Results of a 7-Week School-Based Physical Activity and Nutrition Pilot Program on Health-Related Parameters in Primary School Children in Southern Spain

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The goal of this study was to determine the effect of nutrition education combined with sessions of vigorous extracurricular physical activity (VEPA) on the improvement of health related parameters in children in primary education. The sample group consisted of 54 children in the fifth year of primary education divided into two groups: an intervention group (IG) of 25 students and a control group (CG) of 29 students. The intervention lasted 7 weeks and consisted of 13 sessions of VEPA combined with sessions of nutritional education that were attended by the students in the IG as well as their parents. During the intervention the IG showed a decrease in the body fat percentage, total cholesterol, cholesterol linked to low-density lipoproteins and blood pressure, together with an increase in cholesterol linked to high-density lipoproteins, and an improvement in the maximum oxygen uptake and dietary intake profile compared with the CG, which showed an increase in the percentage of fats and no significant changes (p < .05) in other parameters. The results of this study provide evidence that a 7-week program of nutritional education and vigorous short-duration physical activity can improve health related parameters in children.
Physical inactivity is considered to be one of the main problems of public health in the 21st century (5). Engaging in regular physical activity is widely accepted as an effective preventative measure for a variety of obesity related chronic diseases including diabetes, metabolic syndrome and cardiovascular diseases. An increase in aerobic capacity is inversely related with certain health parameters in youth, such as the lipid profile, insulin resistance, arterial resistance and fat mass (21). Studies report that the greatest decreases in physical activity occur during early to late adolescence, a critical period of child growth and development. This decrease is correlated with a rapid increase in the prevalence of children who are overweight or obese.

In Spain, the association between saturated fatty acids and plasma cholesterol levels in children has been found to be similar to that observed in adults. The consumption of saturated fatty acids induces an increase in plasma LDL cholesterol levels and is associated with higher cardiovascular risk (29). Diets with less saturated fat are associated with better food intake, nutritional profile and plasma lipid profiles. Through research into the prevention and treatment of adult diseases, it has become clear that many originate in childhood (16) and as illustrated in this review such antecedents are largely a function of the nutrition, physical activity, and other habits of developing children.

Results gathered in international research show that diet, physical activity and sedentary behavior are “universal” factors contributing to the risk of excessive mass among the young (10). Mainly because of technological advances and social change (4), there is a high percentage of Spanish youth today that has a sedentary lifestyle and is resistant to change (34). These behavioral alterations include changes in eating habits, with an increase in consumption of foods with high calorie content and rich in saturated fats, and a lower consumption of unrefined carbohydrates. Maintaining a balanced diet adapted to the different stages of life is important for the healthy physical and psychological growth of the individual, to prevent illness and obtain an optimum level of health (6).

The typical paradigm used to view pediatric obesity is based on common knowledge derived from the adult experience. This suggests that reducing energy intake and introducing physical activity into the lifestyle will create an energy deficit resulting in mass loss. The results of a recent study (15) illustrate the need for the problem of pediatric obesity prevention to be viewed in a different light. It is noteworthy that this study found lower levels of percentage body fat to be associated with higher amounts of vigorous physical activity, but not with moderate physical activity. Other studies have also found that relatively active young people tend to consume more energy and accumulate less fat than inactive youths (22).

The American Heart Association (AHA) has identified the importance of prevention and treatment, based on studies of vigorous physical training in obese children and adolescents during after-school hours that have demonstrated improvements in some physiological risk factors (25). The American Academy of Pediatrics (2) recommends increasing the amount of daily physical activity engaged in by students in US schools. Exercise has been shown to reduce systolic and diastolic blood pressure over 8 months in children with hypertension.

The aim of our study was to determine the effect of nutritional education given to children and their parents combined with sessions of vigorous extracurricular physical activity (VEPA) on the improvement of health-related parameters
in primary education students. Our hypothesis was that the intervention program would improve the fat profile, aerobic capacity, blood pressure, and blood cholesterol, while nutritional habits would also improve.

