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School-based obesity and overweightness correction programme. Design, implementation and assessment of a physical-education programme for the first cycle of Spain's Compulsory Secondary Education systems

Health Promotion

The objective of this research project is to ascertain the effectiveness of an extracurricular physical-sporting activity programme designed for overweight and obese adolescents. An assessment is made of the programme's impact on their physical condition, body fat percentage, body image and physical self-concept, while also checking for any gender differences. This involved a six-month quasi experimental study of 45 overweight or obese pupils from the first cycle (12 to 14 years old) of Spain's Compulsory Secondary Education (Educación Secundaria Obligatoria: ESO). The cut-off for inclusion in the study was a body mass index exceeding the 85th percentile. The main conclusion drawn from this study is that a properly designed and implemented physical-sporting activity programme for children with obesity and overweightness problems helps to improve their body fat readings, physical condition, body image and physical self-concept.

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Childhood obesity has now become one of today's biggest health problems; in fact it can now be classed as one of the twenty-first century's worst epidemics[1]. Spain's overweightness and obesity rate in children aged 6 to 10 now stands at 44.5 percent[2]. Among children aged 13 to 14 the overweightness rate is one in three, giving Spain one of Europe's highest childhood obesity rates[3].

Obese or overweight minors also tend to suffer from psychosocial disorders such as low physical self-concept, body dissatisfaction, depression and eating disorders

The main factors that seem to be fuelling this overweightness-obesity epidemic are a sedentary lifestyle, a reduction of physical and sporting activities and changing eating habits [4].

Childhood overweightness and obesity impinge on health and welfare in both the short and long term. An obese child is much likelier to become an obese adult[5] and runs a higher risk too of suffering as an adult from cardiovascular, hepatic and respiratory diseases and bone and joint pain[6]. As well as these health

problems, children and adolescents with these problems also suffer from psychosocial disorders such as a low physical self-concept, dissatisfaction with their bodies, depression, anxiety, attention deficit, hyperactivity and eating disorders[7].

Several studies have borne out these findings, reporting soaring rates of body-image dissatisfaction and low physical self-concept[8]. In adolescent age groups this has now become a public-health problem. Teenagers who consider themselves to be obese or overweight or have concerns about their weight are likelier to suffer from eating disorders[9].

In line with the increase in childhood obesity rates there has been a parallel rise in adolescents' body dissatisfaction[10]. This may stem from a distorted perception of reality, discrepancy between the perceived and ideal body, or simply from unhappiness with their own body[11]. This is now a very common problem among obese or overweight children and adolescents. Taken together with other risk factors like eating disorders, low levels of physical activity and mental health problems it makes the sufferers likelier to suffer from obesity as an adult[12].

Participation in sporting-physical activities on a regular basis is known to be highly beneficial in terms of health and welfare[13]. Despite this, physical activity levels among children and adolescents have been falling, especially from the age of 12[14]. Thirty five percent of minors aged 6 to 18 within the education system are now leading a sedentary lifestyle. This means that Spain's children and adolescents are now breaching the international recommendations of one hour's moderately vigorous physical activity a day, as laid down by the World Health Organisation (WHO)[15].

In view of this proven problem of obesity and overweightness among Spain's teenage population, the objective of this research project is to assess the effectiveness of a six-month, extracurricular physical-sporting activity programme with overweight and obese adolescents, checking the results of this programme in terms of such indicators as a reduction in body-fat percentage, improved physical condition and enhanced body image and physical self-concept, and finally to weigh up any gender differences.

Materials and Method

A quasi-experimental study was designed with a control group and intervention group, with pre-tests and post-tests. The study began with a total of 45 pupils from the first cycle (12 to 14 years) of Spain's Compulsory Secondary Education system with the following characteristics: none of them carried out any form of regular physical activity or followed any diet or were under any sort of medical supervision; they had no injury or illness and in each case their BMI exceeded the 85th percentile. By the end of the programme this number had fallen to 38 as 7 pupils either failed to complete the programme or participate in the necessary readings. The final sample was therefore made up by an intervention group (IG) (n = 22) that carried out the whole physical activity programme, consisting of 8 boys and 14 girls with a mean age of 12.95 (SD = 0.89) and a mean weight of 68.01 kilograms (SD = 13.93); and a control group (CG) (n = 16) who did not carry out the physical activity programme, comprising 9 boys and 7 girls with a mean age of 13.2 (SD = 0.95) and a mean weight of 72.68 kilograms (SD =15.73).

