

## **NORMOCALORIC DIET AND EXERCISE: A GOOD CHOICE FOR TREATING OBESE ADOLESCENTS**

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The results of a slimming treatment in which the main features were: energy intake according to expected body weight for height (normocaloric), exercise, education and psychological support, are evaluated after one year of experience. Twenty-four obese adolescents (15 boys and 9 girls), out of thirty who started treatment, completed this stage successfully. Pubertal changes occurred and growth continued normally, mainly of lean body mass, as shown by the increase of lean body weight and muscle area of the mid-upper arm. A substantial loss of fat, expressed in a reduction of fat weight, relative fatness and fat areas of the mid-upper arm was obtained. Body weight for height shifted to lower percentile channels.

The results are promising in indicating the successful treatment of obese subjects in a period of rapid growth without affecting their normal development, profiting also from the usually-observed decrease in fatness at this age. In view of the success in motivating most of the subjects to maintain the continuity of diet and physical activity, this method is considered a good choice for treating obese adolescents without severe energy restriction, thus assuring lasting effects instead of the short-term ones commonly reported in the literature.

### **INTRODUCTION**

Previous studies have shown that the use of hypoenergetic diets for weight reduction in obese children and adolescents may lead to negative nitrogen balance, growth retardation and delay of puberty (5,7,16,26,27,28,29).

One of the expressions of negative nitrogen balance is lean

body weight (LBW) reduction. The quantity of LBW lost for each kg of body fat reduced during weight loss measures the efficiency of treatment and has been named Efficiency Index (EI) /3/. This Index shows a wide range of variation in children and adolescents subject to hypoenergetic diets, regardless of the quantity of body fat reduced, a fact which reflects the breadth of individual variability in response to such treatments /4,17/.

Immediately prior to the onset of pubertal changes, significant variations in body composition occur. In both sexes, absolute and relative body fat and LBW increase, the first two more notably in girls and the third in boys /12,13,25/. Nutrient requirements for growth of body mass are thus increased at this age; therefore, any food restriction could affect normal developmental changes.

The goal of obesity treatment at this age should not be to obtain a dramatic short term (and usually non-lasting) body weight reduction, but rather a significant change in body composition characterized by a reduction of absolute and relative body fat, without affecting LBW growth. Such a goal may be achieved over the long term, without food restriction below energy requirements for age and height, thus insuring a return to normal percentiles of body weight in a reasonable time. This paper presents the preliminary results of our experience after one year of treatment of a group of obese schoolchildren.

#### SUBJECTS AND METHODS

Thirty obese children (18 boys and 12 girls) with mild to moderate overfatness were selected for study, based on the following criteria:

- Age range: 10-12 years,
- Degree of overfatness: relative body fat weight above 30 % in boys and above 35 % in girls,
- Sexual development in stage G2 for males and B2 for females, according to Tanner /29,30/,
- No signs or symptoms of any disease, especially endocrine abnormalities,
- No treatment for weight loss for at least six months before this study.



The aims of the study were explained to parents and children, and consent obtained. It was understood that a change in relative body composition with no dramatic weight loss would be expected after one year.

Subjects were selected at the hospital's outpatient clinic from among those seeking specialized consultation for obese children. After selection, they were admitted to the hospital ward at the Service of Clinical Nutrition for three weeks. The first week was used for carrying out the necessary pretreatment studies, and the second and third for starting treatment and assuring that parents understood everything regarding diet and exercise and could follow it successfully at home. The rest of the treatment was ambulatory and lasted up to twelve months.

At admission to the ward, the following anthropometric measurements were obtained for each child:

- 1) Body Weight (BW)
- 2) Stature (HT)
- 3) Five fatfolds: (triceps, T; subscapular, SS; biceps, B; suprailiac, SI; calf, C).
- 4) Arm circumference (AC).

The equipment and methods employed were those recommended by the International Biologic Programme /31/, except for SI, in which case the methodology recommended by Parízková was used /23/. Measurements were made at the left hand side of the body. Sexual development was evaluated according to Tanner /30/.