Material and Methods

Participants

We chose two schools in a similar rural environment and with the same socioeconomic status. Students were aged between 10 and 11 years ($M = 10.6 \pm 0.4$). Within each school there were two fifth-year classes made up of 25 pupils (classes A and B). The program consisted of one control group (CG) and one intervention group (IG). The CG was made up of class A from each school and the IG group was made up of class B from each school, giving 50 pupils in each group. Class A and B were homogenous but entirely independent within each school. The chance to participate was offered to the parents of all the children regardless of BMI. Out of a total of 100 pupils, 64 decided to participate (64%), these were divided into a CG and an IG containing 32 pupils each. In the CG, three pupils failed to complete some or all of the posttest exercises and were eliminated from the study, while in the IG seven pupils failed to complete the process. This left 25 children (15 boys and 10 girls) in the IG and 29 children (10 boys and 19 girls) in the CG. A total of 27.59% and 36% presented as overweight or obese in the CG and IG respectively. Overweight or obesity was defined according to international criteria (7).

The Tanner and Whitehouse stage of sexual maturity was established by a trained researcher of the same sex as the young person via brief observation of the mammary development in females and genital development in males. All the participants in the study were found to be in stages 1 or 2 with no significant differences between the sexes for any of the studied parameters, thus this aspect was not taken into account when forming the IG and CG.

All children were healthy and were not undergoing any medical treatment. All the participants took part voluntarily in accordance with the Declaration of Helsinki regarding ethical research. The ethical committee of the University of Granada for human research approved the study. Informed consent was also obtained from all of the children’s parents.

Intervention

This is a pilot study for a wider research project in which we shall examine the health benefits of physical exercise and nutritional intervention both separately and in combination. The intervention will be carried out over an extensive period to see whether changes occurring to the parameters increase or remain steady over time.

The intervention consisted of thirteen 60-min sessions of physical activity held twice a week. In addition nutritional education sessions lasting approximately 2 hr each were provided to both students and their parents with parents completing 4 and the student completing 2. The study was carried out for 7 weeks between April and June 2010. The intervention consisted of thirteen 60-min sessions of VEPA [80% of the maximum heart rate (MHR) for 35–40 min, 60–70% of the MHR for 10–15 min, and 50–60% for 5–10 min] twice a week (scheduled between 4:30
and 5:30 p.m.). Physical activity was controlled by means of heart rate monitoring (Polar RS800cx pulsometer). The aim of the training sessions was to improve aerobic capacity, using physical activity such as motor skills, games and sports, specifically targeted for health gains. Play was used in all the activities to motivate the students and achieve the desired level of physical activity. All games and tasks were designed and developed by a group of experts in education and sports science and were directed by the same supervisor. The methodology has been put into practice in previous studies and was adapted to the age of the participants for this study. Only students who attended more than 75% of sessions were included in the intervention group; those not completing the sessions were excluded from the study. Out of a total of 32 pupils, 26 completed over 75% of the sessions (81.25%).

The nutritional education sessions informed participants about the benefits of healthy diets and lifestyle. Nutritional education involved both parents and students. For parents, there were four classes of nutritional education, each lasting approximately 2 hr (16:00–18:00). There was one session per week for the first 4 weeks of physical intervention. Either one or both parents could attend the sessions. For children, there were two nutritional education sessions during school hours (tutorial hours), each lasting about 1 hr. One session was held per week for the first 2 weeks of physical intervention. It was compulsory for pupils to attend both nutrition sessions held during school time. All of the 32 initial participants attended these sessions (100%). Pupils were considered fit to participate as participants for the IG if they participated in over 75% of the school physical activity sessions, attended the two sessions on nutritional education, and had at least one parent attend over 75% of the parental educational sessions. Out of a total of 32 pupils, 25 fulfilled these conditions (78.1%).

During the intervention period, the CG continued doing the same activities as they were doing before the intervention (they did not receive intervention). They participated in pre and posttest measures only to provide a comparison with the IG and identify any changes in parameters.

**Measures**

The following variables were measured in the pretest as well as in the posttest:

**Aerobic Capacity.** The maximal oxygen uptake ($\text{VO}_{2\text{max}}$) was estimated with 20 m Shuttle Run Test. This test is a 20 m incremental-maximum shuttle field test, employing the equation proposed by Ruiz et al. (31) to estimate the $\text{VO}_{2\text{max}}$. The “Shuttle Run Test” or “Course Navette Test” involves running to and fro between two lines 20 m apart. Participants start at an initial velocity of 8.5 kph, and increase their speed by 0.5 kph for every 20 m covered as indicated by an audio recording played on a validated CD-ROM. The test concludes when the subject is unable to reach the line on two consecutive occasions at the speed demanded by the audio recording.