All participants were made aware of study objectives and the tests to be carried out. Informed consent was duly obtained from their parents, as legal guardians, and the minors themselves. The study was approved by the Bioethics Committee of the Universidad de *Castilla-La Mancha* and abided by all the principles of the Helsinki Declaration [16].

Measurements and Procedure

Anthropometric Assessment

Study protocol followed the recommendations of the International Society for the Advancement of Kinanthropometry (ISAK). Measurements were taken by a researcher with ISAK (level I) training, on school days and outside classroom hours. Anthropometric readings were taken with the participants barefoot and wearing bathing costumes. Height was measured using a Seca-222 portable height rod (with 0.1 cm degrees) and weight with a Tanita BF-522 scale. BMI was calculated from the weight (Kg) / height (m) formula. Body fat percentage was calculated using a Holtain AW-610 skinfold caliper (triceps, subscapular, suprailiac, abdominal, thigh and medial calf). Perimeter readings (waist, hip, arm and medial calf) were taken with a Lufkin W-606 tape measure.

Assessment of physical condition

- Sit-and-Reach. This test is used to measure hamstring flexibility.
- Maximal isometric peak force of the trunk and upper limbs, measured by means of a Takei TKK 5401 digital handgrip dynamometer (range 5-100 kg) to assess maximum grip strength in both hands.
- Standing long jump with feet together to assess the explosive force of the lower limbs.

- Throwing a medicine ball with both hands from a standing position, to assess the explosive force of upper limbs.
- 4 x 10 m. agility test to measure speed of movement and coordination.
- Multi-stage physical condition test (bleep test) to measure maximum aerobic capacity.
- 30-second abdominal endurance test to assess torso flexion strength.

Assessment of body-image perception

The body-image assessment test, adapted to bring it into line with the Spanish population, was used to gauge the perceived body image[17]; the test was conducted on the same day as the anthropometric measurements. Body image distortion was gauged by means of the difference between the subject's own perceived body shape and the silhouette actually pertaining to their BMI. The central silhouette shown to the participants corresponded to a BMI adjusted by age and gender, according to WHO's BMI tables[18], while the silhouettes to the right increased by BMI increments of 5 percent and those to the left decreased by 5 percent. Body dissatisfaction was calculated as the difference between the perceived body shape and the desired body shape.

Assessment of physical self-concept

The CAF Physical Self-Concept Questionnaire (*Cuestionario de Autoconcepto Físico*: CAF)[19] was used to assess this aspect. This comprises 36 items broken down into four scales of physical self-concept (physical attractiveness, sporting skill, physical condition and strength) and two general scales (general physical self-concept and general self-concept).

Intervention Programme

The programme was carried out continuously from January to June 2013. Three 90-minute physical-sporting activity sessions were carried out each week. Each session was structured as follows: warm up (5-10 minutes), main physical activity (65-70 minutes) and warm down (7-10 minutes). No control was kept over participants' diet.

The main characteristics of the physical activity programme were the following: a) the warm up consisted of joint-mobility exercises, runs and muscle stretching; b) the main physical activity was subdivided into muscular strength work and cardiovascular resistance work. The former involved bodyweight exercises and games, rubber bands and work with dumbbells. The latter involved sporting-skill preparatory games, dancing and bike trips. Lastly, c), the warm down involved leisurely stretching exercises.

Data Analysis

The computer software SPSS version 19.0 was used for data analysis. First of all an analysis was made of variance and homogeneity of variance. A descriptive analysis was then carried out to obtain a general view of the studied variables. Student-t tests for related samples and independent samples were then conducted to ascertain the programme's effects on the intervention group and bring out any differences between the CG and IG. A Wilcoxon (z) test was then carried out with pre- and post-programme readings of the CG and IG, plus a variance analysis (ANOVA) to detect any gender differences.

Results

Table 1 shows the IG's and CG's pre- and post-programme variables of physical condition and sum of skinfolds. IG results show significant differences in relation to the variables of strength ($t = -2.92$, $p < .01$), isometric force ($t = -4.04$, $p < .01$), agility ($t = 3.68$, $p < .01$), jumping ($t = -3.86$, $p < .01$), throwing ($t = -6.25$, $p < .01$), flexibility ($t = -4.56$, $p < .01$) and abdominal force ($t = -5.52$, $p < .01$). The results also show significant post-programme changes in the sum of six skinfolds ($t = 3.63$, $p < .01$) and the sum of eight skinfolds ($t = 2.97$, $p < .01$), showing no significant BMI differences.