From the anthropometric measurements described, the following indices were calculated:

- 1) Relative fatness (% FBW), according to Parízková and Roth's regression equations for five fatfolds, on the left hand side of the body /24/.
- 2) Fat body weight (FBW) was obtained from %FBW and BW.
- 3) Fat area (F), and muscle area (M) of the middle third of the upper arm were calculated from AC, T and B according to Himes, Roche and Webb /18/.
- 4) BW for HT was determined from the percentile distribution of Cuban Standards /10/ in channels and in percentual values, considering 100 % the value for the 50th percentile.
- 5) Composite Indices based on BW and HT, /1,9,28/. These were:  $BW/HT$  ratio; Body Mass Index ( $BW/HT^2$ ) and Ponderal Index ( $HT/\sqrt[3]{BW}$ )

Each child was followed monthly for twelve months and at each visit, anthropometric measurements and clinical examination were repeated by the same observers. This paper focuses on results obtained at onset and after one year (12 months) of treatment. Each subjects who remained until the end of the study is identified in this paper by a consecutive number from 1 to 24.

Treatment consisted of diet, exercise, education and psychological support. Energy requirements for the age range studied were established at 60 Kcal (0.05 MJ) per kg of expected BW for HT. Energy distribution of the diet was 45% in carbohydrate, 35% in fat and 20% in protein. Customary energy intake of all the children involved in this study (previous to the treatment) ranged between 65 and 80 Kcal (0.27-0.32 MJ) per kg of expected BW for HT/day as recorded through a three-day recall dietary survey.

Physical exercise consisted in a comprehensive program of activities: gymnastics, jogging, walking, running and sports, with progressive loads. Children came to the Hospital once a week to assure that relative energy expenditure did not decrease.

Education and psychological support were directed at changing the attitude of the subject and his parents about food intake and physical activity. Individual and collective sessions were organized, and the patients took active part in their control. An effort was made to promote a more active life. Educational activities took place daily during admission to the ward, and monthly, during the ambulatory period of the study.

## RESULTS

Six children (three boys and three girls) dropped out of the follow-up within the first three months of the study. All those who reached the twelfth week continued up to the end.

Table I shows the initial age and the stages of sexual development at onset of treatment and one year later of the 24 children who completed the follow-up study. All the children manifested pubertal changes and their sexual development continued normally during treatment.

In Figure 1, changes of BW for HT are shown. Body weight for height was above the 97th percentile at the beginning of treatment in every subject. After one year all but six had moved between the 90th and 97th percentiles or lower. BW increased in 11 of the 24 subjects (7 boys and 4 girls). Figure 2 shows the individual changes of three composite indices of BW and HT, and Table II details the initial and final values of BW for HT, BW/HT ratio and Body Mass Index (BMI). A wide range of variation of these indices can be observed.

Figure 3 shows the changes in some adiposity and lean body mass indices during treatment. All the subjects showed, in varying degrees, reduction in fatness and increases in lean body mass. Means and standard deviations for those changes appear in Table III. The initial values for %FBW ranged from 36.29% to 29.36% in boys, and from 38.89% to 32.33% in girls; final values were always under 25% in males and under 30% in females (Table IV).

No signs of growth deceleration were observed in our patients (Figures 4 and 5). It can be seen that all children grew normally relative to Cuban Standards: the mean increase for boys was  $6.76 \pm 1.44$  cm; and for girls it was  $5.62 \pm 0.81$  cm.

