Journal for Re Attach Therapy and Developmental Diversities
eISSN: 2589-7799
2023 August; 6 (9s2): 1208-1222

Changes in Quality of Life after Weight Reduction and Physical Therapy Interventions in Children with Obesity

Kholoud Sameh Ghoniem[1], Heba Said Abdelhaliem[2], Mohamed Ibrahim Kamel[3]

[1]B.Sc., Department of Physical Therapy for Paediatrics, Faculty of Physical Therapy, Cairo University, Egypt.
[2]Assistant Professor of nutrition, National nutrition institute, Egypt.
[3]Associate Professor of Physical Therapy for Paediatrics, Faculty of Physical Therapy, Cairo University, Egypt.

Received: 24- June -2023
Revised: 27- July -2023
Accepted: 21- August -2023

Abstract

Background: Obesity in children is a complex medical condition. The mental health of obese children is currently receiving increasing attention from researchers and medical practitioners. The wellbeing and quality of life of obese children are negatively impacted by a variety of psycho-social problems. Children who are overweight or obese may benefit from a training program that incorporates weight management, strengthening, and neuromuscular activities by increasing their strength, balance, participation, self-confidence, and general quality of life. Although there are many guidelines for strengthening and neuromuscular exercises, the majority of it do not specifically address the population of obese children. Therefore, the purpose of this study is to assess the effectiveness of a designed program that incorporates strength and neuromuscular exercise in addition to weight management that is specifically tailored to the restrictions and abilities of the obese child. **Patients and methods:** From schools, thirty obese children between the ages of 8 and 11 were chosen. The control group followed a nutritionist-designed weight-loss diet. The study group followed the same weight-loss program in addition to a neuromuscular and strength-training exercise program. **Results:** Our results revealed that there were significant differences (MD=11.06; P= 0.002; P<0.05) (MD=9.70; P= 0.002; P<0.05) in the mean ±SD values of pediatric quality of life inventory for both children and parents' proxies respectively between the control group and the study group at after-treatment (55.70±9.88 and 66.76±6.86, respectively) (56.65±5.89 and 66.35±10.36, respectively). This significant increase in pediatric quality of life inventory score for children at post-treatment is more favorable of the study group (66.76 ±6.86) (66.35 ±10.36) than the control group (55.70 ±9.88) (56.65 ±5.89). **Conclusion:** The findings determined that a neuromuscular and strength training exercise program for obese children population is an effective approach to improve quality of life of obese children.

Keywords: obesity, children, quality of life, strength, neuromuscular exercise.

Introduction

obesity has become global concern Due to the increasing incidence of this condition (1). Obesity has negative psychological effects as well as an elevated chance of morbidity. Obese children as young as 5 years old have been shown to have a negative self-image (2). Adolescents who suffer from obesity have diminishing levels of self-esteem that are linked to rejection, loneliness, anxiety, and high-risk behavior (3).

According to Han et al the obese child finds it difficult to engage in physically demanding tasks, carry heavy loads, climb stairs, bend over, get up from a chair, walk more than one kilometre, and take a bath (4).

Compared to their peers who were healthy and those who had chronic illnesses, obese children reported lower health-related quality of life. Recent research has shown the significant effect that childhood obesity has on how these kids perceive their health, particularly in regards to social life (5).

There was no difference between males and females in how being overweight affected quality of life (6).
Regarding the complexity of obesity, a multicomponent intervention carried out by a multidisciplinary team focusing on both weight and musculoskeletal components may be the optimal intervention [7,8].

There is evidence that enhancing motor coordination, fundamental movement skills, and physical activity may effectively manage childhood obesity. The common hypothesis in this field of research is that children with good foundational motor skills are more likely to engage in vigorous physical activity than children with inadequate functional motor skills. An obese child lacks his peers who are of a healthy weight in terms of coordination, balance, speed, agility, and fine and gross motor abilities (9). Therefore, they find it challenging to achieve the guidelines for physical activity (10–11).

Children who are overweight or obese might gain a lot from improving functional motor skill and increasing physical activity by physiotherapy [12]

However, physiotherapy for management of pediatric obesity has not been focused on in studies prior to this one, the primary goal of physical therapy may be improved movement quality or increased engagement in physical activity.

Although there have been many research studies done on strength and neuromuscular exercises (13), they are not exclusively made for the obese children and there is still an absence of high-quality research on the outcomes of such methods for this particular demographic. Therefore, the purpose of this study was to explore how strengthening and neuromuscular exercise affect obese children's quality of life.

Materials & Methods:

We conducted our study at The Egyptian Ministry of Education schools. The inclusion criteria were children with ages between 8-11 years who scored 95th percentile or greater on the growth chart (obese category), Children who had been suffering from obesity and lower limb musculoskeletal pain or discomfort for more than 3 months, Calorie intake exceeded 1600 kcal/day for girls and 1800 kcal/day for boys, all participants were able to follow the verbal and visual command.

The exclusion criteria were children with recent injury or fracture in the lower limb through the past six months, malnutrition disorders, diet or anti-inflammatory medications, any musculoskeletal deformity in the lower extremities or trunk, physiological growing pains.

Children were randomly allocated into 2 groups: 15 children for each group:

-The control group underwent a weight reduction plan designed by a nutritionist.

-The study group underwent the same weight reduction plan in addition to six weeks of physical therapy rehabilitation program.

Children and parents were fully informed about the risks and benefits of the procedures. Informed consent was obtained from parents.

Study procedures:

A- Assessment procedures

1. Assessment of body mass index percentiles

Children were recruited after height and weight assessment to calculate Body Mass Index (BMI). BMI percentile was determined through finding the weight status category for the calculated BMI-for-age percentile using Body mass index -for-age percentiles, boys, 2 to 20 years (figure 1) and Body mass index - for-age percentiles, girls, 2 to 20 years (figure 2).