Table 1. Students' T test of pre- and post-test physical condition and skinfolds

	Related differences PC				Related differences PC			
	IG (n = 22)				CG (n = 16)			
	M	SD	*t*	*p*	M	SD	*t*	*p*
Max isometric force (kg)	-2.89	(3.35)	-4.04	.001	-2.17	(4.81)	-1.80	.092

PC: physical condition; IG: Intervention group; CG: Control Group, max. isometric force: maximum isometric force; BMI: body mass index

Σ 6 skinfolds: triceps brachii, subscapular, suprailiac, abdominal, quadriceps, medial calf

Σ 8 skinfolds: triceps and biceps brachii, subscapular, iliac crest, suprailiac, abdominal, quadriceps, medial calf

	Related differences PC				Related differences PC			
	IG (n = 22)				CG (n = 16)			
	M	SD	*t*	*p*	M	SD	*t*	*p*
Agility (sec)	.81	(1.03)	3.68	.001	.019	(.657)	.118	.908
Throwing (m)	.64	(.48)	-6.25	.000	.071	(.438)	.656	.522
Jumping (m)	.14	(.17)	-3.86	.001	.018	(.081)	.890	.388
Strength (periods)	-1.08	(1.73)	-2.92	.008	-.218	(.446)	-1.96	.069
Flexibility (cm)	-4.31	(4.43)	-4.56	.000	6.37	(28.64)	.890	.387
Sit-ups (repetitions)	-3.50	(2.97)	-5.52	.000	5.62	(22.52)	.999	.334
BMI	.295	(1.25)	1.10	.283	-.635	(.826)	-3.07	.008
Σ 6 skinfolds	16.01	(20.68)	3.63	.002	-16.26	(16.98)	-3.83	.002
Σ 8 skinfolds	16.96	(26.78)	2.97	.007	-20.67	(19.55)	-4.22	.001

PC: physical condition; IG: Intervention group; CG: Control Group, max. isometric force: maximum isometric force; BMI: body mass index

Σ 6 skinfolds: triceps brachii, subscapular, suprailiac, abdominal, quadriceps, medial calf

Σ 8 skinfolds: triceps and biceps brachii, subscapular, iliac crest, suprailiac, abdominal, quadriceps, medial calf

The CG results, on the other hand, show no significant effect on any of the physical condition variables under study although there was a significant worsening both in the sum of six skinfolds (t = -3.83, p < .01) and in the sum of eight skinfolds (t = -4.22, p < .01); there was also a significant worsening of the BMI (p < .01).

Any gender differences were studied jointly. The IG results show that boys improved in the variables of throwing (t = -3.03, p <.05), flexibility (t = -2.96, p <.05) and abdominal force (t = -2.85, p <.05). The girls, on the other hand, showed significant differences in the variables of isometric force (t = -5.57, p < .01), throwing (t = -5.54, p <.01), strength (t = -4.98, p <.01), abdominal force (t = -4.93, p <.01), jumping (t = -4.58, p <.01), agility (t = 3.54, p <.01), flexibility (t = -3.39, p <.005) and the sum of six (t = 3.21, p < .01) and eight skinfolds (t = 2.75, p <.016), respectively. No significant gender differences were observed in the CG.

As for the perceived body image, Table 2 shows the situation before and after implementing the physical activity programme in the IG, broken down by gender. Boys show no significant changes, despite improvements in the perception of the ideal body and body image distortion and body dissatisfaction by the end of the programme. Girls show significant changes in the ideal body variable; there is also a slight, non-significant correction of distortion and body dissatisfaction; in other words, the girls bring their body-image perception into line with their actual image.