**Anthropometric Data.** Following all the considerations of the International Society for the Advancement of Kinanthropometry (ISAK; 20), all anthropometric measurements were carried out at the same place by an ISAK-certified level II anthropometrics researcher. The following instruments were used: GPM Stadiometer ($\pm 1$ mm accuracy); Tefal scale ($\pm 50$ g accuracy); Holtain skinfold
The following measurements were taken: height, weight, skinfolds (triceps, biceps, subscapular, suprailliac, supraspinous, abdominal, thigh, and calf), perimeters (waist, hip, relaxed biceps, flexed and contracted biceps, thigh and calf), and diameters (bicondylar humerus, bistiloid, and bicondylar femur). The Body Mass Index (BMI) was calculated from height and weight. Using the Slaughter equation, we compared the results gathered from the sum of the 6 skinfolds (triceps, subscapular, supraspinous, abdominal, thigh, and calf), 8 skinfolds (triceps, biceps, subscapular, suprailliac, supraspinous, abdominal, thigh, and calf), and fat percentage.

**Blood Biochemistry.** We used venous blood analysis to determine the health-related biochemical components. The analysis was performed in the morning after a 12 hr fast. Ten millilitres of whole blood samples were taken from each subject by venipuncture using vacutainers and stored in containers with ice packs to maintain the temperature between 3 and 4 °C. Blood was centrifuged at 3,000 rpm for 15 min for plasma separation using a bench centrifuge and 1.5 ml aliquots pipetted into plastic Eppendorf tubes. The aliquots were then stored at -80 °C until further analysis. The following parameters were measured: total cholesterol (TC; mg/dl), HDL cholesterol (cHDL; mg/dl), LDL cholesterol (cLDL) and triglycerides (TG; mg/dl). TC, cHDL and TG were determined using commercially available enzymatic colorimetric assays (Sigma Diagnostics, St. Louis, MO) on an automated ACE analyzer. cLDL was calculated by the Friedewald equation (13).

**Blood Pressure.** Both systolic and diastolic blood pressure measurements were taken using an OMROM M7 monitor (Omrom Health Care, Ukyo-ku, Kyoto, Japan) and a cuff on the right arm, according to the recommendations of the European Hypertension Society (24), and with the greatest care, following the method stipulated by international guidelines (19). Resting blood pressure was determined in situ on the morning (casual blood pressure) of the pre and post tests with measurements taken at the same time of day on each occasion. Participants were instructed to sit quietly for 5 min with their right arm rested at heart level and their feet flat on the floor. Three blood pressure readings were taken at 5, 7, and 9 min, and the cuff was then removed. An average blood pressure measure was calculated.

**Dietary Changes.** All the pupils completed two dietary intake diaries, one before the intervention and another after. Diaries were for 3 consecutive days and included at least one weekend day. All children and their parents were instructed to fill out the forms using weights and home measurements, noting all the food they consumed both at home and outside.

**Healthy Habits Survey.** Together with the dietary intake diaries, the pupils also completed a questionnaire (Kreece Plus; 32) on their dietary habits and lifestyle, with consideration of adequacy of intake to the Mediterranean diet. The surveys were administered by trained personnel, with the aim of evaluating the physical, psychological, and nutritional status of the participants. The sum of answers 7 and 8 gave an evaluation of physical activity on a scale of 0–10, while the sum of questions 9–23 gave an evaluation of dietary habits on a similar scale. According
to the scores obtained, the children’s feeding was classified as having a very low nutritional level (≤ 3), medium nutritional level (4–7), or high nutritional level (≥ 8). This test also classifies the lifestyle based on the average time in hours the children spend watching television or playing videogames, and the hours spent weekly in sporting activities outside school, with scores classified as being bad (0–3), average (4–6), or good (≥ 7).