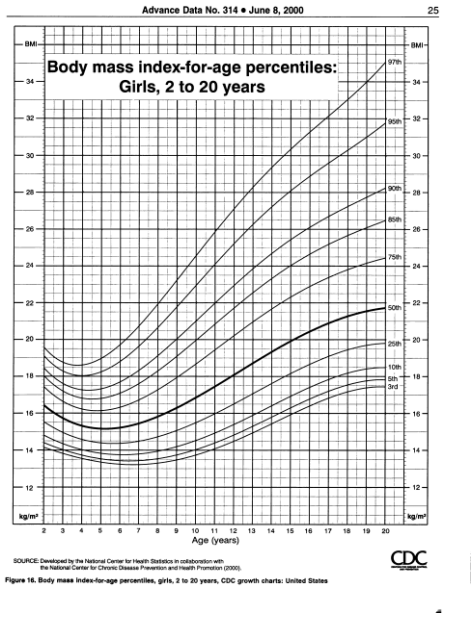

Fig. (1): Body mass index -for-age percentiles, boys, 2 to 20 years.

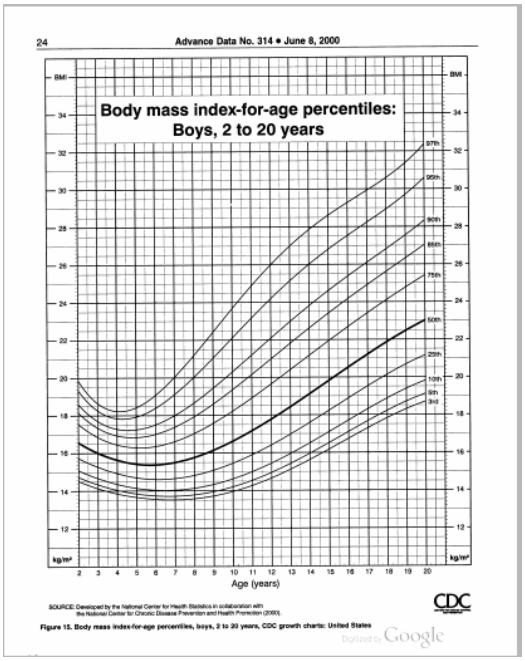

Fig. (2): Body mass index - for-age percentiles, girls, 2 to 20 years.

2. Assessment of food intake by

A. Food frequency questionnaire

Children were asked to report how frequently they ate or drank some typical foods and/or beverages. They were given a list of items and asked to indicate how frequently they ate each one in each month. From the children's answers, a rough idea of usual intake was established.

B. 24-hour recall

From the first intake in the morning to the last intake at night (whether it's before or after going to the bed and for those who wake up at midnight and eat and/or drink something), the children were asked to accurately recall, describe, and quantify foods and beverages' consumption over the course of 24 hours before, or during the day prior to the test. The information included the characteristics and food type (fresh food, pre-cooked, refrigerated, packed in a can, or stored), the total amount that was consumed, the way to prepare, the brand name, the additional sauces, dressings (including the composition of fats and oils usage), , drinks, supplements of multivitamin, and supplements of food , in addition to the consumption time and location (whether they were at home or not), among other details.

C. Assessment of quality of life by The Pediatric Quality of Life Inventory (PedsQL)

The 23 items on the PedsQL (4.0) Generic key Scales were created to assess role (school) functioning as well as the WHO's key aspects of health. The assessment also includes child self-report and parent proxy report. Physical functioning (8 items), emotional functioning (5 items), social functioning (5 items), and school functioning (5 items) are the four broad scales.

The PedsQL evaluation Model, which combines the reliability, validity, responsiveness, and practicality not usually found in all in one pediatric HRQOL instrument, marks a significant development in the evaluation of children's HRQOL. The PedsQL will be an appreciated improvement to the assessment of pediatric medical outcomes by researchers, policy-makers, providers, and health plans (14-15).

testing of the Arabic version of the PedsQLTM (4.0) reveals that the Arabic scale has good psychometric qualities (16).

Treatment procedures

Both groups received a diet plan which concentrated on

I. Maintaining adequate levels of calorie intake for each child which was calculated through the equation 1000+(age-1) x110
II. Meeting the nutritional needs through balancing the macronutrients (protein-fat- carbohydrates) of all individuals based on their age which is 20% protein, 30% fat and 50% carbohydrates.

The Study group received a 6-week neuromuscular training and strengthening exercise in the form of knee/hip joint muscle strength training.

Quadriceps strengthening

Both weight-bearing and non-weight-bearing exercises were done by the kids. We adhered to Lim's quadriceps strengthening plan (17). Three non-weight-bearing exercises were performed by the participants at the start to help them adapt to the exercise. Three weeks later, three additional weight-bearing workouts were added. Exercises for the quadriceps were performed in sets of two, progressing as fast as possible to three sets, with ten repetitions in each set. Table 2 lists the quadriceps strengthening exercises.

Table (2) Quadriceps strengthening exercises*:*

1	Flexing the hip to 30°, ankle weights were used to give resistance from supine position.
2	extension of the knee and a roll under it, ankle weights were used as a resistance from supine position.
3	full knee extension beginning at a 90° angle from sitting position, ankle weighs were used as resistance.
4	squatting from full extension to 30° of knee flexion, placing a ball against a wall and may be advanced by holding dumbbells in both hands.
5	squatting between 40° and 90° of knee flexion with placing a ball between the child's back and the wall then advancing by holding dumbbells in both hands.
6	Ascending a stepper with a height of 30 cm.

1	raising leg to 30° of hip flexion, ankle cuff weights were used to give resistance from supine position.
2	knee extension with a roll under the knee, ankle cuff weights were used as a resistance from supine position.
3	Full knee extension starting from 90° from sitting position, ankle cuff weighs were used as resistance.
4	Small squats from full extension to 30° of knee flexion, placing a ball against a wall and may be advanced by using two dumbbells in each hand.
5	Small squats between 40° and 90° of knee flexion with placing a ball against the wall and advancing by using two dumbbells in each hand.
6	Step up on a stepper of thirty centimetres height.