TABLE I

Stages of sexual development at onset of slimming treatment (initial) and twelve months later (final)

Patient no.	Decimal age at onset (y)	Sexual development	
		Initial	Final
01	12.2	G2 P2	G4 P3
02	12.0	G2 P2	G3 P3
03	11.8	G2 P1	G3 P2
04	12.6	G2 P2	G4 P3
05	11.4	G2 P1	G3 P2
06	12.5	G2 P2	G4 P3
07	12.7	G2 P2	G3 P2
08	12.5	G2 P2	G3 P2
09	11.7	G2 P1	G3 P3
10	11.4	G2 P1	G3 P2
11	11.2	G2 P1	G3 P2
12	12.3	G2 P2	G4 P3
13	12.4	G2 P2	G4 P3
14	12.9	G2 P2	G4 P3
15	12.7	G2 P2	G4 P3
16	10.7	B2 P1	B3 P2
17	11.9	B2 P2	B3 P3
18	11.5	B2 P2	B3 P2
19	11.3	B2 P2	B3 P2
20	11.8	B2 P2	B3 P3
21	11.9	B2 P2	B4 P3
22	10.6	B2 P1	B3 P2
23	12.1	B2 P2	B4 P3
24	11.5	B2 P1	B3 P2

G: Genitals  
B: Breast  
P: Pubic Hair



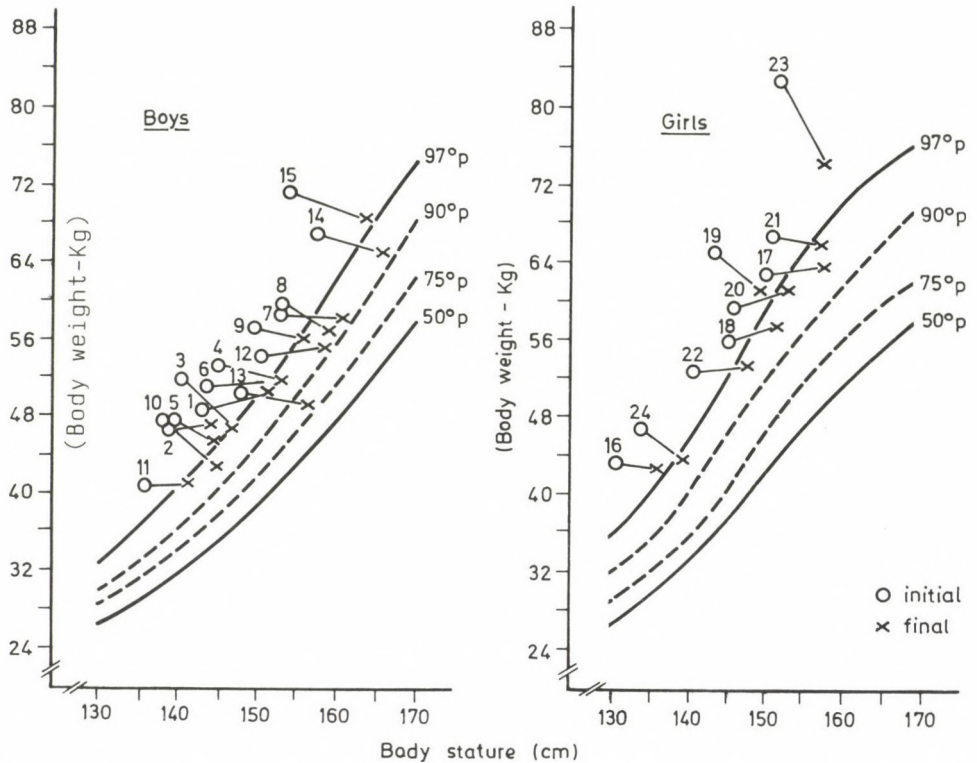


Fig. 1. Changes of body weight and height of 15 boys and 9 obese girls after one year of slimming treatment. Initial and final values for each patient are plotted in the corresponding percentile charts of body weight for height. Observe patient's reduction in relative weight, though in 7 of them absolute weight showed slight increase.

## DISCUSSION

This study has demonstrated that a program consisting of normocaloric diet and exercise can be effective in obese adolescents. In particular, such a program has been demonstrated to bring about a reduction in body weight without affecting adversely normal growth in lean body mass.

