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The influence of physical exercise upon the body composition of obese children

By

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Thirtyseven obese children 8 to 14 years of age were given a diet 115 kJ/kg of ideal weight for height and were distributed in two groups. One group was under normal ward conditions and the other underwent a physical exercise programme. Body weight, the percent of ideal weight referred to height, percent body weight, and absolute body fat were determined before and 15 days after both therapeutic regimes. The results revealed significant differences in the reduction of these parameters ($p < 0.001$).

When comparing the two groups, only the reduction of percent body fat displayed a significant difference ($p < 0.02$), showing a greater reduction in those who had performed physical exercise.

Regulation of body mass is dependent on energy intake, energy expenditure, and on the behaviour of mass regulating mechanisms. The last factors are numerous, complex, and not well understood [5]. The first two factors can be controlled and their combination seems to be the most physiological way to reduce body fat [13].

The variations in total body weight or the percent of body weight referred to height are data of limited value when one assesses the changes occurring during different therapeutic regimes, and especially so if physical exercise is involved, but determination of the changes in body composition allows to avoid this difficulty [16, 17].

Our purpose was to study the influence of physical exercise combined with a reduced energy intake in a short period upon the body composition and other anthropometric parameters of obese children.

Patients and Methods

A selected group of 16 obese girls and 21 obese boys, otherwise healthy, ranging in age from 8 to 14 years, has been studied.

Body weight and stature were measured in each patient to the nearest 0.1 kg and weight referred to actual height (IW/AH) was calculated. Skinfold thickness on the right side of the body was measured above the triceps, biceps, subscapular, suprailiac and calf regions (4) with a Holtain caliper with a standard pressure of 10 g/mm^2. Body fat percent (% BF) was estimated by the prediction equation of Parizková (14) from these skinfolds.

The patients were distributed in two groups. Group A was given a diet of 115 kJ/kg of ideal weight for height with an approximate proportion of 50% carbohydrate, 30% fat, and 20% protein under ward conditions for 15 days.

Group B was given the same diet and underwent a training programme that consisted of an initial warming up for 1 minute followed by stepping onto and down from a 45 cm high platform thirty times a minute for 4 minutes, five times weekly. Every day these patients spent two hours walking.

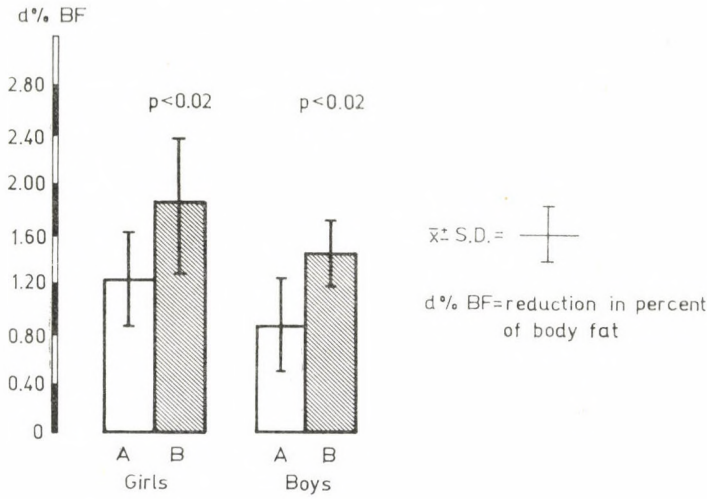

FIG. 1

At the end of the 15 day period, body weight, height, IW/AH, %BF, and the absolute value of body fat in kg (kg BF) were assessed again.

Means and standard deviations were calculated by Student's t test for paired series and by binary comparisons (19), considering sexes and therapeutic regimes.

RESULTS

The individual changes in body weight, IW/AH, %BF, and kg BF are shown in Figures 2, 3, 4 and 5 respectively. In group A as well as in group B a significant decrease of the 4 parameters was recorded ($p < 0.001$).

Table I shows the mean $\pm$ SD for body weight, IW/AH, %BF, and kg BF in each therapeutic trial.

Binary comparisons for each of the variables in group A and group B showed no differences except for the percent body fat ($p < 0.02$), for each sex (Figure 1, and Table I).