Intensity of the exercises were monitored continuously. The training load was adjusted using the one repetition maximum (1RM) test which is known as the heaviest weight that can be lifted one time and the correct lifting technique is maintained (18). The 1RM test has been found to be safe across a variety of groups, including those of children, older people, and patients (19, 20)

80% of the 1RM was used as the training load. The 1RM was calculated by gradually increasing the load until child could not lift it while moving through the recommended joint range of motion. Every two weeks, the 1RM was measured in order to modify the training load (21,22).

Hip strengthening exercise

The training plan described by Bennell et al (23) was employed to strengthen the hip muscles. There are six exercises in this program that target the hip abductor and adductor muscles. Ten repetitions were done in three sets by all children. Exercises were modified based on the child's capacity to perform10 repetitions. Table 3 lists all hip muscle strengthening exercises.

Table (3) Hip strengthening exercises

1	Abduction in side lying, ankle cuff weights were used as resistance.
2	Abducting the hip in standing unilaterally with the use of a resistance band.
3	Standing with one shoulder to the wall while performing isometric hip abduction with knee 90° flexed and the other lower limb on the floor.
4	Clam in side lying position, elastic band was used as a resistance.
5	Bridging from supine.
6	Unilateral bridging from supine with 90° of knee flexion in the opposite limb.
1	Abduction in side lying, ankle cuff weights were used as resistance.
2	Abduction in standing: unilateral hip abduction performed standing with the use of a resistance band.
3	Standing wall isometric hip abduction: performed in unipedal stance with the opposite limb in 90° of knee flexion.
4	Clam in side lying position, elastic band was used as a resistance.
5	Bridging bilateral.
6	Unilateral bridging with 90° of knee flexion in the opposite limb.

Neuromuscular exercises

Balance exercises on one leg and two legs made up the neuromuscular exercises. According to the technique established by Bennell et al (26), participants were given instructions for maintaining more neutral knee alignment during specific tasks to improve the control over their hips and knee to assist in minimizing pain and prevent excessive strains to the joint, knee flexion shouldn't be allowed to go over 30 degrees. Unstable surfaces, like a foam mat or balancing board, were supplied to assure progression. In addition, the number of repetitions was raised along with a variety of movement patterns and training speeds. The progression was tailored on each person's needs in order to reduce pain while exercising. Table 4 provides an overview of the neuromuscular exercises.

Table (4) Neuromuscular exercises

1	Standing on both limbs and advancing from a mat to balance board.
2	Standing on both limbs and advancing from a mat to balance board closing his/her eyes.
3	Standing on both limbs and advancing from a mat to balance board: two subjects are standing in front of each other throwing and catching a ball.
4	Static squats, advancing from a mat to balance board.
5	Static squat on foam surface throwing and catching a ball.
6	Standing on one leg on a soft surface advancing from a mat to balance board.
7	Standing on one leg, advancing from a mat to balance board and their eyesight is covered.

Statistical analysis:

The statistical analysis was performed by using the statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). The following statistical procedures were conducted:

- Quantitative descriptive statistics data including the mean and standard deviation for children's demographic data (age and BMI) and quality of life variables.
- Qualitative descriptive statistics data including the frequency and percentage of children's gender variable.
- Independent t-test to compare between control group and study group for children demographic data variables (age and BMI).
- Chi-square test to compare between the control group and study group for children gender variables.

Multivariate analysis of variance (MANOVA) was used to compare the tested major dependent variables of interest (quality of life) at different tested groups and measuring periods. Mixed design 2 x 2 MANOVA-

Results:

Pediatric Quality of Life Inventory (PedsQL) for children

Results of before and after treatment's PedsQL for children in both groups

The control group, the mean ±SD values of PedsQL score for children at before and after treatment were 46.71 ±10.08 and 55.70 ±9.88, respectively. Multiple pairwise comparisons test revealed that there was significant (P= 0.010; P< 0.05) increase in PedsQL score for children after more than before intervention with change and improvement percentages 8.99 and 19.25%, respectively (Table 11 and Figure 18).

The study group, the mean ±SD values of PedsQL for children at before and after treatment were 45.94 ±9.65 and 66.76 ±6.86, respectively. Multiple pairwise comparisons confirmed a significant (P= 0.0001; P< 0.05) increase in PedsQL for children after compared to before intervention with change and improvement percentage 20.82and 45.32%, respectively (Table 11 and Figure 18).

The obese children with lower limb musculoskeletal pain for more than 3 months who underwent the same weight reduction plan in addition to six weeks of physical therapy rehabilitation program (study group) improved higher PedsQL for children (45.32%) than obese children (19.25%) underwent a weight reduction plan designed by a nutritionist program (control group)

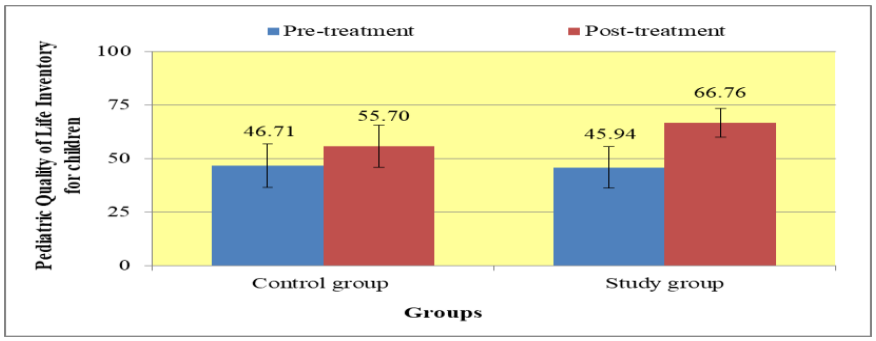

Figure (3): Mean values of before- and after-treatment PedsQL for children within each group.