The effectiveness of programs designed to reduce fatness, is typically evaluated on the basis of weight reduction. While this may be sufficient in adults, who have completed their

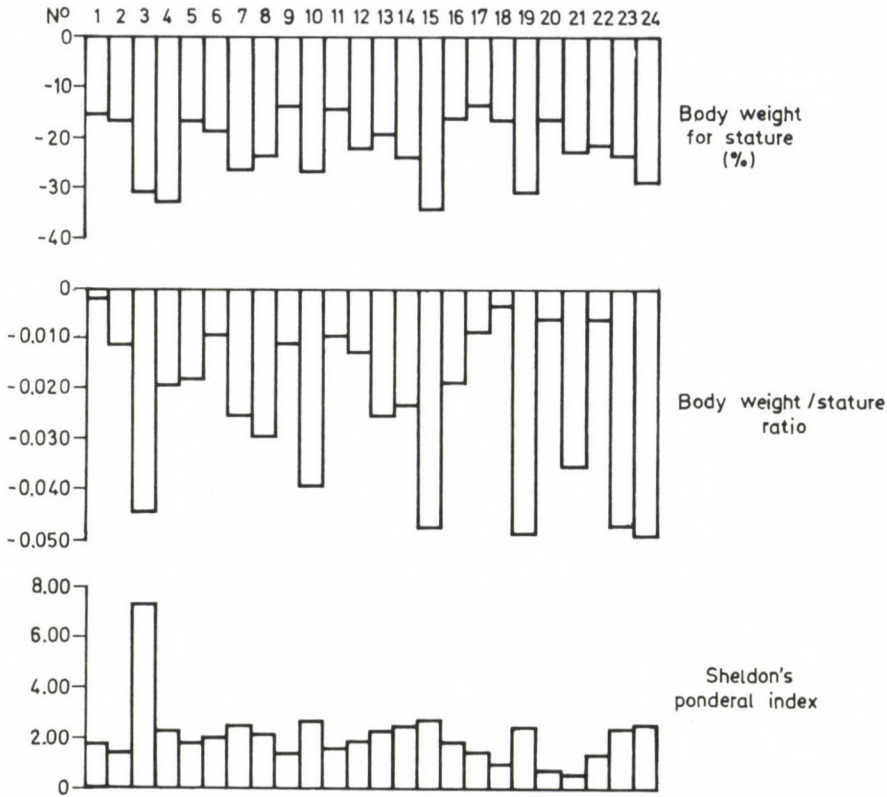


Fig. 2. Individual changes in three composite indices of body weight and height. Each subject is identified by a consecutive number from 1 to 24.

growth, it is not a satisfactory procedure in adolescents, whose fat/lean proportions are changing in the course of normal development /2,19/.

In the preadolescent ages of growth, body weight increases at a faster rate than does lean body mass. Thus, the normal child becomes relatively fatter during this period. However, with the onset of the adolescent spurt, lean body mass increases more rapidly than weight, resulting in a normal reduction in relative fatness /11/. In the three years preceding the peak height velocity, there is a decrease in the rate of fat accumulation in both sexes, though it is

TABLE II

Weight/height indices at onset of treatment (Initial) and twelve months later (Final)