TABLE I

Differences between group A and group B in body weight (dW), ideal weight referred to height (d IW/AH), percent body fat (d %BF), and absolute body fat

GROUPS		dW	d %IW/AH	d % BF	d kg BF
Girls	A n = 8	3.08 ± 1.04	7.11 ± 1.34	1.24 ± 0.38	1.82 ± 0.61
	B n = 8	3.35 ± 1.50	8.53 ± 3.38	1.83 ± 0.55*	2.20 ± 0.95
Boys	A n = 13	3.55 ± 1.56	7.76 ± 2.51	0.87 ± 0.37	1.75 ± 0.68
	B n = 8	3.69 ± 1.32	8.62 ± 2.38	1.33 ± 0.38*	1.99 ± 0.57

* $p < 0.02$

the other comparisons showed no significant differences

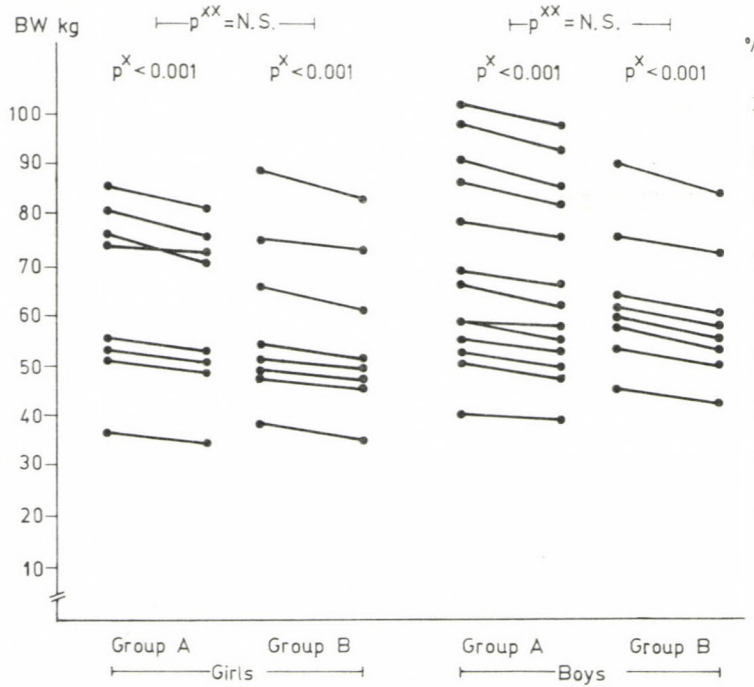
BW kg
p^xx = N.S.
p^xx = N.S.
p^x < 0.001
p^x < 0.001
p^x < 0.001
p^x < 0.001
100
90
80
70
60
50
40
30
20
10
Group A
Group B
Girls
Group A
Group B
Boys
x Before treatment versus after treatment
xx Group A versus Group B

FIG. 2

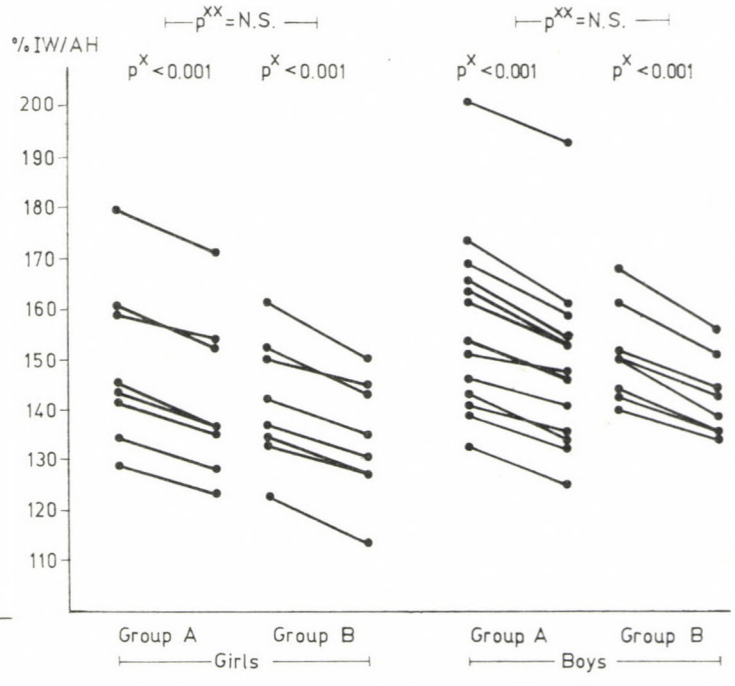
% IW/AH
p^xx = N.S.
p^xx = N.S.
p^x < 0.001
p^x < 0.001
p^x < 0.001
p^x < 0.001
200
190
180
170
160
150
140
130
120
110
Group A
Group B
Girls
Group A
Group B
Boys
x Before treatment versus after treatment
xx Group A versus Group B