Results of PedsQL for children between groups at before and after treatment

Considering the effect of the tested group on PedsQL for children (Table 11 and Figure 19), The results of the pairwise comparisons test showed that there was no difference between the control group and study group's mean and standard deviation of the PedsQL scores for children at the beginning of the intervention (46.7110.08 and 45.949.65, respectively) (MD=0.77; P=0.819; P>0.05). However, the difference became significant (MD=11.06; P=0.002; P<0.05) in the mean ±SD values of PedsQL for children between control and study groups at after-treatment (55.70±9.88 and 66.76±6.86, respectively). So, this significant increase in PedsQL for children at post-treatment is favorable of study group (66.76 ±6.86) than control group (55.70 ±9.88).

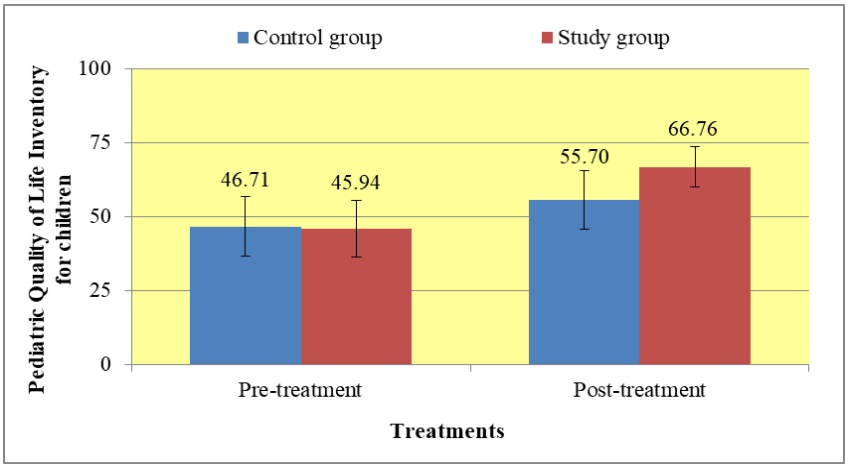

Figure (4): Mean values of PedsQL for children at before- and after-treatment between both groups.

Table (5): Mixed MANOVA for the effect of treatment on PedsQL for children

PedsQL for children (Mean ±SD)			
Items	Control group (n=15)	Study group (n=15)	
Before-treatment	46.71 ±10.08	45.94 ±9.65	
After-treatment	55.70 ±9.88	66.76 ±6.86	
Mixed MANOVA (Overall effect)			
MANOVA Overall effect	FF-value	P-value	Significance
Group effect	4.674	0.035*	S

Time effect	39.277	0.0001*	S
Interaction (Group x Time) effect	6.185	0.016*	S
Comparison between before- and after-treatment within each group (time effect)			
Time effect	Control group (n=15)	Study group (n=15)	
Mean difference (change)	8.99	20.82	
Improvement %	19.25%	45.32%	
95% CI	2.25 – 15.73	14.08 – 27.56	
F-value	7.145	38.317	
P-value	0.010*	0.0001*	
Significance	S	S	
Comparison between both groups at before and after treatment (group effect)			
Group effect	Before-treatment	After-treatment	
MD (change)	0.77	11.06	
95% CI	-5.96 – 7.51	4.32 – 17.80	
F-value	0.053	10.806	
P-value	0.819	0.002*	
Significance	NS	S	

Data are expressed as mean ±standard deviation CI: confidence interval
P-value: probability value S: significant * Significant (P<0.05) NS: non-significant

3.2. Pediatric Quality of Life Inventory (PedsQL) for parents

Results of before and after treatment PedsQL for parents for both groups

The control group, the mean ±SD values of PedsQL for parents at before- and after-treatment were 43.90 ±7.40 and 56.65 ±5.89, respectively. Multiple pairwise comparisons test revealed the significant (P= 0.0001; P< 0.05) increase in PedsQL for parents after more than before intervention with change and improvement percentage 12.75 and 29.04%, respectively (Table 12 and Figure 20).

In study group, the mean ±SD values of PedsQL for parents at before- and after-treatment were 48.47 ±9.15 and 66.35 ±10.36, respectively. Multiple pairwise comparisons test revealed that there was significant (P=0.0001; P<0.05) increase in PedsQL for parents after treatment compared to before treatment with change and improvement percentage 17.88 and 36.89%, respectively (Table 12 and Figure 20).

The obese children with lower limb musculoskeletal pain for more than 3 months who underwent the same weight reduction plan in addition to six weeks of physical therapy rehabilitation program (study group) improved higher PedsQL for parents (36.89%) than obese children (29.04%) underwent a weight reduction plan designed by a nutritionist program (control group)