Data Analysis

For all measures the investigators were blinded to the grouping. Normality of the data were analyzed using the Shapiro-Wilk test. A series of 2 (gender) × 2 (group: intervention vs. control) ANOVAs assessed gender differences in the outcome variables at pre and post time points. There was no significant main effect of gender on any of the tested outcome variables at pre- (p > .05) or at postintervention (p > .05). The interactions between group and gender were also not significant (p > .05). Based on these results further analyses were not stratified by gender. We carried out the T test or Wilcoxon test for two related samples comparing the variables of aerobic capacity, blood composition, blood pressure, and dietary changes. We used the Chi-Squared parameter or the McNemar test to evaluate the changes produced in the results of the Kreec Plus test and to compare two categorical variables. Diet-Source 3.0 was used to evaluate macronutrients. All analyses were made using the SPSS 19.0 statistics package. The level of significance was established at 0.05. The statistical power test was performed for all variables, and type II error probability associated with this test of null hypothesis was 0.05.

Results

Maximal Oxygen Uptake

We found no significant differences between the IG and CG in the pretest (43.45 ± 2.56 ml/kg/min VS. 42.95 ± 2.99 ml/kg/min). For CG there were no significant differences between pretest and posttest (42.95 ± 2.99 ml/kg/min VS. 43.25 ± 3.29 ml/kg/min), however the IG showed significant (p < .01) improvement after treatment (43.45 ± 2.56 ml/kg/min VS. 45.95 ± 4.26 ml/kg/min). At posttest values were significantly higher in the IG relative to the CG (45.95 ± 4.26 ml/kg/min VS. 43.25 ± 3.29 ml/kg/min).

Anthropometric Parameters

The results show a statistically significant increase in weight between the pretest and posttest values of both groups. However, BMI increased significantly only in the CG, remaining stable in the IG (Table 1). The CG shows a statistically significant increase for the sum of the 6 skinfolds, sum of the 8 skinfolds and fat percentage. Conversely, we observed a slight decrease in the sum of the skinfolds and fat percentage in the IG. Comparison of posttest values between the CG and the IG also show the IG to exhibit significantly lower fat percentage.
Table 1  Changes produced in the body and blood profile after a short-term nutritional and physical intervention

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th></th>
<th>IG</th>
<th></th>
<th>Power</th>
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<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
<td>Posttest</td>
<td></td>
</tr>
<tr>
<td>SBP (mmHg) ± SD</td>
<td>98.7 ± 17.0</td>
<td>96.8 ± 13.2</td>
<td>100.8 ± 8.2</td>
<td>97.0 ± 7.1*</td>
<td>.869</td>
</tr>
<tr>
<td>DBP (mmHg) ± SD</td>
<td>60.8 ± 10.0</td>
<td>58.9 ± 7.9</td>
<td>59.0 ± 6.5</td>
<td>54.3 ± 4.3*</td>
<td>.942</td>
</tr>
<tr>
<td>TC (mg/dl) ± SD</td>
<td>161.8 ± 19.1</td>
<td>155.9 ± 19.4</td>
<td>156.1 ± 23.4</td>
<td>140.5 ± 15.8**,+</td>
<td>.997</td>
</tr>
<tr>
<td>cHDL (mg/dl) ± SD</td>
<td>51.9 ± 14.8</td>
<td>52.6 ± 12.0</td>
<td>49.2 ± 9.4</td>
<td>54.3 ± 7.9</td>
<td>.815</td>
</tr>
<tr>
<td>cLDL (mg/dl) ± SD</td>
<td>93.9 ± 23.4</td>
<td>93.3 ± 11.6</td>
<td>93.5 ± 21.0</td>
<td>73.3 ± 13.4**,+</td>
<td>.897</td>
</tr>
<tr>
<td>TG (mg/dl) ± SD</td>
<td>67.3 ± 21.7</td>
<td>64.1 ± 25.2</td>
<td>68.9 ± 28.7</td>
<td>71.5 ± 26.0</td>
<td>.857</td>
</tr>
<tr>
<td>Weight (kg) ± SD</td>
<td>39.1 ± 10.3</td>
<td>41.9 ± 11.7**</td>
<td>45.2 ± 11.7</td>
<td>46.0 ± 11.8***</td>
<td>.976</td>
</tr>
<tr>
<td>BMI (kg/m²) ± SD</td>
<td>19.17 ± 4.14</td>
<td>19.34 ± 4.06**</td>
<td>21.20 ± 3.88</td>
<td>21.22 ± 3.86</td>
<td>.821</td>
</tr>
<tr>
<td>Fat % (Slaughter) ± SD</td>
<td>17.3 ± 6.3</td>
<td>18.1 ± 6.4*</td>
<td>15.0 ± 5.7</td>
<td>14.7 ± 5.4+</td>
<td>.806</td>
</tr>
<tr>
<td>6 Fold Sum ± SD</td>
<td>103.6 ± 46.9</td>
<td>109.2 ± 49.8*</td>
<td>98.4 ± 39.7</td>
<td>95.8 ± 37.2</td>
<td>.915</td>
</tr>
<tr>
<td>8 Fold Sum ± SD</td>
<td>133.3 ± 60.9</td>
<td>140.9 ± 63.9**</td>
<td>126.4 ± 51.4</td>
<td>124.6 ± 49.1</td>
<td>.822</td>
</tr>
</tbody>
</table>