Table 2. Comparison of IG and CG body image variables, broken down by gender

	Boys (n = 8)				Girls (n = 14)			
Intervention group	**Pre**	**Post**	*Z*	*p*	**Pre**	**Post**	*Z*	*p*
Perceived body shape	9.00 (1.41)	9.00 (1.69)	-.09	.93	9.50 (1.65)	9.93 (1.27)	-.73	.46
Ideal body shape	5.00 (1.31)	5.75 (2.49)	-.57	.57	5.07 (1.73)	6.07 (1.38)	-2.17	.03
BMI body shape	10.13 (2.10)	9.75 (2.25)	-.74	.46	10.57 (1.74)	10.21 (2.01)	-1.15	.25
Body image distortion	-1.13 (1.55)	-.75 (1.28)	-.54	.59	-1.07 (2.13)	-.29 (1.20)	-1.92	.06
Body dissatisfaction	4.00 (1.41)	3.25 (1.91)	-.95	.34	4.43 (2.38)	3.86 (1.92)	-.87	.38

	Boys (n = 9)				Girls (n = 7)			
Control group	**Pre**	**Post**	*Z*	*p*	**Pre**	**Post**	*Z*	*p*
Perceived body shape	9.11 (1.36)	9.00 (1.12)	-.26	.79	9.71 (1.98)	11.14 (1.21)	-1.45	.15

	Boys (n = 9)				Girls (n = 7)			
Control group	Pre	Post	*Z*	*p*	Pre	Post	*Z*	*p*
Ideal body shape	5.67 (2.18)	6.56 (2.13)	-1.99	.05	5.43 (1.27)	5.86 (1.86)	-.64	.52
BMI body shape	10.67 (1.58)	10.78 (1.86)	-.45	.65	10.86 (1.46)	11.29 (1.25)	-1.73	.08
Body image distortion	-1.56 (1.67)	-1.78 (1.48)	-.54	.59	-1.14 (2.73)	-.14 (2.04)	-1.06	.29
Body dissatisfaction	3.44 (1.33)	2.44 (1.33)	-2.17	.03	4.29 (1.80)	5.29 (1.80)	-1.02	.31

CG results show that the girls' body dissatisfaction was significantly higher than the boys both before [F(1, 14) = 2.78, p <.01] and after the physical activity programme [F(1, 14) = 13.22, p <.01].

Table 3 shows the results in the pre- and post-programme IG and CG variables of general physical self-concept and general self-concept. In the IG both variables improved after the programme, while no increase was recorded in the CG. Broken down by gender, IG boys show a higher score than girls after the programme both in terms of general physical self-concept and general self-concept. CG boys show a fall in the total value of general physical self-concept and general self-concept after the end of the programme, while the girls show no change in the initial pre-test values.

Table 3. Comparison of IG and CG variables of general physical self-concept and general self-concept

	General physical self-concept		General self-concept			General physical self-concept		General self-concept	
	M	SD	M	SD		M	SD	M	SD
IG Pre(n=22)	16.45	4.98	19.68	3.88	GC Pre (n=16)	17.43	5.76	18.81	4.08
IG Post(n=22)	19.54	3.01	21.04	3.57	GC Post (n=16)	15.75	3.80	17.56	2.63

	General physical self-concept IG (n=22)				General self-concept IG (n=22)			
	Boys (n=8)		Girls (n=14)		Boys (n=8)		Girls (n=14)	
	M	SD	M	SD	M	SD	M	SD
Pre-test	18.87	5.13	15.07	4.49	21.12	4.42	18.85	3.43
Post-test	20.50	4.34	19.00	1.92	22.62	3.50	20.14	3.41

	General physical self-concept CG (n=16)				General self-concept CG (n=16)			
	Boys (n=9)		Girls (n=7)		Boys (n=9)		Girls (n=7)	
	M	SD	M	SD	M	SD	M	SD
Pre-test	20.22	5.82	13.85	3.33	20.55	3.60	16.57	3.73
Post-test	17.44	3.32	13.71	3.40	18.66	2.59	16.14	2.03

An analysis of the related means shows a significant difference in the IG's general physical self-concept variable (t= 3.63; p= 0.002); the general self-concept variable also improves, though not significantly. The CG shows no change..

Lastly, broken down by gender, IG girls show significant changes in the general physical self-concept variable (t= 3.75; p= 0.02); neither girls nor boys show any significant changes in the general self-concept variable. In the CG there were no significant changes in either sex.