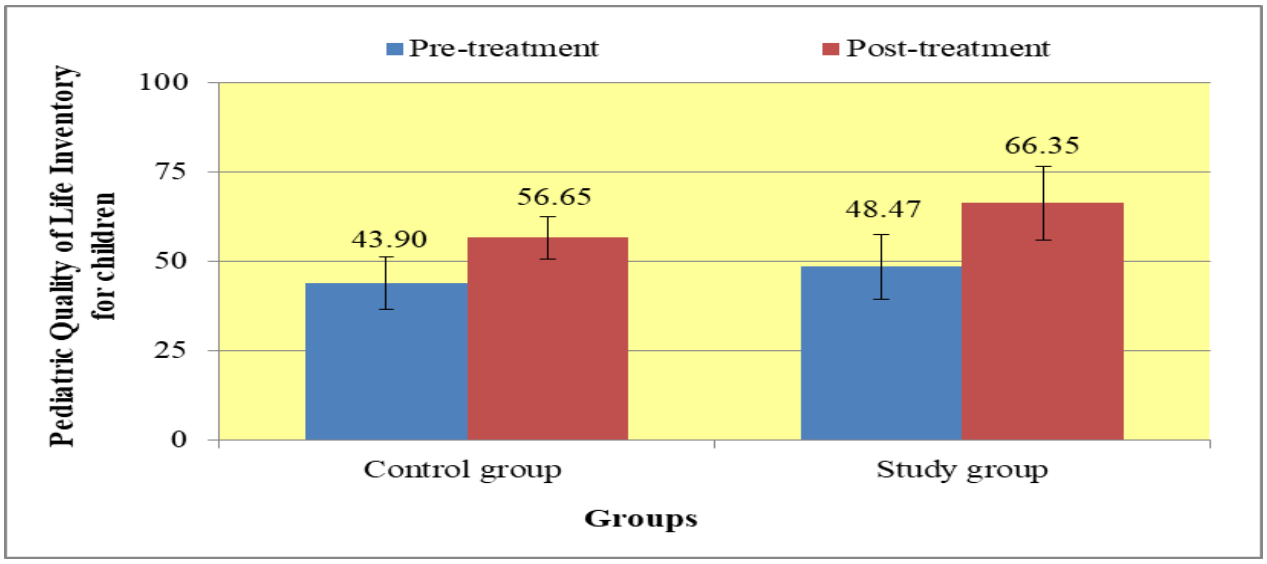

Figure (5): Mean values of before- and after-treatment PedsQL for parents within each group.

Results of PedsQL for parents between groups at before and after treatment

Regarding the PedsQL score for parents (Table 12 and Figure 21), the pairwise comparisons test revealed that no significant difference (MD=4.56; P=0.141; P>0.05) in the mean ±SD values of PedsQL for parents between control group and study group at before-treatment (43.90±7.40 and 48.47±9.15, respectively). However, there was significant difference (MD=9.70; P=0.002; P<0.05) in the mean ±SD values of PedsQL for parents between control group and study group at after-treatment (56.65±5.89 and 66.35±10.36, respectively). So, this significant increase in PedsQL for parents at post-treatment is favorable of the study group (66.35 ±10.36) than control group (56.65 ±5.89).

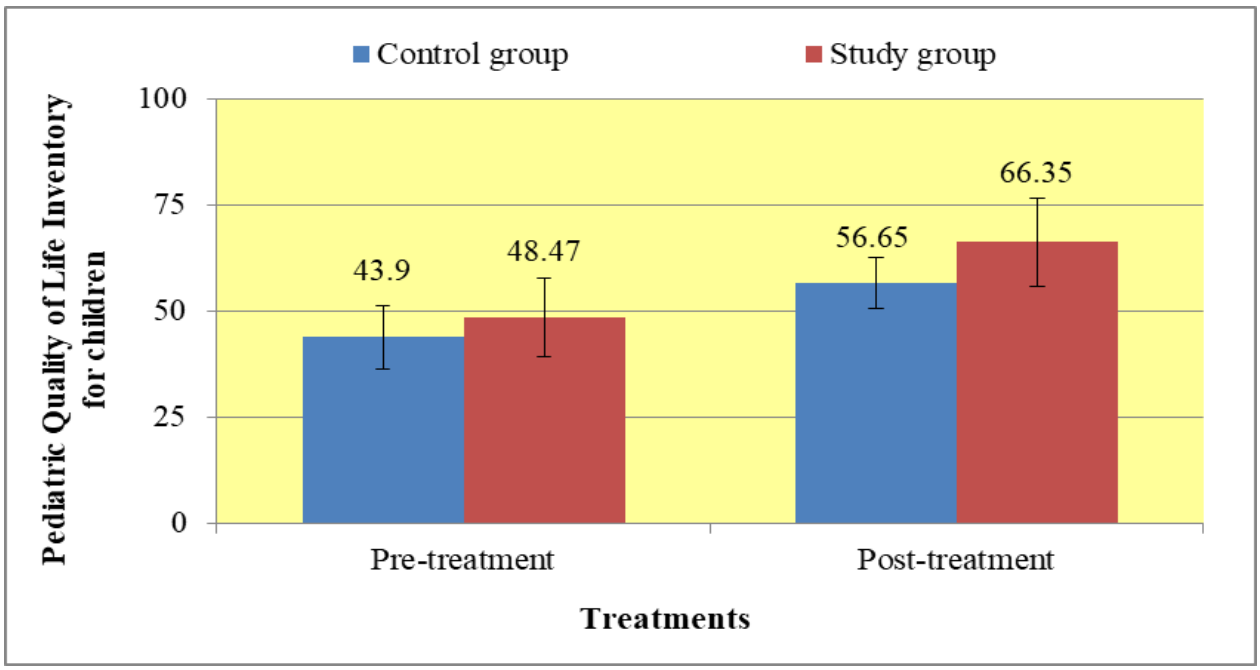

Figure (6): Mean values of PedsQL for parents at before- and after-treatment between both groups.

Table (6): Mixed MANOVA for the effect of treatment on PedsQL for parents

PedsQL for parents (Mean ±SD)			
Items	Control group (n=15)	Study group (n=15)	
Before-treatment	43.90 ±7.40	48.47 ±9.15	
After-treatment	56.65 ±5.89	66.35 ±10.36	
Mixed MANOVA (Overall effect)			
MANOVA Overall effect	F-value	P-value	Significance
Group effect	10.868	0.002*	S
Time effect	50.085	0.0001*	S
Interaction (Group x Time) effect	1.407	0.241	NS
Comparison between before- and after-treatment within each group (time effect)			
Time effect	Control group (n=15)	Study group (n=15)	
Mean difference (change)	12.75	17.88	
Improvement %	29.04%	36.89%	
95% CI	6.61 – 18.87	11.75 – 24.01	
F-value	17.351	34.141	
P-value	0.0001*	0.0001*	
Significance	S	S	
Comparison between both groups at before and after treatment (group effect)			
Group effect	Before-treatment	After-treatment	
MD (change)	4.56	9.70	
95% CI	-1.56 – 10.69	3.57 – 15.83	
F-value	2.227	10.048	
P-value	0.141	0.002*	
Significance	NS	S	

Data are expressed as mean ±standard deviation CI: confidence interval
P-value: probability value S: significant * Significant (P<0.05) NS: non-significant

4.3. Correlation between weight and quality of life

Bi-variate Pearson correlation coefficients were computed between weight and quality of life (Table 15). The results of these correlational analyses revealed that there was significant (P<0.05) negative strong correlation between weight and PedsQL for children (r=-0.87; P=0.0001; Table 15; Figure 29) and PedsQL for parents (r=-0.79; P=0.0001; Table 15; Figure 30) within study group, but in control group (Table 15) no significant correlations (P>0.05) between weight and PedsQL for children (r=-0.29; P=0.300) and PedsQL for parents (r=-0.47; P=0.554). These negative strong correlations in study group mean that change in weight is consistent with change in quality of life and that stands for both children and parent proxies .