No	Weight for height (%)			Weight/height ratio			Body mass index		
	Initial	Final	(F-1)	Initial	Final	(F-1)	Initial	Final	(F-1)
01	145.2	130.2	-15.0	0.338	0.336	-0.002	23.69	22.22	-1.47
02	149.8	134.7	-15.1	0.333	0.321	-0.012	24.10	22.19	-1.91
03	162.5	131.7	-30.8	0.367	0.322	-0.045	26.07	22.04	-4.03
04	155.3	123.1	-32.2	0.369	0.351	-0.018	25.45	23.15	-2.30
05	153.1	135.6	-17.5	0.340	0.323	-0.017	24.30	22.32	-1.98
06	152.9	133.3	-19.6	0.355	0.346	-0.009	24.68	22.70	-1.98
07	143.8	116.9	-26.9	0.382	0.355	-0.027	24.95	22.13	-2.82
08	145.1	120.8	-24.3	0.388	0.358	-0.030	25.34	22.52	-2.82
09	148.5	136.0	-12.5	0.385	0.373	-0.012	25.62	23.15	-2.47
10	153.7	126.4	-27.3	0.341	0.301	-0.040	24.73	20.77	-3.96
11	141.1	127.5	-13.6	0.298	0.289	-0.009	22.00	20.44	-1.56
12	139.7	117.0	-22.7	0.360	0.347	-0.013	23.90	21.89	-2.01
13	134.9	115.2	-19.7	0.342	0.316	-0.026	23.18	20.21	-2.97
14	146.5	122.5	-24.0	0.415	0.391	-0.024	26.48	23.62	-2.86
15	168.4	134.3	-34.1	0.466	0.418	-0.048	30.12	25.64	-4.48
16	164.2	148.6	-15.6	0.333	0.315	-0.018	25.56	23.31	-2.25
17	143.6	129.7	-13.9	0.413	0.404	-0.009	27.51	25.64	-1.87
18	144.3	126.9	-17.4	0.379	0.376	-0.003	26.12	24.82	-1.30
19	178.9	147.3	-31.6	0.453	0.403	-0.050	31.68	26.88	-4.80
20	152.5	136.9	-15.6	0.401	0.407	-0.006	27.64	26.61	-1.03
21	154.2	131.5	-22.7	0.444	0.408	-0.036	29.46	25.91	-3.55
22	159.7	137.8	-21.9	0.370	0.364	-0.006	26.39	24.56	-1.83
23	175.8	152.0	-23.8	0.537	0.472	-0.065	35.37	30.10	-5.27
24	168.8	139.9	-28.9	0.348	0.313	-0.075	26.05	22.41	-3.64



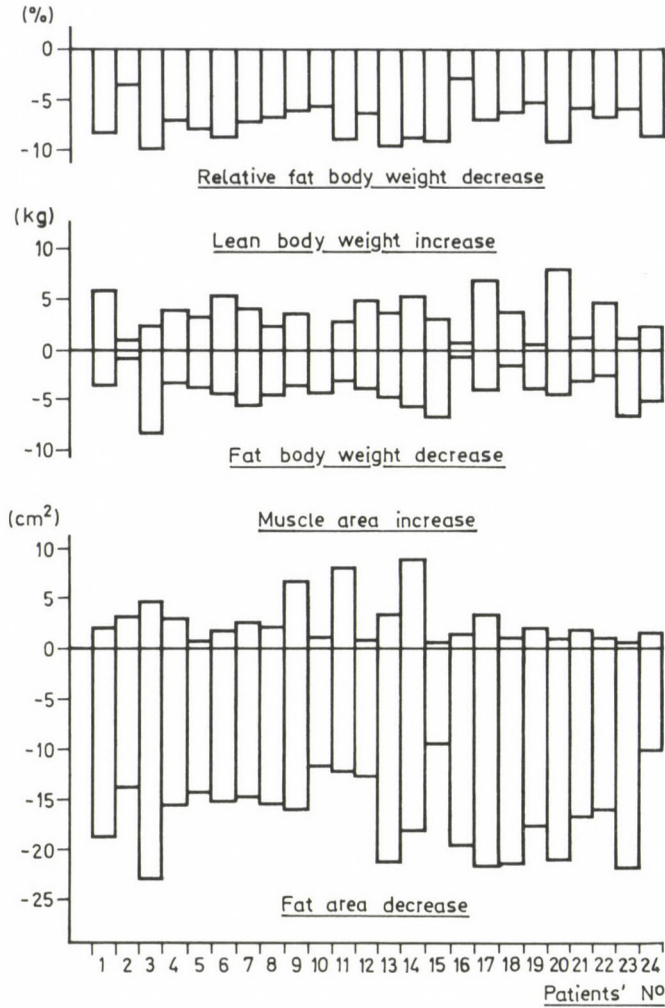


Fig. 3. Changes in some adiposity and lean body mass indices during slimming treatment in 15 boys and 9 girls. Patients are identified by a consecutive number from 1 to 24. Note the individual variability in fatness reduction and lean body mass increase one year after the onset of the study.

considerably more marked in males. At peak height velocity in males, there is usually an absolute loss in body fat. The rate of accumulation of lean body mass shows a sharp rise in males beginning at an average height of approximately 137 cm., and a

TABLE III

Means and standard deviations of the changes of indices which reflect adiposity or lean body mass development after one year of slimming treatment.