Discussion

The results of this research project show significant post-programme changes in the IG's readings of physical condition

(aerobic resistance, maximum isometric force, agility, jumping, throwing, flexibility and abdominal force); in the CG, on the other hand, all these readings either worsened or showed no significant change. These improvements observed in obese children after the physical-sporting activity programme chime in with the findings of similar programmes in the past, such as the six-month programme of Weintraub *et al*.[20] and the nine-month programme of Carrel *et al*.[21]. The results of these studies clearly show significant improvements not only in aerobic resistance but also in body-fat skinfold readings at the end of these programmes. Like these previous studies our own research project showed an IG reduction in body fat percentage in the sum of six and eight skinfolds, respectively, at the end of the programme

It must nonetheless be pointed out that our study throws up no significant BMI changes in the IG. Despite the significantly improved skinfold readings after the programme, these do not translate into BMI improvements. Similar research projects in the past show comparable results to ours. Witness the meta-analysis on school-based physical activity carried out by Harris *et al*.[22]. These authors concluded that a three-to-six-month physical activity programme does not significantly improve BMI.

As for the gender breakdown of the programme's effect, both girls and boys within the IG showed significant improvement in terms of body values and physical condition, but it was the girls who proved most sensitive to this intervention programme. The girls' indicators of physical condition and body fat percentage improved more than the boys', who recorded improvements only in certain aspects of the physical condition. This tallies with the findings of the research project run by Lazaar *et al*.[23], involving a six-month physical activity intervention programme to ascertain its effect on overweightness in young children. They found, indeed, that the intervention programme was effective in all anthropometric readings for girls but not for boys.

As for the body-image variable, our study tried to characterise the physical activity's effect thereon. We thus found that the IG's body-image distortion readings improved. That is to say, by the end of the programme, the subjects' perception of their body image was more in line with the real situation. These improvements seem to stem from the types of games and sports played in the intervention programme, since they try to maintain an aerobic character with an intensity ranging from moderate to vigorous. Along these lines, previous studies by Hausenblas and Fallon[24] found that moderate or vigorous exercise had a bigger effect on body image than lower-intensity exercise. Similar findings were made by the work of Martin Ginis and Lichtenberger[25], who concluded that resistance training had more positive effects on body image.

This study bears out the need for mixed school-based physical activity programmes designed to reduce levels of obesity and overweightness in adolescents

People with a low body image, therefore, can improve with physical exercise, according to Martin Ginis, and Bassett[26]. Our study, indeed, showed that the IG, after the physical activity programme, showed more improvement than the CG in terms of waist, hip and arm perimeters, aspects directly tied in with distorted body image. This finding bears out the fact that body dissatisfaction is due to worries about excess weight in girls[27], whereas in males it is likelier to bear a relationship to being too fat, too thin, insufficiently muscled or a combination of all these factors[28]. As the study by Levine and Smolak[29] has shown, therefore, body dissatisfaction in girls tends to centre on the mid and lower torso (stomach, hips, glutei and thighs); it also reports that between 40 and 70 percent of girls express dissatisfaction with two or more aspects of their body, a finding borne out by our study.

Our study also shows that, after a systematic physical activity programme, the IG's variables of general physical self-concept and general self-concept improved in the post-test, boys obtaining higher readings than girls in both variables, although the scores of both groups are clearly lower than those of normal-weight subjects. The CG showed a slight descent in these variables, with a very low self-concept in girls, chiming in with the literature on this subject[30]. This could be due to the design of the programme with a higher load of physical-sporting activities. A t-test comparison of related means in the IG shows that girls obtain a single significant improvement in the variable of general physical self-concept. As reflected throughout this study, the girls among the intervention group obtained bigger post-programme improvements in all study variables: physical condition, skinfolds, body image and general physical self-concept.

In conclusion, the study results bear out the need for mixed school-based physical activity programmes designed to reduce levels of obesity and overweightness in an adolescent population, reducing body fat percentages and improving fitness, while also dealing with emotional and social aspects bound up with a correct perception of body image and improvement of their physical self-concept. We have in fact found that the carrying out of a structured physical activity programme in a population group with problems of obesity or overweightness improves certain body perimeter measurements (waist, hips and arms), with a knock-on improvement on body image perception and physical self-concept.

In this study we have found some limitations that should be borne in mind in any future research along these lines.

Some of these limitations are associated with the lack of any monitoring of other variables such as diet, family background and genetic factors, all of which might have thrown up further insights. There is also a need of monitoring the intensity of effort within the physical activity programme in the interests of controlling effort levels and pinpointing tasks with a higher calorie burn rate.

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