Table (7): Correlation between weight and pediatric quality of life inventory (PedsQL) in control group and study group

PedsQL	Weight			
	Group	r	P-value	Significance
PedsQL for children	Control group	-0.29	0.300	NS
	Study group	-0.87	0.0001*	S
PedsQL for parents	Control group	-0.47	0.554	NS
	Study group	-0.79	0.0001*	S

r: Pearson correlation coefficient value
P-value: probability value S: significant * Significant (P<0.05) NS: non-significant

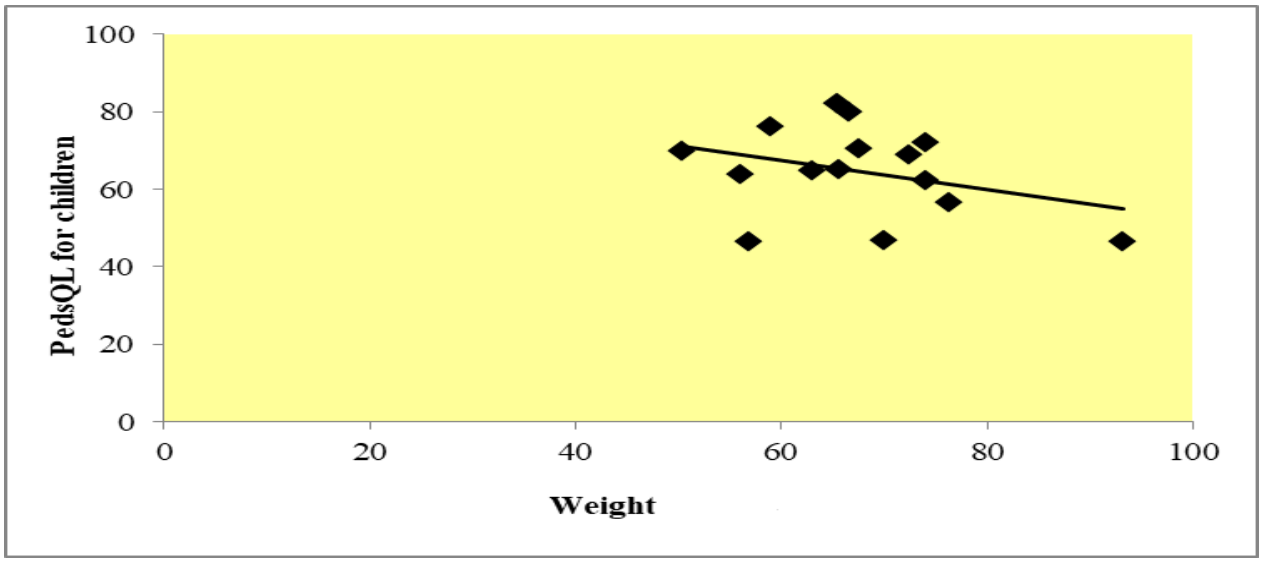

Figure (7): Relation between weight and PedsQL for children in study group.

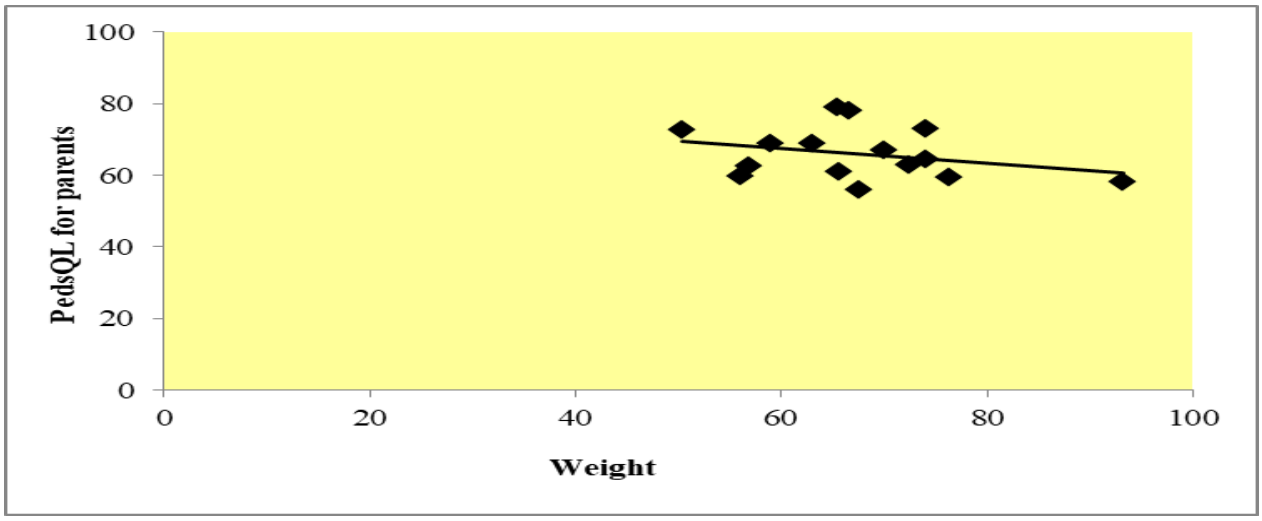

Figure (8): Relation between weight and PedsQL for parents in study group.