		$\Delta$ FBW	$\Delta\%$ FBW	$\Delta$ F	$\Delta$ LBW	$\Delta$ M
Boys	$\bar{X}$	-4.45	-7.69	-18.58	3.49	2.26
	S	1.50	1.62	3.36	1.46	1.17
Girls	$\bar{X}$	-4.18	-6.63	-15.96	3.06	1.54
	S	1.54	1.66	2.98	1.52	0.85

$\Delta$ FBW: Changes in absolute fat body weight (in kg)

$\Delta\%$ FBW: Changes in relative fat body weight (in %)

$\Delta$ F: Changes in fat area of the mid-upper arm (in cm<sup>2</sup>)

$\Delta$ LBW: Changes in lean body weight (in kg)

$\Delta$ M: Changes in muscle area of the mid-upper arm (in cm<sup>2</sup>)

$\Delta$ : Final - Initial

less dramatic rise in females at about 112 cm /8,31/. At the beginning of the study, our patients all displayed the initial signs of puberty, but none had reached peak height velocity.

The results of this study were better for males, not only because a greater proportion dropped below the 97th percentile of weight-for-height, but because there was a greater decrease in fatness, absolute and relative, than in females. Since motivation was comparable among the subjects who completed the study and their parents, it may be concluded that the normal tendency of males to lose more fat than do females during adolescence /14/ enhanced the results of the treatment.

No method of weight reduction will be entirely satisfactory for all patients. However, in children and adolescents, any method employed should preserve growth. In addition, the psychological stress of severe food restriction should be avoided and a true motivation of the patient achieved /15/.

TABLE IV

Initial and final values of relative fatness in 24 adolescents who underwent a slimming treatment during one year

Relative fatness (%FBW) (boys)			Relative fatness (%FBW) (girls)		
No	Initial	Final	No	Initial	Final
01	33.17	24.84	16	34.22	30.00
02	29.58	24.88	17	36.00	28.76
03	36.29	24.86	18	36.27	29.11
04	31.59	23.65	19	37.69	29.57
05	33.04	25.00	20	38.89	29.12
06	33.83	24.90	21	32.23	20.85
07	30.75	23.35	22	34.54	27.94
08	31.15	23.88	23	37.90	29.38
09	32.69	23.29	24	36.71	27.34
10	30.54	24.40			
11	33.59	24.94			
12	29.36	22.36			
13	32.33	23.08			
14	32.88	24.61			
15	35.66	24.72			

Every reducing diet will finally be rejected by a patient. The length of time that a diet is followed will depend upon the attitude and will of the child and his or her parents, as well as the continuing interest of the therapist /6/. Häger /15/ considers realistic goals for treatment to be no further weight gain in early adolescence before peak height velocity; in late adolescence, a slow weight loss over a rather long period of time is advised.

Our results are promising because a reduction of body fat and a substantial change in body composition were obtained without affecting growth and development, and without the marked food restriction is usually the main cause of rejection by the patient. Overfatness was reduced even in those subjects who