*, **, ***: significant differences between Pretest-Post-Test in both groups at the level of p≤.05, p≤.01, p≤.001 respectively
+, ++: significant differences between Pretest vs. Pretest and Post-Test vs. Posttest at the level of p≤.05, p≤.01 respectively
CG: Control Group; IG: Intervention Group; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; TC: Total Cholesterol; cHDL: cholesterol linked to High Density Lipoproteins; cLDL: cholesterol linked to Low Density Lipoproteins; TG: Triglycerides
Blood Pressure and Blood Composition

As shown in Table 1, students in the IG showed significant reductions in both systolic blood pressure (SBP) and diastolic blood pressure (DBP; \( p < .05 \)). In contrast the CG showed no such changes. The IG achieved statistically significant reductions in TC and cLDL \( p < .01 \) between pre and post test. In addition DBP, CT \( p < .05 \) and cLDL \( p < .01 \) measured at posttest were significantly lower in the IG relative to the CG.

Dietary Intake in 72-Hour Regimen

The calorie profile of the diets analyzed before intervention showed an excess of proteins (15.4% CG and 15.2% IG) and fats (40.2% CG and 36.3% IG), and a lack of carbohydrates (44.4% for CG and 48.5% for IG). This is inadequate to recommendations for the Spanish population of; 10–15% proteins, 30–35% fats, and 50–60% carbohydrates (Table 3). Cholesterol levels were higher than recommended (<300 mg/day) for both groups (CG: 439.9 mg/day, IG: 466.6 mg/day). Throughout the intervention, the IG experienced changes in calorie profile, adjusting to the Spanish recommended levels (Table 2). At posttest the IG showed significant reductions in cholesterol, however levels remained higher than values stated by the recommendations (Table 2).

Krece Plus Test

At posttest the IG showed increased levels of physical activity relative to pretest (Table 3). In addition posttest values regarding the dietary variable were significantly better in the IG relative to the CG. Following the intervention the IG showed a tendency toward improvement for all items on the questionnaire. This reached significance for the following items \( p < .05 \): hours of daily physical exercise, hours of television per day, cereal breakfasts and pasta or rice consumption less than three times per week (Table 3).

Discussion

The rising prevalence of childhood obesity represents a major public health crisis, because it is associated with considerable risks to the child’s present and future health (12). Our study demonstrates that a program combining physical activity and nutritional education and conducted within the school environment can produce significant improvements in various health-related variables. In this study, while the CG experienced significant deterioration in most measured variables, the IG showed significant and consistent improvements.

Vigorous physical activity can reduce overall body fat while simultaneously increasing bone and muscle mass. A child can therefore improve their body composition with no significant reduction in weight or BMI (9). This may have occurred during the current study which detected no significant change in BMI despite increases in weight. We therefore suggest that other body composition indices may be more appropriate for use in future studies.
### Table 2  Comparison of macronutrient ingestion and cholesterol for the CG and IG