Discussion:

The purpose of this study was to investigate the effect of strengthening and neuromuscular training on the quality of life in obese children in order to evaluate the significance of physiotherapy rehabilitation programs as a needed approach during weight loss in obese children.

The results of our study showed that with a combined diet and rehabilitation program that focused on strength and neuromuscular exercise lasting six weeks in the study group versus diet only program in the control group,

- Health related quality of life (HRQOL) improved in both groups. Still, there was a significant improvement in the study group compared to the diet-only group.
- There was a strong negative correlation between the subject's body weight and the health-related quality of life (HRQOL) in both groups.

There are several studies concerning the relationship between obesity and quality of life but there is a lack of research concerning the management of the condition particularly a multidisciplinary one including the management of weight and musculoskeletal problems together so, our study focused on treating the obese child as a whole to gain the best outcomes.

Our study found that quality of life has improved in both groups as a result of weight reduction. This finding comes in agreement with Berentzen & Sørensen who found that if fat mass is lost and lean body mass is protected, weight loss alone can decrease mortality and improve health-related quality of life (24).

However, more improvement in health-related quality of life was found in the study group as a result of exercise programs that accompanied weight loss yielding better outcomes. This was agreed by Goldfield et al who stated that the perceived competence, self-worth, participation, and total physical capacities can all be improved by training programs, which may raise the patient population's ability to increase the energy expenditure required for weight loss (25).

Exercise can improve quality of life as a result of breaking the morbidity cycle of obesity. Increased weight causes increased joint loading causing inflammation which contributes to the increased level of inflammatory cytokines which causes more pain/discomfort that lead to less participation and fear of movement that gives rise to muscle weakness and adaptation of faulty loading mechanisms during locomotion to avoid pain all the previous factors in addition to the low satisfaction of body image leads to less activity and more adoption of sedentary style.

Annesi & Whitaker reported that weight loss combined with exercise program can break that cycle. Losing weight helps ease the strain on the tissues and joints that support our weight, which in turn lessens the inflammatory reaction to injury. Exercise can help to restore normal joint kinematics and repair strength deficiencies near painful joints. when there is less fat in our bodies, the circulating pro-inflammatory cytokines are decreased. Regular exercise reduces inflammatory cytokine levels throughout the body, lowers stress by improving self-efficacy, reduce depression symptoms and Overall mood disturbance is reduced. Supervised exercise dramatically enhances numerous psychosocial dimensions such as tension, anger, energy, weariness, body area satisfaction, and physical self-concept (26).

Similarly, this finding was also reported by Mikkelsen et al who stated numerous physiological and chemical suggestions have been put out as to why exercise enhances mood and mental wellness. These include the hypotheses that have been believed to play a mechanistic role in altered psychological state, such as the endorphin hypothesis, the thermogenic hypothesis, mitochondrial dysfunction, the mammalian target of rapamycin, neurotransmitter dysfunction, and the hypothalamus pituitary-adrenal axis. These findings emphasize the significance of physical training adding to weight loss in order to gain more improvement in quality of life and can be implemented in future management. Future research can investigate the best exercise strategy that brings about more adherence and improvement in child's mood (27).

Regardless of the great difference (MD=11.06; P=0.002; P<0.05) in the mean ±SD values of Pediatric Quality of Life Inventory (PedsQL) for children between control group and study group at after-treatment (55.70±9.88 and 66.76±6.86, respectively), the difference was not that large. This may differ if the treatment was applied for a longer period or if adherence increased. So, future research is required to investigate the possible difference in mean values of PedsQL for children between both groups with longer training periods.

This study found that There is a significant positive correlation between subject's body weight and discomfort symptoms in the lower limb which was clear after weight loss as there was an improvement in lower limb symptoms in both groups.

This was agreed by Okifuji, & Hare who reported that one of the most notable causes of obesity-related pain is greater loading because of heavy weight on joints, and reducing weight seems to improve pain and related quality of life. This emphasizes the importance of weight loss when seeking pain relief in obese children. Though, Further research is needed to investigate the exact threshold of weight loss at which there is an improvement in musculoskeletal symptoms and to explore post-treatment strategies to help children maintain weight loss (28).

Another important finding is that there was a strong negative correlation between the subject's body weight and the health-related quality of life (HRQOL) in both groups which was clear after weight loss that quality of life improved in both groups and this emphasizes the priority of weight management as a means to gain better mental health, participation and overall quality of life in obese children. Similarly, further research is needed to investigate the exact threshold of weight loss at which there is a tangible improvement in HRQOL and to explore post-treatment strategies to help children maintain weight loss.

From the previous findings, it can be concluded that a strengthening and neuromuscular training program was effective in managing lower limb musculoskeletal pain, improving muscle strength and quality of life in obese children. Therefore, it can be a valuable addition when managing children who suffer from obesity and lower limb pain to gain the best outcomes.

Conclusion:

From the results obtained from the current study, it can be concluded that there was a statistically significant difference after treatment between the control group and the study group in quality-of-life scores which was favorable for the study group. The strengthening and neuromuscular exercise training program was effective in improving the quality of life in obese children.