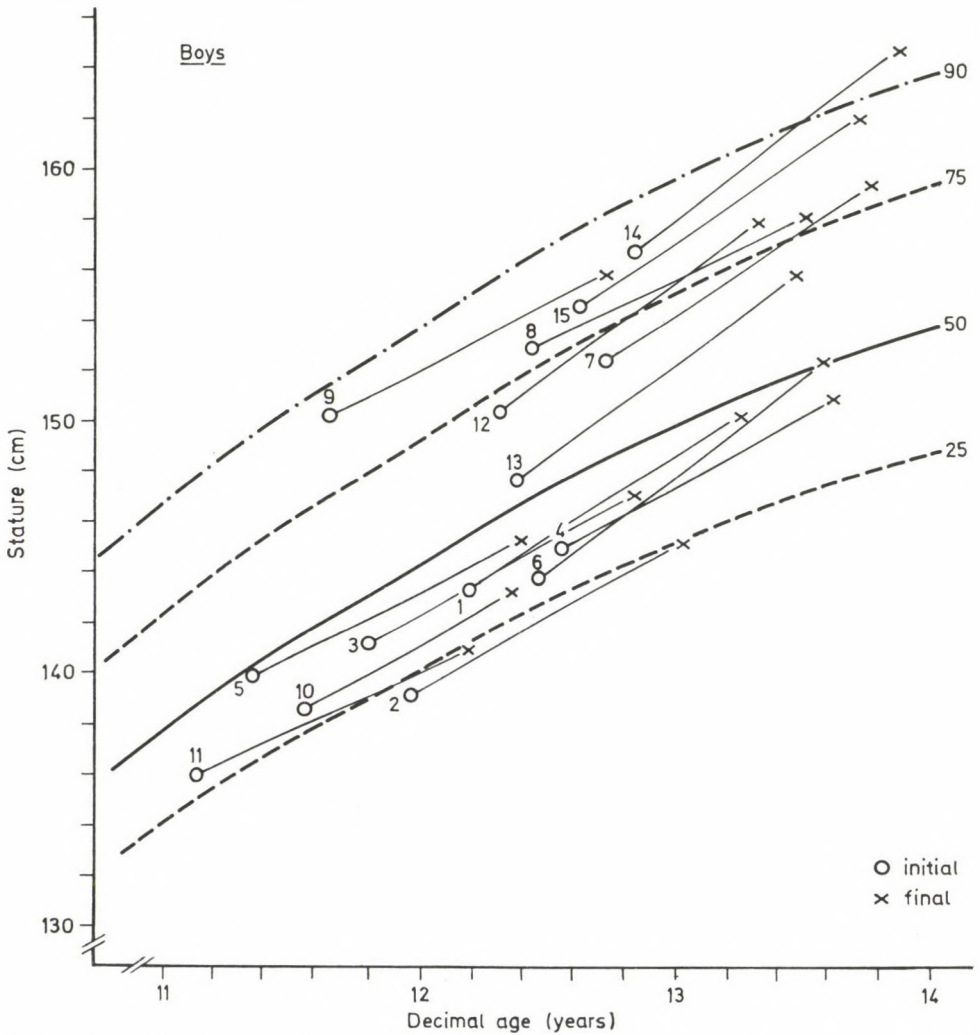


Fig. 4. Displacement of stature along percentile channels of Cuban standards of 15 obese boys during one year of slimming treatment.

gained weight during the year of study, because such increase was in lean body mass. In all patients, relative fatness could be reduced below the out-off values generally accepted /21/. In the six subjects who remained with BW for HT above the 97th percentile, relative fatness also dropped below the out-off lines, which suggests that the remaining overweight was due to lean body mass.