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>Posttest</th>
<th>IG</th>
<th>Posttest</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy (Kcal) ± SD</strong></td>
<td>2371 ± 608</td>
<td>2370 ± 546</td>
<td>2309 ± 554</td>
<td>2218 ± 498</td>
<td>.957</td>
</tr>
<tr>
<td><strong>Proteins (g) ± SD (%)</strong></td>
<td>91.4 ± 18.6 (15.4%)</td>
<td>90.5 ± 17.7+ (15.3%)</td>
<td>87.9 ± 21.0 (15.2%)</td>
<td>77.0 ± 12.4 (13.9%)</td>
<td>.853</td>
</tr>
<tr>
<td><strong>Carbs (g) ± SD (%)</strong></td>
<td>263.0 ± 79.8 (44.4%)</td>
<td>262.8 ± 80.0 (46.3%)</td>
<td>280.0 ± 80.1 (48.5%)</td>
<td>299.1 ± 68.2 (53.9%)</td>
<td>.836</td>
</tr>
<tr>
<td><strong>Fats (g) ± SD (%)</strong></td>
<td>105.9 ± 28.7 (40.2%)</td>
<td>106.3 ± 28.5+ (40.4%)</td>
<td>93.0 ± 19.6 (36.3%)</td>
<td>79.3 ± 18.3* (32.2%)</td>
<td>.965</td>
</tr>
<tr>
<td><strong>Cholesterol (mg) ± SD</strong></td>
<td>463.9 ± 169.6</td>
<td>457.9 ± 172.0+</td>
<td>466.8 ± 182.2</td>
<td>322.6 ± 90.0**</td>
<td>.999</td>
</tr>
</tbody>
</table>

*, **: significant differences between Pretest-Post-Test in both groups at the level of p ≤ .05, p ≤ .01 respectively
+, ++: significant differences between Pretest vs. Pretest and Post-Test vs. Posttest at the level of p ≤ .05, p ≤ .01 respectively

CG: Control Group  IG: Intervention Group
There are many papers describing intervention programs targeting obesity within prepubertal children and adolescents. Such interventions are based on physical activity, sometimes in combination with controlled diets or nutritional education for families. However, it is noteworthy that most of the studies are performed with an overweight or obese population whereas we focused on prevention with a sample including normal weight children.

A recent study (8) successfully improved the plasma glucose, insulin, cLDL and triglycerides of overweight prepubertal children by introducing a physical-activity program, a parental dietary-modification program, or a combination of the two. There were no changes in DBP, cHDL or TC. Similar results had been found in another study using obese prepubertal children (12). This showed reductions in whole body and abdominal fat, TG, TC and cLDL and increases in fat-free mass.

Resaland et al. (26) found similar changes after a school-based physical activity intervention.

Importantly, early reports have suggested that regular exercise may have beneficial effects on cardiovascular risk factors particularly in obese children. In our study we observed changes in health-related parameters in a school population of healthy

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Results obtained from the Krece Plus Test</th>
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</thead>
<tbody>
<tr>
<td>Group</td>
<td>Physical Activity ± SD (points)</td>
</tr>
<tr>
<td>CG</td>
<td>4.78 ± 1.85</td>
</tr>
<tr>
<td>IG</td>
<td>5.56 ± 1.29</td>
</tr>
<tr>
<td>p value</td>
<td>.442</td>
</tr>
<tr>
<td>Dietary</td>
<td>CG</td>
</tr>
<tr>
<td>IG</td>
<td>6.32 ± 1.53</td>
</tr>
<tr>
<td>p value</td>
<td>.432</td>
</tr>
<tr>
<td>Hours of</td>
<td>CG</td>
</tr>
<tr>
<td>Phys. Exercise ± SD (hours/day)</td>
<td>IG</td>
</tr>
<tr>
<td>p value</td>
<td>.692</td>
</tr>
<tr>
<td>Television± SD (hours/day)</td>
<td>CG</td>
</tr>
<tr>
<td>IG</td>
<td>1.32 ± .89</td>
</tr>
<tr>
<td>p value</td>
<td>.316</td>
</tr>
<tr>
<td>Cereal/similar</td>
<td>CG</td>
</tr>
<tr>
<td>Breakfast. ± SD (% consumption per day)</td>
<td>IG</td>
</tr>
<tr>
<td>p value</td>
<td>.137</td>
</tr>
<tr>
<td>Pasta or Rice</td>
<td>CG</td>
</tr>
<tr>
<td>+3 times/wk ± SD (% consumption)</td>
<td>IG</td>
</tr>
<tr>
<td>p value</td>
<td>.497</td>
</tr>
</tbody>
</table>

p≤.05, p≤.01, p≤.001 CG: Control Group IG: Intervention Group
prepubertal children. Hypertension is considered to be an important cardiovascular disease risk factor, contributing to around 50% of coronary heart disease. Multiple epidemiological studies have described an inverse relation between level of habitual physical activity and blood pressure (33). The decrease in SBP for the IG observed in our study corresponds with other studies using obese children (12,8). To our knowledge, just one recent paper (26) describes improvements in systolic and diastolic blood pressure in 9-year old children after a physical activity intervention at school.