References

1. Aaseth J., Roer, G. E., Lien L., & Bjorklund G (2019). Is there a relationship between PTSD and complicated obesity? A review of the literature. Biomedicine & Pharmacotherapy. 117(10):348-256.
2. STRAUSS, Richard S. Childhood obesity and self-esteem. *Pediatrics*, 2000, 105.1: e15-e15.
3. Gortmaker, S. L., Must, A., Perrin, J. M., Sobol, A. M., & Dietz, W. H. (1993). Social and economic consequences of overweight in adolescence and young adulthood. *New England journal of medicine*, *329*(14), 1008-1012.
4. Han, T. S., Tajar, A., O'Neill, T. W., Jiang, M., Bartfai, G., Boonen, S., Casanueva, F., Finn, J. D., Forti, G., Giwercman, A., Huhtaniemi, I. T., Kula, K., Pendleton, N., Punab, M., Silman, A. J., Vanderschueren, D., Lean, M. E. J., Wu, F. C. W., & the EMAS group. (2011). Impaired quality of life and sexual function in overweight and obese men: the European Male Ageing Study, *European Journal of Endocrinology*, *164*(6), 1003-1011.
5. Retrieved May 21,2022 from https://eje.bioscientifica.com/view/journals/eje/164/6/1003.xml
6. Jalali-Farahani, S., Shojaei, F. A., Parvin, P., & Amiri, P. (2018). Comparison of health-related quality of life (HRQoL) among healthy, obese and chronically ill Iranian children. *BMC Public Health*, *18*(1), 1-10.
7. Pimenta, F. B., Bertrand, E., Mograbi, D. C., Shinohara, H., & Landeira-Fernandez, J. (2015). The relationship between obesity and quality of life in Brazilian adults. *Frontiers in psychology*, *6*, 966. https://doi.org/10.3389/fpsyg.2015.00966 .
8. Al-Khudairy, L., Loveman, E., Colquitt, J. L., Mead, E., Johnson, R. E., Fraser, H., ... & Cochrane Metabolic and Endocrine Disorders Group. (1996). Diet, physical activity and behavioural interventions for the treatment of overweight or obese adolescents aged 12 to 17 years. *Cochrane database of systematic reviews*, *2017*(6).
9. NHMRC. Clinical practice guidelines for the management of overweight and obesity in adults, adolescents and children in Australia 2013 [https://www.nhmrc.gov.au/about-us/publications/clinical-practice-guidelines-management-overweight-and-obesity#block-views-block-file-attachments-content-block-1.
10. Liang, J., Matheson, B. E., Kaye, W. H., & Boutelle, K. N. (2014). Neurocognitive correlates of obesity and obesity-related behaviors in children and adolescents. *International journal of obesity*, *38*(4), 494-506.
11. Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports medicine*, *40*, 1019-1035.
12. Tsiros, M. D., Coates, A. M., Howe, P. R. C., Grimshaw, P. N., & Buckley, J. D. (2011). Obesity: the new childhood disability? *Obesity Reviews*, *12*(1), 26-36.
13. Palermo, T. M., Long, A. C., Lewandowski, A., Drotar, D., Quittner, A. L., & Walker, L. S. (2008). Evidence-based assessment of health-related quality of life and functional impairment in pediatric psychology.Journal of Pediatric Psychology, 33, 983–996.
14. Varni, James W., Michael Seid, and Paul S. Kurtin. (2001). "PedsQL™ 4.0: Reliability and validity of the Pediatric Quality of Life Inventory™ Version 4.0 Generic Core Scales in healthy and patient populations." *Medical care*: 800-812.
15. WCPT. Promoting physical activity in children, the role of physiotherapists 2018 [https://www.erwcpt.eu/file/164.
16. Kristensen J, Franklyn-Miller A. (2012) Resistance training in musculoskeletal rehabilitation: a systematic review. Brit J Sport Med, 46:719–26
17. Ciarán M. Duffy, Brian M. Feldman, in Textbook of Pediatric Rheumatology (Seventh Edition), 2016.
18. Lim B, Hinman RS, Wrigley TV, Sharma L, Bennell KL. (2008). Does knee malalignment mediate the effects of quadriceps strengthening on knee adduction moment, pain, and function in medial knee osteoarthritis? A randomized controlled trial. Arthritis Rheum.;59:943–51.

19. Kraemer WJ, Ratamess NA, Fry AC (2006). Strength testing: development and evaluation of methodology. In: Maud PJ, Foster C, editors. Physiological Assessment of Human Fitness. Champaign, IL: Human Kinetics;p. 119–50.
20. Buckley TA, Hass CJ.(2012). Reliability in one-repetition maximum performance in people with Parkinson's disease. Parkinsons Dis.;2012:928736.
21. Levinger I, Goodman C, Hare DL, et al (2009). The reliability of the 1RM strength test for untrained middle-aged individuals. J Sci Med Sport.;12(2):310–6.
22. Kawakami Y, Abe T, Kuno SY, Fukunaga T (1995). Training-induced changes in muscle architecture and specific tension. Eur J Appl
23. Physiol Occup Physiol 72:37–43.
24. Wakahara T, Miyamoto N, Sugisaki N, Murata K, Kanehisa H, Kawakami Y, Fukunaga T, Yanai T (2012). Association between regional differences in muscle activation in one session of resistance exercise and in muscle hypertrophy after resistance training. Eur J Appl Physiol 112:1569–157
25. Bennell KL, Egerton T, Wrigley TV, Hodges PW, Hunt M, Roos EM, et al (2011). Comparison of neuromuscular and quadriceps strengthening exercise in the treatment of varus malaligned knees with medial knee osteoarthritis: a randomized controlled trial protocol. BMC Musculoskelet Disord.;12:276.
26. Berentzen, T., & Sørensen, T. I. (2006). Effects of intended weight loss on morbidity and mortality: possible explanations of controversial results. *Nutrition Reviews*, *64*(11), 502-507.
27. Goldfield, G. S., Mallory, R., Parker, T., Cunningham, T., Legg, C., Lumb, A., ... & Adamo, K. B. (2007). Effects of modifying physical activity and sedentary behavior on psychosocial adjustment in overweight/obese children. *Journal of Pediatric Psychology*, *32*(7), 783-793.
28. Annesi, J. J., & Whitaker, A. C. (2008). Weight loss and psychologic gain in obese women-participants in a supported exercise intervention. *Perm J*, *12*(3), 36-45.
29. Mikkelsen, K., Stojanovska, L., Polenakovic, M., Bosevski, M., & Apostolopoulos, V. (2017). Exercise and mental health. *Maturitas*, *106*, 48-56.
30. Okifuji A, Hare BD (2015). The association between chronic pain and obesity. *J. Pain Res.* 8, 399–408