FIG. 3

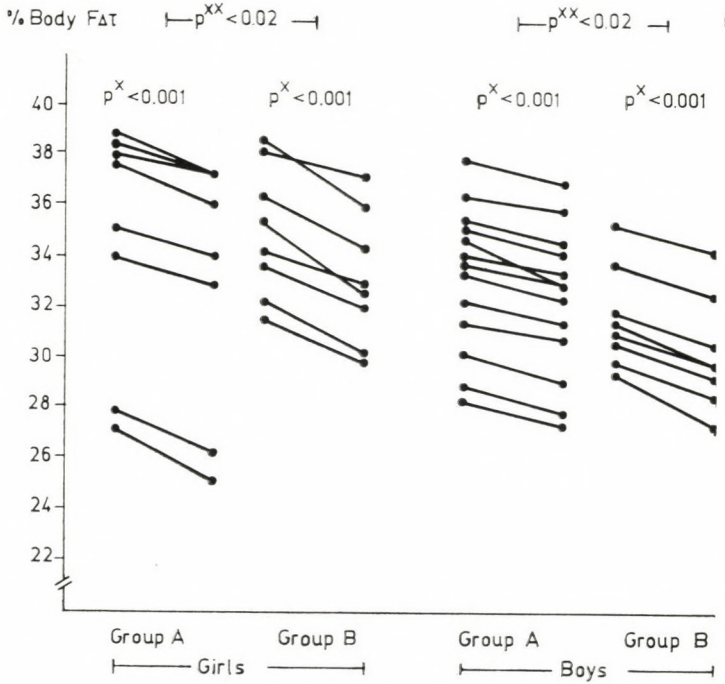
% Body Fat
$p^{xx}<0.02$
$p^{xx}<0.02$
$p^{x}<0.001$
$p^{x}<0.001$
$p^{x}<0.001$
$p^{x}<0.001$
40
38
36
34
32
30
28
26
24
22
Group A
Group B
Group A
Group B
Girls
Boys
^{x}Before treatment versus after treatment
^{xx}Group A versus Group B

FIG. 4

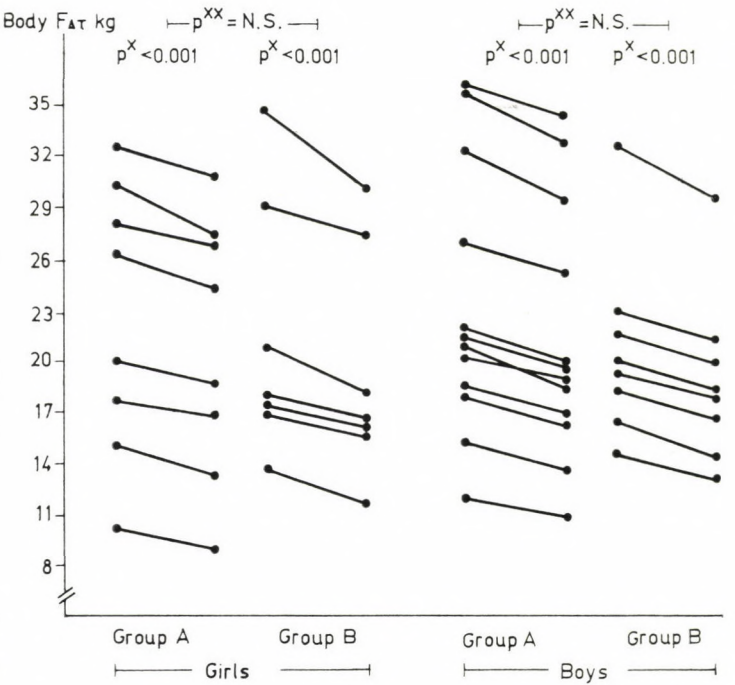
Body Fat kg
p^{xx} = N.S.
p^{xx} = N.S.
$p^{x}<0.001$
$p^{x}<0.001$
$p^{x}<0.001$
$p^{x}<0.001$
35
32
29
26
23
20
17
14
11
8
Group A
Group B
Group A
Group B
Girls
Boys
^{x}Before treatment versus after treatment
^{xx}Group A versus Group B

FIG. 5

Discussion

As it was stated before [16], to assess adequately the effect of therapeutic trials, body composition must be taken into account. In our patients we did not find significant differences either in body weight or in the IW/AH, but as regards the %BF, physical exercise caused a large reduction in it in spite of the short period of exposure. The results agree well with those reported by other authors [9, 12] who, found no significant changes in body weight with significant variations in the %BF.

Dietary restrictions alone can produce a great reduction of body weight depending on the magnitude of the restriction, but this may mainly be due to the lean body mass and in children can interfere with growth and development and induce serious disorders [15, 20].

