables	Pre	Post	p-value	Significance
Total cholesterol within group I	186.7±9.7	179.9±9.20	0.015	S
Total cholesterol within group II	181.5±8.8	173.9±8.87	0.000	S

Values are Mean±SD, S: Significant

- According to the comparison between the pre and post training mean values of total cholesterol for the study group (I), the results revealed that there was significant difference ($p<0.05$) as shown in Table 3. This significant difference may be attributed to increase in lean mass, which increase oxygen consumption. Treadmill training may also improve motor function and enhance exercise safety. It was, as anticipated, associated with a significant improvement of body composition and total cholesterol
- This is in accordance with the data of Thompson *et al*. (2001), who demonstrated that Treadmill exercise generally produces small reductions in TC and LDL-C. The effect of exercise on TC is the summation of changes in the various lipoprotein sub fractions so that changes in TC alone have little physiological significance
- These results come in agreement with Antonopoulos (2002), who reported that according to the standard of National Cholesterol Education Program, the total cholesterol and triglyceride levels values lowered from border line into the desirable classification after the treadmill training program
- At the end of the short circuit training program for children of group (II), the post training mean values of the total cholesterol were increased, when compared to those of pre-training , the results revealed that there were significant difference ($p<0.000$) as shown in Table 3. These results indicated that there is significant decrease in the total cholesterol blood level. This decrease may be due to the increase in the cross-sectional area of type IIA fibers and the increase in lean mass. This is in accordance with the data of Fett *et al*. (2009). This is in agreement with the study of Paoli *et al*. (2013), who found that different kinds of circuit weight training has long been accepted as a means for developing and maintaining, muscular strength, endurance, power and muscle mass
- Upon comparing the post training mean values of total cholesterol in both groups (I and II), the results revealed that there were significant differences ($p<0.05$) as shown in Table 4
- In the present study, results indicated that the gained value of the total cholesterol by the short circuit training was lower than that gained by treadmill and this difference is statistically significant ($p<0.05$). Study group (II) results clearly demonstrated the positive effect of short circuit training program on the blood total cholesterol level of the obese children
- The study results come in agreement with Sothern *et al*. (2000), who demonstrated that resistance training can be effective at lowering BMI, body fat and weight. Also, Sung *et al*. (2002) showed that 6 weeks strength training and dietary intervention for obese children led to a 2.3% increase in fat free mass and decrease in HDL: LDL cholesterol ratio and the explanation of the positive effect of short circuit training on obese children was due to an increase in lean body mass and decrease in percentage body fat
- Similarly, results of this study agree with the findings reported by Dobbins *et al*. (2009) who showed that the majority of circuit training had a positive effect on VO2max, blood cholesterol. Also, Vijayakumar and Shenbagavalli (2014) mentioned that the short circuit training may enhance motor control and fundamental movement

Table 4: Pre and post training Mean±SD values between both group

	Groups (Mean±SD)			
Measured variables	Group (I)	Group (II)	p-value	Significance
Total cholesterol (pre)	186.7±9.7	181.5±8.80	0.087	NS
Total cholesterol (post)	179.9±9.2	173.9±8.87	0.006	S

SD: Standard deviation, NS: Non significant, S: Significant

- On the other hand, the finding of our study disagreed with Honkola *et al*. (1997), who found no significant reduction in the total cholesterol level after 5 months of progressive circuit training and this might be attributed to the short duration of training

CONCLUSION

On basis of the present study supported by the relevant literature, it could be concluded that the short circuit training program provided for 12 successive weeks, was valid and reliable method to improve the total cholesterol level in obese children from 6-10 years. This training procedure can be combined with an aerobic training to obtain more improving of the total cholesterol blood level in the obese children.

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