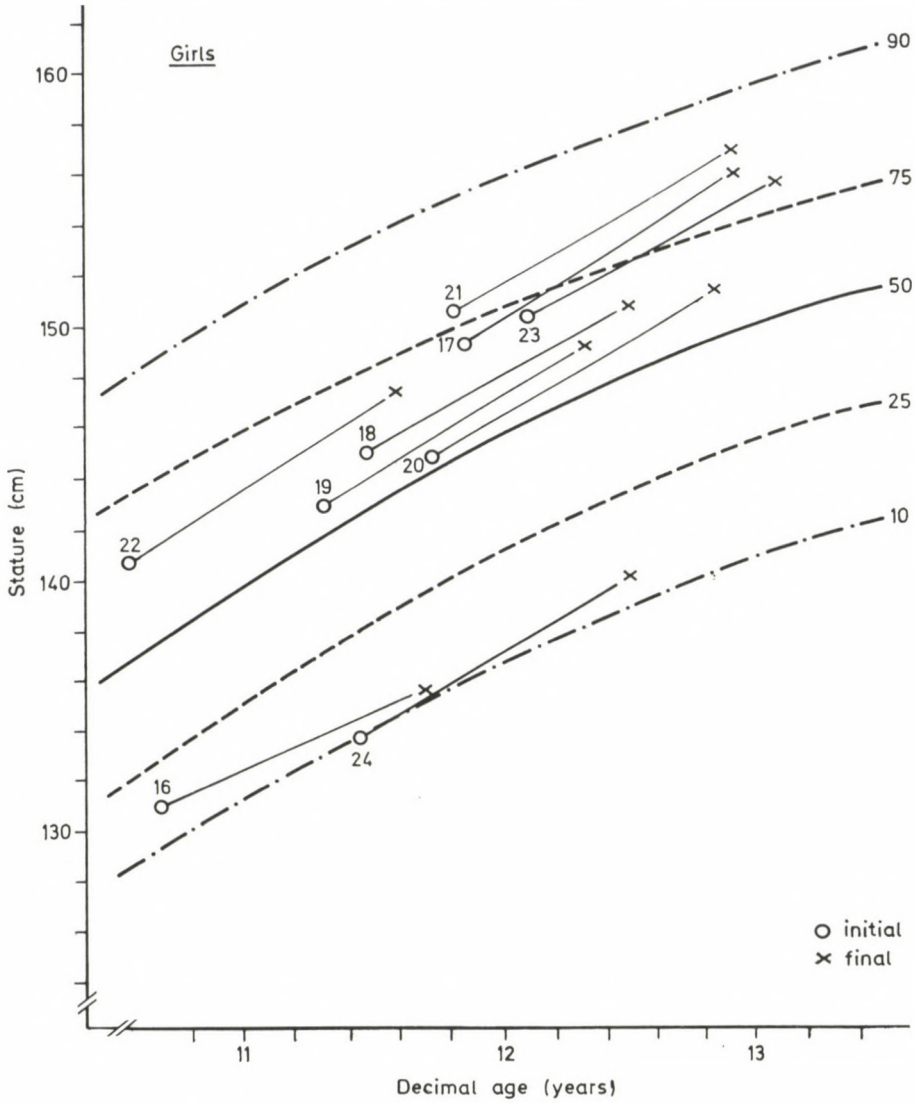


Fig. 5. Displacement of stature along percentile channels of Cuban standards of 9 obese girls during one year of slimming treatment.

Increase of energy output through a comprehensive program of physical activity which included not only scheduled exercises but also optional sports and a changing of attitudes toward a more active life, assured the equilibrium of energy balance.

Very few of the children who underwent this treatment complained of hunger or anxiety; however, many of them considered that the diet, while not restrictive in quantity, was deficient for them in sweets or starchy foods. Nevertheless, the diet was actually restrictive if we consider that daily energy intake previous to treatment was in all cases above the requirements for this age group.

We consider that we succeeded in motivating our patients because the proportion who failed to attend follow-up appointments was low, and after three months, nobody else dropped out. Nevertheless, the possibility of relapse after one year of treatment exists. Prognostic data of the literature indicate that about 80% of obesity in childhood and adolescence will persist into adulthood in spite of treatment /22/. Häger /15/ has obtained good results in his outpatient obesity clinic and only about 50% of patients relapsed during observation for up to 8 years.

The possibility of relapse of our patients after the treatment should be lower. We have benefited from normal physiological trends and the treatment generally was not stressing for our young patients. Whether these results obtained in patients with mild to moderate obesity could be obtained in youngsters with more severe forms of overfatness, needs to be investigated. Whether the results obtained in one year are maintained or even improved throughout the adolescence, is now being studied. The long-term evaluation of our results will be the subject of a further publication.

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