Physical exercise has been postulated to act by several mechanisms. It may facilitate the supply of energy-rich substrates contributing to oxidation in the muscles [2], a greater ability to mobilize fat [11, 18], to increase the oxidative capacity, enzyme activity and total protein of the mitochondrial fraction of skeletal muscle [7, 8, 21], lowering the fasting plasma triglyceride level [6], and by increasing physical activity, a balance is attained between appetite and energy expenditure [1, 10]. Therefore, the combination of mild energy restriction and expenditure increase are of great importance, both acting synergistically on the diminution of body lipid stores. Since diet and physical activity are subject to voluntary regulation [3], they can be influenced by appropriate behavioural regulation.

References

1. Astrand, P. O.: How to get rid of the excess of calories? In: Nutricia Symposium on nutritional aspects of physical performance. Nutricia, Mouton and Co, The Hague, 1971, pp 135—145
2. Bray, G. A., Whipp, B. J., Sankar, N. K., Wasserman, K.: Some respiratory and metabolic effects of exercise in moderately obese men. Metabolism **26**, 403 (1977)
3. Buskirk, E. R.: Obesity: a brief overview with emphasis on exercise. Fed. Proc. **33**, 1948 (1974)
4. Durnin, J. V. G. A., Womersley, J.: Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. Brit. J. Nutr. **32**, 77 (1974)
5. Fox, F. W.: The enigma of mass regulation with special reference to obesity. S. Afr. med. J. **48**, 287 (1974)
6. Gyntelberg, F., Brennan, R., Holloszy, J. O., Schonfeld, G., Rennie, M. J., Weidman, S. W.: Plasma triglyceride lowering by exercise despite increased food intake in patients with type IV hyperlipoproteinemia. Amer. J. clin. Nutr. **30**, 716 (1977)
7. Holloszy, J. O., Oscai, L. B., Mole, P. A., Don, I. J.: Biochemical adaptations to endurance exercise in skeletal muscle. In: B. Pernow and B. Saltin (Eds.): Muscle metabolism during exercise. Plenum Press. New York
8. Kraus, H., Kirsten, R., Wolff, J. R.: Die Wirkung von Schwimm und Lauftraining auf die cellulare Funktion und Struktur des Muskels. Pflügers Arch. **308**, 57 (1969)
9. Leusink, J. A.: Body composition, glucose, and non-esterified fatty acids during exercise in periods of training and out of training. In: Nutricia Symposium on Nutritional aspects of physical performance. Ed. Nutricia, Mouton and Co., The Hague 1971, pp 100—116
10. Mayer, J., Thomas, D. W.: Regulation of food intake and obesity. Science **156**, 328 (1967)

11. Parizková, J.: Nutrition related to body composition and exercise. Experiments in rats. In: Nutricia Symposium on nutritional aspects of physical performance. Nutricia, Mouton and Co., The Hague 1971. pp 89—99
12. Parizková, J.: Body composition, nutrition and exercise. Med. Sport **27**, 2 (1974)
13. Parizková, J.: Consequences of adaptation to increased physical activity in obese children. In: Body Fat and Physical Fitness. Martinus Nijhoff, The Hague 1977, p. 175
14. Parizková, J., Roth, Z.: The assessment of depot fat in children from skinfold thickness measurements by Holtain caliper. Hum. Biol. **44**, 613 (1972)
15. Peña, M.: Uso de la dieta en el tratamiento de la obesidad. In: Simposio sobre Obesidad, CNICM, La Habana 1978, pp 9—23
16. Peña, M., Barta, L., Regöly-Mérei, A., Tichy, M.: Some anthropometrical considerations regarding obese children in paediatric practice. Acta paediat. Acad. Sci. hung. **20**, (1979)
17. Pierson, R. N. Jr., Wang, J., Yang, M. V., Hashim, S. A. van Itallie, T. B.: The assessment of human body composition during weight reduction: Evaluation of a new model for clinical studies. J. Nutr. **106**, 1694 (1976)
18. Poledne, R., Parizková, J.: Metabolic adaptation to prolonged physical exercise, 2nd Int. Symp. on Biochemistry of exercise, Magglingen 1973, Ed. H. Howald and J. R. Poortmans. Birkhäuser Verlag, Basel 1975. p. 201
19. Radakrishna Rao, C.: Advanced statistical methods in biometric research. John Wiley and Sons, New York 1966, pp. 92—102
20. Runcie, J., Hilditich, I. E.: Energy provision, tissue utilization, and weight loss in prolonged starvation. Brit. med. J. **343**, 352 (1974)
21. Varnauskas, E., Bjorntorp, P., Fahlen, M., Prekousky, I., Stenberg, J.: Effects of physical training on exercise, blood flow and enzymatic activity in skeletal muscle. Cardiovasc. Res. **4**, 418 (1970)

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