In our study, the levels of serum lipids obtained are similar to those obtained by Ruiz et al. (30) in a representative sample of Spanish adolescents. Ben Ounis et al. (3) also combined physical activity and dietary restriction over two months and similarly reduced the TC and cLDL of a group of 24 obese adolescents between the ages of 12 and 14 years. In addition significant improvements to cHDL and TG were observed.

Collins et al. (8) found important changes in biochemical parameters after a 6-month intervention. Beneficial developments in blood pressure and the lipid profile have also been found after a 2-year intervention (26). Most studies propose a daily physical activity program at school (2,11,26) even for preschool children (18). The program structures are usually very different, however the majority last between 10–12 weeks and consist of three 30–60 min sessions a week (11). The present study observed changes in health related parameters with an exercise program of just 7 weeks. The physical activity program was performed twice a week, with sessions lasting 60 min.

In our study, a vigorous physical activity program was achieved. Other authors found that interventions with obese children are more effective when the emphasis on vigorous physical activity is increased (15). Previous studies have shown that aerobic fitness was inversely associated with metabolic risk. However, aerobic fitness level is still not well recognized as a screening tool in pediatric populations (1). As schools provide an opportunity to promote lifestyle change and health-related fitness, school-based programs which assess aerobic fitness could play a pivotal role in identifying high-risk children and supporting them to engage in physical activity. It is notable that successful interventions often involve the whole family (14), as parents can be important role models, particularly for younger children. This was apparent in our study, as both the participating children and their parents committed to making lifestyle changes. Other authors such as Collins et al. (8), have encouraged parental involvement, suggesting that future treatment programs may need to target parents, especially when interventions include a dietary program.

In addition to increasing vigorous physical activity other methods exist which can reduce negative habits. These methods relate to time spent sitting in front of a computer, consumption of sugary beverages and excessive snacks, dietary composition and eating habits. Reviews of interventions targeting childhood obesity indicate that a combination of a reduction in sedentary behavior, exercise, and nutritional programs could drastically improve body fat loss (27). In the present research, the students in the IG showed significant improvements in the hours spent watching TV per day, physical exercise, and the number of points earned for their nutrition habits, all of which may have resulted in significant fat loss.

The dietary profile developed from the diets analyzed at pretest is clearly unbalanced with a high percentage of calories obtained from proteins and fats, and a low percentage of calories obtained from carbohydrates. This situation is typical in Spain and other countries whose dietary habits could be classified as
Health Parameters in Children in Southern Spain

Mediterranean (23). Some authors to have analyzed the diet of school-aged children from Spain found significant differences for lipid levels depending on saturated fat intake (28). In our study, the high ingestion of proteins coincides with other studies carried out in Spain and agrees with the general tendency in the Spanish population to consume high amounts of meat and meat products (17). Regarding carbohydrates, the daily intake was lower than recommended which is similar to that found in other studies (27).

Conclusions

The results of this study provide evidence that a 7 week program incorporating vigorous short-duration physical activity and a nutritional education component carried out at school can improve health-related parameters in children.

Limitations and Future Recommendations

The results obtained in this study must be understood in the context of several limitations. Firstly, we recognize that the sample size is small and therefore it is not representative of the population of 10–11 years-old in southern Spain. However, this enabled us to have greater control over delivery of the intervention so implementation could be consistent for all participants e.g., all participants received the same instructor for all components thus receiving identical information.

Secondly, the heart rate monitors were used exclusively to control the intensity of physical activity sessions. Future study could use accelerometry or heart rate monitoring continuously throughout the day to provide more detailed information on total physical activity and enable closer control of physical activity programs.

Thirdly, groups were made up of pupils from within the same school and the occurrence of contamination is not known. However, this method was chosen to make groups more homogenous and reduce influences on the physical activity levels of children resulting from having different physical education teachers. The classes were also independent making contamination less likely. Finally, the results obtained do not show the cause and effect of health-related parameters. The intervention consisted of numerous components; exercise, nutritional education and lifestyle education. Independent effects of each component cannot therefore be determined.

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References


